

EB

ENCYCLOPÆDIA BRITANNICA

A New Survey of Universal Knowledge

ENCYCLOPÆDIA BRITANNICA



1768

LET KNOWLEDGE BEGIN FROM HERE TO MORE
AND THERE BE SEEN THE KNOWLEDGE



ENCYCLOPÆDIA BRITANNICA, INC.

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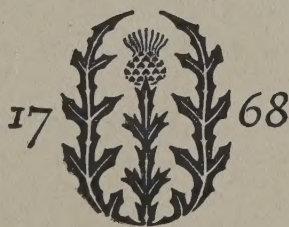
"LET KNOWLEDGE GROW FROM MORE TO MORE
AND THUS BE HUMAN LIFE ENRICHED."

ENCYCLOPÆDIA BRITANNICA

A New Survey of Universal Knowledge

Volume 1

A to ANNOY



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FEB



EDITOR'S PREFACE

DEDICATED BY PERMISSION

TO

THE HEADS OF THE TWO ENGLISH-SPEAKING PEOPLES

DWIGHT DAVID EISENHOWER

PRESIDENT OF THE UNITED STATES OF AMERICA

AND

HER MAJESTY
QUEEN ELIZABETH THE SECOND

EDITOR'S PREFACE

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One difficulty has been to keep this essential part to a convenient and usable form. Times change, fresh information demands inclusion, and supplementary volumes added to old ones offer no adequate solution of the problem of keeping the reader abreast of the times; nor, indeed, do new editions solve the problem. Editions in the past have taken from three to fourteen years to make, and material in one volume was old before the next volume was made.

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The reader can contribute much toward the economical use of the great quantity of material in this reference set by first turning to the index in Volume 24 when in search of information. The index is the direct guide to the many thousands of topics in the 41,000 articles, and the way to use it is described on pages v-x in Volume 24.

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A. F. P.—Alfred Francis Pribram. Former Professor of Modern History in the University of Vienna.

A. F. Po.—Albert Frederick Pollard. Founder and Chairman of the Institute of Historical Research, University of London, 1920–39.

A. Fr.—A. Fisher. Expert Examiner to the Board of Education, London. Gold Medallist, Barcelona. Author of *The Art of Enamelling on Metals*; etc.

A. F. R.—Austin Flint Rogers. Emeritus Professor of Mineralogy, Stanford University, Calif. Author of *Introduction to the Study of Minerals*; co-author of *Optical Mineralogy*.

A. Fs.—Adalbert Farkas. Research Chemist, Barrett Division, Allied Chemical and Dye Corp., Philadelphia, Pa. Author of *Orthohydrogen*, *Parahydrogen and Heavy Hydrogen*; etc.

A. F. S.—Alexander Faulkner Shand. Author of *The Foundations of Character*; etc.

A. F. Sl.—A. Franklin Shull. Professor of Zoology, University of Michigan, Ann Arbor, Mich. Author of *Heredity*; *Evolution*. Co-author (with G. R. LaRue and A. G. Ruthven), *Principles of Animal Biology*.

A. F. W.—A. F. Woodward. Editor of the *Produce Markets Review*, London.

A. F. Ws.—Alan Frank Wells. Lecturer in Social Studies, University of Malaya, Singapore. Author of *The Local Social Survey in Great Britain*; etc.

A. Fx.—Aileen Fox. Lecturer in Archaeology, University College, Cardiff, Wales.

A. F. Z. A.—Abul Faiz Ziauddin Ahmad. Member of the Pakistan Foreign Service. Second Secretary to the High Commissioner for Pakistan in the United Kingdom.

A. G. B. F.—Allan G. B. Fisher. Price Professor of International Economics, Royal Institute of International Affairs, London, 1938–46. Author of *Economic Progress and Social Security*; etc.

A. G. Bs.—Arthur Gilbert Bills. Head of the Department of Psychology, University of Cincinnati, Cincinnati, O. Author of *General Experimental Psychology*; *The Psychology of Efficiency*.

A. G. D.—Sir Arthur G. Doughty. Former Archivist of the Public Records and War Trophies, Canada. Author of *Quebec Under Two Flags*, etc.

A. G. D. W.—Arthur Gilbert Dixon West. Chief Research Engineer, British Broadcasting Corporation.

A. Gé.—André Géraud. *Pertinax* (nom de plume). Foreign editor of *L'Echo de Paris*, 1917–18. Editor of *L'Europe Nouvelle*, 1939–40.

A. Gei.—Sir Archibald Geikie. Director General of the Geological Survey of the United Kingdom and Director of the Museum of Practical Geology, London, 1881–1901.

A. G. F.—A. G. Francis. Chemist, Government Laboratory, Clifford's Inn Passage, London.

A. G. Ga.—Alfred G. Gardiner. Editor of *The Daily News*, London, 1902–19. Author of *Prophets, Priests and Kings*; *The Life of Sir William Harcourt*; etc.; and works under the pen name of "Alpha of the Plough."

A. G. H.—Arthur Garfield Hays. Member of the law firm of Hays, St. John, Abramson and Schulman, New York, N.Y.

A. G. Ht.—Albert Gailord Hart. Research Economist, Committee for Economic Development. Author of *Debts and Recovery*; etc.

A. G. I.—A. G. Ingalls. Contributing Editor, *Scientific American*. Co-author of *Ama-teur Telescope Making*.

A. Gl.—Arnold Glover. Formerly of Trinity College, Cambridge. Co-editor of *Beaumont and Fletcher*, for the Cambridge University Press.

A. G. L. S.—Alan George Lewers Shaw. Senior Lecturer in History, University of Sydney, Sydney, Austr. Author of *The Australian Coal Industry*; co-author of *The Economic Development of Australia*.

A. G. M. B.—A. G. M. Batten. Assistant Manager, Accident Department, Alliance Assurance Co., Ltd.

A. G. McN.—A. G. McNish. Chief, Section of Basic Ionospheric Research, Central Radio Propagation Laboratory, National Bureau of Standards.

A. Gn.—Albert Goodwin. Vice-Principal and Tutor in Modern History, Jesus College, Oxford. University Lecturer in Modern History (French), Oxford University.

A. G. N.—Arthur Geoffrey Norman. Professor of Soils, Iowa State College, Ames, Ia. Biochemist, 1932–37, Rothamsted Experimental Station, Eng.

A. Go.—Rev. Alexander Gordon. Former Lecturer on Church History in the University of Manchester, Eng.

A. G. P.—Arthur George Perkin. Former Professor of Colour Chemistry and Dyeing and Dean of the Faculty of Technology, University of Leeds, Eng. Joint author of *Natural Organic Colouring Matters*.

A. Gr.—Arthur Greenwood. Minister of Health, 1929–31. General Secretary of the Labour Party's Advisory Committees, 1920–21.

A. Gs.—Alexander Gillies. Professor of German Language and Literature, University of Leeds, Leeds, Eng. Editor of *The Modern Language Review*. Author of *Herder*; *Herder und Ossian*.

A. H.—Sir Alfred Hopkinson. Member of Parliament for Combined English Universities, 1926–29.

A. Ha.—Adolf von Harnack. German theologian. Author of *Lehrbuch der Dogmengeschichte*; *Das Mönchtum, seine Ideale und seine Geschichte*; etc.

A. H. A.—A. Hilliard Atteridge. Journalist, specializing on foreign affairs and international questions.

A. Har.—Austin Harrison. Author of *Life of Frederic Harrison*. Former Editor of *The English Review*.

A. H. Bt.—Alva Herschel Bennett. Director of Research, Scientific Instrument Division, American Optical Company, Buffalo, N.Y.

A. H. C.—Arthur Holly Compton. Chancellor, Washington University, St. Louis, Mo. Nobel Prize for Physics, 1927. Author of *Secondary Radiations Produced by X-rays*; etc.

A. H. Ck.—Austin Hobart Clark. Curator, Division of Echinoderms, U.S. National Museum, Washington, D.C.

A. H. Cn.—Alsoph Henry Corwin. Professor and Chairman of the Department of Chemistry, The Johns Hopkins University, Baltimore, Md.

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A. Hf.—Arthur Haseloff. Professor of the History of Art at the Christian Albrechts University, Kiel, Germany.

A. H. F. S.—A. H. Fox Strangways. Music Critic of *The Observer*, London, 1925-39. Editor of *Music and Letters*. Author of *Music of Hindostan*.

A. H. G.—Arnold Hartley Gibson. Professor of Engineering, Victoria University of Manchester, Eng. Author of *Hydraulics*; *Hydro-Electric Engineering*.

A. H. Ge.—Alston H. Garside. Former economist, New York Cotton Exchange. Author of *Cotton Goes to Market and Wool and the Wool Trade*.

A. H. Hn.—Arthur H. Herndon. Research Engineer, Technical Department of California and Hawaiian Sugar Refining Corp., Ltd., San Francisco, Calif.

A. Hk.—Albert Hauck, D.Th. Former Professor of Church History in the University of Leipzig, Germany. Author of *Kirchengeschichte Deutschlands*.

A. H. L.—Albert Howe Lybyer. Former Professor of History, University of Illinois, Urbana, Ill., and former Professor in Robert College, Istanbul, Turkey.

A. H. Lr.—Harold Lancour. Associate Director, Library School, University of Illinois, Urbana, Ill. Author of *American Art Auction Catalogs, 1784-1942*; *Heraldry: A Guide to Reference Books*; *Issues in Library Education*.

A. H-M. Agnes Headlam-Morley. Montague Burton Professor of International Relations, Oxford University. Author of *The New Democratic Constitutions of Europe*.

A. H. M.—Anne Henrietta Martin. National chairman, National Woman's Party, 1916-17. Head, Department of History, University of Nevada, Reno, Nev., 1897-1901.

A. H. Md.—Albert H. Morehead. Bridge Editor, *The New York Times*. Author of *The Modern Hoyle*; etc.

A. H. Mr.—Alpheus Hyatt Mayor. Curator of Prints, Metropolitan Museum of Art, New York, N.Y. Author of *Baroque and Romantic Stage Design*; *The Bibiena Family*; *Giovanni Battista Piranesi*.

A. H. Q.—Mrs. A. H. Quiggin. Lecturer, Department of Geography, Cambridge University.

A. H. S.—Rev. Archibald Henry Sayce, D.D. Professor of Assyriology, Oxford University, 1891-1919. Author of *Sennacherib*; *The Hittites*; etc.

A. H. Sm.—Arthur Hamilton Smith. Keeper of the Department of Greek and Roman Antiquities in the British Museum, London, 1909-25.

A. H. T.—A. Hamilton Thompson. President, Royal Archaeological Institute, 1939-45. Professor of History in the University of Leeds, Eng., 1927-39. Author of *The Cathedral Churches of England*; etc.

A. Hu.—Arthur Hunter. Former Vice-President and Chief Actuary, New York Life Insurance Co., New York, N.Y.

A. H. W.—A. H. Walker. Captain, R.N. Director of Torpedoes and Mining, Admiralty, 1926-29.

A. H. Wt.—A. H. Wright. Professor of Agronomy, University of Wisconsin, Madison, Wis.

A. I.—Asher Isaacs. Professor of Economics, University of Pittsburgh, Pittsburgh, Pa. Author of *International Trade: Tariff and Commercial Policies*.

A. I. A.—Andrew Irving Andrews. Professor and Head of Dept. of Ceramic Engineering, University of Illinois, Urbana, Ill.

A. I. B.—Arthur I. Bloomfield. Economist, Federal Reserve Bank of New York, New York, N.Y.

A. J.—Alexander Johnston. Professor of Jurisprudence and Political Economy, Princeton University, 1884-89.

A. J. A.—Arthur J. Altmeyer. Commissioner for Social Security, Federal Security Agency, Washington, D.C.

A. J. Al.—A. J. Arkell. Commander for Archaeology, Sudan Government, 1938-Sudan Political Service, 1920-38.

A. J. B.—A. J. Bull. Former Principal of the London County Council School of Photo-Engraving.

A. J. Bu.—Arthur John Butler. Former Professor of Italian Language and Literature, University College, University of London. Author of a prose translation of Dante's *Divine Comedy*; etc.

A. J. B. W.—Alan John Bayard Wace. Laurence Professor of Classical Archaeology, Cambridge University, 1934-44. Author of *A Catalogue of the Sparta Museum*; etc.

A. J. By.—Arthur John Berry. Fellow of Downing College, Cambridge.

A. J. C.—Alfred Joseph Clark, M.D. Professor of Materia Medica in the University of Edinburgh, Scot., 1934-41.

A. J. Ce.—Abel Jacobus Coetzee. Professor of Afrikaans Literature and Folklore, University of the Witwatersrand, Johannesburg, U. of S. Af. Author of *Groei van die Afrikaanse Kultuurgedagte aan die Rand*; etc.

A. J. G.—Rev. Alexander James Grieve, D.D. Principal of Lancashire Independent College, Manchester, Eng., 1922-43.

A. J. H.—Alfred J. Hipkins. Author of *Musical Instruments, Historic, Rare and Unique*; etc.

A. J. He.—A. J. Heinicke. Director, New York State Agricultural Experiment Station, Geneva, N.Y., 1942-. Professor of Pomology and Head of Department of Pomology, Cornell University, 1921-.

A. J. Hy.—Arthur James Heighway. Editor and Managing Director, *World's Press News*, London.

A. J. K.—Albert J. Kennedy. Headworker, University Settlement, New York, 1929-43. Author of *The Settlement Horizon*.

A. J. L.—Andrew Jackson Lamoureux. Former Librarian, College of Agriculture, Cornell University.

A. J. La.—Anthony J. Lanza, M.D. Professor and Chairman of the Department of Industrial Medicine, Post Graduate Medical School, Bellevue Medical Center, New York University, New York, N.Y. Author of *Industrial Hygiene*; *Silicosis and Asbestosis*.

A. J. Li.—A. J. Liebman. President, Schenley Research Institute.

A. J. Ln.—Arthur J. Larsen. Secretary and Superintendent, Minnesota Historical Society.

A. J. Lo.—Alfred J. Lotka. Assistant Statistician, Metropolitan Life Insurance Company, 1934-.

A. Jo.—Albert Johannsen. Emeritus Professor of Petrology, The University of Chicago, Chicago, Ill. Author of *Descriptive Petrography of the Igneous Rocks*, 4 vol.

A. J. Pa.—Arthur Josiah Parkes. Captain, Royal Engineers Reserve of Officers.

A. J. Pi.—Adrian John Pieters. Principal Agronomist, Bureau of Plant Industry, U.S. Department of Agriculture, Washington, D.C., 1938-40. Author of *Green Manuring: Principles and Practice*; etc.

A. J. P. T.—Alan John Percivale Taylor. Fellow of Magdalen College, Oxford. Author of *The Course of German History*; *The Habsburg Monarchy, 1809-1918*.

A. J. R.—Miss A. J. Robertson.

A. J. Sh.—Aaron J. Sharp. Associate Professor of Botany, the University of Tennessee, Knoxville, Tenn.

A. J. T.—Arnold Joseph Toynbee. Director of Studies in the Royal Institute of International Affairs and Research Professor of International History, University of London. Director, Research Department, Foreign Office, 1943-46. Author of *A Study of History*; etc.

A. J. W.—A. J. Winkler. Professor of Viticulture and Viticulturist in the Experiment Station, College of Agriculture, University of California.

A. K.—Sir Arthur Keith, M.D. Former Rector, University of Aberdeen, Scot., and Fullerian Professor of Physiology, Royal Institution, London. Author of *Antiquity of Man*; etc.

A. K. C.—Ananda K. Coomaraswamy. Former Fellow for Research in Indian, Persian and Mohammedan Art, Museum of Fine Arts, Boston, Mass. Author of *History of Indian and Indonesian Art*; etc.

A. Kf.—Adolph Knopf. Sterling Professor of Geology, Yale University, New Haven, Conn. Author of *The Mother Lode System of California*; co-author of *Physical Geology*.

A. Kl.—Alexander Klemin. Guggenheim Research Associate, 1941-50; Professor of Aeronautical Engineering, Daniel Guggenheim School of Aeronautics, New York University, 1924-41. Author of *Textbook of Aeronautical Engineering*; etc.

A. Kr.—Arthur Krock. Chief of the Washington Bureau of *The New York Times*, Washington, D.C.

A. K. R.—A. K. Romberg. Director, Preliminary Design Branch, Bureau of Ships, U.S. Department of the Navy, Washington, D.C.

A. K. S.—Albert Kenneth Showalter. Forecaster in Charge, U.S. Weather Bureau, Los Angeles, Calif.

A. L.—Andrew Lang. Journalist, poet, critic and historian. Author of *Myths, Literature and Religion*; *The Book of Dreams and Ghosts*; *The World of Homer*; etc.

A. L. B.—Arthur Lyon Bowley. Acting Director of Oxford University Institute of Statistics, 1940-44. Author of *The Course of Prices and Wages During the War*; etc.

- A. L. Be.**—A. L. Beck. Assistant Director of Statistics and Intelligence, Inland Revenue, London.
- Al. Bu.**—Allison Butts. Professor of Electrometallurgy, Lehigh University, Bethlehem, Pa. Author of *Textbook of Metallurgical Problems*.
- A. L. Cn.**—Arthur Le Roy Cohen. Professor of Biology, Oglethorpe University, Oglethorpe University, Ga.
- A. Ld.**—Aldo Leopold. Professor of Wildlife Management, University of Wisconsin, Madison, Wis., 1933-48. Author of *Game Management*; etc.
- A. L. D.**—Arthur L. Dakyns. Barrister-at-Law.
- A. L. du T.**—Alexander L. du Toit. Former Consulting Geologist, De Beers Consolidated Mines. Author of *Geology of South Africa*; etc.
- A. Le.**—André Levinson. Lecturer on Art at the Louvre and the Sorbonne, Paris.
- Al. E. H.**—Alfred E. Hudson. Associate in Anthropology, Department of Anthropology, University of Washington, Seattle.
- A. LeR. L.**—Alain LeRoy Locke. Professor of Philosophy, Howard Univ., Washington, D.C. Author of *The New Negro*; etc.
- A. L. F.**—Arthur L. Faubel. Former Associate Professor of Economics, New York University. Author of *Principles of Economics*; etc.
- Al. G.**—Alan Gregg, M.D. Director for the Medical Sciences, Rockefeller Foundation, 1930-. Author of *The Furtherance of Medical Research*.
- A. L. H.**—Alexander L. Howard. Formerly of W. W. Howard Brothers and Company (Hardwoods), teak merchants, London.
- A. L. He.**—Albert Leon Henne. Professor of Chemistry, Ohio State University, Columbus, O.
- A. L. Hs.**—Abram Lincoln Harris. Professor of Economics, Howard University, Washington, D.C. Author of *The Black Worker* (with S. D. Spero); *The Negro as Capitalist*.
- A. L. J.**—A. Le Roy Johnson. Professor of Clinical Dentistry, Harvard University.
- A. Lk.**—Captain Albert Larking. Former Secretary, the Early Closing Association, London.
- A. L. K.**—Alfred L. Kroeber. Professor of Anthropology and Director, Anthropological Museum, University of California, Berkeley, 1919-46. Author of *Anthropology*; etc.
- A. L. L.**—A. Lawrence Lowell. Former President of Harvard University.
- A. Ll. D.**—Arthur Llewellyn Davis. Former Barrister-at-Law, Inner Temple, and Assistant Reader in Common Law under the Council of Legal Education.
- A. Ll. J.**—Arthur Lloyd-James. Professor of Phonetics, School of Oriental Studies, London, 1933-43.
- A. Lo.**—Auguste Longnon. Former Professor, Collège de France, Paris. Author of *Géographie de la Gaule au VI^e Siècle*; etc.
- A. L. P.**—Austin L. Poole. President of St. John's College, Oxford. University Lecturer in Mediaeval History, 1927-35.
- A. L. R.**—Arthur Lionel Rawlings. Special Research Engineer, Sperry Gyroscope Co. Inc., New York, N.Y. Author of *The Theory of the Gyroscopic Compass*; etc.
- A. L. Rd.**—Austin L. Rand. Curator, Division of Birds, Chicago Natural History Museum, Chicago, Ill. Author of *Birds of Yukon Territory*; *Distribution and Habits of Madagascar Birds*.
- A. L. S.**—André L. Simon. President, Wine and Food Society; Editor, *Wine and Food Quarterly*. Author of *The Blood of the Grape*; etc.
- A. L. Sc.**—Albert L. Schomp. President, American Bank Note Company, New York, N.Y.
- A. L. Sm.**—A. Lorrain Smith. Sometime Acting Assistant, Department of Botany, British Museum (Natural History), London.
- A. Lu.**—Achille Luchaire. Former Professor of Mediaeval History at the Sorbonne, Paris.
- A. L. W.**—Rev. A. Lukyn Williams, D.D. Former Honorary Canon of Ely Cathedral. Chaplain to the Bishop of Durham, Eng., 1901-13.
- A. M.**—Sir Allen Mawer. Provost, University College, University of London, 1930-43. Author of *The Vikings*; *Problems of Place Names Study*; etc.
- A. M. A.**—Alex M. Arnett. Professor of History, North Carolina College for Women, Greensboro, N.C., 1923-45. Author of *The Populist Movement in Georgia*; etc.
- A. Mac.**—Alexander Macalister, M.D. Former Professor of Anatomy, Cambridge University. Author of *Textbook of Human Anatomy*; etc.
- A. M. B.**—A. M. Boal. Admiralty Counsel, U.S. Shipping Board, Washington, D.C., 1925-29.
- A. M. C.**—Agnes Mary Clerke. Author of *A Popular History of Astronomy during the 19th Century*; *Problems in Astrophysics*; etc.
- A. McF.**—Sir Andrew McFadyean. President, Liberal Party Organisation, Great Britain. General Secretary to Reparation Commission, 1922-24, and to Dawes Committee, 1925. Author of *Reparation Reviewed*; etc.
- A. M. C. S.**—Sir Alexander Morris Carr-Saunders. Director, London School of Economics. Author of *Eugenics*; *World Population*; etc.
- A. M. D.**—A. M. Daniels. Consulting and advisory engineer, Washington, D.C. Author of *Steam and Hot Water Heating*; *Warm Air Furnace Heating*.
- A. M. Du.**—A. M. Dudley. Former Engineering representative in Patent Department, Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa. Author of *Connecting Induction Motors*; etc.
- A. Me.**—Antoine Meillet. Former member of l'Institut de France and Professor at the Collège de France, Paris.
- A. M. E.**—Alba M. Edwards. Statistician for Occupations, U.S. Bureau of Census, Washington, D.C., 1909-43.
- A. Mel.**—Arthur Mellor. Of Messrs. J. and T. Brocklehurst and Sons, silk manufacturers, Macclesfield, Eng.
- A. Mey.**—Alice Meynell. English poet and essayist. Author of *Poems*; *The Rhythm of Life*; etc.
- A. Mf.**—Baron Alexander Meyendorff. Reader in Russian Institutions and Economics, School of Economics and Political Science, University of London, 1922-34.
- A. M. Fa.**—Alfred Morel-Fatio. Former Professor of Romance Languages at the Collège de France, Paris.
- A. M. H.**—Arthur M. Hind. Keeper, Department of Prints and Drawings, British Museum, London, 1933-45. Author of *Great Engravers*; *Introduction to a History of Woodcut*; etc.
- A. Ml.**—Albert Mordell. Author of *The Literature of Ecstasy*; *Quaker Militant*; *John Greenleaf Whittier*; etc.
- A. Mon.**—Alexander Moncur. Accountant in the Hong Kong and Shanghai Banking Corporation.
- A. Mor.**—A. Mora. Director of Plywood Marketing Corporation, Ltd., London.
- A. Ms.**—Rev. Allan Menzies, D.D. Former Professor of Divinity and Biblical Criticism, St. Mary's College, St. Andrews University, St. Andrews, Scot. Author of *History of Religion*.
- A. Mu.**—Arthur Murray. Director of a chain of dancing schools throughout the United States. Author of *Modern Dancing*; *How to Become a Good Dancer*; etc.
- A. M. We.**—Arthur M. Wehrmann. National Handball Chairman, Amateur Athletic Union of the United States.
- A. N.**—Allan Nevins. Professor of American History, Columbia University. Harmsworth Professor, Oxford University, 1940-41. Author of *The Emergence of Modern America*; *Grover Cleveland*; *The Heritage of America*; *American Press Opinion*; etc.
- A. N. C. S.**—A. N. C. Shelley. Barrister-at-Law. Legal Department, Local Government Board, 1910-19.
- A. Nh.**—Arnoldus Noach. Author of *De Oude Kerk te Amsterdam*.
- A. N. J. W.**—A. Neville J. Whyman. Professor of Chinese and Oriental Philosophy, Hosei University, Tokyo. Author of *The Oceanic Theory of the Japanese Language and People*; *China*; *Colloquial Chinese*; *Mongolian Grammar*; *Outlining the Khalkha Mongolian, with Notes on the Buriat, Kalmuck, and Ordoss Mongolian*.
- An. M.**—Andrew McKellar. Astronomer, Dominion Astrophysical Observatory, Victoria, B.C.
- A. No.**—Arne Novák. Professor of Czechoslovakian Literature at the Masarykova University of Brno (Brünn), 1920-39. Co-author of *A History of Czechoslovakian Literature*.
- A. P.**—Attilio Piccirilli. Founder and Former President of the Leonardo da Vinci Art School, New York, N.Y. Sculptor.
- A. P. B.**—Alling Prudden Beardsley. Technical Adviser, Calco Chemical Division, American Cyanamid Company, Bound Brook, N.J.
- A. P. C.**—Alfred Philip Chalkley. Editor of *The Motor Ship*, *The Motor Boat* and *The Oil Engine*.
- A. P. Co.**—Arthur Philemon Coleman. Former Professor of Geology, University of Toronto, Canada. Author of *The Canadian Rockies*; etc.
- A. P. E.**—Adolphus Peter Elkin. Professor of Anthropology, University of Sydney, Sydney, Austr. Author of *Aboriginal Men of High Degree*; *The Australian Aborigines: How to Understand Them*.
- A. Ph.**—Alexander Petrunkevitch. Emeritus Professor of Zoology, Yale University. Author of *Morphology of Invertebrate Types*; *A Study of Amber Spiders*.
- A. P. Hi.**—Arthur Pierson Hirose. Former Research Co-ordinator, War Advertising Council. Author of *Domestic Electric Refrigeration*.

A. P. L.—Arthur Pillans Laurie. Principal of the Heriot-Watt College, Edinburgh, Scot., 1900–28. Author of *Processes, Pigments and Vehicles—A Manual for Art Students*; *New Light on Old Masters*; etc.

A. P. Lr.—Abba P. Lerner. Associate Professor of Economics, Graduate Faculty of Political and Social Science of the New School for Social Research, New York, N.Y. Author of *The Economics of Control*.

A. P.-S.—A. Parker-Smith. Counsel in patent and trade-mark cases, New York, N.Y.

A. P. Sl.—Alfred Pritchard Sloan, Jr. Chairman, Board of Directors, General Motors Corporation, New York, N.Y., 1937–.

A. P. W.—Archibald Percival Wavell, 1st Earl Wavell. Field Marshal. Viceroy and Governor-General of India, 1943–47.

A. P. Wi.—Albert P. Wills. Former Professor of Mathematical Physics, Columbia University.

A. Ra.—Arthur Ransome. Author of *The Crisis in Russia*; *Six Weeks in Russia*; etc.

A. R. C.—Alexander Ross Clarke. In charge of Trigonometrical Operations of the Ordnance Survey, 1854–81.

A. Re.—Arthur Rose. Associate Professor of Chemical Engineering, The Pennsylvania State College, State College, Pa.

Ar. F.—Arthur Fisher. Register of Copyrights, Library of Congress, Washington, D.C.

A. R. H.—A. R. Hamilton. Former Exhibitioner of Winchester College and Scholar of New College, Oxford.

A. R. L.—Arthur Robert Ling. Professor of Malting and Brewing and of the Biochemistry of Fermentation, University of Birmingham, Eng., 1920–31.

A. R. M. C.—Albert Raymond Maillard Carr. Fellow at New College, Oxford.

A. R. Mr.—Albert R. Miller, D.V.M. Chief, Meat Inspection Division, Bureau of Animal Industry, U.S. Department of Agriculture, Washington, D.C.

A. R. Ms.—Arthur Richard Margetts. Scientific Officer, Fisheries Laboratory, Ministry of Agriculture and Fisheries, England and Wales.

A. Rn.—Arthur Reisman. Author of *Championship Checkers: The Pioneer System*; etc.

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A. R. P.—Antonio R. Pastor. Cervantes Professor of Spanish Language and Literature, King's College, London, 1930–45. Author of *Contemporary Spanish Literature*.

A. R. Po.—Alfred Richard Powell. Research Chemist and Assistant Director of Research, Koppers Company, Pittsburgh, Pa.

A. R. Pr.—Alan Reed Priest. Curator of the Department of Far Eastern Art, Metropolitan Museum of Art, New York, N.Y.

A. R. Pt.—Alan Richmond Prest. Lecturer in Economics, Cambridge. Author of *War Economics of Primary Producing Countries*.

Ar. R. H.—Arthur R. Hutchens. Commissioner of Football Officiating, Southern Conference. Author of *Manual of Football Officiating*; *NCAA Football Rules, Revised and Recodified*.

A. Rs.—A. Richards. Professor of Zoology and Director of the School of Applied Biology, University of Oklahoma, Norman, Okla.

A. R. S.—A. R. Smythe. Professor of Materia Medica and Therapeutics, Royal Veterinary College, Camden Town, London.

A. R. S. K.—Rev. Archibald Robert Stirling Kennedy, D.D. Professor of Hebrew and Semitic Languages in the University of Edinburgh, Scot., 1895–1937.

A. R. T.—A. Ranger Tyler. Director, Bureau of Business Publicity, New York State Department of Commerce, Albany, N.Y.

Ar. 'Y.—Art (Arthur Henry) Young. American cartoonist. Author of *On My Way*.

A. S.—A. Safrastian. Former British Vice-Consul at Bitlis, Kurdistan.

A. Sa.—Sir James Arthur Salter. Gladstone Professor of Political Theory and Institutions, Oxford University, 1934–44. Author of *Allied Shipping Control: An Experiment in International Administration*; etc.

A. Sab.—A. Sabonadière. Professor of Indian Law, School of Oriental and African Studies, London University.

A. Sau.—Aurelien Sauvageot. Lecturer in French Language and Literature, University of Budapest.

A. S. Ba.—Right Rev. Monsignor Arthur Stapylton Barnes. Former Domestic Prelate to Pius XI. Author of *The Popes and the Ordinal*; etc.

A. S. Bl.—Asa S. Bushnell. Executive Director, Central Office for Eastern Intercollegiate Athletics.

A. S. C.—Alan Summerly Cole. Author of *Ancient Needle Point and Pillow Lace*; *Ornament in European Silks*; etc.

A. Sd.—Archibald Safford. Barrister-at-Law, Middle Temple, London. Author of *Law of Town and Country Planning*, etc.

A. S. E.—Sir Arthur Stanley Eddington. Former Plumian Professor of Astronomy and former Director of the Observatory, Cambridge University. Author of *Stellar Movements and the Structure of the Universe*; *The Expanding Universe*; etc.

A. S. G.—Arthur S. Gelston, Jr. Assistant in History, University of California.

A. Sh.—Arthur Sherwell. Member of Parliament for Huddersfield, 1906–18. Author of *The Russian Vodka Monopoly*; *State Purchase of the Liquor Trade*; etc.

A. S. H.—Arthur Surridge Hunt. Professor of Papyrology in Oxford University, 1913–34, and Fellow of Queen's College. Author of *New Classical Fragments, and Other Papyri*, etc.

A. H. Hs.—Agnes H. Hicks. Consultant on Scandinavian Affairs to the Royal Institute of International Affairs, London.

A. Si.—Arthur Sidgwick. Former Fellow of Corpus Christi College, Oxford; Reader in Greek, Oxford University.

A. Sk.—Aloys Skoumal. Cultural Attaché to the Czechoslovak Embassy, London.

A. Sl.—Arthur Shadwell, M.D. Author of *Drink, Temperance and Legislation*; etc.

A. S. L.—Arnold S. Lott. Lieutenant, U.S. Navy. Office of Public Information, Office of Secretary of Defense, Washington, D.C.

A. Slo.—Antoni Slonimski. Writer. Director of the Polish Cultural Institute, London. Author of *Selected Poems*; *The Family*.

A. S. M.—Alexander Stuart Murray. Former Archaeologist and Keeper of the Department of Greek and Roman Antiquities in the British Museum, London. Author of *White Athenian Vases*; etc.

A. Smi.—Alexander Smirnoff. Former Military Correspondent to *Rossvia*.

A. S. P.—Arthur Samuel Peake, D.D. Rylands Professor of Biblical Exegesis, Victoria University, Manchester, Eng., 1904–29. Author of *Recent Developments in Old Testament Criticism*; *The Religion of Israel*; etc.

A. S. P.-P.—Andrew Seth Pringle-Pattison. Professor of Logic and Mathematics in the University of Edinburgh, Scot., 1891–1919. Author of *The Philosophical Radicals*; *The Idea of Immortality*; etc.

A. S. Rr.—Alfred S. Romer. Professor of Zoology and Curator of Vertebrate Paleontology, Museum of Comparative Zoology, Harvard University. Author of *Vertebrate Paleontology*; etc.

A. Ss.—Ashton Stevens. Drama critic and columnist, *Chicago Herald American*, 1932–51.

A. St.—Anna Stancioff. Wife of Dimitri Stancioff, former Bulgarian Minister in London.

A. S. T.—Arthur Stanley Tritton. Emeritus Professor of Arabic, the School of Oriental and African Studies, University of London. Author of *Rise of The Imams of Sanaa*; *Arabic Self-Taught*; etc.

A. Std.—Alexander Stoddart. General Outdoor Advertising Company, New York, N.Y.

A. St. H. B.—Alan St. Hill Brock. Director of C. T. Brock & Company's "Crystal Palace" Fireworks, Ltd. Author of *Pyrotechnics*; etc.

A. Sto.—Albert Stoessel. Head of Opera and Orchestra, Juilliard Graduate School, New York, N.Y., 1930–43. Author of *Technique of the Baton*.

A. S. W.—Sir Arthur Smith Woodward. Keeper of Geology in the British Museum, London, 1901–24. Author of *Catalogue of Fossil Fishes in the British Museum*; *Outlines of Vertebrate Paleontology*; etc.

A. Sy.—Arthur Symons. English poet and critic. Author of *Studies in Seven Arts*; etc.

A. T.—Albert Thibaudet. Author of *La Poésie de Stéphane Mallarmé*; *Trente ans de vie française*; etc.

A. T. C.—Arthur T. Coode. Of Messrs. Coode, Fitzmaurice, Wilson and Mitchell, London.

A. T. F.—A. T. Fidler. Assistant Secretary of the Dunlop Rubber Company, Ltd., and of its subsidiary companies.

A. Ti.—Avray Tipping. Author of *English Homes*; *The Cabriole Period of English Furniture*; etc.

A. T. I.—Alexander Taylor Innes. Scotch Advocate. Author of *John Knox*; *Studies in Scottish History*; etc.

A. T. Ls.—Anthony Thomas Lucas. Assistant Keeper, National Museum of Ireland, Dublin, Ire.

A. Tp.—Sir (Herbert) Alker Tripp. Assistant Commissioner of Police, Scotland Yard, 1932–47. Member of the London and Home Counties Traffic Advisory Committee, 1932–47. Member of the Royal Academy Planning Committee, 1942–49. Author of *Road Traffic and Its Control*; *Town Planning and Road Traffic*; etc.

A. T. P.—Albert Theodore Poffenberger. Professor of Psychology, Columbia University. Author of *Psychology in Advertising*; *Applied Psychology—Its Principles and Methods*; etc.

- A. T. Q.-C.**—Sir Arthur Thomas Quiller-Couch. King Edward VII Professor of English Literature, Cambridge University, 1912-44. Author of *Studies in Literature*; Editor, *Oxford Book of Prose*, 1925; etc.
- A. T. R.**—Arthur T. Robb. Former Editor, *Editor & Publisher*, New York, N.Y.
- A. T. S.**—A. Tate Smith. Director, Department of Research and Statistics, New York Stock Exchange, New York, N.Y. Editor, *New York Stock Exchange Bulletin*, 1930-39.
- A. T. T.**—Alfred T. Thorson. Former Chief, Division of Finance, U.S. Coast Guard, Treasury Department, Washington, D.C.
- A. T. W.**—Sir Arnold Talbot Wilson. Lieutenant Colonel, formerly of the Indian Army. Acting Civil Commissioner and Political Resident in the Persian Gulf, 1918-20. Author of *The Persian Gulf*; etc.
- A. Ty.**—Albert Tyler. Associate Professor of Embryology, California Institute of Technology, Pasadena, Calif.
- A. U. D.**—Arthur Ulderick Desjardins, M.D. Head, section of Therapeutic Radiology, Mayo Clinic, Rochester, Minn. Author of *Anatomical Cross-Section Charts of the Human Body*.
- A. U. P.**—Arthur Upham Pope. Director, American Institute for Persian Art and Archaeology, 1930-. Editor of *Survey of Persian Art*, 1929-38. Author of *An Introduction to Persian Art*; etc.
- Au. S.**—Austin Stromberg. Editor, Treasurer and Copublisher, *Power Wagon*.
- A. van M.**—Alexander van Millingen, D.D. Former Professor of History, Robert College, Istanbul, Turkey. Author of *Byzantine Constantinople*; *Constantinople*; etc.
- A. V. B.**—Albert Victor Bleining. Chemist, Homer Laughlin China Company, Newell, W.Va., 1920-46. Author of *The Manufacture of Hydraulic Cements*.
- Av. Be.**—Avery Brundage. President, International Olympic Committee.
- A. V. C.**—A. Vaughan Chinnock. Sales Development Department, Hooker Electrochemical Company, Niagara Falls, N.Y.
- A. v. d. V.**—Adriaan van der Veen. Literary Editor, *Nieuwe Rotterdamse Courant*, Rotterdam, Neth.
- A. V. H.**—Archibald Vivian Hill. Foulerton Research Professor of the Royal Society, London, 1926-. Nobel Prize for Physiology and Medicine, 1922. Author of *Muscular Activity*; *Living Machinery*; etc.
- A. Vo.**—August Vollmer. Chief of Police, Berkeley, Calif., 1905-32.
- A. Vs.**—Alfred Vagts. Member of Institute for Advanced Study, Princeton, N.J., 1939-42. Author of *A History of Militarism*; *Landing Operations*.
- A. V. W.**—A. V. Williamson. Professor of Geography, University of Leeds, Eng.
- A. Wa.**—Arthur Waugh. Former Chairman of Chapman and Hall, Ltd. Author of *Alfred, Lord Tennyson*; *Reticence in Literature*; etc.
- A. W. Ay.**—Arthur Wilfred Ashby. Former Director, Institute for Research in Agricultural Economics, Oxford University. Author of *Small Holdings in Oxfordshire*; *Rural Education*.
- A. W. B.**—Andrew Wilson Brown. Former Associate Professor of Psychology, The University of Chicago, Chicago, Ill.
- A. W. C.**—Rev. A. W. Climenhaga. Dean and Instructor in Church History and Systematic Theology, Messiah Bible College. Author of *History of Brethren in Christ*.
- A. We.**—Alice Werner. Former Professor of Swahili and Bantu Languages at the School of Oriental and African Studies, University of London. Author of *Native Races of British Central Africa*; etc.
- A. W. F.**—Sir Alfred William Flux. Assistant Secretary, Statistics Department, Board of Trade, London, 1918-32.
- A. W. F. K.**—Sir Alfred William Fortescue Knox. Major General. Chief of British Military Mission to Siberia, 1918-20. Author of *With the Russian Army*, 1914-17.
- A. W. G.**—Albert William Giles. Head of the Department of Geology and Geography, University of Arkansas, Fayetteville, Ark.
- A. W. G. B.**—Sir Arthur William Garrard Bagshawe, M.B. Director, Bureau of Hygiene and Tropical Diseases, 1912-35. Medical Officer, Uganda Protectorate, 1900-07.
- A. W. Hu.**—Rev. Arthur Wollaston Hutton. Former Rector of Bow Church, Cheshire. Author of *Life of Cardinal Newman*; *Life of Cardinal Manning*; etc.
- A. W. Kn.**—A. W. Knapp. Chief Chemist to Cadbury Bros., Ltd., Bournville, England. Author of *The Cocoa and Chocolate Industry*.
- A. W. Le.**—Alec Wilfred Lee. Major General (retired), British Army.
- Aw. M.**—Andrew Meiklejohn, M.D. Senior Lecturer in Industrial Medicine, University of Glasgow, Glasgow, Scot.
- A. W. Ma.**—Alexander W. Mair. Former Professor of Greek, Edinburgh University, Scot. Author of *Hesiod: Introduction, Translation and Appendices*; etc.
- A. W. M. D.**—Arthur W. M. Dickins. Photographic Chemist, Eastman Kodak Company, Kodak Park, Rochester, N.Y.
- A. W. M. Dy.**—A. W. M. Disney. Member of the Sudan Political Service.
- A. Wo.**—Abraham Wolf. Former Head of the Dept. of the History and Method of Science at University College, University of London, and of the Department of Logic and Philosophy at the London School of Economics and Political Science. Author of *The Oldest Biography of Spinoza*; *Textbook of Logic*; etc.
- A. W. P.**—Alfred William Pollard. Professor of English Bibliography, King's College, University of London, 1919-32. Editor of *English Miracle Plays*; *Macmillan's Library of English Classics*. Author of *Fine Books*; *Chaucer Primer*; etc.
- A. W. Po.**—Alfred William Porter. Former Professor of Physics in the University of London. Editor of Preston's *Theory of Light* (fifth edition). Co-author of *Treatise on Electricity and Magnetism*; etc.
- A. W. R.**—Sir Alexander Wood Renton. Puisne Justice Supreme Court, and Procureur and Advocate-General, Mauritius, 1901-05; Ceylon, 1905-14. Author of *Law and Practice of Lunacy*.
- A. Wt.**—Alexander Wetmore. Secretary, Smithsonian Institution, Washington, D.C. Former President, American Ornithologists' Union. Author of *The Migration of Birds*; *Fossil Birds of North America*; etc.
- A. W. V. B.**—Albert William Van Buren. Emeritus Professor of Archaeology, American Academy in Rome, It. Author of *Ancient Rome as Revealed by Recent Discoveries*.
- A. W. W.**—Sir Alfred William Watson. President of the Institute of Actuaries, 1920-22. Chief Actuary to the National Health Insurance Committee, 1912-19. Government Actuary, 1917.
- A. W. Wa.**—Sir Adolphus William Ward. Vice-Chancellor, Victoria University of Manchester, Manchester, Eng. Author of *History of English Dramatic Literature to the Death of Queen Anne*.
- A. W. W.-E.**—Rev. Arthur Wade Wade-Evans. Rector of Wrabness, 1932-. Author of *Welsh Medieval Law*; *Life of St. David*; etc.
- A. Y.**—Alexander Yewdall. Lecturer in the Textile Industries Department, University of Leeds, England.
- A. Yo.**—Allyn Abbott Young. Former Professor of Political Economy in the University of London.
- Ay. Sy.**—Anthony Sillery. Secretary to the Curators of the Taylor Institution, Oxford. Author of *The Bechuanaland Protectorate*.
- A. Z.**—Sir Alfred Zimmern. Adviser, U.N.E.S.C.O. Preparatory Commission, 1946. Burton Professor of International Relations, Oxford University, 1930-44. Author of *Europe in Convalescence*; *The Third British Empire*; etc.
- A. Zd.**—Antoni Zygmund. Former Professor of Mathematics, Mount Holyoke College, South Hadley, Mass. Author of *Trigonometric Series*; etc.
- A. Z. R.**—Alfred Zantzing Reed. Staff Member in charge of the Carnegie Study of Legal and Professional Education, Carnegie Foundation for Advancement of Teaching, New York, 1913-40. Author of *Training for the Public Profession of the Law*.
- B.**—Frederick Edwin Smith, 1st Earl of Birkenhead. Secretary of State for India, 1924-28. Author of *International Law*; etc.
- B. A. El.**—Burl A. Ely. Director of Promotion, International News Service, New York, N.Y.
- B. A. M.**—Brian Allan Marwick. Government Secretary, Basutoland. Author of *The Swazi*.
- B. A. T.**—B. A. Tyson. Principal, Fisheries Department, Ministry of Agriculture and Fisheries, London.
- B. A. W. R.**—Bertrand Arthur William Russell, 3rd Earl Russell. Professor of Philosophy, University of California, 1939. Author of *Philosophical Essays*; *The A. B. C. of Relativity*; etc.
- B. B. B.**—B. B. Bayles. Principal Agronomist in Wheat Investigations and Assistant to the Head of the Division of Cereal Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, U.S. Department of Agriculture, Washington, D.C.
- B. Be.**—Bernard Brodie. Research Associate, Institute of International Studies, Yale University. Author of *Sea Power in the Machine Age*; etc.
- B. B. K.**—Benjamin B. Kendrick. Professor and Chairman of the Department of History and Political Science, North Carolina College for Women, Greensboro, N.C., 1930-46. Author of *The Journal of the Joint Committee on Reconstruction, 1865-7*.
- B. Br.**—Barbara Buckmaster (the Hon. Mrs. Barbara Miller). Writer on Balkan affairs, London. Former member of the staff, Foreign Research and Press Service, Royal Institute of International Affairs. Author of "Roumania" in *Hitler's Route to Baghdad*; etc.

- B. B. R.**—B. B. Robinson. Senior Agronomist, Office of Fiber Plants, Bureau of Plant Industry, Soils, and Agricultural Engineering, U.S. Department of Agriculture, Washington, D.C.
- B. C. G.**—Basil Campbell de Guérin. Journalist, Guernsey, Channel Islands. Author of *The Norman Isles*; etc.
- B. Ch.**—Bertram Cholet. Educational Director, Charles M. Higgins and Company, Inc., Brooklyn, N.Y.
- B. Cha.**—Bennett Chapple. Assistant to the President of Armco Steel Corp., Middletown, O.
- B. C. P.**—B. C. Palmer. Former Chief Engineer, American Taximeter Company.
- B. Cr.**—Benedetto Croce. Minister without Portfolio, Italy, 1944. Senator of the Kingdom of Italy, 1930. Author of *Filosofia dello spirito*; *Problemi di Estetica*; etc.
- B. De.**—Byron Defenbach. Author of *Idaho: The Place and Its People*, etc.
- B. D. L.**—Bertram David Lewin, M.D. President, American Psychoanalytic Association.
- B. E.**—Bengt Edlén. Professor of Physics, University of Lund, Lund, Sweden.
- B. E. A.**—Basil E. Allen. Head of Metal Work and Enamelling Department, Royal College of Art, London.
- B. E. E.**—B. Eldred Ellis. Author of *Gloves and the Glove Trade*.
- B. E. O.**—Benjamin Evan Owen. Schoolmaster at Deykin Avenue Secondary Modern School, Birmingham, Eng. Lecturer, University of Birmingham Extra-Mural Department in English Literature. Lecturer, Workers' Educational Association in English Literature, Drama and World Affairs.
- B. E. P.**—Barthélemy Edmond Palat. Former General of Brigade in the French Army. Author of *La Grande Guerre sur le Front Occidental*, *Les Batailles d'Arras et de Champagne*.
- B. E. S.**—Bernadotte Everly Schmitt. Emeritus Professor of Modern History, The University of Chicago. Chief, German War Documents Project, U.S. Department of State, Washington, D.C. Author of *The Coming of the War, 1914*; etc.
- B. E. Sz.**—Birl E. Shultz. Formerly Educational Director of the New York Stock Exchange and Director of the New York Stock Exchange Institute. Author of *The Securities Market*.
- B. E. W. C.**—Sir Borlase Elward Wyndham Childs. Major General. Assistant Commissioner, Metropolitan Police, 1921-28.
- B. F.**—Bernard Fay. Former Professor in the Faculté des Lettres de l'Université de Clermont-Ferrand, France. Author of *Franklin, the Apostle of Modern Times*; etc.
- B. F. A.**—Benjamin Franklin Affleck. Former Director of Universal Atlas Cement Company.
- B. F. C. A.**—B. F. C. Atkinson. Under-Librarian, University Library, Cambridge.
- B. F. D.**—Byrce F. Denno. Lieut. Col. Assistant Editor, *Officers' Call*, Office of the Chief of Information, Department of the Army, Washington, D.C.
- B. F. H.**—Bert Frank Hoselitz. Associate Professor of Social Sciences, The University of Chicago, Chicago, Ill. Co-author of *The Economics of Military Occupation*.
- B. F. Hl.**—Benjamin Franklin Howell. Professor of Geology and Palaeontology, Princeton University, Princeton, N.J.
- B. F. L.**—B. F. Lynip, Jr. Statistician, California and Hawaiian Sugar Refining Corporation, Ltd., San Francisco, Calif.
- B. F. S. B.-P.**—Baden Fletcher Smyth Baden-Powell. Major. Inventor of man-lifting kites, 1894. Author of *Balloonng as a Sport*; etc.
- B. G.**—Bartow Griffiss. Head of Department of Economics, Carnegie Institute of Technology, Pittsburgh, Pa., 1924-36. Author of *New York Call Money Market*.
- B. G. C.**—B. G. Chitwood. Associate Nematologist, Bureau of Plant Industry, Soils, and Agricultural Engineering, U.S. Department of Agriculture, Washington, D.C. Author of *An Introduction to Nematology*.
- B. G. H.**—Benjamin Grad Holzman. Colonel, Air Corps. Chief, Evaluation and Development Division, H.Q.A.A.F. Weather Service.
- B. Gm.**—Bessie Graham. Director, Temple University Library School, Philadelphia, Pa., 1925-40. Author of *The Bookman's Manual and Famous Literary Prizes and Their Winners*.
- B. Gt.**—Bruce Grant. Author of *Isaac Hull: Captain of Old Ironsides*; co-author of *Tong War*.
- B. Hd.**—Bray Hammond. Former Assistant Secretary, Federal Reserve Board, Washington, D.C. Author of *The Federal Reserve System—Its Purposes and Functions*.
- B. H. L. H.**—B. H. Liddell Hart. Captain. Military historian and critic. Military correspondent of *The Times*, London, 1935-39. Author of *The British Way in Warfare*; *T. E. Lawrence—in Arabia and After*; etc.
- B. H. M. V.**—Bernard H. M. Vlekke. Director, Netherlands Institute of International Affairs. Author of *The Evolution of the Dutch Nation*; *A History of the East Indian Archipelago*.
- B. H.-S.**—Brooke Heckstall-Smith. Major. Yachting Editor of the *Field*, 1900-28. Editor of the *Yachting World*. Author of *The Complete Yachtsman*; *The Helmsman's Handbook*; etc.
- B. Hz.**—Bernhard Haurwitz. Associate Professor of Meteorology, Massachusetts Institute of Technology, Cambridge, Mass. Co-author of *Dynamic Meteorology*, *Climatology*.
- B. I.**—Beresford Ingram. Organizer of Continuation Schools, London County Council.
- B. J. H.**—Burton Jesse Hendrick. Associate Editor of the *World's Work*, 1913-27. Co-author of *The Victory at Sea* (Pulitzer Prize, 1920); author of *Life and Letters of Walter H. Page* (Pulitzer Prize, 1922); etc.
- B. J. O.**—B. J. Owen. Captain. Director of the Institute of Agricultural Engineering, Oxford.
- B. Ko.**—Bjorn Kornerup. Superior Archivist, National Record Office, Copenhagen, Den. Author of *Bishop Hans Poulsen Resen; Ribe Katedralskoles Historie*, I.
- B. Le.**—Bernard Lewis. Professor of the History of the Near and Middle East, University of London. Author of *The Origins of Islamism*; *The Arabs in History*; etc.
- B. Ls.**—Bernard Lewis. Chief, Explosives Division, Bureau of Mines, U.S. Department of the Interior. Author of *Combustion, Flames and Explosions of Gases*.
- B. L. S.**—Burdell L. Springer. Deputy Chief, Airframe and Equipment Engineering Branch, Office of Aviation Safety, Civil Aeronautics Administration, Washington, D.C.
- B. M.**—Budgett Meakin. Author of *The Moors*; *The Land of the Moors*; etc.
- B. Ma.**—Bronislaw Malinowski. Professor of Anthropology in the University of London, 1927-42.
- B. M. A.**—Bennet M. Allen. Professor of Zoology, University of California at Los Angeles.
- B. Mack.**—Benton Mackaye. On staff of U.S. Rural Electrification Administration, 1942-45. Author of *The New Exploration*; co-author of *Regional Planning*.
- B. Mar.**—Benjamin March. Curator of Asiatic Art, The Detroit Institute of Arts, Detroit, Mich. Author of *The History of Chinese Painting in Outline*.
- B. M. B.**—Bernard Mannes Baruch. U.S. Representative, U.N. Atomic Energy Commission, 1946. Author of *The Making of Economic and Reparation Sections of Peace Treaty*.
- B. M. Bk.**—Bertram Maurice Beck. Director, Special Juvenile Delinquency Project, Children's Bureau, Federal Security Agency. Author of *Five States, A Study of Youth Authorities*; *Youth Within Walls*.
- B. Mc.**—Beatrice McConnell. Director, Industrial Division, Children's Bureau, Federal Security Agency, Washington, D.C.
- B. Md.**—Ben Markland. Assistant Outdoor Editor, *Chicago Tribune*.
- B. M. E. M.**—Brita Maud Ellen Mortensen. Lecturer in Swedish, Cambridge University. Co-author of *Scandinavian Literature*; *Strindberg, An Introduction*.
- B. Mi.**—Broadus Mitchell. Lecturer in Economics, Rutgers University, New Brunswick, N.J. Author of *The Rise of Cotton Mills in the South*; etc.
- B. M. J.**—Sir Bennett Melville Jones. Francis Mond Professor of Aeronautical Engineering, Cambridge University, 1919-. Co-author of *Aerodynamic Theory*.
- B. M. P.**—B. M. Pickering. Sometime Scholar of Gonville and Caius College, Cambridge, and Hebrew Master at Merchant Taylor's School.
- B. M. St.**—Ben M. Stern. Director, Office of Aviation Information, Civil Aeronautics Administration, Washington, D.C.
- B. N.**—Beaumont Newhall. Author of *Photography, A Short Critical History*; etc.
- B. O. M.**—Byron Omar McCoy. Hydraulic Engineer, Chas. T. Main, Inc., Boston, Mass.
- B. P. B.**—Burton Peter Block. Assistant Professor of Chemistry, Pennsylvania State College, State College, Pa.
- B. Ra.**—Bernard Rackham. Keeper of the Department of Ceramics, Victoria and Albert Museum, London, 1898-1938. Author of *A Book of Porcelain*; etc.
- B. R. C.**—B. R. Coad. In charge, Delta Laboratory, Bureau of Entomology, U.S. Department of Agriculture, Washington, D.C.
- B. R. D.**—B. R. Donaldson. Of the Ford Motor Company, Dearborn, Mich.
- B. Re.**—Bertha Rembaugh. Lawyer. Author of *Political Status of Women in United States*.

- B. R. L.**—B. R. Lewis. Major, Ordnance Department, U.S. Army, Washington, D.C.
- B. R. P.**—Bertie Reginald Pearn. Former Professor of History, University of Rangoon, Burma. Author of *History of Rangoon*; *The Indian in Burma*; etc.
- B. R. Pn.**—Buel R. Patterson. Assistant Professor of Physical Education and Coach of Wrestling, University of Illinois, Urbana, Ill. Author of *Wrestling Guide*.
- Br. S.**—Bruce Smith. Secretary, Institute of Public Administration, New York, N.Y.
- B. Sa.**—Bernard Samuel. Mayor, Philadelphia, Pa., 1944-51.
- B. Sm.**—Bernard Smith. Director of Geological Survey of Great Britain and Museum of Practical Geology, London, 1935-36. Author of *Physical Geography for Schools*.
- B. S. M.**—Bernard Sandler Meyer. Professor and Chairman of the Department of Botany, Ohio State University, Columbus, O. Co-author of *Laboratory Plant Physiology*; *Plant Physiology*.
- B. Sn.**—Brady Sandeman. Lieutenant, U.S. Army.
- B. S. R.**—B. Seeborn Rowntree. Chairman of Rowntree and Company Ltd., 1925-41. Author of *Poverty: A Study of Town Life*; etc.
- B. S. Y.**—Basil Selig Yamey. Reader in Economics, University of London.
- B. T.**—Sir Basil (Home) Thomson. Assistant Commissioner, London Metropolitan Police, 1913-19. Director of Intelligence, 1919-21. Author of *The Criminal*; etc.
- B. T. D. S.**—Rev. B. T. D. Smith. University Lecturer in Divinity and Fellow of Sidney Sussex College, Cambridge.
- B. To.**—Bailey Townshend. Former Chief Physicist and Manager, Research Laboratories, Johns-Manville Corporation.
- B. T. P. B.**—Bertie Thomas Percival Barker. Professor of Agricultural Biology, University of Bristol, England, 1912-43. Author of *Cider Apple Production*; etc.
- B. U. R.**—B. U. Ratchford. Professor of Economics, Duke University, Durham, N.C. Author of *American State Debts*.
- B. V.**—Birgit Vennesland. Associate Professor of Biochemistry, The University of Chicago.
- B. V. N.**—Bruno Victor Nordberg. Executive Engineer, Nordberg Manufacturing Co., Milwaukee, Wis.
- B. W. B.**—Barry Wallace Bruce. Specialist in advertising and commercial organizing. Author of *Business Simplified*; etc.
- B. W. Ba.**—Rev. Benjamin Wisner Bacon, D.D. Former Professor of New Testament Criticism and Exegesis in Yale University. Author of *The Fourth Gospel in Research and Debate*; *The Founding of the Church*; etc.
- B. W. Be.**—B. W. Best. Editor, *Cycling*, London.
- B. W. H.**—Bernard William Henderson. Fellow and Tutor of Exeter College, Oxford. Author of *Civil War and Rebellion in the Roman Empire*; etc.
- B. Wi.**—(Arthur Frederic) Basil Williams. Professor of History at Edinburgh University, Scot., 1925-37. Author of *The Life of William Pitt, Earl of Chatham*; etc.
- B. Wl.**—Bernard Wall. Author of *North-ern Italy*; *Rome and South Italy*; *These Changing Years*.
- B. Y.**—Barney Yanofsky. Editor of *Foreign Service* and Director of Public Relations, Veterans of Foreign Wars of the United States, Kansas City, Mo.
- B. Y. L.**—Benson Y. Landis. Associate Director, Department of Research and Survey, National Council of the Churches of Christ in the U.S.A. Author of *Rural Welfare Services*.
- B. Z.**—Béla Zolnai. Professor of Contemporary Literature, University of Budapest, Hungary.
- C.**—Ronald John McNeill, 1st Baron Cushendun. Chancellor of the Duchy of Lancaster, 1927-29. Parliamentary Under-secretary of State for Foreign Affairs, 1922-24. Author of *Ulster's Stand for Union*; *Home Rule: Its History and Danger*; etc.
- C. A. Be.**—Sir Charles Alfred Bell. Former British Political Agent for Tibet, Bhutan and Sikkim. Author of *Tibet: Past and Present*; etc.
- C. A. C.**—Claude A. Claremont. Assistant to Dr. Maria Montessori (Montessori Diploma).
- C. A. C. B.**—Charles A. C. Brown. Institute of Agricultural Engineering, Oxford University.
- C. A. Co.**—Charles Abel Corwin. Former Staff Artist, Chicago Natural History Museum.
- C. A. Dt.**—Carl Albert Dragstedt, M.D. Professor and Chairman of the Department of Pharmacology, Northwestern University, Evanston, Ill.
- C. A. E. L.**—C. A. E. Lea. Member of the Sudan Political Service.
- C. A. F. R. D.**—Caroline A. F. Rhys Davids. Lecturer on History of Buddhism, School of Oriental Studies, London, 1918-33. Author of *Buddhist Psychology: Ethics*; *Old Creeds and New Needs*; etc.
- C. A. H.**—Carl August Heiland. Professor and Head of Department of Geophysics, Colorado School of Mines, Golden, Colo., 1926-.
- C. A. H. F.**—Charles Aubrey Hamilton Franklyn, M.D. Bedell of Convocation and Member of the Standing Committee, University of London. Author of *The Bearing of Coat Armour by Ladies*; *A Genealogical and Heraldic History of Four Families*; etc.
- C. A. J. A.**—Charles Arthur John Armstrong. Fellow of Hertford College, Oxford. Author of *Politics and the Battle of St. Albans, 1455*; *The Usurpation of Richard III*.
- C. A. Je.**—Cyril Alfred Joyce. Headmaster, the Cotswold School. Former Governor, His Majesty's Prison and Borstal Service.
- C. A. M.**—Carille Aylmer Macartney. Research Fellow of All Souls College, Oxford, 1936-. Author of *The Social Revolution in Austria*; etc.
- C. A. P.**—Charles A. Perkins. Member of the firm of Perkins, Malone and Washburn, Attorneys-at-Law, New York.
- C. A. R.**—C. A. Richardson. Chief Inspector, Ministry of Education, London. Author of *Spiritual Pluralism and Recent Philosophy*; etc.
- Car. B.**—Carleton Beals. Associate Editor, *Mexican Folkways*, 1925-37. Author of *America South*; *Mexico—An Interpretation*; etc.
- C. A. Rd.**—Clarence Arthur Reed. Associate Pomologist, U.S. Department of Agriculture, Washington, D.C.
- C. A. R. N.**—Cyril Alfred Rankin Nitch. Fellow of the Royal College of Surgeons.
- C. A. Ro.**—C. A. Robins. Governor of Idaho.
- C. A. Sc.**—Rev. Charles Anderson Scott, D.D. Former Dunn Professor of the New Testament, Theological College of the Presbyterian Church of England.
- C. A. Sp.**—Charles A. Sprague. Editor and Publisher, the *Oregon Statesman*, Salem, Ore.
- C. A. Ss.**—Charles Anderson Stokes. Director of Research and Development, Godfrey L. Cabot, Inc., Boston, Mass.
- C. B.**—Cyril Bailey. Jowett Lecturer, 1932-39, and Classical Tutor, 1902-39, of Balliol College, Oxford. Author of *Religion of Ancient Rome*; etc.
- C. Ba.**—Christian Barman. Fellow of the Royal Institute of British Architects. Assistant Director, Post-War Building, Ministry of Works and Buildings, 1941-45. Author of *Sir John Vanbrugh*; *The Bridge*; etc.
- C. Bau.**—Catherine Bauer. Vice-President, National Housing Conference. Council Member, International Federation for Housing and Town Planning. Author of *Modern Housing*.
- C. B. B.**—Arthur C. Barrington Brown. Consulting oil geologist.
- C. B. Bl.**—Charles Bedford Biswell. Research Chemist, Jackson Laboratory, E. I. du Pont de Nemours & Co., Wilmington, Del.
- C. B. Br.**—Carl Benjamin Boyer. Assistant Professor of Mathematics, Brooklyn College, Brooklyn, N.Y. Author of *The Concepts of the Calculus*.
- C. B. Bt.**—Charles Barron Bisset. Director, Geological Survey, Tanganyika.
- C. B. C.**—Christopher Bush Coleman. Director of Indiana State Historical Bureau, 1924-44, and of the State Library, 1936-42.
- C. B. de M.**—Cecil Blount de Mille. Playwright, actor and motion picture producer. Productions: *Ten Commandments*; *Cleopatra*; etc.
- C. Be.**—Charles Bennion. Formerly of The British United Shoe Machinery Company Ltd., Leicester, England.
- C. Bem.**—Charles Bémont. Author of *Les Chartes des Libertés anglaises*; *Histoire de l'Europe au moyen âge, de 395 à 1270*; etc.
- C. Bg.**—Carl Berg. Vice-President and Chief Engineer, Nickel Cadmium Battery Corporation, Easthampton, Mass.
- C. Bi.**—Rev. Charles Bigg, D.D. Regius Professor of Ecclesiastical History, Oxford, 1901-08. Author of *Neoplatonism*; etc.
- C. B. M.**—Charles B. MacDonald. Historian, Office of the Chief of Military History, Department of the Army, Washington, D.C.
- C. Bn.**—A. Curtis Brown. Former President of Curtis Brown, Ltd., International Publishing Bureau, London and New York.
- C. B. N.**—Charles B. Nutting. Vice-Chancellor and Professor of Law, University of Pittsburgh, Pittsburgh, Pa. Co-author of *Cases and Materials on Legislation*.
- C. B. P.**—Charles Benjamin Purdom. Finance Director, Welwyn Garden City, Ltd., 1919-28. Author of *The Garden City*; etc.

C. B. Ph.—Catherine Beatrice Phillips. Sometime Associate of Bedford College, University of London.

C. Br.—Cloudeley Brereton. Former Divisional Inspector for Modern Languages to the London City Council. Member of Legion of Honour. Author of *Modern Language Teaching*; *Studies in Foreign Education*; etc.

C. B. R.—Charles Bedell Rose. President, American-La France and Foamite Corporation, New York, 1927-36. Former Vice-President, Baldwin Locomotive Works, Eddystone, Pa.

C. B. Sn.—Chester Baker Slawson. Professor of Mineralogy, University of Michigan, Ann Arbor, Mich. Co-author of *Gems and Gem Materials*.

C. B. Sr.—Charles Baldwin Sawyer. President, the Brush Laboratories Company, and Chairman, the Brush Beryllium Company, Cleveland, O.

C. B. T.—C. B. Tracey. Governor of Northern (Ed Damer) Province, Anglo-Egyptian Sudan.

C. B. W.—C. B. Williams. Chief Entomologist, Rothamsted Experimental Station, Harpenden, Herts., Eng., 1932-.

C. C.—Charles Cestre. Professor of American Literature and Civilization at the Sorbonne. Author of *An Introduction to Edwin Arlington Robinson*; etc.

C. Ca.—Clarence Cannon. U.S. Congressman from Missouri, 1923-49. Author of *A Synopsis of the Procedure of the House*; etc.

C. C. D.—Cuthbert Collin Davies. Reader in Indian History, Oxford University. Author of *The Problem of the North-West Frontier, 1800-1908*; *Warren Hastings and Oudh*; *An Historical Atlas of the Indian Peninsula*; etc.

C. C. F.—C. C. Foster. Former Secretary of The Singer Manufacturing Company, New York, N.Y.

C. Ch.—Cecil Chisholm. Chairman of Business Publications, Ltd. Editor of *System*. Author of *Marketing and Merchandising*.

C. Chr.—Charles Chree. Superintendent, King's Observatory, Kew, England, 1893-1925.

C. C. J. W.—Clement Charles Julian Webb. Oriel Professor of the Philosophy of Christian Religion, Oxford University, 1920-30. Honorary Fellow of Oriel College and of Magdalen College, Oxford. Author of *In Time of War*; *Divine Personality and Human Life*; *History of Philosophy*; etc.

C. Cl.—Charly Clerc. Professor of French Language and Literature, Zürich Federal Polytechnic School. Author of *Jésus et Marc Aurèle*; etc.

C. C. Le.—Clarence Cook Little. Director, Roscoe B. Jackson Memorial Laboratory, Bar Harbor, Me., 1929- . Managing Director, American Society for Control of Cancer, 1929-45. Author of *Civilization against Cancer*.

C. C. M.—C. C. MacDuffee. President, Mathematical Association of America, 1945-46. Author of *The Theory of Matrices*; etc.

C. Co.—Carlos Contreras. Professor of City Planning, National University of Mexico, Mexico City.

C. Com.—Christine Comber. Foreign Research and Press Service, Royal Institute of International Affairs, London, 1941-43. Foreign Office, London, 1943-48.

C. C. Pa.—Clifford Copland Paterson. Director, Research Laboratory, General Electric Company Ltd., Wembley, Middlesex, England, 1919-48.

C. C. Pe.—Charles C. Price. Professor of Chemistry, University of Notre Dame, Notre Dame, Ind. Author of *Brief Course in Organic Chemistry*; *Reactions at the Carbon-Carbon Double Bond*.

C. C. T.—Charles Cutler Torrey, D.D. Emeritus Professor of Semitic Languages, Yale University. Author of *Our Translated Gospels*; etc.

C. C. Ta.—Charles Callan Tansill. Professor of American History, Georgetown U., Washington, D.C. Author of *Pennsylvania and Maryland Boundary Controversy*; etc.

C. C. Tay.—Charles Carlisle Taylor. Former British Vice-Consul at New York, N.Y. Author of *The Life of Admiral Mahan*; etc.

C. Cy.—Charles Clay. Director, Canadian Research and Editorial Institute. Author of *Muskat Man*; *Phantom Fur Thieves*; *Young Voyageur*; etc.

C. C. Z.—Carle Clark Zimmerman. Sociologist, Harvard University. Author of *Family and Civilization*; *Graphic Regional Sociology*.

C. D.—Charles Davison. Author of *The Origin of Earthquakes*; etc.

C. Da.—Cyril James H. Davenport. Major. Former Superintendent of Bookbinding, British Museum, London. Author of *Cameos*; *Mezzotints*; etc.

C. D. A.—Charles Dennis Adams. Lecturer in Botany, University College of the Gold Coast, Achimota, Gold Coast.

C. De.—Calvin Derrick. Former Superintendent, State Home for Boys, Jamesburg, N.J.

C. D. Hd.—Charles DeWitt Hurd. Professor of Chemistry, Northwestern University, Evanston, Ill. Author of *Open-Chain Nitrogen Compounds*; *Pyrolysis of Carbon Compounds*.

C. D. J. B.—Coenraad Dirk Jan Brandt. Extraordinary Professor in Contemporary History, University of Utrecht, Utrecht, Neth.

C. D. Mc.—Charles Duncan McGilvray, M.D.V., D.V.Sc. Former Principal, Ontario Veterinary College, University of Toronto, Toronto, Ont. Author of *Bang's Disease in Cattle*; *Diseases of the Foal*.

C. D. My.—Charles Dudley Massey. Managing Director, Pickering and Chatto, London.

C. Do.—Campbell Dodgson. Keeper of Prints and Drawings, British Museum, London, 1912-32. Author of *Old French Colour-Prints*; *Woodcuts of the Fifteenth Century in the British Museum*; etc.

C. D. S.—Chauncey Depew Snow. Manager, American Section, International Chamber of Commerce, 1935-42.

C. D. Sn.—C. D. Stein, V.M.D. Veterinarian, Pathological Division, Bureau of Animal Industry, Agricultural Research Administration, U.S. Department of Agriculture, Washington, D.C.

C. D. T.—Carl Dean Thompson. Former Director, Public Ownership League of America. Author of *Municipal Ownership*; *Public Ownership*; etc.

C. E.—Charles Everitt. Sometime Scholar of Magdalen College, Oxford.

C. E. A.—C. E. Allred. Head of Department of Agricultural Economics and Rural Sociology, University of Tennessee, Knoxville.

C. E. Br.—Charles E. Brown. Lieut. Col. General Staff Corps, Office of the Chief of Staff, Department of the Army, Washington, D.C.

C. E. Bs.—Charles E(verett) Bills. Research Director, Mead Johnson and Company, Evansville, Ind.

C. E. Bu.—Claude E. Buxton. Professor of Psychology, Yale University, New Haven, Conn., 1949-.

C. E. C.—Sir Charles Edward Callwell. Major General. Director of Military Operations at the War Office, London, 1914-16. Author of *Small Wars*; *The Dardanelles*; etc.

C. E. C. F.—C. E. C. Fischer. Assistant Botanist on Indian Botany, Kew Herbarium, Kew, England.

C. E. Cg.—Cecil Edwin Corrigan, M.D. Assistant Professor of Surgery, University of Manitoba, Winnipeg, Man. Director, Departments of Surgery, Deer Lodge Hospital and St. Boniface Hospital, Winnipeg, Man. Author of *Clinical Diagnosis of Swellings*.

C. E. Ch.—Charles Edward Chapman. Professor of History, University of California, 1914-41. Author of *History of Spain*; etc.

C. E. Cl.—Charles Edward Clark. Judge, U.S. Court of Appeals, 2nd Circuit, 1939- . Dean of the Law School, Yale University, 1929-39. Author of *Code Pleading*; etc.

C. E. Cn.—Charles Edward Cauthen. Professor of History and Political Science, Wofford College, Spartanburg, S.C.

C. E. D.—Charles Edward Dupuis. Former Adviser to the Egyptian Ministry of Public Works.

C. E. De.—Charles Eugene Denney. President, Northern Pacific Railway Co.

C. E. F.—C. Ernest Fayle. Author of *Seaborne Trade (History of the Great War)*; *The War and the Shipping Industry*; etc.

C. E. G.—C. E. Golding. Treaty Insurances, Ltd., London.

C. E. Gn.—C. E. Gapen. Senior Information Specialist, Division of Information, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, U.S. Department of Agriculture, Beltsville, Md.

C. E. H.—Charles Evans Hughes. Chief Justice, Supreme Court of the United States, 1930-41. Secretary of State, 1921-25. Author of *Our Relation to the Nations of the Western Hemisphere*; etc.

C. E. K.—Charles E. Kellogg. Chief, Division of Soil Survey, Bureau of Plant Industry, Agricultural Research Administration, U.S. Department of Agriculture, Beltsville, Md. Author of *Soils That Support Us*; *Soil Survey Manual*.

C. E. Ke.—C. Edith Kerby. Associate for Program Planning and Research, National Society for the Prevention of Blindness.

C. E. K. M.—Charles Edward Kenneth Mees. Director, Vice-President in Charge of Research, Eastman Kodak Company, Rochester, N.Y. Author of *The Fundamentals of Photography*; etc.

C. El.—Sir Charles Norton Edgcombe Eliot. British Ambassador to Japan, 1919-26. Author of *Hinduism and Buddhism*; etc.

C. E. L.—Charles E. Locke. Professor of Mining Engineering, Massachusetts Institute of Technology, Cambridge, Mass., 1906-41. Co-author of *Text Book of Ore Dressing*; etc.

C. E. L. C.—Charles E. L. Corthorn. Assistant Manager and Secretary of the Ottoman Bank, 1911-28.

C. E. Lu.—Cyril Edward Lucas. Head of Department and Deputy Director of Research, Department of Oceanography, University College, Hull, Eng. Co-editor, *Hull Bulletins of Marine Ecology*.

C. E. M.—Sir Charles Edward Mallet. Secretary for Indian Students at the India Office, London, 1912-16. Author of *Herbert Gladstone, A Memoir*; etc.

C. E. Mc.—Constantine Edward McGuire. Economic adviser to private concerns and to governments. Author of *Germany's Capacity to Pay*; *Italy's International Economic Position*.

C. E. Me.—Coyle E. Moore. Dean of the School of Social Welfare, Florida State University, Tallahassee, Fla.

C. E. N.—Charles Eliot Norton. Editor of the *Orations and Addresses of George William Curtis*; etc.

C. E. O'H.—Charles E. O'Hara. Captain, U.S. Air Force. Instructor, Office of Special Investigations Training School, U.S. Air Force. Co-author of *An Introduction to Criminalistics*; *Practical Photographic Chemistry*.

C. E. P. B.—C. E. P. Brooks. Former Honorary Secretary, Royal Meteorological Society.

C. E. Pr.—Carl E. Pray. Former Head, Department of History and Social Sciences, Michigan State Normal College, Ypsilanti, Mich.

Ce. R.—Cecil Rowntree. Former Consulting Surgeon to the Royal Cancer Hospital.

C. E. R. S.—Charles Ely Rose Sherrington. Secretary, British Railways Research Service.

C. E. S.—Courtney Edward Stevens. Tutor in Ancient History, Magdalen College, Oxford.

C. E. S. P.—C. E. S. Phillips. Major. Former Honorary Lecturer in Radiology at University College, University of London.

C. Et.—Carl Eckart. Associate Professor of Physics, The University of Chicago (on leave for government service).

C. E. T.—Cecil Edgar Tilley. Professor of Mineralogy and Petrology, Cambridge University, 1931-.

C. E. Ta.—Creassey Edward Cecil Tattersall. Keeper, Department of Textiles, Victoria and Albert Museum, London (retired). Co-author of *Hand-Woven Carpets*, *Oriental and European*; etc.

C. E. We.—Charles Edwin Weaver. Professor of Palaeontology, University of Washington, Seattle, Wash.

C. E. Wi.—Charles Edward Wilson. Director, U.S. Office of Defense Mobilization, 1950-52. President, General Electric Company, 1940-50.

C. F.—Cesare Foligno. Professor of English, University of Naples, Italy, 1940-.

C. F. A.—Charles Francis Atkinson. Author, *The Wilderness and Cold Harbour*.

C. F. A.-C.—Sir Charles Frederick Arden-Close. Colonel. President, International Geographical Union, 1934-38. Author, *Text Book of Topographical Surveying*; etc.

C. F. B.—Charles Francis Bastable. Former Professor of Political Economy, Dublin University. Regius Professor of Laws, 1908-32. Author of *Theory of International Trade*; *Public Finance*; etc.

C. F.-Br.—Sir Charles Fortescue-Brickdale. Chief Registrar, Land Registry, 1900-23. Author of *Registration of Title to Land*; etc.

C. F. C.—Charles Frederick Cross. Analytical and consulting chemist. Co-author of *Researches on Cellulose*; *Text-Book of Paper-making*.

C. Ff.—Charles John Ffoulkes. Trustee of the Imperial War Museum, London, 1934-47. Author of *Armour and Weapons*; etc.

C. F. F.—Carl F. Floe. Professor of Metallurgy, Massachusetts Institute of Technology, Cambridge, Mass. Consulting metallurgist.

C. F. G.—Charles Francis Goldthwait. Senior Cotton Technologist, Southern Regional Research Laboratory, U.S. Department of Agriculture, New Orleans, La., 1941-.

C. F. Gu.—C. F. Gummer. Professor of Mathematics at Queen's University, Kingston, Ont., Canada.

C. F. K.—Charles Fabens Kelley. Curator of Oriental Art and Assistant Director of the Art Institute of Chicago.

C. F. Ke.—Charles Franklin Kettering. Vice-President and Director, Charles F. Kettering Foundation, Inc.

C. Fl.—Carl Flink. Mechanical Engineer, American Radiator and Standard Sanitary Corporation, New York, N.Y.

C. F. L.-H.—Carl F. Lehmann-Haupt. Former Professor of Ancient History in the University of Innsbruck, Austria.

C. F. Lo.—C. Frances Loomis. Former Director of Program, Camp Fire Girls, Inc.

C. F. Ls.—Charles F. Lewis. Director, the Buhl Foundation, Pittsburgh, Pa.

C. F. McK.—Charles F. McKhann, M.D. National Medical Director, United Cerebral Palsy Associations, Inc.

C. F. N.—Charles F. Neergaard. Consulting Service in Hospital Planning, Organization and Management, New York, N.Y.

C. F. R.—Sir Charles Fernand Rey. Lieutenant Colonel. Commander of the Star of Ethiopia, 1924. Author of *Unconquered Abyssinia as It Is Today*; etc.

C. F. S.—Charles Felton Scott. Former Professor of Electrical Engineering, Sheffield Scientific School, Yale University.

C. F. St.—Carl Frederic Schmidt, M.D. Professor of Pharmacology, University of Pennsylvania, Philadelphia, Pa. Co-author of *Ephedrine and Related Substances*; co-editor, J. J. Macleod, *Physiology in Modern Medicine*.

C. Fu.—Clyde Furst. Former Secretary, Carnegie Foundation for the Advancement of Teaching.

C. G.—Charles Gide. Former Professor at the Collège de France, Paris.

C. Ga.—Clement Gatley. Author of *The Law and Practice of Libel and Slander in a Civil Action*; etc.

C. G. A.—Charles Greeley Abbot. Research Associate, Smithsonian Institution, Washington, D.C. Director of the Smithsonian Astrophysical Observatory, 1907-44. Author of *The Sun*; etc.

C. G. B.—Hon. Charles Granville Bruce. Brigadier General. Leader of the Mount Everest Expedition. Author of *The Assault on Mount Everest*.

C. Gd.—Calvin Hooker Goddard, M.D. Colonel, U.S. Army. Member of Historical Section, General Headquarters, Far Eastern Command, Tokyo, Jap. Chief of Historical Section, Ordnance Department, Army War College, Washington, D.C., 1942-45.

C. G. D.—Sir Charles Galton Darwin. Director of National Physical Laboratory, Teddington, Eng. Tait Professor of Natural Philosophy in Edinburgh University, Scot., 1923-36. Author of *The New Conceptions of Matter*; etc.

C. G. F.—Colin Garfield Fink. Professor of Chemical Engineering, Head of Division of Electrochemistry, Columbia University, 1922-50. Invented ductile tungsten filament and electrochemical restoration of ancient bronzes.

C. G. Gr.—Constantine G. Grand. Research Associate, Laboratory of Cellular Physiology, New York University.

C. G. H.—Clay G. Huff. Chief Parasitologist, Naval Medical Research Institute, Bethesda, Md., 1947- . Co-author of *Parasitology*; author of *A Manual of Medical Parasitology*.

C. Gi.—Cedric Gibbons. Art Director, Metro-Goldwyn-Mayer Studios, Culver City, Calif., 1924- .

C. G. P.—Carl G. Paulsen. Chief Hydraulic Engineer, Geological Survey, U.S. Department of the Interior.

C. Gr.—Charles Gross. Professor of History at Harvard University, 1888-1909. Author of *The Gild Merchant*.

C. G. Ro.—Sir Charles Grant Robertson. Principal, Birmingham University, Birmingham, Eng., 1920-38. Author of *England under the Hanoverians*; etc.

C. Gs.—Clifford Goes. Member of U.S. Olympic Committee.

C. G. S.—Charles Gabriel Seligman, M.D. Former Professor of Ethnology, University of London.

C. G. T.—C. Gordon Tether. Money Market Editor, the *Financial Times*, London.

C. G. W.—Carter Godwin Woodson. Former Editor of *Journal of Negro History*.

C. H.—Charles Hose. Member of the Sarawak State Advisory Council at Westminster, London, 1919.

C. H. A.—Charles Henry Ambler. Emeritus Professor of History, West Virginia University, Morgantown, W.Va. Author of *History of Transportation in the Ohio Valley*; *Francis H. Pierpont*.

C. H. B.—Charles Herbert Best, M.D. Director of Banting-Best Department of Medical Research, University of Toronto, Canada, 1941- . Co-discoverer of insulin, 1921.

C. H. Br.—Sir Charles Herbert Bresssey. Principal Technical Officer, British Ministry of Transport, 1928-35.

C. H. C.—Charles Herbert Colvin. Director, Daniel Guggenheim School of Aeronautics, New York University, 1941-44.

C. H. C. B.—Charles H. Collins Baker. Research in Art History, Huntington Library, Calif. Author of *British Painting*; etc.

C. H. Cn.—C. H. Curran. Curator, American Museum of Natural History, New York, N.Y. Author of *Families and Genera of North American Diptera*; etc.

C. H. Cr.—Charles Howard Crane. Architect, designer of Music Box and Guild Theatres, New York, N.Y., etc.

C. H. D.—Charles H. Dennis. Former Editor of the *Chicago Daily News*.

C. H. F.—Clarence Henry Faust. Dean of Humanities and Sciences and Professor of English, Stanford University, Stanford, Calif. Co-author of *Jonathan Edwards*.

C. H. H.—Carlton Joseph Huntley Hayes. Seth Low Professor of History in Columbia University. Author of *Historical Evolution of Modern Nationalism*; etc.

C. H. Ha.—Charles Henry Hall. Associate Editor, *Yachting*.

C. H. Hr.—Chester Henry Heuser. Curator of the Embryological Collection, Department of Embryology, Carnegie Institution of Washington, Baltimore, Md.

C. H. K.—Clarence Hill Kelsey. Former Chairman of the Board of Title Guarantee and Trust Company.

C. H. K. B.—The Rev. Canon Charles Henry Knowler Boughton. Former Vicar of Saint John the Baptist, Knighton.

C. H. Ky.—Clarence Hamilton Kennedy. Professor of Zoology and Entomology, Ohio State University, Columbus, O. Author of *Manual for the Study of the Internal Anatomy of Insects*.

C. H. L.—Cecil H. Lander. Professor of Engineering at Imperial College, London, 1931-46.

C. H. LaW.—Charles H. LaWall. Former Dean, Philadelphia College of Pharmacy and Science, Philadelphia, Pa.

C. H. L. J.—Charles Haven Ladd Johnston. Author of *Famous Cavalry Leaders*; etc.

C. H. M.—Conrad Henry Moehlan. Visiting Professor, School of Religion, University of Southern California, Los Angeles, Calif. Author of *The Christian-Jewish Tragedy*; *Protestantism's Challenge*; *School and Church: The American Way*; *The Wall of Separation Between Church and State*; etc.

C. Ho.—Sir Charles Holroyd. Director, National Gallery, London.

C. Hol.—Carl Hollweg. Admiral. Former Director of Department in German Admiralty (Reichsmarineamt). Author of *Unser Recht auf dem U-Bootskrieg*.

C. Hos.—Constance Hoster. Former Principal of Secretarial Training College for Educated Girls and Women, London. Author, with Ellen, Countess of Desart, of *Style and Title*.

C. H. P.—Charles Herman Pritchett. Assistant Professor of Political Science, The University of Chicago. Author of *The Tennessee Valley Authority*.

C. H. R.—Charles H. Reilly. Former Professor of Architecture, University of Liverpool, England.

C. H. Rn.—Charles Howard Richardson. Professor of Entomology, Iowa State College, Ames, Ia.

C. H. T.—Crawford Howell Toy. Former Professor of Hebrew and Oriental Languages, Harvard University.

C. H. Tu.—Cuthbert Hamilton Turner. Grinfield Lecturer on the Septuagint, 1925-27. Author of *Studies in Early Church History*; etc.

C. H. Tut.—Charles H. Tuttle. Member of the Board of Higher Education of the City of New York. Member of Special Committee of National Crime Commission, 1927-28.

C. H. van T.—Claude Halstead van Tyne. Former Head of Department of History, University of Michigan, Ann Arbor, Mich. Author of *Causes of the War for Independence*; etc.

C. H. V. S.—Charles Humphrey Vivian Sutherland. Student of Christ Church, Oxford. Author of *Coinage and Currency in Roman Britain*; *Coinage in Roman Imperial Policy*; *The Romans in Spain*.

C. H. W.—Camilla H. Wedgwood. Principal of Women's College, University of Sydney, Austr., 1935-44.

C. J.—Charles James. Former Professor of Chemistry, University of New Hampshire, Durham, N.H.

C. J. B.—Charles Jasper Blunt. Colonel, R.A.O.C. Served in World War I at Gallipoli.

C. J. Bt.—Clarence Joseph Bulliet. Former Art Critic, the *Chicago Daily News*. Former Chicago Contributing Critic, *Art Digest*, New York, N.Y. Author of *Apples and Madonnas*; *The Significant Moderns*.

C. J. D.—Charles James Dunn. Lecturer in Modern Japanese, School of Oriental and African Studies, London.

C. J. F.—Charles James Fox. Lieutenant Colonel. Former Chief Officer, London Salvage Corps, and President of Association of Professional Fire Brigade Officers.

C. J. Ff.—Constance Jocelyn Ffoulkes. Translator of Morelli's *Italian Painters*; etc.

C. J. Fh.—Carl Joachim Friedrich. Professor of Government and Director of the School for Overseas Administration, Harvard University, Cambridge, Mass. Author of *The New Belief in the Common Man*.

C. J. G.—Cyril John Gadd. Deputy Keeper, Egyptian and Assyrian Antiquities, British Museum, London.

C. J. H.—Sir Charles John Holmes. Director of the National Gallery, London, 1916-28. Author of *Constable*; etc.

C. J. Hk.—C. Judson Herrick. Emeritus Professor of Neurology, The University of Chicago. Author of *Neurological Foundations of Animal Behavior*; etc.

C. J. J.—Charles Jasper Joly. Former Royal Astronomer of Ireland, and Andrews Professor of Astronomy in the University of Dublin, 1897-1906.

C. J. J. F.—Charles J. J. Fox. Former Principal of Physical Chemistry, Royal Institute of Science, Bombay, India.

C. J. L.—Sir Charles James Lyall. Former Secretary, Judicial and Public Department, India Office, and Fellow of King's College, London. Author of *Translations of Ancient Arabic Poetry*; etc.

C. J. Ln.—C. J. Livingstone. Industrial Fellow, Mellon Institute of Industrial Research.

C. J. Mi.—Courtenay J. Mill. City Editor of *The Times*, London.

C. Joh.—Charles Johnston. Bengal Civil Service (retired). Orientalist, author and student of bird life.

C. J. P.—C. John Phillips. Corning Glass Works, Corning, N.Y. Author of *Glass: The Miracle Maker*.

C. J. Pf.—Carl J. Potthoff, M.D. National Director of First Aid and Associate Medical Director, American Red Cross.

C. J. Pn.—C. J. Pederson. Research Associate, Jackson Laboratory, E. I. du Pont de Nemours & Company, Wilmington, Del.

C. J. Sh.—Rev. Charles John Shebbeare, D.D. Chaplain to H.M. the King, 1921-45. Author of *Religion in an Age of Doubt*; etc.

C. K.—Charles Kerr, Jr. Transportation Engineer, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.

C. K. H.—Charles Kenneth Hobson. Author of *The Export of Capital*.

C. K. O.—Charles Kay Ogden. Originator of Basic English. Organizer of the Orthological Institute, London. Founder, Basic English Foundation.

C. Kr.—Clark Kerr. Chancellor of the University of California, Berkeley, Calif. Co-author of *Unions, Management and the Public*.

C. K. T.—Cheng Kwei Tseng. Research Associate, Scripps Institution of Oceanography, University of California.

C. K. W.—Charles Kingsley Webster. Stevenson Professor of International History, London School of Economics, 1932-. Preparatory Commission to General Assembly, U.N., London, 1945-46. Author of *British Diplomacy, 1813-1915*; etc.

C. K. We.—Chester Keeler Wentworth. Principal Geologist, Honolulu Board of Water Supply, Honolulu, Haw.

C. La.—Carney Landis. Professor of Psychology, Columbia University. Author of *Personality and Sexuality of the Physically Handicapped Woman*; etc.

C. L. A.—Charles L. Amick. Illuminating Engineer, General Electric Company, Cleveland, O. Author of *Fluorescent Lighting Manual*.

C. L. Bo.—Charles L. Bolte. Major General. Director of Plans and Operations, General Staff, Department of the Army, Washington, D.C.

C. L. Bt.—Carroll L. Bryant. National Director, Water Safety Service, American National Red Cross. Author of *Swimming and Diving*; *Life Saving and Water Safety*.

C. Ld.—Catherine Littlefield. Former Director, The Philadelphia Ballet Company, Philadelphia, Pa.

C. Le.—Cal Lewis. Of The Manufacturing Clothier, New York, N.Y.

Cl. F.—Clifford Frondel. Associate Professor of Mineralogy and Curator of the Mineralogical Museum, Harvard University. Co-author of *System of Mineralogy of James Dwight Dana and Edward Salisbury Dana* (7th ed.).

C. L. F.—C. L. Ferguson. Former Assistant Clerk, House of Commons, London.

C. L. Fe.—Carroll Lane Fenton. Author of *Our Amazing Earth*; co-author of *The Rock Book*; *Story of the Great Geologists*, etc.

C. L. Hs.—Carl L. Hubbs. Professor of Biology, Scripps Institution of Oceanography, University of California, La Jolla, Calif. Author of *Guide to the Fishes of the Great Lakes and Tributary Waters*; etc.

C. Li.—Caldwell H. Lipsett. Former Editor, *Civil and Military Gazette*, Lahore, India.

C. L. K.—Charles Lethbridge Kingsford. Assistant Secretary, Board of Education, London, 1905-12. Author of *Life of Henry V.*

C. Ll. M.—Conwy Lloyd Morgan. Former Professor of Zoology and Geology, University College, Bristol, England. Author of *Introduction to Comparative Psychology*; etc.

C. L. P.—C. L. Patton. Former President of the American Whist League.

C. L. St.—C. L. Stewart. Professor of Agricultural Economics and Chief in Land Economics, University of Illinois, Urbana.

C. L. T.—Charles Lamar Thomas. Associate Director of Research, Sun Oil Co., Marcus Hook, Pa.

C. L. V. M.—Carroll L. V. Meeks. Associate Professor of Architecture and the History of Art, Yale University.

C. L. Wn.—Carl Louis Wilson. Professor of Botany, Dartmouth College, Hanover, N.H.

C. M.—Christopher Morley. Author of *The Haunted Book Shop*; *Chimneysmoke*; *Inward Hol*; *Thunder on the Left*; etc.

C. Ma.—Charles Marriott. Art Critic, *The Times*, London, 1924-40. Author of *Modern English Architecture*; etc.

C. M. A.—C. M. Austin. Commander, U.S.N. Formerly stationed at Washington, D.C.

C. M. Al.—Carleton M. Allen. Former Part Time Instructor in Economics, Boston University, Boston, Mass.

C. Mas.—Charles Masson. Conservateur Musée du Luxembourg.

C. M. Ay.—Cecilia Mary Ady. Honorary Fellow, St. Hugh's College, Oxford. Author of *The Bentivoglio of Bologna*; *Milan Under the Sforza*; *Morals and Manners of the Quattrocento*; *Pope Pius II*.

C. M. Br.—C. M. Breder, Jr. Chairman and Curator, Department of Fishes and Aquatic Biology, the American Museum of Natural History, New York, N.Y. Author of *Field Book of Marine Fishes of the Atlantic Coast*.

C. M. Cd.—Charles Manning Child. Emeritus Professor of Zoology, The University of Chicago.

C. M. Cl.—Constance Margaret Cornell. Diplomatic Correspondent, *The Glasgow Herald*.

C. M. Cr.—Charles M. Carpenter, M.D. Professor and Chairman of the Department of Infectious Diseases, School of Medicine, University of California, Los Angeles, Calif.

C. M. Cs.—Cecil Marvin Charles, M.D. Associate Professor of Anatomy, Washington University, St. Louis, Mo.

C. M. E. M.—Charles Marie Emmanuel Mangin. General Commanding the French V, VI and X Armies, 1916-18, and the French forces in Rhineland, 1918-19.

C. M. H.—Charles Meyer Hardin. Assistant Professor of Political Science, The University of Chicago.

C. M. H. C.—Charles Manning Hope Clark. Professor of History, Canberra University College, Canberra, Austr. Editor of *Select Documents in Australian History, 1788-1850*.

C. Mi.—Carl Theodor Mirbt. Former Professor of Church History in the University of Marburg, Germany. Author of *Publizistik im Zeitalter Gregor VII*; *Quellen zur Geschichte des Papsttums*; etc.

C. Mij.—Chedomille Mijatovich. Former Senator of the Kingdom of Serbia. Serbian Minister to the Court of St. James's, 1895-1900 and 1902-03. Author of *Serbia and the Serbians*; etc.

C. M. J.—Rev. Charles Michael Jacobs, D.D. Former Professor of Church History and President of the Graduate School, Lutheran Theological Seminary, Philadelphia, Pa. Editor of *Luther's Correspondence*.

C. M. K.—Sir Charles Malcolm Kennedy. Head of Commercial Department, Foreign Office, 1872-93.

C. M. Kn.—C. M. Knowles. Former Assistant Legal Adviser, Home Office, London.

C. M. L.—Charles Mostyn Lloyd. Lecturer and Head of the Department of Social Science and Administration in the London School of Economics and Political Science, University of London. Assistant Editor of *The New Statesman*.

C. Mo.—Herbert Clifford Mortimer. Barrister-at-Law, Probate and Divorce Court, London.

C. Mon.—William Cosmo Monkhouse. English poet and art critic. Author of *The Italian Pre-Raphaelites*; *Life of Turner*; etc.

C. M. P.—Sir Charles Max Page. Fellow of the Royal College of Surgeons, London. Author of *The Treatment of Fractures in General Practice*; etc.

C. M. S.—Cecil M. Smith. Editor, *Musical America*. Author of *Musical Comedy in America*.

C. M. Tr.—Carlisle Monroe Thacker. Solvay Process Corporation, Hopewell, Va.

C. M. Wn.—Charles Macon Wesson. Major General. Office of Lend-Lease Administration, 1942-45.

C. N. E.—Carl N. Everstine. Research Assistant, Maryland Legislative Council.

C. N. G.—C. Norman Guice. Formerly on faculty of Stephens College, Columbia, Mo.

C. N. H.—Clarence N. Hickman. Research Physicist, Bell Telephone Laboratories, Inc., New York, N.Y.

C. N. P.—Cyril Northcote Parkinson. Raffles Professor of History, University of Malaya, Singapore. Author of *Trade in the Eastern Seas*; *War in the Eastern Seas (1793-1815)*.

Co. B.—Cornelius Betten. Emeritus Professor of Entomology, Cornell University, Ithaca, N.Y. Author of *The Caddis Flies, or Trichoptera of New York State*; etc.

C. O. B.—Charles Otto Blagden. Dean, School of Oriental Studies, London, 1922-35.

C. O. F.—Charles Owen Fairchild. President, The Instrument Society of America. Co-author of *Pyrometric Practice*.

C. P.—Rev. Charles Plummer. Former Fellow and Chaplain of Corpus Christi College, Oxford. Author of *Life and Times of Alfred the Great*.

C. Pa.—Cesare Paoli. Italian historian. Former Editor of *Archivio storico italiano*.

C. P. B.—Charles Paul Boner. Associate Director, Underwater Sound Laboratory, Harvard University. Author of *Laboratory Manual on General Physics*; etc.

C. Pe.—Charles Palache. Emeritus Professor of Mineralogy, Harvard University. Co-author of *Dana's System of Mineralogy*.

C. Pf.—Christian Pfister. Former Professor at the Sorbonne, Paris. Author of *Étude sur le règne de Robert le Pieux*; etc.

C. P. I.—Sir Courtenay Peregrine Ilbert. Former Clerk of the House of Commons and Chairman of Statute Law Committee.

C. P. L.—Rev. Charles Patrick Loughran, S.J. Professor of Classics, St. Andrew on Hudson, Poughkeepsie, N.Y.

C. P.-li.—Chen Pu-li. Secretary to Chiang Kai-shek. Former Editor, *Shang Pao* and *China Times*.

C. P. O.—Charles P. Olivier. Director of Flower Observatory and Cook Observatory, University of Pennsylvania, Philadelphia, Pa. Author of *Meteors*; etc.

C. P. S.—Clifford P. Smith. Former Editor, Department of History of The First Church of Christ Scientist, Boston, Massachusetts.

C. P. Sa.—Charles Percy Sanger. Formerly of Lincoln's Inn, Barrister-at-Law.

C. P. Sy.—Charles Perry Stacey. Colonel, Canadian Army. Director, Historical Section, Army Headquarters, Ottawa, Ont. Author of *Canada and the British Army*; *The Canadian Army*.

C. P. W.—Charles P. Wood. Industrial Engineer, Lockwood Greene Engineers, Inc., New York, N.Y. Author of *Factors Controlling the Location of Various Types of Industry*.

C. P. Y.—Constantin Prodromos Yaglou. Associate Professor of Industrial Hygiene, Harvard University School of Public Health, 1938-.

C. R.—Cecil Roth. Reader in Post-Biblical Jewish Studies, Oxford University, 1939-.

Author of *The Last Florentine Republic*; etc.

C. Ra.—Cornelia M. Raymond. Former Director, Bureau of Publications, Vassar College, Poughkeepsie, N.Y.

C. R. Al.—Carl R. Addinall. Foreign Scientific Adviser of Merck & Co., Inc., Rahway, N.J. Author of *Story of Amino Acids*.

C. R. B.—Sir Charles Raymond Beazley. Emeritus Professor of History, Birmingham University, England. Co-author of *History of Russia*; author of *Nineteenth Century Europe*; etc.

C. R. Bl.—Carleton Roy Ball. Collaborator, Correlating Committee, Land-Grant Colleges of Southern States, Tennessee Valley Authority and U.S. Department of Agriculture.

C. R. Br.—Rev. Charles Reynolds Brown, D.D. Former Dean, the Divinity School, Yale University, New Haven, Conn. Author of *The Modern Man's Religion*; etc.

C. Re.—Charles Reiteil. Partner, Stevenson, Jordan and Harrison, Inc., management engineers, New York, N.Y.

C. R. Fi.—Carl Russell Fish. Former Professor of American History, University of Wisconsin, Madison, Wis. Author of *American Diplomacy*; etc.

C. R. Gy.—Carl Raymond Gray, Jr. Administrator of Veterans' Affairs, Veterans' Administration, Washington, D.C.

C. R. H.—C. R. Houseman. Of the British Oxygen Company Ltd., Research Laboratory, Middlesex, Eng.

C. Ric.—Corrado Ricci. Former President of the Royal Institute of Archaeology and History of the Arts. Author of *Il Correggio*; etc.

C. R. K.—Charles Richard Knappett, M.D. Lecturer, Department of Bacteriology, St. Mary's Hospital Medical School, London.

- C. R. Me.**—Carl Richard Moore. Professor of Zoology, The University of Chicago.
- C. R. N.**—Carl Robert Noller. Professor of Chemistry, Stanford University, Stanford, Calif.
- C. Ro.**—Monseigneur Camille Roy. Former Professor of French Literature and Rector of Laval University, Quebec, Canada. Author of *Essais sur la littérature canadienne*; etc.
- C. R. P.**—Chesley R. Perry. President, Rotary Club of Chicago, Ill., 1944-45.
- C. R. Ro.**—Clarence Rufus Rorem. Executive Director, Hospital Council of Philadelphia, Philadelphia, Pa. Author of *The Public's Investment in Hospitals*; *Private Group Clinics*; etc.
- C. R. Wy.**—Charles R. Whittlesey. Professor of Finance and Economics, University of Pennsylvania, Philadelphia, Pa. Economist, the Penn Mutual Life Insurance Company. Author of *International Monetary Issues*.
- C. S. B.**—Charles S. Braden. Professor and Chairman of the Department of History and Literature of Religions, Northwestern University, Evanston, Ill. Author of *Modern Tendencies in World Religions*; *Religious Aspects of the Conquest of Mexico*; etc.
- C. Se.**—Charles Seignobos. Former Professor, Faculty of Letters, Sorbonne, Paris. Author of *The Rise of European Civilization*.
- C. Sey.**—Charles Seymour. President, Yale University, 1937-50. Author of *The Diplomatic Background of the War*; etc.
- C. S. F.**—Sir Cyril Sankey Fox. Director, Geological Survey, India, 1939-43.
- C. S. G.**—Charles Stuart Gager. Director, Brooklyn Botanic Garden, Brooklyn, N.Y., 1910-43. Author of *Fundamentals of Botany*; etc.
- C. Sh.**—C. Shaw. Assistant Inspector of Special Schools (Blind and Deaf), London County Council.
- C. S. H.**—Cornelius Searle Hurlbut, Jr. Associate Professor of Mineralogy, Harvard University. Co-author of *Manual of Mineralogy*; *Minerals and How to Study Them*.
- C. Si.**—Charles Singer, M.D. Emeritus Professor of the History of Medicine, University of London. Author of *Greek Biology and Greek Medicine*; etc.
- C. S. I.**—C. S. Imison. United Alkali Co., Ltd., Widnes, England.
- C. S. K.**—Clarence Selby Kempff. Rear Admiral, U.S. Navy (retired). Former Hydrographer, Bureau of Navigation, Navy Department, Washington, D.C.
- C. S. Kr.**—Chester Scott Keefer, M.D. Wade Professor of Medicine, Boston University School of Medicine.
- C. S. L.**—Charles Sumner Lobingier. Securities and Exchange Commission Officer, 1934-46. Author of *The Beginnings of Law*; *Extraterritorial Cases*; etc.
- C. Sp.**—Carl Shoup. Professor of Economics, Columbia University. Author of *The Sales Tax in France*. Co-author, *Facing the Tax Problem*; *Taxing to Prevent Inflation*.
- C. S. P.**—Rev. Charles Stanley Phillips. Formerly of King's College, Cambridge. Gladstone Memorial Prize, 1904.
- C. S. Pa.**—Rt. Hon. Charles Stuart Parker. Author of *Life of Sir Robert Peel*; etc.
- C. Sr.**—Charles Sawyer. Secretary, U.S. Department of Commerce, Washington, D.C.
- C. S. R.**—C. Stanford Read, M.D. Lecturer in Psychological Medicine, Bethlem Royal Hospital, and Clinical Psychologist to the West End Hospital for Nervous Diseases, London. Author of *The Struggles of Male Adolescence*; etc.
- C. S. Ri.**—Clarence Self Ridley. General. Governor of the Panama Canal Zone, 1936-40.
- C. S. Rs.**—Carl S. Roys. Professor of Electrical Engineering, University of Massachusetts, Amherst, Mass.
- C. S. S.**—Sir Charles Scott Sherrington, M.D. Former Waynflete Professor of Physiology, Oxford University. Nobel Prize for Medicine, 1932. Author of *The Integrative Action of the Nervous System*; etc.
- C. St.**—Constantine Stanislavsky. Russian theatrical producer. Founded, with V. N. Danchenko, the Moscow Art Theatre. Author of *My Life in Art*.
- C. Str.**—Carl Stripe. Manager, Stoker Division, Combustion Engineering Company, Inc., New York, N.Y.
- C. Ta.**—Claude Taylor. Organizing Secretary, British Industries Fair, 1914; Director, 1932-37.
- C. T. B.**—Clinton T. Bissell. Associate Consulting Engineer, National Board of Fire Underwriters, New York, N.Y.
- C. T. Bs.**—Charles Thomas Brues. Emeritus Professor of Entomology, Harvard University. Author of *Insects and Human Welfare*; etc.
- C. T. C.**—Sir Cecil T. Carr. Editor of *Statutory Rules and Orders*, 1923-43. Author of *Law of Corporations*; etc.
- C. Te.**—Sir Charles Bruce Locker Tennyson. Former Deputy Director of the Federation of British Industries.
- C. T. H.**—Charles T. Haven. Co-author of *The History of the Colt Revolver and Automatic Arms, Their History, Development and Use*.
- C. T. H. W.**—Sir Charles Theodore Hagberg Wright. Former Librarian and Secretary of the London Library.
- C. T. O.**—Charles Talbot Onions. Reader in English Philology, Oxford University, 1927-. Joint Editor, *Oxford English Dictionary*, 1914-33.
- C. T. R.**—C. Tate Regan. Director, British Museum (Natural History), London, 1927-38. Author of *British Freshwater Fishes*; etc.
- C. V. C.**—Chester V. Clifton. Colonel, U.S. Army. Assistant to the Chairman, Joint Chiefs of Staff, Washington, D.C.
- C. V. D.**—Charles Vickery Drysdale. Director of Scientific Research, Admiralty, 1929-34.
- C. V. U.**—Cecil Vivian Usborne. Vice-Admiral, formerly with Royal Navy. Author of *The Conquest of Morocco*; *Smoke on the Horizon*.
- C. W.**—Charles Wright. Of Messrs. Henry Head and Company, Ltd., Brokers, London. Co-author of *A History of Lloyd's*.
- C. Wa.**—Sir Charles Walston. Former Slade Professor of Fine Art, Cambridge University. Author of *Greek Sculpture and Modern Art*.
- C. Was.**—Carleton Wolsey Washburne. Superintendent of Winnetka, Ill., schools, 1919-45. Author of *Adjusting the School to the Child*; etc.
- C. W. B.**—Carl W. Bishop. Associate Curator of the Freer Gallery of Art, Smithsonian Institution, 1922-42.
- C. W. Be.**—Clarence W. Balke. Research Director, Farnsteel Metallurgical Corporation, North Chicago, Ill., 1916-48.
- C. W. C. O.**—Sir Charles William Chadwick Oman. Member of Parliament for Oxford University, 1919-35. Author of *A Short History of England*.
- C. W. D.**—C. W. Dannatt. Lecturer in Assaying, Imperial College of Science and Technology, London.
- C. We.**—Cecil Weatherly. Former Scholar of Queen's College, Oxford.
- C. W. E.**—Charles William Eliot. President of Harvard University, 1869-1909.
- C. W. Ee.**—C. Wesley Eisele, M.D. Associate Professor of Medicine, University of Colorado School of Medicine, Boulder, Colo.
- C. W. G.**—Claude William Guillebaud. Lecturer in Economics, Cambridge University.
- C. W. H.**—Charles Wilson Hackett. Professor of Latin-American History, University of Texas, Austin, Tex. Author of *The Mexican Revolution and the United States (1910-1926)*.
- C. W. He.**—Charles W. Hinkle. Major, U.S. Air Force. Office, Secretary of Defense, Washington, D.C.
- C. W. M.**—C. W. Metz. Professor of Zoology and Director of the Zoological Laboratory, University of Pennsylvania, Philadelphia, Pa.
- C. W. N.**—Chester William Nimitz. Commander in Chief, Pacific Fleet, 1941-45.
- C. Wr.**—Clark Wissler. Consulting Anthropologist, Bishop Museum, Honolulu, Haw., 1920-47. Author of *The American Indian*; etc.
- C. W. R.**—Rev. Charles W. Reinhardt, S.J. Professor of History and German, St. Andrew-on-Hudson, Poughkeepsie, N.Y. Author of *An Outline of Roman History*.
- C. W. Ro.**—Sir Charles Walker Robinson. Major General. Governor and Secretary, Royal Military Hospital, Chelsea, 1895-98. Author, *Strategy of the Peninsular War*; etc.
- C. W. T.**—Charles Warren Thornthwaite. Director, Laboratory of Climatology, The Johns Hopkins University, Seabrook, N.J. Former Principal Climatologist, U.S. Soil Conservation Service, Washington, D.C. Author of *Internal Migration in the United States*; etc.
- C. Wtr.**—Charles Winter. Barrister-at-Law, Gray's Inn, London.
- C. W. W.**—Sir Charles William Wilson. Former British Commissioner on the Serbian Boundary Commission. Author of *From Korti to Khartum*; etc.
- C. Z.**—Carl Zeisberg. President, U.S. Table Tennis Association.
- C. Z. K.**—Charles Z. Klauder. Former Consulting Architect, Harkness Memorial Dormitories, Yale University.
- D. A.**—Sir David Anderson. Former senior partner in the firm of Mott, Hay and Anderson, consulting engineers.
- D. A. D.**—Dorothy Anne Dondore. Former Professor of English Literature, William Woods College, Fulton, Mo. Author of *Four Centuries of Description*; etc.

D. A. Gd.—David Alexander Guild. Sheriff-Substitute of Lanarkshire at Glasgow, Scot. Author of *The Law of Arbitration in Scotland*.

D'A. Mc.—D'Arcy McNickle. Director, Branch of Tribal Relations, Bureau of Indian Affairs, U.S. Department of the Interior, Washington, D.C. Author of *The Surrounded*; *They Came Here First*.

D. A. P.—Douglas Archibald Porteous. Deputy Government Actuary, London. Author of *Pension and Widow's and Orphan's Funds*.

D. A. S.—Damon Alvin Spencer. In Charge, Sheep, Goats, and Animal Fibers, Bureau of Animal Industry, U.S. Department of Agriculture, Washington, D.C. Author of *Factors That Influence Wool Production of Range Rambouillet Sheep*; etc.

D. A. W.—David Alec Wilson. Author of *The Truth about Carlyle*; *Carlyle till Marriage*; *Carlyle at His Zenith*; etc.

D. B.—David Baxandall. Former Deputy Keeper of the Science Division, Science Museum, South Kensington, London.

D. Bea.—Donald Bear. Former Director, Santa Barbara Museum of Art, Santa Barbara, Calif. Author of *Russell Cowles*; *Prelude*.

D. B. K.—David Ballin Klein. Professor of Psychology, University of Texas, Austin, Tex. Author of *General Psychology*.

D. B. M.—Duncan Black MacDonald, D.D. Professor of Semitic Languages, Hartford Theological Seminary, 1892-1931. Author of *Development of Muslim Theology*, *Jurisprudence and Constitutional Theory*; etc.

D. B. Mh.—Dorothy B. Marsh. Good Housekeeping Institute, New York, N.Y.

D. B. Mn.—Dean B. McLaughlin. Professor of Astronomy, University of Michigan, Ann Arbor, Mich.

D. Br.—Dirk Brouwer. Director of the Observatory, Yale University. Editor of the *Astronomical Journal*.

D. Bru.—David Brunt. Professor of Meteorology, Imperial College of Science and Technology, London, 1934-. Author of *Weather Science for Everybody*; etc.

D. B. S.—David Barnard Steinman. Founder, President, 1934-36, National Society of Professional Engineers. Author of *A Practical Treatise on Suspension Bridges, Their Design, Construction, and Erection*; etc.

D. B.-V.—D. Batigan-Verne. Organ expert and tone connoisseur. Editor of *The Rotunda*; etc.

D. C.—Sir David Thomas Chadwick. Secretary of the Imperial Economic Committee, 1927-46.

D. C. Br.—Dorrance Crawford Bronson. Actuary, The Wyatt Company, Washington, D.C.

D. C. C.—Delmer Clair Cooper. Associate Professor of Genetics, University of Wisconsin, Madison, Wis.

D. C. Cr.—Donald C. Cutter. Instructor in History, San Diego State College, San Diego, Calif.

D. C. H.—Daniel Clarence Holtom. Haskell Lecturer, The University of Chicago, 1940. Professor, Theology Department, Aoyama Gakuin, Tokyo, 1936-40. Author of *The National Faith of Japan*; *Modern Japan and Shinto Nationalism*; etc.

D. C. M.—Dana C. Munro. Former Professor of Mediaeval History, Princeton University. Author of *Middle Ages*; *A Source Book of Roman History*; Co-author, *Essays on the Crusades*.

D. C. McD.—D. Clay McDowell. Executive Secretary, Institute of Tropical Meteorology, University of Puerto Rico, Río Piedras, P.R.

D. C. McM.—Douglas C. McMurtrie. National Editor of *American Imprints Inventory*, 1937-41. Author of *The Golden Book*; *American Type Design*; etc.

D. Co.—Dorothy Cocks. Director of Advertising for the Marinello Company, New York, N.Y. Author of *The Etiquette of Beauty*.

D. Coc.—Douglas Bennett Cockerell. Former partner of Douglas Cockerell and Son, Bookbinders. Author of *Bookbinding and the Care of Books*; etc.

D. C. Pe.—Dorothy Constance (Mrs. C. S.) Peel. Former Departmental Editor of *Queen*. Former Editor of *Hearth and Home* and *Woman*. Author of *My Own Cookery Book*; etc.

D. Cr.—Douglas Colyer. Air Marshal. Civil Air Attaché to British Embassies at Paris, Brussels, The Hague and Rome, 1947-

D. C. S.—Rev. Professor David Capell Simpson, D.D. Oriel Professor of Interpretation of Holy Scripture, Oxford University, 1925-. Canon of Rochester Cathedral.

D. C. Sh.—David Clyde Smith. Professor of Agronomy, University of Wisconsin, Madison, Wis.

D. C. So.—David Churchill Somervell. Assistant Master at Tonbridge School, Tonbridge, Kent, 1919-. Author of *The Reign of King George the Fifth*; *The British Empire*; etc.

D. C. To.—Rev. Duncan Crookes Tovey. Former Assistant Master, Eton College. Editor of *The Letters of Thomas Gray*; etc.

D. C. W.—David Cleveland Wimer. Professor of Soil Physics, University of Illinois, Urbana, Ill.

D. D. B.—Donald D. Brand. Professor and Chairman of the Department of Geography, University of Texas, Austin, Tex. Author of *Quiroga, A Mexican Municipio*.

D. D. C.-T.—Dorothy Daisy Cottoing-Taylor. Director, Good Housekeeping Institute, 1924-40. Former Associate Editor, *Homes and Gardens*.

D. D. L.—Don Divance Lescohier. Professor of Economics, University of Wisconsin, Madison, Wis., 1918-. Author of *The Labor Market*; Co-author of *Population Problems*; *Can Business Prevent Unemployment?*; etc.

D. D. P.—David D. Pratt. Assistant Director, Chemical Research Laboratory, Teddington, Middlesex, Eng.

D. D. W.—David Duncan Wallace. Former Professor of History and Economics, Wofford College, Spartanburg, S.C. Author of *Life of Henry Laurens*; etc.

D. E.—David Ewen. Author of *Music for the Millions*; *From Bach to Stravinsky*; *The Book of Modern Composers*; *Music Comes to America*; etc.

D. E. C.—Donald E. Cassels, M.D. Associate Professor of Pediatrics, The University of Chicago Medical School, Chicago, Ill.

D. E. H.—Rev. Dom. E. Horne. Downside Abbey, Bath.

D. E. M.—Donald E. McCown. Associate Professor of Archaeology, the Oriental Institute, The University of Chicago. Field Director, Joint Expedition to Nippur. Author of *Comparative Stratigraphy of Early Iran*; co-author of *Tall-I-Bakht A, Season of 1932*.

D. E. S.—David Eugene Smith. Former Professor of Mathematics, Teachers College, Columbia University. Author of *History of Modern Mathematics*; etc.

D. E. Sp.—Domina Eberle Spencer. Assistant Professor of Physics, Brown University, Providence, R.I.

D. E. Wd.—David E. Wiegand. Senior Physicist, Armour Research Foundation, Illinois Institute of Technology, Chicago, Ill.

D. F. J. L.—Daniel F. J. Lynch. Former Director, Southern Regional Research Laboratory, U.S. Department of Agriculture, New Orleans, La.

D. F. T.—Sir Donald Francis Tovey. Reid Professor of Music, University of Edinburgh, Scot., 1914-40. Author of *Essays in Musical Analysis* comprising the *Classical Concerto*; *The Goldberg Variations*.

D. F. Tr.—Donald F. Taylor. Chief Chemist, Fansteel Metallurgical Corporation, North Chicago, Ill.

D. G.—Denis Rolleston Gwynn. Research Professor of Modern Irish History, University College, Cork, Ire. Author of *Daniel O'Connell*; *History of Partition*; *Life of John Redmond*; etc.

D. Ga.—Daniel Garber. Painter, Member of Faculty, Pennsylvania Academy of Fine Arts, Philadelphia, Pa., 1909-.

D. Gd.—Dorothy Good. Member of the staff of the American Geographical Society, New York, N.Y. Co-author of *Japan: A Geographical View*.

D. Ge.—David (William) Greene. Assistant Professor, School of Celtic Studies, Dublin Institute for Advanced Studies, Dublin, Ire. Member of the Royal Irish Academy.

D. G. H.—David George Hogarth. Former Keeper of the Ashmolean Museum, Oxford; President of the Royal Geographic Society, 1925-27. Excavated at Paphos, 1888; Naucratis, 1889 and 1903; Ephesus, 1904-05; Asyut, 1906-07. Author of *The Nearer East*; *The Ancient East*; etc.

D. Gi.—Sir David Gill. H.M. Astronomer at the Cape of Good Hope, 1879-1907.

D. G. K.—Dattatreya Gopal Karve. Executive Editor, *Bombay District Gazetteers* (revision). Author of *Federations*; *Population Problem in India*.

D. Gry.—Dorothy Grafly. Curator of collections, Drexel Institute, Philadelphia, Pa., 1934-45. Author of *Parade of American Art* series.

D. G. Z.—Donald Guyer Zink. Superintendent, Chemical Products Department, Stanolind Oil and Gas Company, Tulsa, Okla.

D. H.—David Hannay. Former British Vice-Consul at Barcelona. Author of *Short History of Royal Navy, 1217-1688*; etc.

D. H. A.—Donald Hatch Andrews. Professor of Chemistry and Director, Cryogen Laboratory, The Johns Hopkins University, Baltimore, Md.

D. He.—Dudley Heath. Author of *Miniatures*; *Tradition and Modern Schools*; etc.

D. H. L.—Dickson H. Leavens. Former Research Associate, Cowles Commission for Research in Economics, The University of Chicago. Author of *Silver Money*.

D. H. Lr.—Derrick Henry Lehmer. Associate Professor of Mathematics, University of California, Berkeley, Calif.

Dh. M.—Sir Dhiren Mitra. Legal Adviser and Minister, India House, London.

D. H. M.—Donald Howard Menzel. Professor of Astrophysics, Harvard University. Author of *A Study of the Solar Chromosphere*; *Stars and Planets*; etc.

D. H. P.—David Henry Peacock. Former Professor of Chemistry, University of Rangoon, Rangoon, Burma. Author of *Life of Joseph Priestley*.

D. Hr.—Davenport Hooker. Professor of Anatomy and Head of Anatomy Department, School of Medicine, University of Pittsburgh, Pittsburgh, Pa. Managing Editor, *Journal of Comparative Neurology*.

D. H. R.—Dennis Holme Robertson. Professor of Political Economy, Cambridge University, 1944-. Author of *Money in Cambridge Economic Handbook series*.

D. H. S. C.—Very Rev. David Herbert Somerset Cranage. Dean of Norwich, Eng., 1928-45.

D. Hu.—Dard Hunter. Author of *Primitive Papermaking*; *Old Papermaking*; etc.

D. J.—Diamond Jenness. Former Chief, Division of Anthropology, National Museum of Canada, Ottawa.

D. Ja.—Dunham Jackson. Professor of Mathematics, University of Minnesota, Minneapolis, Minn., 1919-46. Author of *Fourier Series and Orthogonal Polynomials*; etc.

D. J. D.—Delbert J. Duncan. Professor of Marketing, University of California, Berkeley, Calif. Co-author of *Marketing: Principles and Methods*; *Retailing: Principles and Methods*.

D. J. K.—Duncan J. Kerr. Former President, Lehigh Valley Railroad, New York, N.Y.

D. J. M.—D. J. Matthews. Formerly with Hydrographic Department, Admiralty, London. Former Hydrographer, Laboratory of the Marine Biological Association of the United Kingdom, Plymouth.

D. J. W.—Dorothy Julia Willmann. Associate Editor, *Now*. National Organizational Secretary, Women's Parish Societies of the United States. Author of *Parish Sodality Helps*; *Parish Union Helps*.

D. K.—David Kinley. Former President, University of Illinois, Urbana, Ill. Author of *The Independent Treasury of the United States*; etc.

D. Ka.—Daniel Katz. Professor and Chairman of the Department of Psychology, Brooklyn College, Brooklyn, N.Y.

D. Kn.—Dorothy Kenyon. Member, League of Nations Committee on Legal Status of Women, 1938-43.

D. K. P.—Douglas King-Page. Author of *Marine Insurance in 1931*.

D. K. Pe.—Don K. Price. Associate Director of Public Administration Clearing House, Chicago, Ill. Co-author of *City Manager Government in the United States*.

D. L.—David Lyell. Colonel. Former Director of Pauling and Company, Ltd., London. Chief Railway Construction Engineer to the British Army in France during World War I.

D. L. F.—Denis L. Fox. Associate Professor of Marine Biochemistry, Scripps Institution of Oceanography, University of California, La Jolla, Calif.

D. L. Hk.—Dalziel Llewellyn Hammick. Fellow and Tutor, Oriel College, Oxford. Aldrichian Praelector in Chemistry, Oxford University. Author of *Introduction to Organic Chemistry*.

D. L. Mu.—David Leslie Murray. Editor, *Times Literary Supplement*, London, 1938-44. Author of *Disraeli*.

D. L. R. L.—David Lockhart Robertson Lorimer. Lieutenant Colonel, Indian Army (retired). Former H.M. Consul, Kerman and Persian Baluchistan; Civil Governor, Amara, 1915-16. Author of *Phonology of the Bakhtiari Badakhshani and Madaglashti Dialects of Modern Persian*; etc.

D. L. W.—D. L. Walker. General Secretary to the Federation of British Industries.

D. M.—Rev. Dugald Macfadyen. Former Director of the London Missionary Society.

D. Ma.—David Masson. Former Historiographer Royal for Scotland. Professor of Rhetoric and English Literature, Edinburgh University, 1865-93. Author of *Life of Milton*; etc.

D. M. B.—Dorothy M. Broome. Former Jones Fellow in the Victoria University of Manchester, England.

D. M. Bl.—Delbert M. Bergenstal, M.D. Assistant Professor of Medicine, The University of Chicago Medical School, Chicago, Ill.

D. McM.—David MacMillan. Assistant General Manager of Braby's Iron and Steel Sheet Rolling Mills and Galvanizing Works, Glasgow, Scot.

D. Md.—Duncan MacDougald, Jr. Author of *The Languages and Press of Africa*.

D. M. H. E.—D. M. H. Evans. Member of the Sudan Political Service.

D. Mi.—David Mitrany. Professor in School of Economics and Politics, Institute for Advanced Study, Princeton, N.J., 1933-. Author of *Marx against the Peasant*; *The Progress of International Government*; *The Effect of the War in Southeastern Europe*; *A Working Peace System*; etc.

D. M. M.—David Morrice Man. Principal, Colonial Office, London.

D. M. P.—Donald M. Pillsbury, M.D. Professor of Dermatology and Syphilology, School of Medicine, University of Pennsylvania, Philadelphia, Pa. Co-author of *Manual of Dermatology*.

D. M. S.—Doris Mary Stenton. Lecturer in History in the University of Reading, England. Author of *The Reign of Henry II*; *The Earliest Lincolnshire Anise Rolls*; etc.

D. M. Se.—Dorothy M. Sells. Former special agent of the U.S. Department of Labor, and Assistant Professor of Social Economy, Bryn Mawr College, Bryn Mawr, Pa. Author of *British Trade Boards System*.

D. M. Sh.—Denis Mack Smith. Fellow and Tutor of Peterhouse, Cambridge University.

D. M. S. W.—David Meredith Seares Watson. Jodrell Professor of Zoology and Comparative Anatomy, University College, University of London.

D. M. W.—Sir Donald Mackenzie Wallace. Director of the Foreign Department of *The Times*, 1891-99. Author of *Russia*.

D. M. Wa.—Dean M. Warren. General Electric Company, Buffalo, N.Y.

D. No.—Daisuke Nohara. Director, Yokohama Saisei Bank, Ltd.

D. Ol.—Rev. Daniel O'Connell, S.J. Librarian at the University of Detroit, Mich.

D. O. W.—David Oakes Woodbury. Assistant Editor, *Power*, New York, N.Y. Author, *The Glass Giant of Palomar*; *Communication*; etc.

D. Pr.—David Morris Potter. Coe Professor of American History, Yale University, New Haven, Conn. Author of *Lincoln and His Party in the Secession Crisis*; *Trail to California*.

D. R.—Dunbar Rowland. Former Director of Mississippi State Department of Archives and History.

D. R. C.—David Raymond Curtiss. Former Professor of Mathematics, Northwestern University, Evanston, Ill. Author of *Analytic Functions*; etc.

D. Ri.—Dorothy Lois Riker. Editor, Indiana Historical Bureau, Indianapolis, Ind.

D. R. J.—Dennis Ross-Johnson. General Manager and Secretary, Port of Bristol Authority, England, 1911-28.

D. R. M.—David Randall-MacIver. Archaeologist and anthropologist engaged in research work in Italy, 1921-45. Author of *Italy before the Romans*; etc.

D. S.—Denis Saurat. Professor of French Language and Literature, King's College, University of London. Author of *Literature and Occult Tradition*; etc.

D. S. B.—Dallas S. Burch. Head of the Information Division, Bureau of Animal Industry, Agricultural Research Administration, U.S. Department of Agriculture.

D. Sc.—Dorothy Scarborough. Former Associate Professor of English, Columbia University. Author of *On the Trail of Negro Folk-Songs*; etc.

D. Se.—Daniel Clemens Sayre. Former Chief, Division of Safety Rules and Education, Civil Aeronautics Board, Washington, D.C.

D. S. F.—Douglas Southall Freeman. Editor, the *News Leader*, Richmond, Va., 1915-49. Editor of *Calendar of Confederate Papers*; *Lee's Dispatches*.

D. S. J.—David Starr Jordan, M.D. Former Chancellor, Stanford University, Stanford, Calif. Author of *Guide to the Study of Fishes*; etc.

D. S. K.—Dexter Simpson Kimball. Former Dean, College of Engineering, Cornell University, Ithaca, N.Y. Author of *Industrial Education*; etc. Editor, *The Book of Popular Science*.

D. S. M.—Prince Dimitri Mirsky. Lecturer in Russian Literature, King's College, University of London, 1922-32. Author of *Contemporary Russian Literature*; *Pushkin*; *History of Russian Literature*; etc.

D. S. Ma.—David Samuel Margoliouth. Laudian Professor of Arabic, Oxford University, 1880-1937. Author of *Arabic Papyri of the Bodleian Library*; *Mohammed and the Rise of Islam*; etc.

- D. S. Mu.**—David Saville Muzzey. Emeritus Professor of American History, Columbia University. Author of *The United States of America*; etc.
- D. Sn.**—David Snedden. Former Professor of Education, Columbia University. Author of *Vocational Education*; etc.
- D. S.-S.**—David Seth-Smith. Former Curator of Mammals and Birds, Zoological Society, London. Former Editor, *Bulletin of British Ornithologists' Club* and *Avicultural Magazine*.
- D. S. Sg.**—Donald Stuart Strong. Associate Professor of Political Science, University of Alabama, University, Ala. Author of *Organized Anti-Semitism in America*.
- D. St.**—Daniel Starch. Psychologist and consultant in business research and management. Author of *Principles of Advertising*; *Educational Psychology*; etc.
- D. Su.**—Dragutin Subotic. Reader in Serbo-Croatian Language and Literature, University of London.
- D. T. F.**—David Theodore Fyfe. Former Convener, Panel of Architects for Air Raid Damage to Buildings of Historical Importance, Cambridgeshire, under Ministry of Works and Planning. Author of *Hellenistic Architecture*; etc.
- D. Tn.**—David Thomson. University Lecturer in History, Cambridge University. Fellow and Senior Tutor of Sidney Sussex College, Cambridge. Author of *The Babeuf Plot*; *Democracy in France—The Third Republic*; *The Democratic Ideal in France and England*; *England in the Nineteenth Century*; etc.
- D. T. S.**—David T. Shute. Assistant Vice-President, Liberty Mutual Insurance Company, Boston, Mass.
- D. V.**—Douglas Veale. Registrar of the University of Oxford. Fellow of Corpus Christi College, Oxford.
- D. V. B.**—Dow Vawter Baxter. Professor of Forest Pathology, University of Michigan, Ann Arbor, Mich. Author of *Pathology in Forest Practice*; etc.
- D. W.**—Diedrich Hermann Westermann. Professor of African Languages in the University of Berlin, 1920-. Co-author of *Practical Phonetics for Students of African Languages*; etc.
- D. Wd.**—Daniel Willard. Former President of the Baltimore and Ohio Railroad, Baltimore, Md.
- D. Wh.**—Derwent Whittlesey. Professor of Geography, Harvard University. Author of *The Earth and the State*; *A Study of Political Geography*; etc. Editor, *Annals of the Association of American Geographers*, 1930-42.
- D. W. K.**—Dudley Wright Knox. Commodore, U.S. Navy (ret.). Author of *A History of the United States Navy*; *The Eclipse of American Sea Power*; *The Naval Genius of George Washington*; etc.
- D. W. Ku.**—Rev. Daniel Webster Kurtz, D.D. Clergyman, educator and author. President of General Education Board, Church of the Brethren, 1915-35.
- D. W. T.**—Sir D'Arcy Wentworth Thompson. Professor of Natural History, University of St. Andrews, Scot., 1917-48.
- D. W. W.**—Dilworth Wayne Woolley. Associate of the Rockefeller Institute for Medical Research, New York, N.Y.
- D. Z. S.**—Doris Zemurray Stone. Research Fellow in Central American Archaeology, Peabody Museum, Harvard University.
- E.**—Reginald Baliol Brett, 2nd Viscount Esher. Former Governor of Windsor Castle, London. Editor of *The Letters of Queen Victoria*; etc.
- E. A.**—Edward Altham. Captain, formerly with Royal Navy. Former Secretary, Editor and Chief Executive Officer, Royal United Service Institution. Senior Naval Officer, Archangel River Expeditions, 1918-19.
- E. A. A.**—E. A. Atkins. Director of Research, the Pearson and Knowles Engineering Company, Ltd., and Rylands Brothers, Ltd., Research Laboratories.
- E. A. B.**—Eric Arthur Barber. Rector of Exeter College, Oxford.
- E. A. Ba.**—Ernest A. Baker. Director, University of London School of Librarianship, 1919-34; Author of *The Public Library*; *The Uses of Libraries*; etc.
- E. A. Bl.**—Emery A. Brownell. Executive Director, National Legal Aid Association. Author of *Legal Aid in the United States*.
- E. A. Br.**—Edwin Arthur Baker. Principal Scientific Officer, Royal Observatory, Edinburgh, Scot.
- E. A. D.**—Edgar A. Doll. Co-ordinator of Research, Devereux School, Devon, Pa. Author of *Clinical Studies in Feeble-mindedness*.
- E. A. F.**—Edward Augustus Freeman. English historian. Author of *History of the Norman Conquest*; etc.
- E. A. G.**—Eugene Allen Gilmore. Professor of Law, 1942-, President, 1934-40, State University of Iowa, Iowa City, Ia.
- E. A. Gr.**—Emanuel Alexander Goldenweiser. Former member of the Institute for Advanced Study, Princeton, N.J. Director of Division of Research and Statistics, Board of Governors of the Federal Reserve System, 1926-45. Author of *Federal Reserve System in Operation*.
- E. A. H.**—E. A. Hollowell. Senior Agronomist, Division of Forage Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, U.S. Department of Agriculture, Washington, D.C.
- E. A. Hl.**—E. Adamson Hoebel. Professor and Head of the Department of Anthropology, University of Utah, Salt Lake City, Utah. Author of *The Cheyenne Way*; *Law and Anthropology*; co-author of *Conflict and Case Law in Primitive Jurisprudence*.
- E. A. J.**—E. Alfred Jones. Author of *Old English Gold Plate*; *Old Church Plate of the Isle of Man*; etc.
- E. A. K.**—Ewald A. Kamp. Manager, Mechanisms Research, Mechanics Research Department, American Machine and Foundry Co., Chicago, Ill.
- E. A. M.-H.**—Emyr Alun Moelwyn-Hughes. University Lecturer in Physical Chemistry, Cambridge University. Director of Studies in Natural Science, Trinity Hall, Cambridge. Author of *The Kinetics of Reactions in Solution*; *Physical Chemistry*.
- E. A. Mi.**—Edward Arthur Milne. Rouse Ball Professor of Mathematics and Fellow of Wadham College, Oxford, 1928-50. Author of *Thermodynamics of the Stars*; etc.
- E. A. Mn.**—Ethel Austin Martin. Director of Nutrition Service, National Dairy Council, Chicago, Ill.
- E. An.**—Ernest Anderson. Professor and Head of the Department of Chemistry, University of Arizona, Tucson, Ariz.
- E. Ap.**—Erik Arup. Former Professor of Danish History at the University of Copenhagen, Denmark.
- E. A. P.**—Edgar Allison Peers. Former Gilmour Professor of Spanish, University of Liverpool, Liverpool, Eng. Author of *Spain*; *A Companion to Spanish Travel*; *Studies of the Spanish Mystics*; etc.
- E. A. Pr.**—E. A. Power. Chief, Statistical Section, Branch of Commercial Fisheries, Fish and Wildlife Service, U.S. Department of the Interior, Washington, D.C. Author of *Fishery Statistics of the United States*.
- E. A. Ps.**—Edward Alexander Parsons. President, Louisiana Historical Society. Author of *The Letters of Robert R. Livingston—The Diplomatic Story of The Louisiana Purchase*; etc.
- E. Ar.**—Edward Armstrong. University Lecturer in Modern History, Oxford University. Author of *The Emperor Charles V*; etc.
- E. A. R.**—Rev. Edward A. Ryan, S.J. Archivist, Woodstock College, Woodstock, Md. Author of *The Historical Scholarship of St. Bellarmine*.
- E. A. S.**—Rev. E. A. Shattock. Vicar of St. Mark, Woodcote, Purley, England.
- E. A. Sp.**—Elmer A. Sperry. Founder of the Sperry Gyroscope Company.
- E. At.**—Edith Abbott. Professor and Emeritus Dean of the School of Social Service Administration, The University of Chicago. Author of *Public Assistance: American Principles and Policies*; *The Tenements of Chicago*.
- Ea. T.**—Earl Theisen. Honorary Curator Motion Pictures and Theatrical Arts, Los Angeles Museum, Los Angeles, Calif.
- E. B.**—Sir Ernest Barker. Life Governor of King's College, University of London. Author of *Greek Political Theory*; *Essays on Government*; etc.
- E. B. B.**—Sir Edward Battersby Bailey. Director of Geological Survey of Great Britain and Museum of Practical Geology, 1937-45. Author of *Recumbent Folds in the Schists of the Scottish Highlands*; etc.
- E. B. By.**—Emmet Blackburn Bay, M.D. Professor of Medicine, The University of Chicago, Chicago, Ill. Author of *Medical Administration of Teaching Hospitals*.
- E. B. C.**—Edwin Beresford Chancellor. Former member of the Council of London Topographical Society. Author of *The London of Charles Dickens*; *The Clubs of London, Past and Present*.
- E. Bd.**—Edwin Borchard. Professor of Law, Yale University, 1917-50. U.S. Technical Adviser, Conference on Codification of International Law, 1930.
- E. Be.**—Eduard Beneš. President of the Czechoslovak Republic, 1935-38 and 1946-48. Author of *Building a New Europe*; *Problems of Czechoslovakia*; etc.
- E. Ben.**—Emile Benveniste. Professor of Comparative Philology, École des Hautes Études, Paris.
- E. Bg.**—Eskil Berg. Formerly of General Electric Company, Schenectady, N.Y.
- E. B. H.**—E. B. Hudson. Senior General Engineer, American Rolling Mill Company, Middletown, O.
- E. B. He.**—Edward Butler Hodge. Research Chemist, Commercial Solvents Corp., Terre Haute, Ind.

- E. B. Hg.**—Emanuel Benjamin Hershberg. Research Chemist, Schering Corporation, Bloomfield, N.J.
- E. B. Hy.**—Ethel Browne Harvey. Independent Investigator, Department of Biology, Princeton University.
- E. Bn.**—Eduard Bernstein. Editor, with August Bebel, of *Sozialdemokrat*. Author of *Die Voraussetzungen des Sozialismus und die Aufgaben der Sozialdemokratie*; etc.
- E. B. N.**—Evan Baillie Noel. Former Secretary of Queen's Club, London.
- E. B. O.**—E. B. Osborn. Former Literary Editor of *The Morning Post*, London. Author of *The New Elizabethans*; *Our Debt to Greece and Rome*; *The Middle Ages*; *Socrates and His Friends*; etc.
- E. B. Po.**—Sir Edward Bagnall Poulton. Hope Professor of Zoology in Oxford University, 1893–1933. Author of *The Colours of Animals*; *Essays on Evolution*; etc.
- E. Br.**—Edward Breck. Former Foreign Correspondent of *The New York Herald* and *The New York Times*. Executive, History Section, U.S. Navy Department, 1919–22. Author of *Sporting Guide*; etc.
- E. Bra.**—Erich Brandenburg. Former Lecturer in Philosophy and History at the Prussian Akademie der Wissenschaften, Berlin.
- E. B. Rd.**—Edwy B. Reid. Director of Information and Extension, Farm Credit Administration, U.S. Department of Agriculture, Washington, D.C.
- E. Bs.**—Elizabeth Brandeis. Lecturer in Economics, University of Wisconsin, Madison, Wis.
- E. B. Sa.**—Eleanor B. Sachs. Former Assistant Curator, Metropolitan Museum of Art, New York, N.Y.
- E. B. T.**—Sir Edward Burnett Tylor. Anthropologist. Author of *Researches into the Early History of Mankind*; *Primitive Culture*; etc.
- E. B. V. V.**—E. Burr Van Vleck. Former Professor of Mathematics, University of Wisconsin, Madison, Wis. Editor of *Transactions of the American Mathematical Society*.
- E. B. Wn.**—Edwin Brayton Wilson. Executive Editor of the *Brooklyn Daily Eagle*, Brooklyn, N.Y.
- E. Bz.**—Eiríkur Benedikz. First Secretary, Icelandic Legation, London. Author of *Ensk Verzlunarbref*; *Enska I-II*.
- E. C.**—Edward Channing. Former Professor of History, Harvard University. Author of *History of the United States*; *Town and Country Government in English Colonies of North America*; etc.
- E. Ca.**—Emile Cammaerts. Professor of Belgian Studies and Institutions in the University of London. Author of *Belgium, From the Roman Invasion to the Present Day*; *New Belgian Poems*; *Albert of Belgium*; etc.
- E. Cas.**—Egerton Castle. Formerly of Trinity College, Cambridge. Author of *English Book Plates*; *Bibliotheca Dimicatoria*; etc.
- E. C. B.**—Rt. Rev. Edward Cuthbert Butler. Abbot of Downside Abbey, Bath, England, 1906–22.
- E. C. Bn.**—Edmund Charles Blunden. Author of *Undertones of War*; *Shelley: A Life-Story*; *Shells by a Stream*; *After the Bombing*.
- E. C. Br.**—Edward C. Bridgman. President, Bridgman Publishers, Inc., Pelham, N.Y.
- E. C. Bu.**—Eric C. Burkman. Secretary, United States Rubber Company, New York, N.Y.
- E. C. Cr.**—Elliott C. Carter. Associate in Music, Columbia University, New York, N.Y.
- E. C. D. M.**—E. Charles D. Marriage. Former Librarian, Nevada State Library, Carson City, Nev.
- E. C. F.**—Ernest Carroll Faust. Professor of Parasitology, Head of Division, Department of Tropical Medicine and Public Health, Tulane University of Louisiana, New Orleans, La. Author of *Human Helminthology*; *Clinical Parasitology*.
- E. C. G.**—Egerton C. Grey. Former Professor of Chemistry, University of Cairo. Author of *Practical Chemistry by Micromethods*; etc.
- E. C. J.**—Edward C. Johnson. Former Director of Research, Worsham College of Mortuary Science, Chicago, Ill.
- E. C. Kl.**—E. C. Kendall. Visiting Professor in Chemistry, Princeton University, Princeton, N.J. Author of *Thyroxine*.
- E. Cl.**—E. Clouzot. Head of Secretarial Department, International Red Cross, Geneva, Switz.
- E. C. L.**—E. C. Laidlay. Subeditor of *The Fur World*, London.
- E. Cn.**—Emil Carlsen. Former member of National Academy of Design and of Institute of Art and Letters.
- E. C. of D.**—Ellen Odette Desart, Countess Dowager of Desart. Former Senator, Irish Free State. Author of *A Guide for Secretaries, Public and Private*; *Style and Title* (with Constance Hoster).
- E. C. Q.**—Edmund Crosby Quiggin. Former Fellow of, and Lecturer in, Modern Languages and Monro Lecturer in Celtic, Gonville and Caius College, Cambridge.
- E. Cr.**—Ernst Cassirer. Former Professor of Philosophy and Rector of Hamburg University, Hamburg, Ger. Author of *Kants Leben und Lehre*; *Substanzbegriff und Funktionsbegriff*; etc.
- E. C. Ra.**—Rev. E. C. Ratcliffe. Ely Professor of Divinity, Cambridge University, and Canon of Ely.
- E. C. Sd.**—Edwin Colston Shepherd. Secretary-General, Air League of the British Empire. Author of *Great Flights*; *The R.A.F. Today*.
- E. C. Ss.**—E. C. Simmons. Associate Professor of Economics, Duke University, Durham, N.C.
- E. Cu.**—Edmund Curtis. Lecky Professor of Modern History, University of Dublin, 1939–43. Author of *A History of Ireland*; etc.
- E. Cul.**—Ely Culbertson. Author of *Contract Bridge Red Book on Play*; *Contract Bridge Blue Book*; etc. Editor, *The Bridge World Magazine*.
- E. Cy.**—Elbridge Colby. Colonel, U.S. Army (retired). Author of *The Profession of Arms*; *Masters of Mobile Warfare*; *American Militarism*; etc.
- E. D.**—Sir Edwin Deller. Former Principal, University of London, and University Extension Lecturer.
- E. Da.**—Eloise Davison. Director, *Herald Tribune* Home Institute, New York, N.Y.
- E. D. A.**—Edgar Douglas Adrian M.D. Professor of Physiology in Cambridge University, 1937–. Nobel Prize for Medicine, 1932. Author of *The Mechanism of Nervous Action*; etc.
- Ed. B.**—Edward Bower. Director, British Industries Fair, London.
- E. De.**—Ernest Dale. Economist, American Management Association, New York, N.Y.
- E. de W.**—Ernest De Weerth. Stage designer, Max Reinhardt Productions in America, etc.
- Ed. G.**—Edward Girden. Professor of Psychology, Brooklyn College, Brooklyn, N.Y.
- Ed. M.**—Eduard Meyer. Former Professor of Ancient History in the University of Berlin. Author of *Geschichte des Alterthums*; etc.
- E. D. M.**—Edward Darley Miller. Lieutenant Colonel. Author of *Modern Polo*; etc.
- E. D. Macl.**—Sir Edward Douglas MacLagan. Governor of the Punjab, 1921–24. Lieutenant Governor, 1919–21. Former President of Royal Asiatic Society.
- E. D. Ml.**—Elmer Drew Merrill. Arnold Professor of Botany; former Administrator of Botanical collections and Director of Arnold Arboretum, Harvard University. Author of *Plantae Elmerianae Borneenses*; *Discussion and Bibliography of Philippine Flowering Plants*; etc.
- E. D. P.**—Everett Dudley Plass, M.D. Former Professor of Obstetrics and Gynaecology, State University of Iowa, Iowa City, Ia. Author of *Obstetrics for Nurses*.
- Ed. P. F.**—Edward Paul Farrell. Student at the Dominican House of Studies, Washington, D.C. Author of *The Theology of Religious Vocation*.
- E. D. R.**—Sir Edward Denison Ross. Director, School of Oriental Studies, London, and Professor of Persian in the University of London, 1916–37. Author of *Eastern Art and Literature*; *The Persians*; etc.
- E. D. Ra.**—Emilius C. Delme-Radcliffe. Lieutenant Colonel. Author of *Falconry: Notes on the Falconidae used in India in Falconry*.
- E. D. T. J.**—Evan David Thomas Jenkins. Professor of Classics, University College of Wales, Aberystwyth, 1938–47.
- E. D. Ts.**—Elbert Duncan Thomas. Senator from Utah, 1933–51. Professor of Political Science, University of Utah, Salt Lake City, 1924–33.
- Ed. W.**—Edward Pearson Warner. President of the Council, International Civil Aviation Organization, Montreal, Canada. Author of *The Aviation Handbook*; *Airplane Design*.
- Ed. Ws.**—Edward Wichers. Chief, Division of Chemistry, National Bureau of Standards, U.S. Department of Commerce, Washington, D.C.
- E. E.**—Earl Franklin English. Dean of the Faculty, School of Journalism, and Professor of Journalism, University of Missouri, Columbia, Mo. Author of *Exercises in Journalism*; *Introduction to Journalism Research Methods*; co-author of *Scholastic Journalism*.
- E. E. A.**—Eugene E. Agger. Professor and Head of the Department of Economics and Director of Bureau of Economic and Business Research, Rutgers University, New Brunswick, N.J. Author of *The Budget in the American Commonwealth*; etc.
- E. E. B.**—Edward E. Bennett. Professor of History and Political Science, Montana State University, Missoula, Mont.
- E. E. Bs.**—Sir Edward Ettingdene Bridges. Permanent Secretary to H.M. Treasury, London.

- E. E. C.**—Elliott E. Cheatham. Professor of Law, Columbia University, New York, N.Y. Editor, *Cases on the Legal Profession*; co-editor, *Cases on Conflict of Laws*.
- E. E. De.**—E. E. Dale. Research Professor of History, University of Oklahoma, Norman, Okla. Author of *The Range Cattle Industry*; *Cow Country*; etc.
- E. E. DeT.**—Ernest E. DeTurk. Professor of Soil Fertility, University of Illinois, Urbana, Ill.
- E. E. E.**—E. E. Evans. Lecturer in Geography, University of Belfast, N.Ire.
- E. E. Es.**—Everett Eugene Edwards. Agricultural Historian, Division of Statistical and Historical Research, Bureau of Agricultural Economics, U.S. Department of Agriculture, Washington, D.C., 1927—. Editor of *Agricultural History*, 1931—.
- E. E. F.**—Edward Elway Free. Consulting chemist and physicist. Lecturer on Outlines of Science, New York University, 1926–34. Author of *Pocket Guide to Science*.
- E. E. H.**—Edward Everett Hale. American writer. Author of *The Man Without a Country*.
- E. E. He.**—Edgar Erskine Hume, M.D. Brigadier General, formerly with U.S. Army. Commanding Officer, Winter General Hospital, Topeka, Kan., 1942–43. Former Associate Editor, *Annals of Medical History*.
- E. E. Hu.**—E. E. Hughes. Professor of History, University College of Swansea, Wales.
- E. E. K.**—Edward Ernest Kellett. Former literary critic and author. Former Senior English Master, the Leys School, Cambridge, Eng. Author of *Suggestions*; *Fashion in Literature*; *The Northern Saga*; etc.
- E. E. L.**—Edward Ernest Long. British journalist.
- E. En.**—Edward Epstean. Former Treasurer and Director, Walker Engraving Corporation, New York, N.Y.
- E. E. R.**—Edgar Eugene Robinson. Director, Institute of American History, and Executive Head, Department of History, Stanford University, Stanford, Calif. Author of *The Presidential Vote*; *The New United States*; *The Evolution of American Political Parties*.
- E. E. S.**—Edward Ernest Sikes. Former Fellow, President and Lecturer, St. John's College, Cambridge. Newton Student at Athens, 1890. Editor of Aeschylus' *Prometheus Victus*, 1898; *The Homeric Hymns*, 1904. Author of *Anthropology of the Greeks*; etc.
- E. E. Sh.**—Eben E. Smith, M.D. Captain, Medical Corps, U.S. Navy, 1941—. Editor, *U.S. Naval Medical Bulletin*; Instructor in History of Medicine, U.S. Naval Medical School, Washington, D.C.
- E. E. Sl.**—E. E. Slosson. Author of *Great American Universities*; *Snapshots of Science*.
- E. E. Sm.**—Ernest Ellsworth Smith, M.D. Former specialist in Experimental Medicine and Clinical Pathology.
- E. E. T.**—Ernest Edgar Thum. Editor, *Metal Progress*. Author of *Practice Book in Elementary Metallurgy*; Editor and Compiler of *National Emergency Steels*; etc.
- E. E. Wa.**—E. E. Ware. The Sherwin-Williams Company, Cleveland, O.
- E. E. Wi.**—Edwin Elliot Willoughby. Chief Bibliographer, The Folger Shakespeare Library, Washington, D.C., 1935—. Author of *The Times and Books of William Jaggard*; etc.
- E. F. A.**—Edward F. Albee. Former President of the Keith-Albee Circuit, New York, N.Y.
- E. F. Be.**—E. F. Bullene. Major General, U.S. Army. Chief Chemical Officer, U.S. Department of the Army, Washington, D.C.
- E. F. B. G.**—Elinor F. B. Grogan (Lady Grogan). Author of articles on Balkan subjects in the *Nineteenth Century*; *New Europe*; etc.
- E. F. C.**—Eugene Francis Clark. Secretary, Dartmouth College, Hanover, N.H., 1918–30. Former Editor, *150 Years of Dartmouth College*; *Dartmouth Alumni Magazine*.
- E. F. D.**—Edward French Dow. Professor of Government and Head of the Department of History and Government, University of Maine, Orono, Me.
- E. F. G.**—Edwin Francis Gay. Professor of Economic History, Harvard University, 1924–36. Member of Research Staff, Huntington Library, San Marino, Calif., 1936–46.
- E. F. H.**—Eldred Frederick Hitchcock. Director Sisal Estates, Ltd., Bird and Company (Africa), Ltd. During World War I, Government Wool Statistician and Deputy Director, Wool Textiles, War Office, London.
- E. Fi.**—Eugen Fischer. Author of *Kriegsschuldfrage und Aussenpolitik und Holsteins grosses Nein*.
- E. F. L.**—Edward F. Law. Messrs. Riley, Harbord and Law, consulting metallurgists and chemists.
- E. F. La.**—Edward Frederick Lawson, 4th Baron Burnham. Major General. Director of Public Relations in the War Office and Senior Military Advisor to Ministry of Information, 1942–45.
- E. F. M.-S.**—Elizabeth F. Malcolm-Smith. Former Fellow of Newnham College, Cambridge.
- E. F. O.**—Edwin F. Orlemann. Assistant Professor of Chemistry, University of California, Berkeley, Calif.
- E. F. Ph.**—Everett Franklin Phillips. Former Professor of Apiculture, Cornell University, Ithaca, N.Y. Author of *Beekeeping*.
- E. Fr.**—Edward Fuller. Compiler of *International Handbook of Child Care and Protection*. Editor, *The World's Children*, London.
- E. F. R.**—Eleanor F. Rathbone. Member of Parliament (Ind.) Combined English Universities, 1929–46.
- E. F. Rg.**—Edward F. Rosenberg, M.D. Assistant Professor of Medicine, Chicago Medical School, Chicago, Ill. Staff member, Michael Reese Hospital and Mt. Sinai Hospital, Chicago. Contributing author, *Therapeutics in Internal Medicine*; *Arthritis and Allied Conditions*.
- E. F. S.**—Edward Fairbrother Strange. Lieutenant Colonel. Former Keeper of Woodwork, Victoria and Albert Museum, London. Author of *Chinese Lacquer*; *Flowers and Plants for Designers and Schools*; etc.
- E. F. S. D.**—Lady Dilke. Author of *French Painters of the Eighteenth Century*; etc.
- E. F. W.**—Eltinge Fowler Warner. Publisher, *Field and Stream*, New York, N.Y.
- E. F. Wn.**—Edward Foss Wilson. President, Wilson and Company, Inc., Chicago, Ill., 1934—.
- E. G.**—Sir Edmund Gosse. Former Assistant Librarian, British Museum, London. Author of *History of Eighteenth Century Literature*; etc.
- E. Gar.**—E. Garcke. Former Managing Director of British Electric Traction Co., Ltd. Author of *Manual of Electrical Undertaking*; etc.
- E. G. Bor.**—Edwin Garrigues Boring. Professor of Psychology, Harvard University. Author of *History of Experimental Psychology*; *The Physical Dimensions of Consciousness*; Co-editor of *Psychology: A Factual Textbook*; etc.
- E. G. Bow.**—E. G. Bowen. Professor of Geography and Anthropology, University College of Wales, Aberystwyth.
- E. G. Br.**—Elmer Grimshaw Butler. Vice-President, the American Society of Zoologists, 1946. Professor of Zoology, Princeton University, 1937—. Chairman of Department of Biology, 1933—.
- E. G. C.**—E. Gladys Clarke. Former Principal of the National Training College of Domestic Subjects, London.
- E. G. Co.**—Ernest George Coker. Former Professor of Civil and Mechanical Engineering, and Dean of the Faculty, University of London.
- E. G. G.**—E. G. Gardner. Former Professor of Italian at University College, University of London. Author of *Dante*; *Dante and the Mystics*.
- E. G. Gr.**—Eugene Gifford Grace. Chairman and Director, Bethlehem Steel Corporation and Bethlehem Steel Company.
- E. G. H.**—Earl Grant Harrison. Dean of the Law School and former Vice-President, University of Pennsylvania, Philadelphia, Pa. Practising lawyer.
- E. Gi.**—Eric Gill. Sculptor and engraver. Author of *Work and Property*.
- E. G. K.**—E. Gordon Keith. Associate Professor of Finance, Wharton School of Finance and Commerce, University of Pennsylvania, Philadelphia, Pa.
- E. Gl.**—Lord Edward Gleichen. Major General. Former Equerry to H.M. the King. Served in the South African War and in World War I.
- E. G. Mc.**—Elizabeth Glen McAllister. Member of the Executive, Town and Country Planning Association, London. Co-author of *Town and Country Planning*; Joint Editor of *Homes, Towns and Countryside*.
- E. G. P.**—Edward Greydon Pickels. President, Specialized Instruments Corp., San Carlos, Calif.
- E. Gr.**—Ernest Arthur Gardner. Vice Chancellor of the University of London, 1924–26. Former Yates Professor of Archaeology, University College, University of London. Author of *The Art of Greece*.
- E. G. R.**—Ernest George Ravenstein. Professor of Geography at Bedford College, University of London, 1882–83. Author of *The Russians on the Amur*; *A Systematic Atlas*; etc.
- E. Gru.**—Ernest Gruening, M.D. Governor of Alaska, 1939—. Chairman, Alaskan War Council. Former Editor of the *Nation*; *New York Evening Post*; etc.
- E. G. W.**—Ernest Glen Wever. Professor of Psychology, Princeton University, Princeton, N.J.
- E. H.**—Emil Hatschek. Lecturer on Colloids at the Sir John Cass Technical Institute, London. Author of *Introduction to the History of Colloids*.
- E. H. A.**—Edmund Hugh Ashton. Director, Native Administration, Bulawayo, Southern Rhodesia. Author of *The Basuto*.

- E. H. B.**—Sir Edward Herbert Bunbury. Author of *A History of Ancient Geography*; etc.
- E. H. Bn.**—E. H. Baumgarten. Secretary, American Bowling Congress. Author of *Bowl—Here's How*.
- E. H. C.**—Ernest Hartley Coleridge. Editor of *Byron's Poems*; *Letters of Samuel Taylor Coleridge*; etc.
- E. Hd.**—Edwin Haward. Secretary, India, Pakistan and Burma Association, London. Author of *A Picture of India*; etc.
- E. He.**—Edouard Herriot. President of the French Chamber of Deputies, 1925, 1936 and 1947— . Author of *Madame Récamier et ses amis*.
- E. Hea.**—Edward Heawood. Librarian, Royal Geographical Society, 1901–34. Author of *Geography of Africa*; etc.
- E. Her.**—Ernst Emil Herzfeld. Former Professor at Institute for Advanced Study, Princeton, N.J. Explorations and travels in Kurdistan, Constantinople, India, Syria, Turkey, Persia, Afghanistan.
- E. H. G.**—Emile Henry Gauvreau. Author of *What So Proudly We Hailed; My Last Million Readers*; *Billy Mitchell, Prophet Without Honor*; etc.
- E. H. H.**—E. Herman Hespelt. Professor of Spanish, New York University.
- E. H. He.**—Ernest Herman Hahne. Former President, Miami University, Oxford, O.
- E. Hi.**—Eva Hibbert. Assistant Lecturer in Applied Chemistry, University of Manchester, England.
- E. Hir.**—Emanuel Hirsch. Former Professor of Church History, University of Göttingen, Germany.
- E. H. Kd.**—Earle Hesse Kennard. Physicist, U.S. Navy Dept., Washington, D.C. Professor of Physics, Cornell University, Ithaca, N.Y., 1927–46. Author of *Kinetic Theory of Gases*; etc.
- E. H. L.**—Eugene Heitler Lehman. President, Highland Manor School and Junior College, West Long Beach, N.J. Editor of *Camps and Camping*. Associate Editor of *Camp Life*.
- E. H. Ld.**—Erwin Hugo Loewenfeld. Solicitor of the Supreme Court, Great Britain. Legal Adviser of Liechtenstein Government. Co-author of *Recht der Staatsangehörigkeit*; *Der Zivilprozess in den Europäischen Staaten*.
- E. H. M.**—Sir Ellis Hovell Minns. Former President and Professor of Archaeology, Pembroke College, Cambridge. Translator and Editor of *Brückner's Literary History of Russia*. Author of *Scythians and Greeks*; etc.
- E. H. Mh.**—E. H. Macintosh. Member of the Sudan Political Service.
- E. H. My.**—Earl Hamlet Myers. Oceanographer, Scripps Institution of Oceanography, La Jolla, Calif. Co-author of *Invertebrates*; *The Protozoa*; etc.
- E. Hn.**—Edward Hutton. Member of the Council of the British Institute of Florence, Italy. Author of *Italy and the Italians*; *Giovanni Boccaccio*; etc.
- E. H. N.**—Edgar Hugo Nollau. Former Staff Assistant, Chemical Division, E. I. du Pont de Nemours and Company, Wilmington, Del.
- E. Hol.**—Emory Holloway. Professor of English, Queens College, Brooklyn, N.Y., 1939— . Author of *Whitman: An Interpretation in Narrative*. Editor of *Leaves of Grass*; etc.
- E. Hr.**—Edna Heibreder. Professor of Psychology, Wellesley College, Wellesley, Mass. Author of *Seven Psychologies*; etc.
- E. H. Sg.**—Edward Helmer Stromberg. Director of Publicity and Publications, Northwestern University, Evanston, Ill.
- E. H. St.**—Ernest Haywood Swift. Professor of Analytical Chemistry, California Institute of Technology, Pasadena, Calif. Author of *A System of Chemical Analysis*; co-author of *Qualitative Chemical Analysis*.
- E. Hu.**—Edmund Husserl. Former Professor of Philosophy, University of Freiburg, Germany.
- E. H. W.**—Egbert H. Walker. Assistant Curator, U.S. National Museum, Washington, D.C. Co-author of *A Bibliography of Eastern Asiatic Botany* (with E. D. Merrill).
- E. I. J.**—E. Ibbetson James. Former member of the Secretariat, League of Nations, and International Labour Office, Geneva, Switz.
- E. I. Je.**—Eldon I. Jenne. Supervisor of Health, Physical Education and Recreation, Portland Public Schools, Portland, Ore.
- E. J.**—Ernest Jones, M.D. President of the International Psycho-Analytical Association. Honorary President of the Institute of Psycho-Analysis and the British Psycho-Analytical Society. Founder and former Editor of the *International Library of Psycho-Analysis*.
- E. Ja.**—Edgar Jadwin. Major General. Former Chief of Engineers, U.S. Army, Washington, D.C.
- E. J. B.**—Edward John Bicknell, D.D. Professor of New Testament Exegesis, King's College, University of London, 1928–33. Author of *A Theological Introduction to the Thirty-nine Articles*; etc.
- E. J. Bn.**—Edgar John Bergen. Radio entertainer. Creator of comedy characters "Charlie McCarthy" and "Mortimer Snerd."
- E. J. D.**—Emile Joseph Dillon. Author of *Russian Characteristics*; *Maxim Gorky*; *The Peace Conference*.
- E. J. En.**—Edward J. Engel. Former President, Atchison, Topeka and Santa Fe Railway Company.
- E. J. F.**—Sir Edgar John Forsdyke. Director and Principal Librarian, British Museum, London, 1936— . Editor of the *Journal of Hellenic Studies*, 1912–23.
- E. J. K.**—Ely Jacques Kahn. Architect for U.S. government housing projects. Author of *Design in Art and Industry*.
- E. J. McN.**—Edward Joseph McNamara. Principal, High School of Commerce, New York, N.Y. Author of *Methods of Teaching Shorthand*; etc.
- E. J. Mr.**—Edward John Minser. Assistant Manager of Operations, Trans-World Airline.
- E. J. N. W.**—E. J. N. Wallis. Governor of the Province of Khartoum, Anglo-Egyptian Sudan.
- E. J. O.**—Elder J. Olson. Associate Professor of English, The University of Chicago. Author of *Thing of Sorrow*; *The Cock of Heaven*; *General Prosody*.
- E. J. P.**—E. J. Passant. University Lecturer in History and Fellow of Sidney Sussex College, Cambridge.
- E. J. Q.**—E. J. Quirin. President, F. R. Harris, Incorporated, New York, N.Y.
- E. J. S.**—Sir Edward James Salisbury. Director, Royal Botanic Gardens, Kew, Eng. Author of *The Living Garden*; *The Reproductive Capacity of Plants*.
- E. J. Sz.**—Edward J. Stieglitz, M.D. Consultant in Geriatrics, Veterans Administration, Washington, D.C. Consulting Editor of *Geriatrics*. Author of *Abnormal Arterial Tension*; *Arterial Hypertension*; *A Future for Preventive Medicine*; *The Second Forty Years*; editor of *Geriatric Medicine*.
- E. J. T.**—Edward J. Thomas. Translator, *Vedic Hymns*. Author of *The Life of Buddha as Legend and History*.
- E. J. Wg.**—E. J. Working. Professor of Agricultural Economics, University of Illinois, Urbana, Ill.
- E. J. Wn.**—E. John Workman. President, Director of Research and Development Division and Professor of Physics, New Mexico School of Mines, Socorro, N.M. Co-author of *A Preliminary Investigation of the Electrical Structure of Thunderstorms*; etc.
- E. K.**—Ernst Kühnel. Keeper of Islamic Art in the Berlin Museum. Author of *Miniaturmalerei im Islam*; *Maurische Kunst*; etc.
- E. Ka.**—Edward Kaser. Adrain Professor of Mathematics, Columbia University. Author of *New Names in Mathematics*; etc.
- E. K. C.**—Sir Edmund Kerchever Chambers. Author of *The Mediaeval Stage*; *The Elizabethan Stage*; *William Shakespeare*; etc.
- E. K. F.**—Earl K. Fischer. Former Head, Physical Chemistry Division, Institute of Textile Technology, Charlottesville, Va.
- E. Kk.**—Edward Kook. Sales Manager-Treasurer, Century Lighting, Inc. Technical lighting consultant.
- E. Ku.**—Eugene Kulischer. Demographer, Library of Congress, Washington, D.C. Author of *Europe on the Move*; *The Displacement of Population in Europe*.
- E. K. W.**—E. K. Wade. Author of *The Piper of Pax*.
- E. La.**—Eduard Laaman. Chief Editor of *Vaba Maa* (Estonian paper), 1923— . Director of the Press Bureau at the Estonian Ministry for Foreign Affairs, 1920–24.
- El. B.**—Elizabeth Bacon. Ethnographic expeditions in Kazakhstan, Iran and Afghanistan. Former Instructor, Far Eastern Department, University of Washington, Seattle, Wash.
- E. L. Bf.**—Elias Lunn Bredsdorff. University Lecturer in Danish, Cambridge University. Author of *Danish Literature in English Translation*; *D. H. Lawrence*; *John Steinbeck*.
- E. L. D.**—Edward L. Drew. Statistician, Tanners' Council of America, Inc., New York, N.Y.
- E. L. De.**—Everette Lee DeGolyer. Senior partner, DeGolyer and MacNaughton, Dallas, Tex. Consulting geologist and petroleum engineer.
- E. Le.**—Emil Lederer. Former Professor, Faculty of Philosophy, University of Heidelberg, Germany. Former Editor of *Archiv für Sozialwissenschaft und Sozialpolitik*; etc.
- E. L. F.**—Ernest Louis Franklin. Former senior partner in the banking firm of Samuel Montagu and Company, London.
- E. L. H.**—Eardley Lancelot Holland, M.D. President of the Royal College of Obstetricians and Gynaecologists, 1943–46. Former Editor of *Journal of Obstetrics and Gynaecology of British Empire*.

- El. Hn.**—Ellsworth Huntington. Former Research Associate in Geography, Yale University. Explorations and travels in Persia, India, China, Siberia, Asia Minor, Central America, etc. Author of *Civilization and Climate*; etc.
- E. L. Hs.**—Ethel L. Hutchins. Head, Reference Department, Cincinnati Public Library, Cincinnati, O.
- El. K.**—Ethel Kavin. Director, Parent Education Project, and Research Associate, The University of Chicago. Author of *Children of Preschool Age*; *The Wise Choice of Toys*.
- E. L. Ka.**—Edward L. Kropa. Research Chemist, American Cyanamid Company, Stamford, Conn.
- E. Ll.**—Edgar Lobel. Sublibrarian, Bodleian Library, Oxford. Reader in Papyrology, Oxford University.
- E. L. M.**—Rev. Edward L. Murphy, S.J. Professor of Ascetical Theology and Missiology, Weston College, Weston, Mass.
- E. L. Mn.**—Edwin Lakenan Marvin. Associate Professor of Philosophy and Psychology, Montana State University, Missoula, Mont.
- E. Lo.**—Ellis Lovejoy. Research Director, Edward Orton Ceramic Foundation, Columbus, O., 1933—. Author of *Scumming and Efflorescence*; *Drying and Burning Clay Wares*; *Scum on Clay Wares*; etc.
- E. Lok.**—Eugene Lokey. Vice-President, New York Stock Exchange, New York, N.Y.
- E. L. Po.**—Edith Louise Potter, M.D. Associate Professor of Pathology, Department of Obstetrics and Gynecology, Medical School, The University of Chicago, Chicago, Ill. Author of *The Fundamentals of Human Reproduction*; etc.
- E. L. Pr.**—E. L. Pfeffer. Chief, Capacity and Density Section, National Bureau of Standards, U.S. Department of Commerce, Washington, D.C.
- E. L. Ru.**—E. Leighton Rudolph. Associate Professor of English, University of Arkansas, Fayetteville, Ark. Author of *Confederate Broadside Verse*.
- E. L. T.**—Edward Lee Thorndike. Former Professor of Educational Psychology, Teachers College, Columbia University. Author of *Mental and Social Measurements*; etc.
- E. Lu.**—E. S. Lumsden. Painter and etcher. Author of *The Art of Etching*; etc.
- E. Lud.**—Emil Ludwig. Author of biographies of Bismarck, William II, etc.
- E. L. W.**—Ernest Llewellyn Woodward. Former Lecturer in Modern History and Tutor at New College, Oxford. Author of *War and Peace in Europe*; etc.
- E. MacN.**—John Eoin MacNeill. Former Professor of Early History, University College, National University of Ireland, Dublin.
- E. Mar.**—Sir Edward Howard Marsh. Former Private Secretary to Winston Churchill. Author of *Memoir of Rupert Brooke*; etc.
- E. McC.**—Edward McCartan. Former Member of National Sculptors' Society.
- E. M. C. D.**—Edward M. C. Denny. Barrister-at-Law of Gray's Inn and the Western Circuit, England.
- E. M. D.**—Edwin Merrick Dodd. Former Professor of Law, Harvard University.
- E. Mey.**—Emile Meyerson. Former Professor of Philosophy, Académie des Sciences Morales et Politiques, Institut de France, Paris.
- E. M. Ge.**—Esson M. Gale. Counsellor to Foreign Students and Director, International Center, University of Michigan, Ann Arbor, Mich. Editor, *Journal of the Royal Asiatic Society, North China Branch*, 1932-37.
- E. M. H.**—Edward Mandell House. Colonel. Representative of the United States at the making of the Armistice, Versailles, 1918. Co-editor, with Charles C. Seymour, of *What Really Happened at Paris*.
- E. M. H. L.**—Edward Mayow Hastings Lloyd. Undersecretary, Ministry of Food, Great Britain. Author of *Experiments in State Control*; *Stabilisation*.
- E. M. Ho.**—Edward Morell Holmes. Former Curator of the Museum of the Pharmaceutical Society, London.
- E. M. L. M.**—Emile Marie Louis Madelin. Chairman of The French Alliance of the United States and of Canada, 1907-08. Author of *La Bataille de France*; etc.
- E. M. N.**—Edward Max Nicholson. Ornithologist, Oxford University Greenland Expedition, 1928. Author of *Birds in England*; *How Birds Live*; etc.
- Em. O.**—Emil Ott. Director of Research, Hercules Powder Company, Wilmington, Del.
- E. Mor.**—Elliott Morrill. Vice-President in Charge of Research, Rit Products Corporation, Chicago, Ill.
- E. Mr.**—Ernest Mezger. Conseil juridique, Paris. Author of *L'Arbitrage commercial et l'ordre public*; *Moyens de défense et voies de recours contre une sentence arbitrale étrangère*.
- E. M. S.**—Elmer M. Soles, O.D. Optometrist. Director of Public Information, American Optometric Association.
- E. M. T.**—Sir Edward Maunde Thompson. Director and Principal Librarian of the British Museum, 1888-1909. Author of *Shakespeare's Handwriting*; etc.
- E. M. W.**—Edmund Murton Walker. Professor, Invertebrate Zoology and Head of Department of Zoology, University of Toronto; Fellow, Royal Society of Canada.
- E. M. Wa.**—Rev. Edward Mewburn Walker. Former Chaplain to the King; Provost of Queen's College, Oxford, 1930-33. Author of *Greek History, Its Problems and Its Meaning*; etc.
- E. N. da C. A.**—Edward Neville da Costa Andrade. Quain Professor of Physics, University of London. Author of *The Structure of the Atom*; etc.
- E. N. H.**—Edmund Newton Harvey. H. F. Osburn Professor of Physiology, Princeton University. Vice-President, Marine Biological Laboratory, Woods Hole, Mass. Author of *The Nature of Animal Light*; *Living Light*; etc.
- E. N. W.**—Edna Noble White. Director, Merrill-Palmer School, Detroit, Mich., 1920-47.
- E. N. Wh.**—Edward Norris Wentworth. Director of Armour's Livestock Bureau, Chicago, Ill., 1923-.
- E. O. E.**—E. O. Essig. Professor of Entomology, University of California; Head of the Division of Entomology and Parasitology, California Agricultural Experiment Station. Author of *Insects of Western North America*; *College Entomology*; etc.
- Eo. S.**—Emilio Segrè. Professor of Physics, University of California, Berkeley, Calif.
- E. O. S.**—Elbert Orla Sowerwine. Vice-President, Anaconda Copper Mining Company, New York, N.Y.
- E. Ow.**—Ernest Ower. Author of *The Measurement of Air Flow*.
- E. P.**—Edgar Prestage. Former Professor of Portuguese Language, Literature and History, University of London. Former Editor of *Zurara's Chronicle of Guinea*; etc. Author of *D. Francisco Manuel de Mello* in Hispanic Society's Portuguese series; etc.
- E. Pa.**—Eric Parker. Editor of "The English Scene" Series; Editor in Chief of *The Field*, 1930-37. Author of *Elements of Shooting*; etc.
- E. Par.**—Eric Partridge. Author of *A Dictionary of Slang and Unconventional English*; etc.
- E. P. B.**—E. Phillips Barker. Reader in Classics, University College, Nottingham, England.
- E. P. C.**—Edward Provan Cathcart, M.D. Regius Professor of Physiology, University of Glasgow, Scotland, 1928-47. Member of War Cabinet Scientific Committee on Food Policy.
- E. P. Cu.**—Ellwood P. Cubberley. Former Dean, School of Education, Stanford University, Stanford, Calif. Author of *History of Education*; *Public School Administration*; etc.
- E. P. F.**—Ephraim Porter Felt. Director and Chief Entomologist, Bartlett Tree Research Laboratories, Stamford, Conn., 1928-43. Author of *Plant Galls and Gall Makers*; etc.
- E. P. Ft.**—Einar P. Flint. Chairman of the Ceramics and Minerals Department, Armour Research Foundation, Illinois Institute of Technology, Chicago, Ill.
- E. P. L.**—Ernest Preston Lane. Professor of Mathematics, The University of Chicago. Author of *Projective Differential Geometry of Curves and Surfaces*; etc.
- E. P. N.**—Edwin P. Norwood. Author of *The Other Side of the Circus*; etc.
- E. Pu.**—Monsignor Enrico Pucci. Former Domestic Prelate to the Pope. Former Editor, *Corriere d'Italia*. Author of *La Pace del Laterano*.
- E. R.**—Elihu Root. Former Member, Permanent Court of Arbitration at The Hague; Secretary of War in Cabinet of President McKinley, 1899-1904. Secretary of State in Cabinet of President Theodore Roosevelt, 1905-09. Awarded Nobel Peace Prize, 1912.
- E. R. B.**—Edwyn Robert Bevan. Former Honorary Fellow of New College, Oxford. Lecturer on Hellenistic History and Literature at King's College, University of London, 1922-33. Author of *Later Greek Religion*; *A History of Egypt under the Ptolemaic Dynasty*; etc.
- E. R. Cn.**—E. Richard Cohen. Physicist, Atomic Energy Research Department, North American Aviation, Inc., Downey, Calif.
- E. R. Cy.**—Everett Ross Clinchy. President, National Conference of Christians and Jews. Author of *All in the Name of God*; *Handbook on Human Relations*; *Human Relations Centers*; *World We Want To Live In*.

E. R. E.—Edwin Rogers Embree. Former President, Julius Rosenwald Fund. Author of *Brown America, The Story of a New Race; Color and Democracy*; etc.

E. R. G. R. E.—Edward Ratcliffe Garth Russell Evans, 1st Baron Mountevans. Admiral, Royal Navy. Author of *Keeping the Seas; South with Scott*; etc.

Er. H.—Eric Hutton. Writer and Editor, *Toronto Star*, Toronto, Can., 1929-46.

E. Rh.—Ernest Rhys. Former Editor of "Everyman's Library."

E. R. J.—Emory Richard Johnson. Professor of Transportation and Commerce, University of Pennsylvania, Philadelphia, Pa., 1902-50. Dean, Wharton School of Finance and Commerce, University of Pennsylvania, 1919-33. Author of *Inland Waterways, Their Relation to Transportation*; etc.

E. Rl.—Elbert Russell. Former Dean, School of Religion, Duke University, Durham, N.C. Author of *The Parables of Jesus; The History of Quakerism*; etc.

E. R. Ld.—E. R. Loveland. Executive Secretary, American College of Physicians.

E. R. Lg.—Esmond Ray Long, M.D. Director, Henry Phipps Institute, Philadelphia, Pa. Director, Division of Research, National Tuberculosis Association. Author of *A History of Pathology*.

E. Ro.—Edward Robertson, D.D. Professor of Semitic Languages and Literature, University of Manchester, England, 1934-45.

E. Row.—Eron Rowland (Mrs. Dunbar Rowland). Consultant, Rowland Historical and Research Library, Jackson, Miss. Author of *Andrew Jackson's Campaign Against the British*; etc.

E. R. Pe.—Elizabeth Robins Pennell. Author of *Life of Mary Wollstonecraft; Feasts of Autolycus*. Co-author of *Lithography and Lithographers*.

E. R. Pk.—Edson R. Peck. Associate Professor of Physics, Northwestern University, Evanston, Ill.

Er. S.—Eric Stone. Lecturer in History, Manchester University, Manchester, Eng.

E. R. S.—Sir Edward Raymond Street. Chairman, the Cotton Board, Manchester, Eng.

E. R. T.—E. Raymond Turner. Professor of European History, The Johns Hopkins University, Baltimore, Md., 1925-29. Author of *The Privy Council of England in the Seventeenth and Eighteenth Centuries*.

E. Ru.—Ernest Rutherford, 1st Baron Rutherford. Cavendish Professor of Experimental Physics and Director of Cavendish Laboratory, Cambridge University, 1919-37. Nobel Prize for Chemistry, 1908.

E. S.—Edward Salmon. Honorary Editor of *United Empire*, journal of Royal Empire Society, 1941-46; Editor, 1920-37. Author of *Life of General Wolfe; The Story of the Empire*; etc.

E. Sa.—Edward Sapir. Former Sterling Professor of Anthropology and General Linguistics, Yale University. Author of *Language, an Introduction to the Study of Speech; Time Perspective in Aboriginal American Culture*; etc.

E. S. B.—E. S. Bunn. Assistant Director of Research, Revere Copper and Brass Inc., Rome, N.Y.

E. S. Ba.—Edson Sunderland Bastin. Former Chairman of the Department of Geology and Emeritus Professor of Economic Geology, The University of Chicago.

E. S. Br.—Edwin S. Baker. Executive Secretary, United States Lawn Tennis Association. Former Editor and Manager, *American Lawn Tennis*. Former Editor of Publications, National Electric Light Association.

E. Sc.—Emil Schürer. Former Professor of New Testament Exegesis in the Universities of Giessen, Kiel and Göttingen. Author of *Geschichte des jüdischen Volkes im Zeitalter Jesu Christi*.

E. S. F.—Edward Sanborn French. President, Boston and Maine Railroad, and Maine Central Railroad Company.

E. Sg.—Eugenie Strong. Member of Council of Hellenic Society, 1892-1943. Assistant Director of the British School of Archaeology in Rome, 1909-25. Author of *Art in Ancient Rome ("Ars Una" Series)*; etc.

E. S. G. B.—E. S. Guzman Barron, M.D. Associate Professor of Biochemistry, The University of Chicago. Author of *Modern Trends in Physiology and Biochemistry*.

E. S. H.—Elizabeth Sanderson Haldane. Former Vice-Chairman, Territorial Nursing Service, Member Q.A.I.M. Nursing Board. Author of *The British Nurse in Peace and War*.

E. S. Hr.—Ellwood Scott Harrar. Professor of Wood Technology, Duke University Graduate School of Forestry, Durham, N.C. Author of *Forest Dendrology and Guide to Southern Trees*.

E. S. Hs.—Edwin Sherbon Hills. Professor of Geology and Mineralogy, University of Melbourne, Melbourne, Austr. Author of *Outlines of Structural Geology; Physiography of Victoria*.

E. S. Jn.—Earl Shepard Johnson. Professor of the Social Sciences, Division of the Social Sciences, The University of Chicago.

E. S. M.—Edwin S. Murphy. Member of the firm of Kirlin, Campbell, Hickox and Keating, New York, N.Y.

E. S. P.—Edward S. Prior. Slade Professor of Fine Arts, Cambridge University, 1912-32. Author of *Eight Chapters on English Mediaeval Art*; etc.

E. S. R.—Edward Stanley Roscoe. Registrar of Prize Court, 1914; Official Law Reporter in Admiralty Court, 1883; Admiralty Registrar, 1904; Assessor, North Sea Enquiry, 1905. Author of *Admiralty Law and Practice*; etc.

E. St.—Miss E. Stevenson. Inspector of Schools to the London County Council. Former Head Mistress of St. George's School for Girls and St. George's Training College for Secondary Women Teachers, Edinburgh, Scotland.

E. T.—Edward Tuthill. Professor of History, University of Kentucky, Lexington, Ky., 1908-45. Author of *Government of Kentucky*.

E. Ta.—Ethelred Taunton. Author of *The English Black Monks of St. Benedict; History of the Jesuits in England*.

E. T. B.—Eric Temple Bell. Professor of Mathematics, California Institute of Technology, Pasadena, Calif. Author of *Men of Mathematics*; etc.

E. T. Be.—Elexious Thompson Bell, M.D. Professor and Head of the Department of Pathology, the Medical School, University of Minnesota, Minneapolis, Minn. Author of *Text Book of Pathology; Renal Diseases*.

E. Te.—Edward Teller. Professor of Physics, Institute for Nuclear Studies, The University of Chicago.

E. T. F. C.—Sir Edward Thomas Frederick Crowe. Comptroller General of the British Department of Overseas Trade, 1928-37.

E. Th.—Edward Thatcher. Former Instructor in Fine and Applied Arts, Teachers College, Columbia University. Author of *Making Tin Can Toys*.

E. T. J.—E. Taylor Jones. Emeritus Professor of Natural Philosophy, University of Glasgow, Scotland. Author of *Theory of the Induction Coil*; etc.

E. T. K.—Edward T. Kennedy. Coach of Swimming and Water Polo, Columbia University.

E. Tr.—Ethel Truman. Bedford College, University of London.

E. T. W.—Edward Thomas Waters. Associate Professor of Physiology, University of Toronto, Toronto, Ontario.

Et. W. B.—Ernest Watson Burgess. Professor of Sociology, The University of Chicago. Author of *The Family From Institution to Companionship; Introduction to the Science of Sociology*.

E. T. Ws.—Edgar Trevor Williams. Brigadier, British Army. Fellow and Tutor, Balliol College, Oxford, 1947- . Chief Intelligence Officer, British 8th Army, 1942-43, and 21st Army Group, 1943-45.

E. Un.—Evelyn Underhill (Mrs. Stuart Moore). Former Fellow of King's College, London. Author of *Mysticism, A Study in the Nature and Development of Man's Spiritual Consciousness*; etc.

E. V.—Ethan Viall. Field Editor of *Motor Service Magazine*. Former Editor in Chief and Special Correspondent of *The American Machinist*. Author of *Broaches and Broaching; Electric Welding*; etc.

E. Va.—Emile Vandervelde. Minister of State in the Belgian Government, 1914-38. Author of *Le Parti Ouvrier Belge (1885-1925)*; etc.

E. V. A.—Sir Edward Victor Appleton. Secretary, Department of Scientific and Industrial Research, London, 1939- . Nobel Prize for Physics, 1947.

E. V. C.—Eugene Van Cleef. Professor of Geography and Professor of Business Organization, Ohio State University, Columbus, O. Author of *Geography for the Businessman; Getting into Foreign Trade*; etc.

E. V. K.—Edmund George Valpy Knox. Editor of *Punch*, 1932- . Author of *Parodies Regained*; etc.

E. V. L.—Edward Verrall Lucas. Former writer and Chairman of Methuen and Company, Publishers, London. Editor of an edition of the *Works and Letters of Charles and Mary Lamb*. Author of *English Leaves*; etc.

E. V. M.—Elmer Verner McCollum. Professor of Biochemistry, School of Hygiene and Public Health, The Johns Hopkins University, Baltimore, Md., 1917-44. Author of *Foods, Nutrition and Health*; etc.

E. V. Mn.—Edward Victor Morgan. Professor of Economics, University College of Swansea, Swansea, Wales. Author of *The Theory and Practice of Central Banking; The Conquest of Unemployment; Studies in British Financial Policy, 1914-25*.

- E. W.**—Edward Alexander Westermarck. Former Professor of Philosophy at the Academy of Abo, Finland; Professor of Sociology at the University of London, 1907-30. Author of *A Short History of Marriage*; etc.
- E. Wa.**—Rev. Edmund Warre, D.D. Former Provost of Eton. Head Master of Eton College, 1884-1905. Author of *Grammar of Rowing*.
- E. Wag.**—E. Wagon. Literary Department, Deutsche Bank, Berlin.
- E. W. Al.**—Edward W. Allen. U.S. Commissioner and Chairman, International Fisheries Commission. U.S. Commissioner, International Pacific Salmon Fisheries Commission. Author of *North Pacific*.
- E. W. An.**—Edward W. Axelson. Chief, Floating Bridge Section, Engineer Research and Development Laboratories, Ft. Belvoir, Va.
- E. W. B.**—Sir Edward Wentworth Beatty. Chancellor, McGill University, Montreal, Can., 1921-43. President, Canadian Pacific Railway Company, 1918-42.
- E. W. B. N.**—Edward Williams Byron Nicholson. Former Librarian of the Bodleian Library, Oxford. Author of *Keltic Researches*; etc.
- E. W. Bs.**—Esther Willard Bates. Professor of Dramatic Art, Rhode Island School of Design, Providence, R.I. Author of *The Art of Producing Pageants*; etc.
- E. W. Ch.**—Edna Woolman Chase. Editor in Chief, *Vogue*, New York, N.Y.
- E. Wf.**—Eugene Wolff. Ophthalmic Surgeon, Royal Northern Hospital, London. Surgeon, Moorfields, Westminster and Central Eye Hospital, London. Author of *Anatomy of the Eye and Orbit; Diseases of the Eye*.
- E. W. G. M.**—E. W. G. Masterman. Former Honorary Secretary, Palestine Exploration Fund, London.
- E. W. Hd.**—Edward William Herold. Research Section Head, RCA Laboratories, Princeton, N.J.
- E. W. He.**—Edgar Wendell Hewson. Assistant Controller, Research and Training Service, Meteorological Service of Canada, Toronto, Can.
- E. W. Ht.**—Edward Weston Hurst, M.D. Head of the Subdivision of Micro-organismal Research, Biological Department, Imperial Chemical (Pharmaceuticals) Ltd., Manchester, Eng.
- E. Wi.**—Elizabeth Wiskemann. Writer on foreign affairs, London. Author of *Czechs and Germans; Italy; The Rome-Berlin Axis; Undeclared War*.
- E. W. L.**—Ernest Walter Lindstrom. Professor and Head of Genetics Department and Vice-Dean of Graduate College, Iowa State College of Agriculture and Mechanical Arts, Ames, Ia.
- E. W. MacB.**—Ernest William MacBride. Former Professor of Zoology, Imperial College of Science, South Kensington, London. Strathcona Professor of Zoology at McGill University, Montreal, Can., 1897-1909. Author of *A Text Book of Zoology; Introduction to the Study of Heredity*; etc.
- E. Wn.**—Edward Weston. Internationally known photographer.
- E. W. P.**—Elbridge Woodman Palmer. President of Kingsport Press, Kingsport, Tenn. Associate Editor, *Merriam Webster's Dictionary*. Author of *A Course of Bookbinding for Vocational Schools*.
- E. W. Pe.**—Emmett W. Price. Assistant Head, Zoological Division, U.S. Bureau of Animal Industry, Department of Agriculture.
- E. Wr.**—Sir Edmund Whittaker. Herbert Spencer Lecturer, Oxford University, 1948-50. Author of *Modern Analysis*; etc.
- E. W. S.**—E. W. Sheppard. Directorate of Recruiting and Organization, War Office, London.
- E. W. Sn.**—Ernst W. Swanson. Research economist, U.S. Chamber of Commerce.
- E. W. Sz.**—Edwin William Schultz, M.D. Professor of Bacteriology and Experimental Pathology, School of Medicine, Stanford University, Stanford, Calif.
- E. W. V.**—Ernest W. Volkmann. Assistant Director of Research, Koppers Company, Inc., Pittsburgh, Pa.
- E. W. W.**—Rev. Canon Edward William Watson, D.D. Former Canon of Christ Church College, Oxford, and Regius Professor of Ecclesiastical History in Oxford University.
- E. Wz.**—Eugene Willihnganz. Director of Research, Gould-National Batteries, Inc., St. Paul, Minn.
- E. Y.**—Ernest Young. Former Inspector of Anglo-Vernacular Schools, Siam. Author of *A Peep at Siam*; etc.
- F.**—Edmund George Fitzmaurice, 1st Baron Fitzmaurice. Chancellor, Duchy of Lancaster, with a seat in the Cabinet, 1908-09; Undersecretary for Foreign Affairs, 1882-85 and 1905-08.
- F. A. B.**—Francis Arthur Bather. Former Keeper, Department of Geology, British Museum (Natural History), London, 1924-28. Author of "Echinodermata" in Sir Edwin Ray Lankester's *A Treatise on Zoology*; etc.
- F. A. Bh.**—Frank A. Beach. Professor of Psychology, Yale University, 1946-50. Chairman and Curator, Department of Animal Behavior, The American Museum of Natural History, New York, N.Y., 1942-46.
- F. A. Bn.**—Frank A. Brown, Jr. Professor of Zoology, Northwestern Univ., Evanston, Ill.
- F. A. Br.**—Frank A. Browne. Consulting Engineer, Barber Asphalt Company, Philadelphia, Pa.
- F. A. Co.**—Francis Arthur Cockfield. Director of Statistics and Intelligence, Board of Inland Revenue, London.
- F. A. E.**—Sir F. A. Eaton. Former Secretary to the Royal Academy.
- F. A. E. C.**—F. A. E. Crew, M. D. Director, Institute of Animal Genetics, University of Edinburgh, Scot., 1921-44. Co-editor of the *British Journal of Experimental Biology*.
- F. A. F.**—Frank Albert Fetter. Former Professor of Political Economy, Princeton University, Princeton, N.J. Author of *Economic Principles*; etc.
- F. A. G.**—F. A. Gould. Senior Principal Scientific Officer, Metrology Division, National Physical Laboratory, Teddington, Middlesex.
- F. A. G. W.**—Frederick Andrew Graves Willis. Rector of Bagenalstown, Ire.
- F. A. Js.**—Francis Arthur Jenkins. Professor of Physics, University of California, Berkeley, Calif. Author of *Fundamentals of Physical Optics*.
- F. A. K.**—Forrest Alva Kingsbury. Associate Professor and Acting Chairman of the Department of Psychology, The University of Chicago. Co-author of *Psychological Tests in Business*.
- F. Al.**—Frederick Allemes. French advocate.
- F. A. Lu.**—Frederic Augustus Lucas. Curator, U.S. National Museum, Washington, D.C., 1893-1904. Director of American Museum of Natural History, New York, N.Y., 1911-23.
- F. A. Lz.**—Friedrich A. Lutz. Professor of Economics, Princeton University. Author of *International Monetary Mechanism, The Keynes and The White Proposals; Corporate Cash Balances*.
- F. A. M.**—Frank Anderson Merrick. Vice-Chairman, 1938-44, and President, 1929-38, of Westinghouse Electric and Manufacturing Company.
- F. A. McN.**—Frank A. McNamee, Jr. Colonel, U.S. Army. Deputy Director, Co-operative for American Remittances to Europe, Inc.
- F. A. M. W.**—Frederick Annesley Michael Webster. Former Editor, *Playing Fields*, London. Author of *Why? The Science of Athletics*; etc.
- F. A. Ph.**—Frederick Adolphus Paneth. Professor of Chemistry, University of Durham, Durham, Eng.
- F. A. R.**—Frederic A. Russell. Professor of Marketing, University of Illinois, Urbana, Ill. Author of *Management of the Sales Organization; Textbook of Salesmanship*.
- F. A. Sw.**—Frederick A. Sweet. Associate Curator of Painting, the Art Institute of Chicago, Chicago, Ill. Author of *George Bellows; The Hudson River School*; co-author of *Colony to Nation*.
- F. B.**—Francis Bickley. Editor of state papers for the Public Record Office and of reports for the Historical Manuscripts Commission, England.
- F. B. L.**—Fred B. Lautzenhiser. Consulting Engineer, International Harvester Company, Chicago, Ill. Author of *The Motor Truck Manual*; etc.
- F. B. M.**—Sir Frederick Barton Maurice. Major General, formerly with British Army. Principal of Queen Mary College, London, 1933-44. Director of Military Operations, Imperial General Staff, 1915-18.
- F. B. McC.**—F. B. McConnell. President, Sears, Roebuck and Co., Chicago, Ill.
- F. B. Mn.**—Frank Barron Morrison. Professor of Animal Husbandry and Animal Nutrition, Cornell University, Ithaca, N.Y. Author of *Feeds and Feeding*.
- F. Bn.**—Sir Frank Brangwyn. Artist. President of Graphic Arts Society, England.
- F. Boo.**—Franklin Booth. Illustrator, painter.
- F. Bra.**—Frederick Bradbury. Freeman of the Company of Cutlers in Sheffield, England. Author of *History of Old Sheffield Plate*; etc.
- F. B. Sr.**—Francis B. Sumner. Former Professor of Biology, Scripps Institution of Oceanography, University of California, La Jolla, Calif.
- F. B. St.**—Florence Barbara Seibert. Associate Professor of Biochemistry, Henry Phipps Institute, University of Pennsylvania, Philadelphia, Pa.
- F. B. T.**—Frederick B. Tolles. Member of Permanent Research Group, Huntington Library, San Marino, Calif. Author of *Meeting House and Counting House: The Quaker Merchants of Colonial Philadelphia*.

F. Bu.—Fred Bullock. Former Secretary and Registrar, Royal College of Veterinary Surgeons, London. Author of *Handbook for Veterinary Surgeons*; etc.

F. Buc.—Francis Buckley. Author of *History of Old English Glass*; *Old London Glasshouses*.

F. B. W.—Frank B. Willis. Former U.S. Senator from Ohio.

F. B. Wy.—Francis Bowditch Wilby. Major General, U.S. Army (retired). Superintendent, United States Military Academy, West Point, N.Y., 1942-45.

F. By.—Frank Brinkley. Captain, R.N. Former Foreign Adviser to Nippon Yusen Kaisha, Tokyo, and Correspondent of *The Times*, London, in Japan. Editor of the *Japan Mail*, 1881-1905. Author of *Japan*; etc.

F. C.—F. Clements. General Manager, the Park Gate Iron and Steel Company, Ltd., Rotherham, England.

F. Ca.—Florian Cajori. Former Professor of History of Mathematics, University of California. Author of *A History of Mathematics*; etc.

F. C. B.—Francis Crawford Burkitt, D.D. Former Fellow of Trinity College, Cambridge. Norrisian Professor of Divinity in Cambridge University, 1905-35.

F. C. Ba.—Frederic Charles Bartlett. Professor of Experimental Psychology, and Director of the Psychological Laboratory, Cambridge University.

F. C. Bd.—Frederick Charles Bradford. Senior Horticulturist, Bureau of Plant Industry, Soils, and Agricultural Engineering, U.S. Department of Agriculture, Glenn Dale, Md. Co-author of *Fundamentals of Fruit Production*; etc.

F. C. Bo.—Frank C. Bowen. Editor of *Merchant Ships of the World*. Author of *The Golden Age of Sail*; etc.

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F. C. C.—Frederick Cornwallis Conybeare. Former Fellow of University College, Oxford, and of the British Academy. Author of *The Ancient Armenian Texts of Aristotle*; etc.

F. C. E.—Franklin Courtney Ellis. Director of Public Information, Eastman Kodak Company, Rochester, N.Y.

F. C. F.—Francis Cowles Frary. Director of Research, Aluminum Company of America, New Kensington, Pa. Co-author of *The Aluminum Industry*.

F. C. H.—Frederic Clare Hawkes. Secretary, the Chartered Auctioneers' and Estate Agents' Institute, London.

F. C. Kk.—Frank Charles Kracek. Physical Chemist, Geophysical Laboratory, Carnegie Institution of Washington, Washington, D.C.

F. C. L.—Frederick C. Lincoln. Assistant to the Director, Fish and Wildlife Service, U.S. Department of the Interior, Washington, D.C.

F. C. Mn.—Frank Charles Mann, M.D. Professor of Experimental Medicine, Mayo Foundation, University of Minnesota, Rochester, Minn.

F. C. R. J.—Rev. Francis C. R. Jourdain. Former Member of the British Ornithological Union; Former Honorary Fellow, American Ornithological Union.

F. C. Sd.—F. C. Steward. Research Associate in Botany, The University of Chicago, 1945-48. Reader in Botany, University of London.

F. C. Si.—Frederick Cameron Sillar. Principal Assistant Secretary, Imperial War Graves Commission, London, Eng.

F. C. S. S.—Ferdinand Canning Scott Schiller. Former Fellow and Senior Tutor of Corpus Christi College, Oxford. Author of *Formal Logic*; *Humanism*; etc.

F. Ct.—François Marie-Joseph Crouzet. Assistant à la Sorbonne, Paris University. Author of *L'Economie du Commonwealth Britannique*.

F. C. Wh.—Frank Clifford Whitmore. Former Dean of the School of Chemistry and Physics, The Pennsylvania State College, State College, Pa. Author of *Organic Chemistry*; *Organic Compounds of Mercury*.

F. D.—Sir Frank Watson Dyson. Astronomer Royal of England, 1910-33.

F. Da.—Frederick Dalgas. Managing Director of The Royal Copenhagen Porcelain Manufactory.

F. De.—Frank Debenham. Professor of Geography, Cambridge University, 1930-. Founder and Director of Scott Polar Research Institute, 1925-46. Former Editor, *The Polar Record*.

F. De C.—Francis De Crue. Rector of the Université de Genève, Geneva, Switz., 1916-18. Author of *La guerre féodale de Genève et l'établissement de la Commune (1285-1320)*; etc.

F. D. G.—Frank D. Graham. Walker Professor of International Finance, Princeton University, 1930-49. Author of *Protective Tariffs*; etc.

F. D. N.—F. D. Nichol. Editor, *Review and Herald*, Washington, D.C. Author of *The Midnight Cry*; *The Answer to Modern Religious Thinking*; etc.

F. D. P.—Frederick Douglas Patterson. President, Tuskegee Institute, Tuskegee Institute, Ala. Co-author of *What the Negro Wants*.

F. D. R.—Frank Driver Reeve. Associate Professor of History, University of New Mexico, Albuquerque. Editor, *New Mexico Historical Review*.

F. D. S.—Franklin D. Scott. Professor of History, Northwestern University, Evanston, Ill. Author, *Bernadotte and the Fall of Napoleon*; etc.

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F. D. W.—Florence Dahl Walrath. Founder and Managing Director, Cradle Society, Evanston, Ill.

F. E. C.—Felix Cole. U.S. Minister to Ethiopia, 1945-47.

F. E. Ci.—Francis Edward Cislak. Director of Research, The Reilly Tar and Chemical Corporation, Indianapolis, Ind.

F. E. D.—F. E. Drury. Former Principal, London County Council School of Building, London.

F. E. F.—Felix Eugen Fritsch. Head of Department of Botany, Queen Mary College, London, and Professor of Botany, University of London. Author of *An Introduction to the Study of Plants*; etc.

F. E. L.—Francis Ernest Lloyd. Emeritus Professor of Botany, McGill University, Montreal, Que. Co-author of *The Teaching of Biology in the Secondary School* ("American Teachers Series"); *Guayule, A Rubber Plant of the Chihuahuan Desert*; etc.

F. E. M.—F. E. Matthews. Former Professor of Chemistry at the Royal Indian Civil Engineering College (Cooper's Hill College), Egham, England.

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F. E. S. J.—F. E. Skone James. Of Lincoln's Inn. Barrister-at-Law.

F. E. Wa.—Rev. Frederick Edward Warren. Hon. Canon of Ely, 1906-14. Author of *The Liturgy and Ritual of the Ante-Nicene Church*; etc.

F. E. Z.—Frederick Everard Zeuner. Professor of Environmental Archaeology, University of London. Author of *Dating the Past*; *The Pleistocene Period*.

F. F.—Ferdinand Foch. Former Marshal of France. Commander in Chief of the Allied Armies in France, World War I. Author of *The Memoirs of Marshal Foch*.

F. F. Ds.—Fanny-Fern Davis. Acting Director, U.S. Golf Association Green Section.

F. F. G.—Frank F. Grout. Visiting Professor of Geology, California Institute of Technology, Pasadena, Calif. Author of *Kemp's Handbook of Rocks*; *Petrography and Petrology*.

F. Fl.—Fred Fletcher. Sporting Department, *New York Herald Tribune*.

F. F. Rx.—Frederick Ferdinand Rex. Librarian, Municipal Reference Library, Chicago, Ill. Author of *The Alderman's Manual*; *The Mayors of the City of Chicago from March 4, 1837, to April 13, 1933*.

F. G.—Frank Gahan. Editor of tenth edition, *Mayne's Treatise on Damages*.

F. G. C.—Frederick Gardner Cottrell. Former Technical Consultant, Research Corporation, New York, N.Y. Consulting Chemist, Bureau of Plant Industry, 1940-43, Bureau of Chemistry and Soils, 1930-40, U.S. Dept. of Agriculture.

F. G. H.—Sir Frederick Gowland Hopkins, Hon. M.D. Professor of Biochemistry in Cambridge University, 1914; Sir William Dunn Professor, 1921-43. Nobel Prize for Medicine, 1929.

F. G. H. T.—Francis G. H. Tate. First Class Chemist, British Government Chemist's Department, London.

F. G. K.—Sir Frederic George Kenyon. Director and Principal Librarian, British Museum, London, 1909-30. Former President, British School of Archaeology, Jerusalem.

F. G. M.—Frank Grant Menke. Author of *Encyclopedia of Sports*; *Down the Stretch*; etc.

F. G. M. B.—Frederick George Mee-son Beck. Former Fellow and Lecturer of Clare College, Cambridge.

F. G. Me.—F. G. Merkle. Professor of Soils, Pennsylvania State College, State College, Pa.

F. G. P.—Frederick Gymer Parsons. Former Research Fellow in Anthropology, St. Thomas's Hospital, London.

- F. G. U.—F. G. Underhay.** Editor of the *Official Reports of Patent, Design and Trade-Mark Cases*. Editor of *Kerly on Trade Marks*.
- F. G. W.—Francis Graham Wilson.** Professor of Political Science, University of Illinois, Urbana, Ill. Author of *The Elements of Modern Politics*, etc.
- F. H.—Fred Horner.** Consulting engineer. Contributor to *The Times Engineering Supplement*, London; *Engineering*; etc.
- F. Ha.—Francis Harper.** Research Associate, John Bartram Association, and of the Morris Arboretum, University of Pennsylvania, Philadelphia, Pa.
- F. H. A. M.—Francis Hugh Adam Marshall.** Reader in Agricultural Physiology, 1919-43, and Dean, 1926-36, Christ's College, Cambridge. Author of *The Physiology of Reproduction*; etc.
- F. H. An.—Frederick Harold Allen.** M.D. Medical Director, Philadelphia Child Guidance Clinic, Philadelphia, Pa. Associate Professor of Psychiatry, University of Pennsylvania, Philadelphia. Author of *Psychotherapy with Children*.
- F. Har.—Frederic Harrison.** Author of *De Senectute*; *Life of Ruskin*; etc.
- F. H. B.—Francis H. Butler.** Associate of the Royal School of Mines, Imperial College of Science and Technology, University of London.
- F. H. Br.—Sir Frank Herbert Brown.** On the Editorial Staff of *The Times*, London. Former Editor of the *Indian Daily Telegraph*.
- F. H. C.—Fred Herbert Colvin.** Consultant, U.S. Navy Bureau of Aeronautics. Emeritus Editor, *American Machinist*. Co-author of *American Machinists' Handbook*; *Aircraft Handbook*; etc.
- F. Hd.—Frank Lloyd Hopwood.** Vice-Dean, Professor of Physics, St. Bartholomew's Hospital Medical College, University of London.
- F. He.—Friedrich Hempelmann.** Former Professor of Zoology, University of Leipzig, Germany.
- F. Hed.—Frank Hedley.** Former President and General Manager, Interborough Rapid Transit Company, New York, N.Y.
- F. H. H.—Franklin Henry Hooper.** Former Editor in Chief of *Encyclopædia Britannica*.
- F. H. Ha.—Frederick Henry Hatch.** Former President, Institute of Mining and Metallurgy, London. Author of *The Iron and Steel of the U.K. under War Conditions*; etc.
- F. H. K.—Frank Hyneman Knight.** Professor of Social Sciences and of Philosophy, The University of Chicago. Author of *Risk, Uncertainty and Profit*; *The Economic Order and Religion*; etc.
- F. H. Kn.—Frank Hammond Krusen.** M.D. Head of Section on Physical Medicine, Mayo Clinic, Rochester, Minn. Professor of Physical Medicine, Mayo Foundation of the University of Minnesota, Minneapolis, Minn. Co-author of *Physical Medicine*.
- F. H. M.—Frederick Henry Marshall.** Koraeas Professor of Modern Greek and Byzantine History, Language and Literature, King's College, University of London.
- F. How.—F. Howarth.** Lecturer in Botany, Imperial College of Science and Technology, University of London.
- F. H. P.—Frederick Henry Pollard.** Senior Lecturer in Inorganic Chemistry, University of Bristol, Bristol, Eng.
- F. Hr.—Friedrich Hrozný.** Former Professor of Cuneiform Writing and History of the Ancient Orient, Charles University, Prague, Czech. Conducted excavations at Cheikh-Saad, Tell-Eriad and Kultepe. Author of *Das Getreide im Alten Babylonien*. Editor of *Hethitica* and *Archiv Orientalni*.
- F. Hs.—Fritz Haas.** Curator of Lower Invertebrates, Chicago Natural History Museum, Chicago, Ill., 1939-.
- F. H. S.—Frederick Hanley Seares.** Research Associate of Mount Wilson Observatory of Carnegie Institution, Washington, D.C., 1940-46. Author of *Practical Astronomy for Engineers*; etc. Collaborating Editor, *Astrophysical Journal*.
- F. H. Sp.—Frank Harold Spedding.** Professor of Chemistry and Physics and Director of the Institute for Atomic Research, Iowa State College, Ames, Iowa, 1942- . Member, Board of Governors, Argonne National Laboratory, Chicago, Illinois.
- F. Hu.—Francis Hueffer.** Former Musical Critic of *The Times*, London, and Editor of *Great Musicians*. Author of *Richard Wagner and the Music of the Future*.
- F. H. Wr.—Frank Henry Westheimer.** Professor of Chemistry, The University of Chicago.
- F. I. C.—Frank Irving Cooper.** Former President, Frank Irving Cooper Corporation, Architects, Boston, Mass.
- F. I. W.—F. I. Watson.** Sports Editor of *The Field*, London.
- F. J. A.—Frederick J. Adams.** Professor and Head of the Department of City and Regional Planning, Massachusetts Institute of Technology, Cambridge, Mass.
- F. J. B.—Frank John Bruno.** Professor of Applied Sociology and Chairman of the Department of Social Work, Washington University, St. Louis, Mo. Consulting Editor, *Social Science Abstracts*; *Encyclopedia of Social Sciences*.
- F. J. C. P.—Sir Felix John Clewett Pole.** General Manager, Great Western Railway, London, 1921-29.
- F. J. D.—F. J. Drover.** Engineer Captain, Royal Navy. Author of *Marine Engineering Practice*; etc.
- F. J. G. Du.—Frank J. G. Duck.** Of the Worthington Pump and Machinery Corporation, New Jersey. Co-author of original edition of *Coal Miner's Handbook*.
- F. J. H.—Francis John Haverfield.** Former Camden Professor of Ancient History, Oxford University.
- F. J. H. D.—F. J. Harvey Darton.** Sometime Scholar of St. John's College, Oxford.
- F. J. H. M.—Hon. Frederick James Hamilton Merrill.** Consulting geologist and mining engineer. State Geologist of New York, 1899-1904. Author of *Reports of New Jersey and New York Geological Surveys*; etc.
- F. J. Hn.—Frederick J. Hoffman.** Associate Professor of English, University of Wisconsin, Madison, Wis. Author of *Freudianism and the Literary Mind*; co-author of *The Little Magazine*.
- F. J. Hu.—F. J. Hudleston.** Former Librarian, War Office, London.
- F. J. M.—Fred J. Miller.** Author of *American and European Machinery Abroad*. Former Editor, *American Machinist*.
- F. J. McC.—Francis John McConnell.** D.D. Former Senior Bishop of the Methodist Episcopal Church. Author of *The Diviner Immanence*; etc.
- F. J. Mn.—Frederick Justin Mann.** Organization and Methods Examiner, Bureau of Security and Consular Affairs, U.S. Department of State, Washington, D.C. Co-author of *Creation of Rights of Sovereignty Through Symbolic Acts, 1400-1800*.
- F. J. N.—Frederick J. North.** Keeper of the Department of Geology, National Museum of Wales, Cardiff.
- F. J. O.—Frances Jenkins Olcott.** Organizer and former Director of Training School for Children's Librarians, Carnegie Library, Pittsburgh, Pa. Author of *The Children's Reading*; etc.
- F. J. S.—Frederick J. Stevenson.** Geneticist, Bureau of Plant Industry, Soils, and Agricultural Engineering, U.S. Department of Agriculture.
- F. J. Sp.—Frank J. Sprague.** Former President, Sprague Development Corporation and Sprague Safety Control and Signal Corporation. Consulting Engineer, Sprague and General Electric Companies.
- F. J. Sr.—Fred Jay Seaver.** Head Curator, New York Botanical Gardens. Editor of *Mycologia*, official organ of Mycological Society of America.
- F. J. T.—Frederick Jackson Turner.** Former Professor of History, Harvard University. Author of *Rise of the New West*; etc.
- F. J. W.—Frank John Wilson.** Chief, U.S. Secret Service, Treasury Department, Washington, D.C., 1936-46.
- F. K.—Friedrich Wilhelm Eduard Keutgen.** Former Professor of History, University of Hamburg, Ger. Author of *Die Hanse und England im 14 Jahrhundert*; etc.
- F. K. B.—Frederic K. Brown.** Author of *The Playtime Guide Book*; etc.
- F. Ke.—Florence Kelley.** Former Secretary, U.S. Board of Control of Labor Standards for Army Clothing. Author of *Modern Industry*.
- F. Kei.—Frank Keiper.** Patent attorney. Lecturer on inventions and patents. Author, *Pioneer Inventions and Pioneer Patents*.
- F. Ki.—Fiske Kimball.** Director, Philadelphia Museum of Art, Philadelphia, Pa. Author of *Thomas Jefferson, Architect*; etc. Editor of *Foundations of Classic Architecture*.
- Fk. R. M.—Frank Rea Mayo.** Research Chemist, General Laboratories, United States Rubber Company, Passaic, N.J.
- F. L.—Frances Little.** Associate Curator, Department of Renaissance and Modern Art, Metropolitan Museum of Art, New York, N.Y.
- F. L. A.—Fred Lyman Adair, M.D.** Mary Campau Ryerson Professor Emeritus of Obstetrics and Gynecology, The University of Chicago.
- F. L. B.—Francis L. Birch.** Attached to the Foreign Office, London. Former Lecturer in History, Cambridge University.
- F. L. Be.—Frederick Lincoln Browne.** Chemist, Forest Products Laboratory, Forest Service, U.S. Department of Agriculture, Madison, Wis. Co-author of *Casein and Its Industrial Applications*.
- F. L. D.—Fred L. Dendy.** Former Professor of Public Speaking and Director of Dramatics, Davidson College, Davidson, N.C.

- F. L. Ea.**—Frank L. Earnshaw. Bureau of Biological Survey, Department of Agriculture, Washington, D.C.
- F. L. G.**—Florence Laura Goodenough. Emeritus Research Professor, Institute of Child Welfare, University of Minnesota, Minneapolis, Minn. Author of *Anger in Young Children*; *Developmental Psychology*; etc.
- F. L. K.**—Francis Lawrence Kent. Librarian, University of Bristol, Bristol, Eng.
- F. L. Kg.**—Frank L. King. Executive Secretary, Fountain Pen and Mechanical Pen Manufacturers' Association.
- F. L. L.**—Lady Lugard (Flora). Former Head of Colonial Department of *The Times*, London. Author of *A Tropical Dependency*.
- F. Ll. G.**—Francis Llewellyn Griffith. Former Professor and Reader in Egyptology, Oxford University. Former Editor of the *Archaeological Survey and Archaeological Reports of the Egypt Exploration Fund*. Author of *The Nubian Texts of the Christian Period*; etc.
- F. L. Mt.**—Frank Luther Mott. Dean, School of Journalism, University of Missouri, Columbia, Mo. Author of *American Journalism*.
- F. L. P.**—Frederic Logan Paxson. Former Margaret Byrne Professor of History, University of California. Author of *History of the American Frontier*; etc.
- F. L. Pa.**—Fred Lewis Pattee. Professor of American Literature, Rollins College, Winter Park, Fla., 1928-41. Emeritus Professor of American Literature, Pennsylvania State College, State College, Pa. Author of *The Foundations of English Literature*; etc.
- F. L. S.**—Frederick Lewis Schuman. Woodrow Wilson Professor of Government, Williams College, Williamstown, Mass. Author of *Germany since 1918*; *The Nazi Dictatorship*; etc. Co-author of *Design for Power*.
- F. L. We.**—Fred Lawrence Whipple. Associate Professor, Harvard University. Author of *Earth, Moon and Planets*.
- F. M.**—Sir Francis Meynell. Author of *The Typography of Newspaper Advertisements*.
- F. Mac.**—Fitzroy Maclean. Member of Parliament for Lancaster, Eng.
- F. M. Bt.**—Frank Macfarlane Burnet, M.D. Director, Walter and Eliza Hall Institute of Medical Research, Melbourne, Austr. Research Professor of Experimental Medicine, University of Melbourne, Melbourne, Austr. Author of *Biological Aspects of Infectious Disease*; *Virus as Organism*.
- F. M. C.**—Frederick M. ("Fog Horn") Clancy. Author of *The Roundup*, *Stampede and Cowboy Sports Guide*.
- F. M. Co.**—F. M. Carpenter. Professor of Entomology, Agassiz Professor of Zoology and Curator of Fossil Insects, Museum of Comparative Zoology, Harvard University.
- F. M. D.**—Frank M. Dudeney. Author of *The Exporter's Handbook and Glossary*; *How to Export Goods*.
- F. M. Du.**—F. Martin Duncan. Former Librarian of the Zoological Society of London.
- F. M. F.**—Franklin Manley Foote, M.D. Executive Director, National Society for the Prevention of Blindness.
- F. M. M.**—Fritz Morstein Marx. Staff Assistant, Office of the Director, Bureau of the Budget, Executive Office of the President, Washington, D.C. Lecturer on Political Science, American and Howard Universities, Washington, D.C.
- F. Mn.**—Frank Morgan. Actor, stage and motion pictures.
- F. Mo.**—Frances Morris. Associate Curator, Department of Decorative Art, Metropolitan Museum of Art, New York, N.Y. Vice-President of the Needle and Bobbin Club.
- F. M. P.**—Sir Frederick Maurice Powicke. Regius Professor of Modern History, Oxford University, 1928-47. Honorary Fellow of Merton College, Oxford, and of Balliol College. Author of *The Loss of Normandy*; *Stephen Langton*; etc.
- F. M. Rn.**—Francis Minot Rackemann, M.D. Physician, Massachusetts General Hospital, Boston, Mass. Author of *Clinical Allergy Particularly Hay Fever and Asthma*.
- F. M. S.**—Sir Frank Merry Stenton. Professor of Modern History, University of Reading. Author of *The Danes in England*; etc.
- F. M. Se.**—Frank Maryl Setzler. Head Curator, Department of Anthropology, U.S. National Museum, Washington, D.C.
- F. M. T.**—Frank M. Tamagna. Economist, Federal Reserve Bank of New York, New York, N.Y. Author of *Italy's Interests and Policies in the Far East*; *Banking and Finance in China*; etc.
- F. M. T. B.**—F. M. T. Böhl, D.D. Rector of the University of Groningen, 1924-25.
- F. Mu.**—Frank Murphy. Associate Justice, U.S. Supreme Court, 1940-.
- F. N.**—Frank Nasmith. Of the Universal Winding Company, Manchester, England.
- F. Na.**—Fridtjof Nansen. Arctic explorer. Former Professor of Oceanography, Oslo University. Minister for Norway at the Court of St. James's, 1906-08. Nobel Peace Prize, 1921-22. Author of *Armenia and the Near-East*.
- F. N. F.**—Frank Nugent Freeman. Professor of Educational Psychology and Dean, School of Education, University of California, Berkeley, Calif. Author of *Visual Education*; etc.
- F. N. M.**—Frederic Natusch Maude. Colonel. Author of *Cavalry, Its Past and Future*; *Evolution of Strategy* (translated into German); *War and the World's Life*; *Campaign of Leipzig*; etc.
- F. No.**—Francis Benedict Vincent Norris. Barrister-at-Law, Lincoln's Inn, London.
- F. N. P.**—Fredus Nelson Peters, Jr. Director of Research, Quaker Oats Company, Chicago, Ill.
- F. O. B.**—Frederick Orpen Bower. Former Professor of Botany, University of Glasgow, Scot. Author of *The Origin of a Land Flora*; *Sixty Years of Botany in Britain*; etc.
- F. O. K.**—Frances Oldham Kelsey, M.D. Co-author of *Essentials of Pharmacology*.
- F. P.**—Frank Podmore. Author of *Studies in Psychological Research*; *Modern Spiritualism*; etc.
- F. P. C.**—Frank P. Cullinan. Assistant Chief of the Bureau of Plant Industry, Soils, and Agricultural Engineering, Washington, D.C.
- F. P. D.**—Francis P. Duffy. Professor of Logic and Metaphysics, St. Joseph's Seminary, New York, N.Y.
- F. P. Do.**—F. P. Dorizzi. Director of George Rowney and Company, Ltd., and Works Manager of Malden Pencil Works, London.
- F. Pe.**—Frances Perkins. U.S. Secretary of Labor, Washington, D.C., 1933-45. Author of *A Social Experiment under the Workmen's Compensation Jurisdiction*; *The Federal Government Today*; etc.
- F. P. F.**—Francis Peloubet Farquhar. Author of *Place Names in the High Sierra*.
- F. Pn.**—Florence Peterson. Professor of Economics, Rollins College, Winter Park, Fla. Author of *Survey of Labor Economics*.
- F. Po.**—Rt. Hon. Sir Frederick Pollock. Former Judge of Admiralty Court of Cinque Ports; Editor of *Law Reports*, 1895-1935; Corpus Professor of Jurisprudence, Oxford University, 1883-1903. Author of *Principles of Contract*; etc.
- F. P. R.**—Frank Plumpton Ramsey. University Lecturer in Mathematics and Fellow of King's College, Cambridge.
- F. P. S.**—Frederick Peter Siebel, Jr. President, J. E. Siebel Sons' Company, Inc., Chicago, Ill. Former President, the American Society of Brewing Chemists.
- F. P. T.**—Frederick Porter Todd. Associate Archivist, War Department Division, National Archives.
- F. P. Z.**—Frederick Paul Zscheile. Associate Professor in Agronomy, College of Agriculture, University of California, Davis, Calif.
- F. R.**—Francis Rawle. Editor of *Revisions of Bouvier's Law Dictionary* 1883, 1898, 1913; etc.
- F. Ra.**—Frank Rabak. Consultant and Biochemist, S. S. Steiner, Inc., New York, N.Y. Associate biochemist, U.S. Department of Agriculture, 1927-46.
- Fr. Br.**—Fritz Brügel. Director of the Research Institute of Social Problems, Vienna.
- F. R. C.**—Frank Richardson Cana. Author of *South Africa from the Great Trek to the Union*; etc.
- F. R. H.**—Frederic Robert Harris. Consulting Engineer, New York, N.Y.
- F. R. H. J.**—F. R. Hurlestons-Jones. Former Joint Secretary of the Incorporated Association of Head Masters. Head Master of Holloway School.
- F. R. L.**—Frank R. Lillie. Former Andrew MacLeish Distinguished Service Professor of Embryology, The University of Chicago. Author, *The Development of the Chick*; etc.
- F. R. M.**—Francis Richard Maunsell. Lieutenant Colonel. Military Attaché, British Embassy, Constantinople, 1901-05. Author of *Kurdistan*; etc.
- F. R. T.**—Frederick Robert Tennant, D.D. Lecturer in Theology, 1913-31, and Fellow of Trinity College, Cambridge. Author of *Philosophical Theology*; etc.
- F. R. W.**—Floyd Rowe Watson. Emeritus Professor of Physics, University of Illinois, Urbana, Ill. Editor of *The Acoustical Journal*, 1929-39.
- F. S.**—Francis Storr. Former Editor of *The Journal of Education*, London.
- F. S. B.**—Frederick S. Boas. Inspector of English Language and Literature to the London County Council, 1905-27. Author of *Shakespeare and His Predecessors*; *University Drama in the Tudor Age*; etc.
- F. Sc.**—F. Scholefield. Lecturer in Bleaching, Dyeing, Printing and Finishing in the Manchester Municipal College of Technology, Manchester, England.

- F. S. E.**—Frederick Seward Erdman. Associate Professor of Mechanical Engineering, Cornell University, Ithaca, N.Y.
- F. S. G. P.**—Francis Stewart Gilderoy Piggott. Major General, formerly with British Army. Author of *Broken Thread; The Elements of Sosho*.
- F. Sh.**—Frederick William Sherwood. Barrister-at-Law, former Recorder of Worcester.
- F. Si.**—F. Simon. Counsellor of the Foreign Office, Berlin. Former Private Secretary to Herr Rathenau.
- F. S. M.**—Rev. Fred Shipley Marsh. Lady Margaret's Professor of Divinity, Cambridge University.
- F. S. N.**—Frederick Samuel Northedge. Lecturer in International Relations, London School of Economics and Political Science, University of London.
- F. S. P.**—Francis Samuel Philbrick. Professor of Law, University of Pennsylvania, Philadelphia, Pa., 1929-47. Translator of Hübner's *History of Germanic Private Law*.
- F. Sz.**—Frederick Seitz. Professor of Physics, Department Head, Carnegie Institute of Technology, Pittsburgh, Pa. Author of *Modern Theory of Solids; The Physics of Metals*.
- F. T.**—Frank Twyman. Honorary Associate, Manchester Municipal College of Technology, Manchester, Eng. Author of *Prism and Lens Making*; etc.
- F. T. B.**—F. T. Browett. Technical Editor of *The Shoe and Leather Record*, London.
- F. T. G.**—Francis Temple Grey. Former Assistant Honorary Secretary of the International Law Association.
- F. T. G. H.**—Sir F. T. G. Hobday. Former Honorary Veterinary Surgeon to the King; Principal and Dean, Royal Veterinary College. Author of *Canine and Feline Surgery*; etc.
- F. T. H.**—F. T. Harvey. Examiner in Veterinary Medicine to the Royal College of Veterinary Surgeons.
- F. T. J.**—Frederic Theodore Jung, M.D. Assistant Secretary, Council on Physical Medicine, American Medical Association.
- F. T. M.**—Sir Frank T. Marzials. Editor of "Great Writers" Series.
- F. T. W.**—Frederick T. Weber. Portrait painter, sculptor and etcher.
- F. v. H.**—Baron F. von Hügel. Author of *The Mystical Element of Religion*; etc.
- F. V. S.**—Frazer V. Sinclair. President, Drug and Cosmetic Industry, New York, N.Y.
- F. V. W.**—Sir Francis Verner Wylie. Indian civil servant (retired).
- F. Wa.**—Sir Frank Warner. Chairman of Silk Advisory Committee, Imperial Institute, 1917-27. President of the Textile Institute, 1918-20. Chairman of British Silk Research Association, 1920-27. Author of *The Silk Industry of the United Kingdom*.
- F. W. A.**—Francis William Aston. Nobel Prize for Chemistry, 1922. Author of *Isotopes*; etc.
- F. W. D.**—Frederic William Drew. Author and journalist. Studied for thirty-five years viniculture and the cultivation and marketing of tropical and subtropical produce.
- F. W. F.**—Frank Whitson Fetter. Professor of Economics, Northwestern University, Evanston, Ill.
- F. Wg.**—Fredrik Wulfsberg. Cultural Attaché, Norwegian Embassy, London.
- F. W. G.**—Sir Frank W. Goldstone. General Secretary of the National Union of Teachers, 1924-31.
- F. W. H.**—Frederick Webb Hodge. Director, Southwest Museum, Los Angeles, Calif. Ethnologist with Museum of American Indian, Heye Foundation, New York, N.Y., 1918-31.
- F. W. Ha.**—Frank W. Halliday. Major, Judge Advocate General's Department, U.S. Army, Washington, D.C. (retired).
- F. W. J.**—Frank William Johnson. Writer and lecturer on botanical subjects.
- F. W. Js.**—Frederic Wood Jones. Honorary Curator, the Royal College of Surgeons, London. Author of *Hallmarks of Mankind; The Mammals of South Australia; Man's Place Among the Mammals*; etc.
- F. W. M.**—Frederic William Maitland. Former Downing Professor, Cambridge University. Author of *History of English Law* (with Sir F. Pollock); *English Law and the Renaissance*; etc.
- F. W. McB.**—F. Webster McBryde. Geographer-Consultant, Bureau of the Census, U.S. Department of Commerce, and Institute of Inter-American Affairs. Lecturer-Professor, Department of Geography, University of Maryland, College Park; Prince George's County and Baltimore, Md. Author of *Cultural and Historical Geography of Southwest Guatemala; Solola: A Guatemalan Town and Cakchiquel Market-Center*.
- F. W. Mo.**—Sir Frederick Walker Mott, M.D. Former Consulting Physician to Charing Cross Hospital, London. Former Pathologist to London County Asylums and Lecturer on Morbid Psychology, Birmingham University. Author of *War Neuroses and Shell Shock*; etc.
- F. W. O.**—Francis Wall Oliver. Quain Professor of Botany, University College, University of London, 1888-1929. Former Editor of *Annals of Botany*.
- F. W. P.**—Frank W. Peek, Jr. Former Engineer in Charge, General Transformer Engineering Department and High Voltage Engineering Laboratory, General Electric Company, Pittsfield, Mass. Author of *Electric Phenomena in High Voltage Engineering*.
- F. Wr.**—Friedrich Weber. University Professor, Law Faculty, Heidelberg University, Heidelberg, Ger. Author of *Beiträge zum gräko-ägyptischen Obligationenrecht; Sachaufklärung und Offenbarungseid in der Zwangsvollstreckung*.
- F. W. R.**—Frederick William Rudler. Curator and Librarian of the Museum of Practical Geology, London, 1879-1902.
- F. W. R. B.**—F. W. Rogers Brambell. Professor of Zoology, University of Wales, University College of North Wales, Bangor, Wales. Author of *The Development of Sex in Vertebrates*; etc.
- F. W. Sh.**—Francis Wayland Shepardson. Former Editor of *Baird's Manual of American College Fraternities*.
- F. Wt.**—Francis Watt. Author of *Law's Lumber Room*.
- F. W. T.**—Frank William Taussig. Professor of Economics, Harvard University, 1901-35. Author of *Principles of Economics; Tariff History of the United States*; etc.
- F. W. Ta.**—Fred Wilbur Tanner. Professor of Bacteriology, also Head of the Department of Bacteriology, University of Illinois, Urbana, Ill. Author of *Bacteriology and Mycology of Foods*; etc. Co-author of *The Yeasts*.
- F. W. Th.**—Frederick William Thomas. Former Librarian to the India Office, London; Lecturer in Comparative Philology and Reader in Tibetan, University College, University of London. Honorary Secretary, 1920-27, and Director, 1921-22, of Royal Asiatic Society. Boden Professor of Sanskrit, Oxford University, 1927-37. Former Editor of *Epigraphia India*.
- F. W. W.**—Frederic W. Whyte. Author of *Actors of the Century*; etc. Translator of Filon's *English Stage*; etc.
- F. W. We.**—Frederick W. Weber. Treasurer and Director of F. Weber Company, Inc., Philadelphia, Pa.
- F. W. W. G.**—F. W. W. Gwynne. Major. A Director of Lena Goldfields Limited, London.
- F. X. T.**—Rev. Francis Xavier Talbot, S.J. Former Editor in Chief of *America*, national Catholic weekly, New York, N.Y. Author of *Jesuit Education in Philadelphia*; etc.
- F. Y.**—Sir Frederic William Young. Former Chief Surveyor, Liverpool Salvage Association. Commodore, R.N.R., and Head of Admiralty Salvage Section, 1914-18.
- G.**—Ronald Gorell Barnes, 3rd Baron Gorell. Honorary Fellow, Royal Society of Teachers. Chairman, Teachers Registration Council, 1922-35.
- G. Ab.**—Grace Abbott. Former Professor, School of Social Service, The University of Chicago. Former Chief of U.S. Children's Bureau, Washington, D.C. Author of *The Immigrant and the Community*.
- G. A. Bl.**—Gilbert Ames Bliss. Former Professor and Chairman of the Department of Mathematics, The University of Chicago.
- G. A. Bo.**—Giuseppe Antonio Borgese. Former Professor of Italian Literature, The University of Chicago. Author of *History of Romantic Criticism*; etc.
- G. A. Bt.**—George Allen Bennett, M.D. Associate Professor of Anatomy, Jefferson Medical College, Philadelphia, Pa.
- G. A. Bu.**—G. A. Burls. Author and Co-editor with Sir Dugald Clerk of works on internal combustion engines.
- G. A. C.**—Rev. George Albert Cooke, D.D. Regius Professor of Hebrew, Oxford University, and Canon of Christ Church, 1914-36. Oriel Professor of the Interpretation of Holy Scripture at Oxford University, 1908-14.
- G. A. Cr.**—G. Arthur Cooper. Curator of Invertebrate Palaeontology and Palaeobotany, United States National Museum, Washington, D.C. Co-author of *Brachiopod Genera of the Suborders Orthoidea and Pentamerioidea*; etc.
- G. Ad.**—Gilbert Adrian. Dress designer. Costume designer for the Metro-Goldwyn-Mayer Studios.
- G. A. E.**—George Anderson Eastwood. President and Chairman of the Board, Armour and Company, Chicago.
- G. A. H. S.**—George A. H. Scott. General Counsel, Illinois Humane Society. Director, American Humane Association.

G. A. K.—George Arthur Kelly. Executive Vice-President of the Pullman Company, Chicago.

G. A. Mn.—George Ashmun Morton. Research Physicist, RCA Laboratories, Princeton, N.J. Co-author of *Television*; etc.

G. An.—Gleb von Anrep. Professor of Physiology in the University of Cairo, Egypt.

G. A. P.—George A. Pfeiffer. Former Professor of Mathematics, Columbia University.

G. A. R. C.—Sir Geoffrey Arthur Romaine Callender. Former Director, National Maritime Museum, London. Honorary Secretary and Treasurer to the Society for Nautical Research. Former Professor of History and English at the Royal Naval College, Greenwich, England. Author of *The Life of Nelson*; *The Naval Side of British History*; etc.

G. A. Rl.—George Armytage Rounsefell. Aquatic Biologist, Fish and Wildlife Service, U.S. Dept. of the Interior.

G. A. Ro.—Gar A. Roush. Metals Engineer, U.S. Treasury Department, Bureau of Federal Supply, Strategic and Critical Material Division, 1946—. Editor, *Mineral Industry*, New York, 1913-43. Mineral Technologist, U.S. Bureau of Mines, 1943-46. Author of *Strategic Mineral Supplies*.

G. At.—Gertrude Franklin Atherton. Author of *Rezánov*; *Ancestors*; etc.

G. A. T.—George Alfred Thiel. Professor and Chairman of the Department of Geology and Mineralogy, University of Minnesota, Minneapolis, Minn. Author of *The Geology and Water Resources of Southern Minnesota*; *Geology, Principles and Processes*; *Limestones and Marls of Minnesota*.

G. B.—Gamaliel Bradford. Author of *Damaged Souls*; *Darwin*; *Lee, the American*; etc.

G. B. A.—George Burton Adams. Former Professor of History, Yale University. Author of *Civilization during the Middle Ages*; etc.

G. B. Br.—George B. Bridgman. Former Instructor, Art Students League, New York, N.Y. Author of *Life Drawings*; *The Hand*.

G. B. C.—George Barr Carson, Jr. Assistant Professor of Modern History, The University of Chicago. Editor, *Journal of Modern History*. Author of *Men and Centuries of European Civilization*; etc.

G. B. D.—George Bion Denton. Emeritus Professor of Dental History and Literature, Northwestern University, Evanston, Ill. Special research worker, American Dental Association.

G. Be.—Gertrude Bell. Former Oriental Secretary to the British High Commissioner of Iraq. Author of *Review of the Civil Administration of Mesopotamia*.

G. B. E.—George Blow Elliott. Former President, Atlantic Coast Line Railroad Company and Atlantic Land and Improvement Company, New York, N.Y.

G. B. En.—George B. Eusterman, M.D. Emeritus Head, Section in Medicine, Mayo Clinic, Rochester, Minn. Emeritus Professor of Medicine, University of Minnesota, Mayo Foundation, Rochester, Minn. Co-author of *Stomach and Duodenum*.

G. Bf.—Garrett Birkhoff. Associate Professor of Mathematics, Harvard University. Author of *Lattice Theory*; etc.

G. B. G.—George Beardoe Grundy. Fellow and Tutor of Corpus Christi College, Oxford, 1903-31. Former University Lecturer in Classical Geography and Lecturer at Brasenose College, Oxford. Author of *The Great Persian War*; etc.

G. B. Gr.—George Buchanan Gray, D.D. Former Professor of Hebrew and Old Testament Exegesis, Mansfield College, Oxford, and Examiner in Hebrew, University of Wales. Author of *The Divine Discipline of Israel*; etc.

G. B. Gy.—George Barnes Galloway. Staff Director, Joint Committee on the Organization of Congress, United States Congress, 1945-46. Author of *Planning for America*; etc.

G. Bh.—Geoffrey Barraclough. Author of *The Origins of Modern Germany*; *Papal Provisions: Aspects of Church History, Constitutional, Legal and Administrative, in the Later Middle Ages*.

G. B. He.—George Baugh Heckel. Former Secretary, National Paint, Varnish and Lacquer Association, Inc. Former owner, Editor, and Publisher of *The Paint Industry Magazine*.

G. B. K.—George B. Kistiakowsky. Abbott and James Lawrence Professor of Chemistry, Harvard University, Cambridge, Mass. Author of *Photochemical Processes*.

G. B. M.—George Bragg Massey. Consulting engineer, Chicago. Author of *The Engineering of Excavation*; etc.

G. Bn.—Gladys Bryson. Former Professor of Sociology and Chairman of the Division of Social Sciences, Smith College, Northampton, Mass. Author of *Man and Society: The Scottish Inquiry of the 18th Century*.

G. Br.—Geoffrey Brooke. Major General (retired). Author of *Horse Sense and Horsemanship of Today*; etc.

G. Bs.—Georges Boussières. Director of Research, Radium Institute, Paris, France.

G. B. S.—George Bernard Shaw. Former novelist, dramatist and writer on social questions. Nobel Prize for Literature, 1925. Author of *The Intelligent Woman's Guide to Socialism and Capitalism*; etc.

G. B. T.—Girard B. Troland. Lieutenant Colonel, Corps of Engineers, U.S. Army, War Department, Washington, D.C.

G. Bu.—Sir Gerald Burrard. Major, Royal Field Artillery (retired). Editor of *Game and Gun*, 1924-25. Gun expert to *The Field*, 1919-33. Author of *Big Game Hunting in the Himalayas and Tibet*; etc.

G. Buc.—Sir George Seaton Buchanan, M.D. Former Senior Medical Officer, Ministry of Health.

G. B. W.—George Bailey Wilson. Consulting Secretary, United Kingdom Alliance, London, 1932-43.

G. B. Wa.—George Benson Watkins. Director of Research, Libbey-Owens-Ford Glass Co., Toledo, O.

G. C.—George Copping. Managing Editor, *The Pottery Gazette and Glass Trade Review* and the *Oil and Colour Trades Journal*, London.

G. Ca.—George Carroll. Publicity Director, Lake Placid Club, New York.

G. C. A.—George C. Allen. Professor of Political Economy, University College, University of London.

G. C. de H.—George Charles de Hevesy. Associate of the Institute of Theoretical Physics, University of Copenhagen, Copenhagen, Den. Associate of the Institute of Research in Organic Chemistry, University of Stockholm, Stockholm, Swed. Author of *Chemical Analysis by X-Rays and Its Application*; *Manual of Radioactivity*.

G. C. Di.—George Campbell Dixon. Critic and playwright. Literary Editor, *The Daily Mail*, London, 1925-31. Author of *From Melbourne to Moscow*; etc.

G. Ce.—Lady Gwendolen Cecil. Co-author of *Life of Robert, Marquis of Salisbury*.

G. C. E.—George C. Engerrand. Graduate Professor of Anthropology, University of Texas. Chief Geologist, Instituto Geológico Nacional, Mexico, 1907-15. Author of *Six Leçons de Préhistoire*.

G. C. F.—George Christian Frank. Assistant to the President, Erie Railroad, Cleveland, O.

G. C. Fd.—Guy Cromwell Field. Emeritus Professor of Philosophy, University of Bristol, Bristol, Eng. Author of *Moral Theory*; *Pacifism and Conscientious Objection*; *The Philosophy of Plato*; *Plato and His Contemporaries*.

G. Ch.—Georg Christensen. Author and literary critic. Principal of the State Training College, Haderslev, Denmark.

G. C. Ha.—George Christie Harris. Research Chemist, Hercules Powder Company Experiment Station, Wilmington, Del.

G. Cl.—George Chrystal. Former Professor of Mathematics and Dean of the Faculty of Arts, Edinburgh University.

G. C. M.—George Campbell Macaulay. Former Lecturer in English, Cambridge University. Former Professor of English Language and Literature, University of Wales. Edited the *Works of John Gower*.

G. C. Mi.—George Charles Miller. Printer and instructor for many etchers and lithographers in America, including George Bellows, Rockwell Kent, Thomas H. Benton, Grant Wood and others.

G. C. Ml.—George Catlett Marshall. General of the Army, U.S. Army. President, American Red Cross. U.S. Secretary of State, 1947-49. Chief of Staff, U.S. Army, 1939-45.

G. C. Ms.—Geoffrey Christopher Morris. Fellow and Director of Studies in History, King's College, Cambridge. University Lecturer in History, Cambridge University.

G. Co.—Georges Contenau, M.D. Director-General of Archaeological Missions in Iran.

G. C. R.—Guy Colwin Robson. Assistant Keeper in the Department of Zoology, British Museum (Natural History), London, 1931-36.

G. C. Rh.—George C. Rhodes. Director and General Passage Manager, Compagnie Générale Transatlantique.

G. Cri.—George W. Crile, M.D. Chairman, Board of Regents, American College of Surgeons, 1917-39.

G. Ct.—George Calingaert. Director of Chemical Research, Ethyl Corporation, Detroit, Mich., 1932-.

G. C.-T.—Gertrude Caton-Thompson. President, Prehistoric Society, England, 1937-46. Director of Excavations in the Fayum for the Royal Anthropological Institute, 1927-28.

- G. C. W.**—George C. Williamson. Author of *Portrait Miniatures*; etc.
- G. D.**—Guillaume Dufrou. Former Professor of History of Flemish Grammar, German Philology and Comparative Grammar, University of Brussels, Belgium.
- G. D. Bi.**—George David Birkhoff. Former Perkins Professor of Mathematics, Harvard University. Author of *Relativity and Modern Physics*; etc.
- G. D. Br.**—George Doswell Brooke. President, Chesapeake and Ohio Railway Company and New York, Chicago and St. Louis Railroad.
- G. D. D.**—G. D. Dunkerley. Former Secretary, Incorporated Association of Assistant Masters in Secondary Schools, England. Co-author, *The Assistant Master*. Co-editor, the *Journal of Education*.
- G. de S.**—Gaetano de Sanctis. Professor of Greek History, University of Rome, 1929-31 and 1945-. Professor of Ancient History, University of Turin, 1900-29.
- G. D. H.**—George Dawes Hicks. Former Professor of Philosophy, University College, University of London.
- G. D. H. C.**—George Douglas Howard Cole. Chichele Professor of Social and Political Theory, Oxford University. Author of *The World of Labour*; *Building and Planning*; etc.
- G. Dk.**—George Dock, Jr. Author of *Why Birds Leave Home and Vast Mystery of the Flyways*.
- G. Do.**—George Dow. Information Agent, the London and North Eastern Railway Company.
- G. D. O.**—George D. Olds. Former President, Amherst College, Amherst, Mass.
- G. E.**—Rev. George Edmundson. Former Fellow and Tutor of Brasenose College, Oxford. Author of *History of Holland* ("Cambridge History" series).
- G. E. B.**—George Earle Buckle. Editor of *The Times*, London, 1884-1912. Editor of *Letters of Queen Victoria*. Author of *The Life of Disraeli*.
- G. E. C.**—George Earl Church. Explorer of the Amazon, 1868-79.
- G. Ed.**—Rev. Gerald Ellard, S.J. Professor of Liturgical Theology, St. Mary's College House of Theological Studies for Members of the Society of Jesus, St. Marys, Kan. Author of *Christian Life and Worship*; *Men at Work at Worship*; etc.
- G. E. F.**—George Emory Fellows. Former Head of Department of History and Political Science, University of Utah, Salt Lake City, Utah. Former President of the University of Maine, Orono, Me.
- G. E. H.**—George Ellery Hale. Former Honorary Director, Mount Wilson Observatory. Inventor of the spectroheliograph.
- G. E. Hn.**—George Evelyn Hutchinson. Professor of Zoology, Scientific Consultant in the Bingham Oceanographic Laboratory and Fellow of Saybrook College, Yale University. Author of *The Clear Mirror*.
- G. E. Hy.**—Godfrey Eric Harvey. Indian Civil Service (Burma), 1912-35. Lecturer in Burmese, Oxford University, 1935-47. Author of *Outline of Burmese History*; *History of Burma*; *British Rule in Burma 1824-1942*.
- G. E. K.**—George Eden Kirk. Middle East Specialist, Royal Institute of International Affairs, Chatham House, London. Author of *A Short History of the Middle East*; *Survey of International Affairs*, 1939-45.
- G. El.**—Sir (Robert) Geoffrey Ellis. Co-editor of *English Reports*. Author of *Peerage Law and History*.
- G. E. Lr.**—George E. Lardner. Associate Editor of the Bell Syndicate, Inc., New York, N.Y.
- G. E. P.**—Grace Evelyn Pickford. Research Assistant, Bingham Oceanographic Laboratory, Yale University.
- G. Es.**—Gardner Emmons. Consulting meteorologist.
- G. E. S.**—G. E. Smith. Chess Editor of *The Field*.
- G. E. Sh.**—George E. Shambaugh, Jr., M.D. Professor of Otolaryngology, Northwestern University Medical School, Chicago, Ill.
- G. E. V.**—George E. Vincent. Former Honorary and Acting President, Community Chests and Councils, Inc., New York, N.Y.
- G. E. W.**—George Earle Wakerlin. Head of the Department of Physiology, College of Medicine, University of Illinois, Chicago, Ill. Author of *Laboratory Manual of Human Physiology*.
- G. E. W. C.**—G. E. W. Crowe. Household labour saving expert.
- G. F. B.**—George Frederick Barwick. Keeper of Printed Books, British Museum, London, 1914-19. Assistant Keeper and Superintendent, Reading Room, British Museum, 1900-14.
- G. F. H.**—Sir George Francis Hill. Director, British Museum, London, 1931-36. Keeper, Department of Coins and Medals, British Museum, 1912-30. Author of *Sources of Greek History*, 478-431 B.C.; *Handbook of Greek and Roman Coins*; etc.
- G. F. K.**—George Frederick Kunz. Former Honorary Curator of Precious Stones, American Museum of Natural History, New York, N.Y. Vice-President and Gem Expert, Tiffany and Company, New York, N.Y., 1879-1932. Author of *Gems and Precious Stones of North America*; etc.
- G. F. M. C.**—Sir Gilbert Francis Montriou Campion. Formerly Clerk of the House of Commons. Author of *An Introduction to the Procedure of the House of Commons*.
- G. F. S.**—Sir George Frederic Still, M.D. Physician Extraordinary to the King, 1937-41. Former Consulting Physician for Diseases of Children, King's College Hospital. Author of *Common Disorders and Diseases of Childhood*; *History of Pediatrics*; etc.
- G. F. Sh.**—Sir George F. Shee. Former Secretary of the Royal National Life Boat Institution.
- G. F. Ss.**—George Finlay Simmons. Assistant Professor of Anatomy, Loyola University School of Medicine, Chicago, Ill. Author of *Birds of the Austin Region*.
- G. F. Sw.**—Gustavus Franklin Swift. Vice-Chairman of the Board, Swift and Company, Chicago, 1881-1943.
- G. F. Z.**—George Frederick Zimmer. Former Consulting Engineer and Co-editor of *Engineering and Industrial Management*. Author of *The Mechanical Handling and Storing of Material*.
- G. G.**—George Glasgow. Author of *The Minoans*; *Ronald Burrows: A Memoir*; *From Dawes to Locarno*; *MacDonald as a Diplomatist*; etc.
- G. Ga.**—George Galloway, D.D. Former Principal and Primarius Professor of Theology, St. Mary's College, St. Andrews University, St. Andrews, Scotland. Former Dean of the Faculty of Divinity. Author of *Religion and Modern Thought*; etc.
- G. G. A.**—Sir George (Grey) Aston. Major General. Former Lecturer on Naval History, University College, University of London. Professor of Fortification at the Royal Naval College, Greenwich, 1896-99. Author of *The Navy of To-day*; etc. Editor, seventh edition, Hamley's *Operations of War*, and of *The Study of War*.
- G. G. A. M.**—George Gilbert Aimé Murray. Regius Professor of Greek, Oxford University, 1908-36. Charles Eliot Norton Professor of Poetry, Harvard University, 1926. Author of *Rise of the Greek Epic*; etc.
- G. G. B.**—George Gordon Battle. Attorney-at-Law, member of the firm of Battle, Levy, Fowler and Neaman, New York, N.Y.
- G. G. C.**—George Gordon Coulton. Ford's Lecturer in English History, Oxford University, 1930-31. Author of *Social Life in Britain from the Conquest to the Reformation*; *The Medieval Village*; etc.
- G. G. Ch.**—George Goudie Chisholm. Secretary, Royal Scottish Geographical Society, 1910-25. Lecturer in Geography, Edinburgh University, Edinburgh, Scotland, 1908-21; Reader, 1921-23. Author of *Handbook of Commercial Geography*; etc.
- G. G. H.**—George Gerald Henderson. Regius Professor of Chemistry, University of Glasgow, Scotland, 1919-37. Author of *Catalysis in Industrial Chemistry*.
- G. G. K.**—G. G. Kloeke. Professor of the Dutch Language, State University of Leyden, Netherlands. Former Lecturer on Dutch Language and Literature, University of Hamburg, Germany.
- G. G. N.**—G. G. Nearing. Horticulturist. Author of *The Lichen Book*.
- G. Go.**—Gerald Gould. Associate Editor of *The Daily Herald*, 1919-22.
- G. G. P.**—George Grenville Phillimore. Barrister-at-Law, Middle Temple.
- G. Gr.**—Gilbert Hovey Grosvenor. President, National Geographic Society, Washington, D.C., 1920-. Author of *History of National Geographic Society*.
- G. G. S.**—George Gregory Smith. Professor of English Literature at Queen's University, Belfast, 1909-30. Author of *Scottish Literature: Character and Influence*; etc.
- G. G. Si.**—George Gaylord Simpson. Chairman, Department of Geology and Palaeontology and Curator of Fossil Mammals and Birds, American Museum of Natural History, New York, N.Y. Author of *A Catalogue of the Mesozoic Mammalia in the Geological Department of the British Museum*; etc.
- G. G. T.**—G. G. Templer. Lieutenant. Instructor in Carriages, Military College of Science, Royal Arsenal, Woolwich, England.

G. G. W.—George Grafton Wilson. Former Professor of International Law, Harvard University. Special Counsel, U.S. Maritime Commission, 1941–51. Former Professor of International Law, Fletcher School of Law and Diplomacy, Tufts College, Medford, Mass. Former Editor in Chief, *American Journal of International Law*. Author of *International Law Situations* (U.S. Naval War College); etc.

G. H. A.—George Henry Addison. Major General (retired). Colonel Commandant, Royal Engineers, 1940–46.

G. H. B.—Rev. George Herbert Box, Hon.D.D. Former Rector of Sutton, Beds., England. Honorary Canon of St. Albans. Davidson Professor of Old Testament History, University of London, 1926–30.

G. H. Ca.—Gilbert Haval Cady. Senior Geologist and Head of Coal Division, Illinois State Geological Survey Division.

G. H. G.—George H. Guttridge. Professor of English History at University of California, Berkeley, Calif. Author of *Life of David Hartley*, *the American Patriot*; etc.

G. H. H.—Green H. Hackworth. Judge on the International Court of Justice, The Hague, Neth. Author of *Digest of International Law*.

G. H. J. D.—George Henry John Daysh. Professor of Geography, King's College, University of Durham, Durham, Eng. Editor of *Studies in Regional Planning*.

G. Hl.—Gottfried Haberler. Professor of Economics, Harvard University, 1936–. Author of *The Theory of International Trade*; etc.

G. Hn.—Göran Hedin. Managing Director of the Swedish Tourist Traffic Association, Stockholm, Swed. Editor of *Ekonomisk Revy*. Author of *Economic Life in Sweden*.

G. H. N. S.W.—(George) Hugh Nicholas Seton-Watson. Professor of Russian History, University of London. Author of *Eastern Europe Between the Wars, 1918–1941*; *The East European Revolution*; etc.

G. H. P.—George Howard Parker. Emeritus Professor of Zoology and Director of Zoological Laboratory, Harvard University. Author of *Biology and Social Problems*; etc.

G. H. R.—George H. Ryden. Former Professor of History and Political Science, University of Delaware, Newark, Del. Author of *Foreign Policy of the United States in Relation to Samoa*.

G. Hs.—Granville Hicks. Author of *The Great Tradition*; *John Reed*. Co-editor of *The Letters of Lincoln Steffens*.

G. H. W.—George H. Warburton. Editor of the sixth edition of *Oils, Fats and Waxes*, by J. I. Lewkowitsch, and Chief Chemist of the Lewkowitsch Laboratories.

G. Hy.—George Humphrey. Professor of Psychology and Director of the Institute of Experimental Psychology, Oxford University. Author of *Nature of Learning*; *Thinking: An Introduction to Its Experimental Psychology*.

G. I. B.—George I. Blanksten. Assistant Professor of Political Science, Northwestern University, Evanston, Ill. Author of *Ecuador: Constitutions and Caudillos*.

G. J.—Geoffrey Jefferson. Professor of Neuro-Surgery, University of Manchester, England. Honorary Surgeon, Salford Royal Hospital.

G. Ja.—George Jack. Architect and wood carver.

G. J. B. F.—George J. B. Fisher. Lieutenant Colonel, Chemical Warfare Service, U.S. Army. Secretary, Chemical Warfare School.

G. J. L.—Grace J. Landon. Formerly with the Statistical Department, National Lumber Manufacturers Association.

G. J. M. J.—George James Morley Jacob. General Secretary, London Police Court Mission. Member, Panel of Chairmen of the Metropolitan Juvenile Courts, London.

G. J. N.—George Jean Nathan. Founder and former Editor (with H. L. Mencken), now drama critic, of *The American Mercury* and the King Features Syndicate. Author of *The Popular Theatre*; *The Critic and the Drama*; *Encyclopaedia of the Theatre*; *Since Ibsen*; *Land of the Pilgrims' Pride*; etc.

G. J. T.—George James Turner. Former Editor of *Select Pleas of the Forests* for the Selden Society.

G. J. W.—G. J. Weston. Journalist and author of articles on the drapery and allied trades.

G. K. A. B.—Rt. Rev. George Kennedy Allen Bell, D.D. Bishop of Chichester, England. Dean of Canterbury, 1924–29. Author of *The Meaning of the Creed*; *Documents Bearing on the Problem of Christian Unity and Fellowship*; *The Modern Parson*; etc.

G. K. C.—Gilbert Keith Chesterton. Author and journalist. Author of *Dickens*; etc.

G. K. N.—G. Kingsley Noble. Curator of Herpetology, American Museum of Natural History, New York, N.Y., 1919–40. Author of *The Biology of the Amphibia*.

G. L.—Gonzalez Lodge. Former Professor, Latin and Greek, Teachers College, Columbia University. Author of *Lexicon Plautinum*; *Vocabulary of High School Latin*.

G. L. A.—Guy L. Arnold. Airman's Standards Specialist (Flight Navigator), Airman Division, Civil Aeronautics Administration, Washington, D.C.

G. L. Bh.—George L. Bach. Professor of Economics and Dean of the Graduate School of Industrial Administration, Carnegie Institute of Technology, Pittsburgh, Pa. Author of *Economic Analysis and Public Policy*; *Federal Reserve Policy-Making*.

G. L. C.—Giles L. Courtney. Assistant Chief Examiner, Farm Credit Administration, Washington, D.C.

G. L. Ck.—George Lindenberg Clark. Professor of Chemistry, University of Illinois, Urbana, Ill. Author of *Applied X-Rays*.

G. L. E.—G. L. Elles. Lecturer in Geology, Newnham College, Cambridge.

G. Le G. N.—G. Le G. Norgate. Contributor to *The Dictionary of National Biography*.

G. L. H.—George Leslie Harrison. President of the Federal Reserve Bank of New York, 1936–40.

G. L. K.—Geoffrey Langdon Keynes, M. D. Edited *Writings of William Blake*. Author of *William Blake*; etc.

G. L. L.—Geoffrey Lewis Lewis. University Lecturer in Turkish, Oxford University.

G. L. Ne.—G. L. Noble. Director, National Committee on Boys and Girls Club Work.

G. L. P.—Grace L. Pennock. Associate Editor, *Ladies' Home Journal*.

G. L. St.—George Leslie Stout. Director, Worcester Art Museum, Worcester, Mass. Author of *The Care of Pictures*; etc.

G. L. Sz.—George Leopold Schwartz. Secretary of London and Cambridge Economic Service, London School of Economics and Political Science. Cassel Lecturer in the University of London, London, England, 1924–45.

G. L. W.—George L. Warren. Adviser on Refugees and Displaced Persons, U.S. Department of State, Washington, D.C.

G. M.—Sir George MacDonald. President, Society of Antiquaries of Scotland, 1933–40.

G. Ma.—Sir George Fletcher MacMunn. Lieutenant General. Commander in Chief, Mesopotamia, April 1919 to January 1920. Author of *The Armies of India*.

G. Mar.—G. Martin. Superintendent, Rubber Investigations, Imperial Institute, London.

G. M. A. R.—Gisela Marie Augusta Richter. Curator of the Greek and Roman Department, Metropolitan Museum of Art, New York, N.Y. Author of *Catalogue of Engraved Gems of the Classical Style in the Metropolitan Museum of Art*; etc.

G. Mc.—Gilbert McAllister. Member of Parliament. Co-author of *Town and Country Planning*; joint editor of *Homes, Towns and Countryside*.

G. M. Ca.—Gerald M. Capers. Professor and Chairman of the Department of History, H. Sophie Newcomb Memorial College for Women, Tulane University, New Orleans, La. Author of *Biography of a River Town*.

G. M. Ce.—Gerald M. Clemence. Senior Astronomer, U.S. Naval Observatory, Washington, D.C.

G. McL. Wo.—George McLane Wood. Editor, U.S. Geological Survey, Washington, D.C., 1886–1925. Author of *Texts for U.S. Geological Survey*; etc.

G. M. Cs.—George M. Curtis, M.D. Professor of Surgery, Ohio State University, Columbus, O.

G. M. D.—George McMillan Darrow. Bureau of Plant Industry, Soils, and Agricultural Engineering, U.S. Department of Agriculture; Beltsville, Md., 1911–. Senior Pomologist in charge of Small Fruit Investigations. Editorial board of *Journal of Heredity*.

G. M. Dk.—Gail M. Dack, M.D. Director, Food Research Institute, The University of Chicago. Author of *Food Poisoning*.

G. M. G.-H.—Geoffrey Malcolm Gathorne-Hardy. Author of *The Norse Discoverers of America*; *Norway*; *A Short History of International Affairs, 1920–39*.

G. Mh.—Geoffrey Mott-Smith. Editor of *The Bridge World*, 1936–46. Editor of *Games Digest*, 1938–39. Author of *Mathematical Puzzles*; etc.

G. Mi.—Rev. George Milligan, D.D. Regius Professor of Divinity and Biblical Criticism in the University of Glasgow, Scotland, 1910–34. Author of *The Theology of the Epistle to the Hebrews*; etc.

G. Mi.—Gabriel Marcel. Dramatist and literary critic for *L'Europe nouvelle*. Author of *Studies on Contemporary English and American Philosophers*.

- G. M. McB.**—George McCutchen McBride. Professor of Geography, University of California, Los Angeles. Visiting Professor, Carnegie Endowment for International Peace, South America, 1929–30; Central America, 1938. Author of *Agrarian Indian Communities of Highland Bolivia*; etc.
- G. Mo.**—Gaetano Mosca. Professor of Constitutional Law, University of Rome, 1922–33.
- G. M. S.**—Gilbert Morgan Smith. Professor of Botany, Stanford University, Stanford, Calif.
- G. M. T.**—Galen M. Taylor. Lieutenant Colonel, Ordnance Department, U.S. Army.
- G. M. W.**—George Mackinnon Wrong. Former Professor of History, University of Toronto, Canada.
- G. M. Ws.**—George Michael Wickens. University Lecturer in Arabic, Cambridge.
- G. N. C.**—George Norman Clark. Provost of Oriel College, Oxford, 1947–. Chichele Professor of Economic History and Fellow of All Souls College, Oxford, 1931–43. Regius Professor of Modern History, Cambridge University, 1943–47. Author of *The Dutch Alliance and the War Against French Trade*; etc.
- G. N. H.**—George N. Halm. Professor of Economics, Tufts College, Medford, Mass.; Professor of International Economic Relations, Fletcher School of Law and Diplomacy, Tufts College. Author of *International Monetary Co-operation*; etc.
- G. N. W.**—George Neville Watson. Professor of Mathematics, University of Birmingham, England. Author of *The Theory of Bessel Functions*.
- G. O'B.**—George O'Brien. Professor of Political Economy, University College, Dublin. Author of *The Economic History of Ireland (1800–47)*; etc.
- Go. P.**—Gordon Pall. Professor of Mathematics, Illinois Institute of Technology, Chicago, Ill.
- G. P. Br.**—G. P. Broomhall. Editor of *Corn Trade News*, Manchester, England.
- G. P. DuS.**—Graham Phillips. DuShane. Professor of Biology, Stanford University, Stanford, Calif.
- G. P. E.**—George Pearse Ennis. Former member, American Water Color Society, Guild of American Painters, Society of Painters, etc.
- G. P. J.**—Gwilym Peredur Jones. Professor of Economics, University of Sheffield, Sheffield, Eng. Co-author of *The Medieval Mason*.
- G. P. K.**—George Philip Krapp. Former Professor of English, Columbia University. Author of *Modern English*; etc.
- G. P. M.**—George Percival Mudge. Former Professor and Head of the Department of Zoology, East London College (now Queen Mary College), University of London.
- G. P. P.**—Gilbert Paul Phillips. Assistant Director, Bureau of Agricultural Economics, Canberra, Austr.
- G. P. T.**—George Pirie Thomson. Rear Admiral, Royal Navy. Public Relations Officer, Hispanic Council and Liso-Brazilian Council, London. Chief Press Censor, Ministry of Information, London, 1940–45. Author of *Blue Pencil Admiral*.
- G. R. B.**—George Reginald Balleine. Honorary Librarian, Société Jersaise, Jersey, Channel Islands. Author of *The Bailiwick of Jersey*; *Biographical Dictionary of Jersey*; *History of Jersey*.
- G. R. C.**—George Rowland Collins. Professor of Marketing and Dean, Graduate School of Business Administration, University College of Arts and Pure Science, New York University. Author of *Marketing*; *An Outline of Business*; etc.
- G. R. D.**—Godfrey Rolles Driver. Grinfield Lecturer on the Septuagint, Oxford University, 1935–39. Professor of Semitic Philology, 1938.
- G. R. de B.**—Gavin Rylands de Beer. Professor of Embryology, University College, University of London. Former Head of Department of Anatomy and Embryology. Jenkinson Lecturer in Embryology, 1927–38, and Senior Demonstrator in Zoology, Oxford University, 1926–38. Author of *Vertebrate Zoology*; *Embryos and Ancestors*; etc.
- G. Re.**—Sir George Reid. Scottish artist.
- G. R. F. B.**—G. R. F. Bredin. Fellow and Bursar of Pembroke College, Oxford, 1950–. Governor of Blue Nile Province, Anglo-Egyptian Sudan, 1941–48.
- G. Ro.**—Guido Romanelli. Lieutenant Colonel. Former Commandant of the Artillery Headquarters at Messina. Former Chief of the Italian Military Mission to Hungary for World War I Armistice.
- G. R. P.**—George Richard Potter. Professor of Modern History, University of Sheffield, Sheffield, Eng. Author of *Autobiography of Ousama*; *Short History of Switzerland*; *Sir Thomas Mac*.
- Gr. P. B.**—Gregory Paul Baxter. Former Theodore William Richards Professor of Chemistry, Harvard University.
- G. R. R.**—G. R. Rudolf. Average adjuster. Co-editor of *Loundes' Law of General Average*.
- G. R. S.**—George Robert Stibitz. Consultant in Applied Mathematics, University of Vermont, Burlington, Vt.
- Gru.**—M. Gruson. General Secretary, Compagnie des Chemins de Fer de l'Est, Paris.
- G. S.**—Grant Showerman. Professor of Latin in the University of Wisconsin, Madison, Wis., 1900–35. Author of *The Great Mother of the Gods*.
- G. Sa.**—George Edward Bateman Saintsbury. Essayist and critic. Former Professor of Rhetoric and English Literature at Edinburgh University. Author of *Essays on French Novelists*; etc.
- G. Sar.**—George Sarton. Associate of the Carnegie Institution of Washington, D.C. Lecturer on History of Science, Harvard University. Author of *Introduction to the History of Science*; etc.
- G. S. Bd.**—George Samuel Blanchard. Major, U.S. Army. Assistant to the Chairman, Joint Chiefs of Staff.
- G. Sc.**—Paul Gerhard Schott. Oceanographer, German Naval Observatory, Hamburg. Honorary Professor of Oceanography, University of Hamburg.
- G. S. C.**—George Sydenham Clarke, 1st Baron Sydenham of Combe. Author of *Imperial Defence*; *Russia's Sea Power*; *The Last Great Naval War*.
- G. S. Co.**—G. S. Coleman. Lecturer in Sanitary Engineering and in the Faculties of Bacteriology, and Preventive Medicine and Technology, Victoria University of Manchester, England.
- G. S. Cr.**—George Stuart Carter. Fellow of Corpus Christi College, Cambridge, and Lecturer in Zoology, Cambridge University.
- G. S. D.**—Geoffrey Spence Davison. Former Assistant Editor of *Motor Cycling*.
- G. S. G.**—Rev. George Stanislaus Glanzman, S.J. Assistant Editor, *Theological Studies*.
- G. S. J.**—Gilbert Starling Jones. Executive Vice-President and Treasurer, Valley Forge Historical Society, Valley Forge, Pa. Author of *Valley Forge Park, An Historical Record and Guide*.
- G. S. L.**—George Somes Layard. Author of *Charles Keene*; *Shirley Brooks*; etc.
- G. Sn.**—George Sampson. Former Inspector of Schools (London County Council).
- G. Ste.**—George Stevenson, M.D. Medical Director, the National Committee for Mental Health, Inc. Co-author of *Child Guidance Clinics*.
- G. S. W.**—Graham Selby Wilson, M.D. Professor of Bacteriology as applied to Hygiene, University of London. Author of *The Bacteriological Grading of Milk and The Pasteurization of Milk*.
- G. S. W. E.**—Sir George Selby Washington Epps. Actuary, Government Actuary's Department, London, 1936–44; Deputy Actuary, 1926–36.
- G. T. A.**—G. T. Atkinson. Superintending Inspector, Animal Health Division, Ministry of Agriculture and Fisheries, England.
- G. T. B.**—George Thomas Burrows. Editor of the *Live Stock Journal*, 1915–33.
- G. T. F.**—George Topham Forrest. Superintending Architect of Metropolitan Buildings and Architect to the London County Council, 1919–35. Author of *The Construction and Control of Buildings and the Development of Urban Areas in the United States of America*; etc.
- G. T. Ft.**—George Tobias Faust. Mineralogist, Section of Geochemistry and Petrology, Geological Survey, U.S. Department of the Interior.
- G. T. G.**—Sir George Taubman Goldie. Former English Administrator and Founder of Nigeria.
- G. T. M.**—Sir Gilbert Thomas Morgan. Director, Chemical Research Laboratory, Department of Scientific and Industrial Research, London, 1925–38. Former Mason Professor of Chemistry, University of Birmingham. Author of *Inorganic Chemistry*; etc.
- G. T. N.**—Gordon Thayer Nightingale. Physiologist, Hawaiian Pineapple Company, Honolulu, Hawaii.
- G. T. P.**—Gabriel Turville-Petre. Vigfusson Reader in Ancient Icelandic Literature and Antiquities, Oxford University. Author of *The Heroic Age of Scandinavia*; *Origins of Icelandic Literature*.
- G. T. Pk.**—George T. Pack, M.D. Clinical Professor of Surgery, New York Medical College, New York, N.Y. Associate Professor of Clinical Surgery, Cornell University Medical School, New York, N.Y. Attending Surgeon, Memorial Center for Cancer and Allied Diseases, New York, N.Y. Author of *End Results in Cancer of the Stomach*; etc.

- G. Tr.**—Griffith Taylor. Head of Department of Geography, University of Toronto, Canada. Former Professor of Geography, University of Sydney, Australia. Author of *Australian Meteorology*; *Australia*; etc.
- G. T. S.**—George T. Springer. President, National Roleo Association.
- G. T. Sg.**—Glenn Theodore Seaborg. Professor of Chemistry and Director of Chemical Research, Radiation Laboratory, University of California, Berkeley, Calif. Member, General Advisory Committee of the U.S. Atomic Energy Commission, 1946-. Co-recipient of the Nobel Prize in Chemistry, 1951.
- G. T. W.**—Sir Gilbert Thomas Walker. Professor of Meteorology, Imperial College of Science and Technology, University of London, 1924-34. Director General of Indian Observatories, 1904-24. Fellow of Trinity College, Cambridge, 1891. Author of *Abration*; *The Theory of Electromagnetism*; etc.
- G. V. C.**—George V. Caesar. Laboratory Director, Stein, Hall and Company, Inc., New York, N.Y.
- G. v. E.**—Guenther von Elbe. Physical Chemist, Bureau of Mines, U.S. Department of the Interior. Co-author of *Combustion, Flames and Explosions of Gases*.
- G. W.**—Geoffrey White. Major General. Director of Remounts, War Office, England, 1925-29. Colonel Commandant, Woolwich Sub-Area, 1920-23.
- G. W. B.**—George William Bartelmez. Emeritus Professor of Anatomy, The University of Chicago.
- G. W. C.**—Graham W. Corddry. Director, Titanium Pigment Corporation, New York, N.Y.
- G. W. Cb.**—George Watson Cobb, Jr. Formerly with the American Can Company, New York, N.Y.
- G. W. Cr.**—George Washington Corner. Director, Department of Embryology, Carnegie Institution of Washington, D.C. Professor of Anatomy, University of Rochester, Rochester, N.Y., 1923-40. Author of *Ourselves Unborn*; etc.
- G. W. Cu.**—G. W. Cussons. Of the firm of Messrs. G. Cussons, Ltd., makers of scientific and technical apparatus for education, research and industry, Manchester, England.
- G. W. D.**—George Walter Dawson. Formerly with Department of Fine Arts, University of Pennsylvania, Philadelphia, Pa.
- G. W. Do.**—George William Douglas. Former Associate Editor of the *Evening Public Ledger* and of the *Philadelphia Public Ledger*. Author of *The American Book of Days*; etc.
- G. W. G.**—George W. Giles. Secretary of the Allotments Organization Society and Small Holders, Ltd.
- G. W. Gi.**—George Waters Gilbertson. Author of *The Balochi Language*; etc.
- G. W. Go.**—George Washington Goethals. Former Instructor in Civil and Military Engineering, U.S. Military Academy, West Point, N.Y. Chief Engineer, Panama Canal, 1907-14. Civil Governor, Panama Canal Zone, 1914-16. State Engineer, New Jersey, 1917.
- G. W. H.**—George William Heise. Research Chemist, National Carbon Company, Cleveland, O.
- G. W. K.**—George Williams Keeton. Professor of English Law and Dean, Faculty of Laws, University College, University of London. Editor of *The Cambridge Review*, 1924. Author of *The Elementary Principles of Jurisprudence*; etc.
- G. W. Ki.**—George W. Kirchwey. Head of the Department of Criminology, New York School of Social Work, 1917-32. Warden of Sing Sing Prison, 1915-16. Author of *Readings in the Law of Real Property*.
- G. W. Kn.**—Rev. George William Knox, D.D. Former Professor of Philosophy and History of Religion, Union Theological Seminary, New York, N.Y. Author of *The Direct and Fundamental Proofs of the Christian Religion*; etc.
- G. W. P.**—George W. Pickels. Former Professor of Civil Engineering, University of Illinois, Urbana, Ill. Author of *Drainage and Flood-Control Engineering*; etc.
- G. W. R.**—George William Redway. Author of *The War of Secession, 1861-62; Fredericksburg: A Study in War*.
- G. W. Ri.**—George Warren Richards, D.D. President, the Theological Seminary of the Reformed Church in the United States, Lancaster, Pa. Author of *Christian Ways of Salvation*; etc.
- G. W. S.**—Geoffrey William Shaw. Former Assistant Lecturer in Geography, University College, London.
- G. W. Sr.**—George W. Schaeffer. Associate Professor and Director of the Department of Chemistry, St. Louis University, St. Louis, Mo.
- G. W. T.**—Rev. Griffiths Wheeler Thatcher. Warden of Camden College, Sydney, N.S.W. Former Tutor in Hebrew and Old Testament History at Mansfield College, Oxford.
- G. W. Tr.**—Sir George Wilfred Turner. Permanent Under-Secretary of State for War, Great Britain; formerly Second Secretary, Ministry of Supply.
- G. W. Wd.**—George Willard Wheland. Professor of Chemistry, The University of Chicago. Author of *The Theory of Resonance*; *Advanced Organic Chemistry*.
- G. W. Wi.**—George Woodward Wick-ersham. Attorney-General of the United States, 1909-13.
- G. Yo.**—Sir George John Young-husband. Major General. Former Keeper of the Jewel House, Tower of London. Author of *The Jewel House*; etc.
- Gy. T.**—Geoffrey Templeman. Lecturer in History, University of Birmingham, Birmingham, Eng.
- H. A.**—Harrison Atwood. Chairman of the Executive Committee, Vice-President and Director, McCann-Erickson, Inc., New York, N.Y.
- H. A. Ar.**—Hans A. Adler. Executive Office of the President, Bureau of the Budget, Washington, D.C.
- H. A. B.**—Harry Arnold Baylis. Deputy Keeper, Department of Zoology, British Museum (Natural History), London.
- H. A. Be.**—Hans Albrecht Bethe. Professor of Physics, Cornell University, Ithaca, N.Y. Author of *Elementary Nuclear Theory*.
- H. A. Cs.**—Harry Alfred Curtis. Dean, College of Engineering, University of Missouri, Columbia, Mo.
- H. A. Cw.**—H. A. Cadow. Secretary-Manager, Wine Institute, San Francisco, Calif.
- H. A. Dr.**—Hugh A. Drum. Lieutenant General, formerly with U.S. Army. Chief of Staff, 1st Army, A.E.F., 1918-19.
- Ha. F.**—Harvey Fletcher. Director of Physical Research, Bell Telephone Laboratories, Murray Hill Laboratory, Murray Hill, N.J.
- H. A. Gr.**—Harold Atheling Grimshaw. Former Departmental Chief in the Diplomatic Division of the International Labour Office, Geneva, Switzerland.
- H. Ah.**—Hakon Ahlberg. Chief Architect to Royal Medical Board of Sweden, 1934-. Professor of Ornamental Architecture, Royal Technical College, Stockholm University, 1918-29. Author of *Modern Swedish Architecture*.
- H. A. H.**—Howard Archibald Hubbard. Professor of History and Head of the Dept. of History and Political Science, University of Arizona, Tucson, Ariz.
- H. A. Ha.**—H. Ainsworth Harrison. Research Chemist, Chemical Research Laboratory, Teddington, Middlesex, England.
- Ha. Hr.**—Harry Hilfer. Chemist, Lucien Lelong Inc., Chicago, Ill.
- H. A. I.**—Harold Adams Innis. Former Professor and Head of the Department of Political Economy, University of Toronto, Toronto, Ont. Author of *A History of the Canadian Pacific Railway*; etc.
- H. A. J.**—Henry Albert Jones. Principal Olericulturist, U.S. Department of Agriculture, Beltsville, Md. Co-author of *Truck Crop Plants*; etc.
- H. A. K.**—Hans Adolf Krebs. Professor of Biochemistry, University of Sheffield, Sheffield, Eng.
- H. A. M.**—Sir Henry Alexander Miers. Trustee of the British Museum, London, 1926-39. Vice-Chancellor of the University of Manchester and Professor of Crystallography, 1915-26. Author of *A Visit to the Yukon Gold Fields*; etc.
- H. A. My.**—Howard A. Murphy. Professor of Music and Music Education, Teachers College, Columbia University, New York, N.Y. Author of *Form in Music for the Listener*; *Teaching Musicianship*; co-author of *Creative Harmony and Musicianship*.
- H. A. R.**—Horace Arthur Rose. District and Sessions Judge, Punjab, India, 1906-17.
- H. A. Re.**—Harrison August Ruehe. Professor of Dairy Manufactures, College of Agriculture, and Chief of Dairy Manufactures, Illinois Agricultural Experimental Station, 1945-. Professor of Dairy Manufactures and Head of the Department of Dairy Husbandry, University of Illinois, Urbana, Ill., 1921-45.
- H. A. R. G.**—Hamilton Alexander Rosskeen Gibb. Laudian Professor of Arabic, Oxford University. Editor of *Whither Islam*. Author of *Arabic Literature*; *Damascus Chronicle of the Crusades*; *Modern Trends in Islam*.
- H. A. Rn.**—Hobart Ansteth Reimann, M.D. Professor of Medicine, Jefferson Medical College, Philadelphia, Pa. Author of *The Pneumonias*; Editor of *Treatment in General Medicine*.
- H. Ar. Rn.**—H. Archie Richardson. Freelance sports writer and sports research specialist. Author of *The Warmerdam Story*; etc.

- H. A. S.**—**H. A. Sloman.** Senior Principal Scientific Officer, Metallurgy Division, National Physical Laboratory, Teddington, Middlesex, England.
- H. A. Sc.**—**Hugh Arthur Scott.** For 25 years Music and Dramatic Critic of the *Westminster Gazette*, London.
- H. A. Sch.**—**Harry August Schoth.** Senior Agronomist, Division of Forage Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, U.S. Department of Agriculture, Oregon State College, Corvallis, Ore.
- Ha. Sh.**—**Haig Shekerjian.** Brigadier General. Commanding General, Chemical Warfare Replacement Training Center, 1942-43; Commanding General, Camp Sibert, Ala., 1943-44.
- H. A. T.**—**Howard A. Turner.** Assistant Agricultural Economist, U.S. Department of Agriculture.
- Ha. W.**—**Harvey Walker.** Professor of Political Science, Ohio State University, Columbus, O. Author of *Public Administration in the United States*.
- H. A. W.**—**Harold Albert Wilson.** Emeritus Professor of Physics, Rice Institute, Houston, Tex. Author of *Electricity; Mysteries of the Atom*; etc.
- H. A. Wf.**—**Heinrich A. Wieschhoff.** Curator, African Section, University of Pennsylvania Museum; Lecturer on African Culture, Graduate School, University of Pennsylvania, Philadelphia, Pa. Author of *Colonial Policies in Africa*; etc.
- H. B.**—**Harry Brearley.** Author of *The Heat Treatment of Tool Steel*.
- H. Ba.**—**Hugh Baillie.** President and General Manager, United Press Associations, New York, N.Y.
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- H. B. C.**—**H. B. Carter.** Secretary, Reuters Limited.
- H. B. D.**—**Harold Baily Dixon.** Chairman of the Royal Technical College, Salford, England, 1916-30. Honorary Professor of Chemistry, University of Manchester, 1922. Author of *The Velocity of Sound in Gases and Vapours*; etc.
- H. Be.**—**Horace Beck.** Specialist on beads; arranged the Egyptian beads in the British Museum, London. Author of *The Classification and Nomenclature of Beads and Pendants*; etc.
- H. B. H.**—**Henry Beetle Hough.** Editor and Publisher, *Vineyard Gazette*, Edgartown, Martha's Vineyard, Mass. Co-author of Pulitzer prize-winning *History of Services Rendered by the American Press*. Author of *Martha's Vineyard, Summer Resort; Country Editor*; etc.
- H. B. Hd.**—**Herbert B. Hungerford.** Head, Department of Entomology and State Entomologist, University of Kansas, Lawrence, Kan.
- H. B. Hs.**—**Henry Bohn Hass.** Head of the Department of Chemistry, Purdue University, Lafayette, Ind.
- H. Bi.**—**Henri Bidou.** Former Editor of *Le Journal des Débats*, Paris.
- H. B. Lm.**—**Harvey Brace Lemon.** Professor of Physics, The University of Chicago, and Curator of Physical Science, Museum of Science and Industry, Chicago, Ill. Author of *From Galileo to Cosmic Rays*; etc.
- H. B. Md.**—**Herbert B. Mulford.** Former banker and newspaperman.
- H. Bn.**—**Harry Bateman.** Professor of Mathematics, Theoretical Physics and Aeronautics, California Institute of Technology, Pasadena, 1917-46. Author of *Partial Differential Equations of Mathematical Physics; Electrical and Optical Wave Motion; Differential Equations*.
- H. Bp.**—**Rev. Herbert Louis Bishop.** Missionary, Lourenço Marques, Mozambique, Portuguese East Africa, 1909-26.
- H. Br.**—**Henry Bradley.** Former Co-editor of *The New English Dictionary* (Oxford). President, Philological Society, 1891-93, 1900-03 and 1909-10. President, Oxford Philological Society, 1921. Author of *The Story of the Goths; The Making of English*; etc.
- H. B. R.**—**Harold B. Rowe.** Member of Research Staff, Brookings Institution, Washington, D.C., 1933-. Former Director, Food Rationing Division, Office of Price Administration.
- H. Bt.**—**Harry Barnhart.** U.S. singer. Former leader of community singing.
- H. B. T.**—**Harold Bradford Tukey.** Head, Department of Horticulture, Michigan State College, East Lansing, Mich. Chief in Research, New York State Agricultural Experimental Station and Professor of Pomology, Cornell University, 1927-45. Editor, *Proceedings of the American Society for Horticultural Science*.
- H. B. Wa.**—**Henry Beauchamp Walters.** Keeper of Greek and Roman Antiquities in the British Museum, London, 1925-32. Author of *The Art of the Greeks*; etc.
- H. B. We.**—**Harry Brandeis Wehle.** Curator of Paintings, Metropolitan Museum of Art, New York, N.Y.
- H. C.**—**Hugh Chisholm.** Editor of the eleventh and twelfth editions of the *Encyclopædia Britannica*.
- H. Ca.**—**Helen M. Cam.** Professor of History, Harvard University and Radcliffe College, Cambridge, Mass., 1948-. Lecturer in History, Cambridge University, 1928-48. Author of *Studies in the Hundred Rolls*.
- H. C. Bo.**—**H. C. Booth.** Consulting Engineer, Messrs. Booth, Wilson and Pettit, London.
- H. C. Br.**—**Harold Chalton Bradshaw.** Former Secretary, Royal Fine Art Commission.
- H. C. C.**—**Henry Cope Colles.** Musical Critic of *The Times*, London, 1911-43. Editor of third edition, *Grove's Dictionary of Music and Musicians*, 1927; fourth edition, 1940.
- H. C. D.**—**Harold Collett Dent.** Editor of *The Times Educational Supplement*, London.
- H. C. Dn.**—**Hobart Cutler Dickinson.** Former Chief, Heat and Power Division, National Bureau of Standards, Washington, D.C.
- H. C. Dy.**—**Henry Clifford Darby.** John Rankin Professor of Geography, University of Liverpool, England, 1945-. Ehrman Fellow, King's College, Cambridge, 1932-45. Author of *The Medieval Fenland*; etc.
- H. Ch.**—**H. Chambers.** Former Principal, Ministry of Agriculture and Fisheries, London.
- H. Cha.**—**Henry Chalmers.** Consultant on Commercial Policy, U.S. Department of Commerce. Author of *Impact of the War Upon the Trade Policies of Foreign Countries*; etc.
- H. C. Hy.**—**Rev. Horace Carter Hovey, D.D.** Author of *Handbook of Mammoth Cave of Kentucky*; etc.
- H. C. I.**—**Harry Clyde Ingles.** Major General. Chief Signal Officer, U.S. Army, 1943-47.
- H. Cl.**—**Sir Hugh Clifford.** Former Governor of the Straits Settlements. High Commissioner for the Malay States and British Agent for Borneo, 1927-29. Governor of Ceylon, 1925-27. Author, *Further India*; etc.
- H. C. L.**—**H. C. Long.** Former Senior Staff Officer, Ministry of Agriculture and Fisheries, London. Editor of *Journal of Ministry of Agriculture and Fisheries*. Author of *Common Weeds of the Farm and Garden; Plants Poisonous to Livestock*; etc.
- H. C. M. C.**—**H. C. M. Case.** Head, Department of Agricultural Economics, College of Agriculture, University of Illinois, Urbana.
- H. C. Nn.**—**Herman Clarence Nixon.** Lecturer in Social Science, Vanderbilt University, Nashville, Tenn. Editorial Director, Vanderbilt University Press. Head of Department of History and Political Science, Tulane University, New Orleans, La., 1931-38. Author of *Forty Acres and Steel Mules*; etc.
- H. C. Pr.**—**Horace Chamberlain Porter.** Consulting chemist and chemical engineer, Philadelphia, Pa. Author of *Coal Carbonization*; etc.
- H. Cr.**—**Herbert Craft.** Board of Trade, London.
- H. C. R.**—**Henry Cushier Raven.** Former Curator, Department of Comparative Anatomy, American Museum of Natural History, New York, N.Y. Prosecutor, N.Y. Zoological Society, 1925-27. Associate, Vertebrate Paleontology, Columbia University, 1926-29.
- H. C. Ro.**—**H. C. Robbins.** Former General Manager, Press Association.
- H. C. S.**—**H. C. Stuart.** Former Assistant Collector, U.S. Custom Service, New York, N.Y.
- H. C. Sc.**—**Henry C. Schneider.** Charge of Windmill Department, Morse and Company, Chicago.
- H. C. Th.**—**Hugh Campbell Thuerk.** President and Director, New Jersey Power and Light Company, Dover, N.J., 1943-. Chairman, General Power Committee, National Electric Light Association.
- H. C. U.**—**Harold Clayton Urey.** Martin A. Ryerson Distinguished Service Professor of Chemistry, The University of Chicago. Nobel Prize for the discovery of deuterium (heavy hydrogen), 1934.
- H. C. V.**—**Hein Cornelis Visser.** Barrister.
- H. Cw.**—**Henry Crew.** Former Professor of Physics, Northwestern University, Evanston, Ill. Author of *General Physics; Rise of Modern Physics*.
- H. C. W.**—**Henry C. Watts.** Fellow of the Royal Aeronautical Society, England. Author of *Screw Propellers for Aircraft*.
- H. C. Wt.**—**Hurd Curtis Willett.** Professor of Meteorology, Massachusetts Institute of Technology, Cambridge, Mass. Author of *Descriptive Meteorology*.
- H. C. Wy.**—**Henry Cecil Kennedy Wyld.** Professor of English Language and Literature, Merton College, Oxford, 1920-45. Author of *The Growth of English*; etc.
- H. Cx.**—**Henri Cochaux.** Advocate of the Court of Appeal, Brussels, Belg. Author of *Le Pape et l'Italie*.

- H. D.**—Herbert Dingle. Professor of History and Philosophy of Science, University College, University of London. Director of the South Kensington Observatory. Author of *Modern Astrophysics*; etc.
- H. Da.**—H. Das. Graduate Member of New College, Oxford. Editor of *The Life and Letters of Toru Dutt*.
- H. D. A. M.**—Rev. Henry Dewsbury Alves Major, D.D. Honorary Canon of Birmingham, England. Examining Chaplain to the Bishop of Birmingham. Editor of the *Modern Churchman*. Author of *English Modernism*; etc.
- Hd. C.**—Howard F. Cline. Director, The Hispanic Foundation, Library of Congress, Washington, D.C.
- H. D. C.**—Harold Dean Cater. Director, Minnesota Historical Society. Author of *Henry Adams and His Friends*; etc.
- H. De.**—Rev. Hippolyte Delehaye, S.J. Former Co-editor of the *Acta Sanctorum*. Author of *The Work of the Bollandists*.
- H. Dev.**—Henry Devine, M.D. Former Examiner in Psychology, Royal College of Physicians, London. Co-editor of the *Journal of Mental Science*.
- H. D. Ho.**—Hubert D. Hoover. Lieutenant Colonel, Judge Advocate General's Department, U.S. Army.
- H. D. K.**—Harry Dexter Kitson. Professor of Education, Teachers College, Columbia University. Author of *The Psychology of Vocational Adjustment*; etc. Editor, "Kitson Careers" Series; *Occupations—the Vocational Guidance Journal*.
- H. D. L.**—Harold D. Lasswell. Professor of Law, Yale University School of Law, New Haven, Conn. Author of *World Politics and Personal Insecurity*; etc.
- H. D. N.**—Henry Darnley Naylor. Former Professor of Classics in the University of Adelaide, South Australia. Former Governor of the Public Library of South Australia.
- H. D. O.**—Hilda Diana Oakeley. Head of Department of Philosophy, King's College, University of London, 1930-31. Author of *A Study in the Philosophy of Personality; History and the Self*; etc.
- H. D. S.**—Harlow Dow Savage. Former President of Dry Quenching Equipment Corporation, New York, N.Y.
- H. D. Sm.**—Hermon Dunlap Smith. Vice-President, Marsh and McLennan, Chicago. Author of *Revolutionary War Journals of Henry Dearborn, 1773-83*, with biographical essay.
- H. D. T.**—Harvey Doria Turing. Editor of *The Salmon and Trout Magazine*, 1933- . Author of *Trout Fishing; Modern Coarse Fishing*; etc.
- H. E.**—Haven Emerson, M.D. Professor of Public Health Administration, Columbia University, 1922-40. Editor of *Alcohol and Man*; etc.
- H. E. A.**—Hugh Elmer Agnew. Chairman of the Department of Marketing, New York University School of Commerce, Accounts and Finance, 1928-43. Author of *Co-operative Advertising by Competitors; Outdoor Advertising*; etc.
- H. E. Ba.**—Harry Everett Barnard. Former President, H. E. Barnard, Inc., Indianapolis, Ind. Editor of *Baking Technology*.
- H. E. Bar.**—Harry Elmer Barnes. Professor of History and Sociology, Smith College, Northampton, Mass., 1923-30. Author of *Progress of American Penology; The Repression of Crime*; etc.
- H. E. Bl.**—Sir Herbert Edward Blumberg. General. Former Honorary Colonel Commandant, Chatham Division, Royal Marines.
- H. E. Bu.**—Harold Ernest Burr. Professor of Psychology, Ohio State University, Columbus, O. Author of *Legal Psychology; Psychology in Advertising*.
- H. E. By.**—Huly Edwin Bray. Former Director, Office of Information, War Assets Administration, Washington, D.C.
- H. E. C.**—H. E. Cox. Public Analyst for the Metropolitan Borough of Hampstead, London.
- H. E. D.**—Harold Edward Dale. Principal Assistant Secretary, Ministry of Agriculture and Fisheries, 1927-35.
- H. E. Da.**—H. E. Dalton. Former Comptroller, Studebaker Corporation, South Bend, Ind.
- H. E. Du.**—Henry Ernest Dudeney. Mathematical puzzle expert. Author of *The Canterbury Puzzles; Amusements in Mathematics*; etc.
- H. E. E.**—H. E. Ewing. Entomologist. Bureau of Entomology and Plant Quarantine, U.S. Department of Agriculture, Washington, D.C., 1929-45. Author of *A Manual of External Parasites*.
- H. E. G.**—Henry Edward Garrett. Professor and Head of the Department of Psychology, Columbia University. Author of *Great Experiments in Psychology*; etc.
- H. E. Hd.**—Herman Eliot Hayward. Senior Plant Anatomist, Bureau of Plant Industry, Soils, and Agricultural Engineering, U.S. Department of Agriculture. Author of *The Structure of Economic Plants*.
- H. E. Ho.**—Henry E. Hoagland. Former Director, Home Owners' Loan Corporation, and former Trustee, Federal Savings and Loan Insurance Corporation, of the United States Housing and Home Finance Agency, Washington, D.C. Author of *Corporation Finance; Work Book in Corporation Finance; Real Estate Principles*; etc.
- H. E. Hy.**—Harold Evans Hartney. Lieutenant Colonel, formerly with Air Corps (Res.), U.S.A. Former Consulting Aeronautical Assistant, Civil Aeronautics Authority. Author of *Complete Flying Manual*.
- H. E. J.**—H. E. Jeffery. Secretary, British Goat Society.
- H. E. L.**—H. Edgar Landauer. Former member of the Board of Managers of Vereinigte Industrie-Unternehmungen A.G., Berlin, and Reichs-Kredit-Gesellschaft A.G., Berlin. Author of *Industrial and Commercial Development*.
- H. E. S.**—Horace Elisha Scudder. Former Editor of *The Atlantic Monthly*. Author of *Life of James Russell Lowell; History of the United States; Dream Children; Life of Noah Webster; Men and Letters*; etc.
- H. E. T.**—H. E. Tunncliffe. Fellow and Lecturer in Physiology, Gonville and Caius College, Cambridge. University Demonstrator in Physiology.
- H. E. Van Ge.**—H. E. Van Gelder. Adviser, Service of Fine Art, The Hague, Netherlands, 1941- . Director of the Service for Art and Science (including the Town Museums) of The Hague, 1919-41. Editor of *Oud Holland*. Author of *Pottenbakkers*.
- He. W.**—Herbert Woodrow. Professor and Head of the Department of Psychology, University of Illinois, Urbana, Ill. Author of *Brightness and Dullness in Children; The Measurement of Attention*.
- H. E. Wi.**—Henry E. Wirth. Associate Professor of Chemistry, Ohio State University, Columbus, O.
- H. F.**—Helena Frank. Translator from the Yiddish of stories and pictures by Perez; *Yiddish Tales*.
- H. Fa.**—Harrison Fahrnkopf. Former Director, Grain Marketing Department, Illinois Agricultural Association.
- H. F. Br.**—Horatio Robert Forbes Brown. Former Editor of the *Calendar of Venetian State Papers* for the Public Record Office. Author of *Life on the Lagoons; Venetian Studies*; etc.
- H. F. By.**—Harry Flood Byrd. U.S. Senator. Governor of Virginia, 1926-30. Publisher of *Winchester Star* and *Harrisonburg (Va.) Daily News Record*.
- H. Fe.**—Hugh Ferriss. President of Architectural League of New York, N.Y., 1943-45. Author of *The Metropolis of Tomorrow*.
- H. F. G.**—Henry Francis Grady. President, American President Lines, Ltd., 1941- . Professor of International Trade and Dean of the College of Commerce, University of California, 1928-37. Vice-Chairman, U.S. Tariff Commission, 1937-39. Assistant Secretary of State, Department of State, Washington, D.C., 1939-41. Leader, American Technical Mission to India, 1942.
- H. F. Gl.**—Harold Foote Gosnell. Special Consultant, Office of Public Affairs, U.S. Department of State, Washington, D.C. Author of *Grass Roots Politics*; etc.
- H. F. Gn.**—Hugo F. Garten. Head of German Department, Westminster School, London. Author of *Georg Kaiser*.
- H. Fi.**—Herman Finer. Professor of Political Science, The University of Chicago. Lecturer and Reader in Public Administration, London School of Economics and Political Science, 1920-42. Special Consultant on Post-war Reconstruction to International Labour Office, Montreal, Canada, 1942. Author of *Foreign Governments at Work; The Case Against Proportional Representation*; etc.
- H. F. J.**—Herbert Felix Jolowicz. Professor of Roman Law in the University of London, 1931- . Dean of Faculty of Law, University of London, 1937-38. Editor, *Journal of the Society of Public Teachers of Law*. Author of *Historical Introduction to the Study of Roman Law*; etc.
- H. F. MacN.**—Harley F. MacNair. Professor of Far Eastern History, The University of Chicago, 1928-47. Author of *Modern Chinese History; China in Revolution*; etc.
- H. Fn.**—Herman Finkelstein. General Attorney, American Society of Composers, Authors and Publishers.
- H. Fo.**—Henry Ford. Organizer and former President of the Ford Motor Company. Author (with Samuel Crowther) of *My Life and Work*; etc.
- H. F. P.**—Henry Francis Pelham. Former Camden Professor of Ancient History in Oxford University and President of Trinity College. Author of *Outlines of Roman History*; etc.
- H. F. Pr.**—Henry Fowles Pringle. Chief, Division of Publications, Office of War Information, 1942-43. Professor of Journalism, Columbia University, 1936-43. Author of *Alfred E. Smith, a Critical Study*; etc.

- H. Fr.**—Henri Frantz. Art Critic, *Gazette des Beaux-Arts*, Paris.
- H. Fs.**—Homer Folks. Secretary of the State Charities Aid Association of New York. Author of *Care of Destitute, Neglected and Delinquent Children*; etc.
- H. F. T.**—Harry F. Tapp. Manager, Oil Heating-Air Conditioning Division, Gilbert and Barker Manufacturing Company, West Springfield, Mass. Author of *Hand Book of Domestic Oil Heating*; etc.
- H. Fu.**—H. Fuchs. Literary Department, Disconto-Gesellschaft, Berlin.
- H. F. W.**—H. Fred Wilson. Assistant Vice-President and Manager, Bank Relations Department, Federal Reserve Bank of Chicago.
- H. Fx.**—Howard Fox, M.D. Emeritus Professor, College of Medicine, New York University, New York, N.Y. Author of *Skin Diseases in Infancy and Childhood*.
- H. G. A.**—Harry G. Armstrong, M.D. Major General. Surgeon General, U.S. Air Force, 1949.
- H. G. Ar.**—Horace Gurney Alexander. Adviser to the Society of Friends in India. Author of *The Indian Ferment; India Since Cripps; Narcotics in India and South Asia*.
- H. G. D.**—H. G. Dowie. Honorary Secretary, Torquay Natural History Society, the Museum, Torquay, England.
- H. G. Dn.**—Herbert Girton Deignan. Associate Curator of Birds, U.S. National Museum, Washington, D.C. Master, the Prince Royal's College, Chiang Mai, Thailand, 1928-32, 1935-37.
- H. G. G.**—Henry George Greenish. Former Professor of Pharmaceutics in the University of London. Co-editor of the *British Pharmacopoeia*.
- H. G. Gd.**—Harry Gehman Good. Emeritus Professor of Education, Ohio State University, Columbus, O. Author of *Benjamin Rush and His Services to American Education*.
- H. G. Gn.**—Harry G. Guthmann. Morrison Professor of Finance, Northwestern University, Evanston, Ill. Author of *Analysis of Financial Statements*; co-author of *Corporate Financial Policy; Investment Principle and Practices*.
- H. G. Hn.**—Henry Garrett Houghton. Professor of Meteorology and Head of Department, Massachusetts Institute of Technology, Cambridge, Mass.
- H. G. K.**—Henry Granger Knight. Chief, Bureau of Agricultural Chemistry and Engineering, U.S. Department of Agriculture, Washington, D.C., 1939-42.
- H. G. M.**—Henry Gascoyen Maurice. Former Fisheries Secretary, Ministry of Agriculture and Fisheries, London.
- H. Gn.**—Hans Gaffron. Associate Professor of Biochemistry and Research Associate in Chemistry (Associate Professor), The University of Chicago.
- H. G. N.**—Herbert George Nicholas. Fellow and Tutor, Exeter College, Oxford. Faculty Fellow, Nuffield College, Oxford. Author of *The American Union*.
- H. Go.**—Hugh Godfrey. Author of *An Elementary Treatise on the Lunar Theory; A Treatise on Astronomy*.
- H. Goe.**—Hermann Goetz. Volunteer Assistant in Charge of the Mohammedan Collections, Museum of Ethnology, Berlin.
- H. Got.**—Hugh Goitein. Professor of Commercial Law, University of Birmingham, England. Author of *Primitive Ordeal and Modern Law*; etc.
- H. G. R.**—H. G. Richardson. Former Assistant Secretary, Ministry of Agriculture and Fisheries, London.
- H. G. Rn.**—Hugh George Rawlinson. Indian Educational Service (retired). Author of *British Achievement in India; India: A Short Cultural History*.
- H. G. Sh.**—H. Grayson Smith. Associate Professor of Physics, University of Toronto, Canada. Co-author of *Phenomena at the Temperature of Liquid Helium; College Physics*.
- H. Gu.**—Harold Gulliksen. Professor of Psychology, Princeton University, Princeton, N.J.
- H. G. W.**—Herbert George Wood, Hon. D.D. Professor of Theology, University of Birmingham, England, 1940-46.
- H. G. Wf.**—Harold G. Wolff, M.D. Associate Professor of Medicine, Cornell University Medical College, Ithaca, N.Y. Attending Physician, New York Hospital, New York, N.Y.
- H. Ha.**—Harry Hansen. Book Critic for *Harper's Magazine*, 1923-39. Author of *The Adventures of the Fourteen Points*; etc.
- H. Hag.**—Hermann Hagedorn. Executive Director and Trustee, Roosevelt Memorial Association. Author of *Roosevelt in the Badlands*; etc.
- H. H. Ar.**—Henry H. Arnold. Former General of the Army. Commanding General, U.S. Army Air Forces, 1942-45. Co-author of *Army Flyer; Winged Warfare*; etc.
- H. H. Br.**—Harold H. Bender, M. Taylor Pyne Professor Emeritus of Indo-Germanic Philology, Princeton University, Princeton, N.J. Author of *The Suffixes "mant" and "vanti" in Sanskrit and Avestan; A Lithuanian Etymological Index; The Home of the Indo-Europeans*.
- H. H. C.**—Sir H. Harding Cunyng-hame. Assistant Undersecretary, Home Office, 1894-1913. Former Vice-President, Institute of Electrical Engineers.
- H. H. Cl.**—Harry Hayden Clark. Professor of English, University of Wisconsin, Madison, Wis.
- H. Hd.**—Eric Hesketh Hubbard. Extension Lecturer in Art, London, Oxford and Cambridge Universities. Author of *Materia Pictoria; Some Victorian Draughtsmen*; etc.
- H. He.**—Halldór Hermannsson. Emeritus Professor of Scandinavian Languages and Curator of the Fiske Icelandic Collection, Cornell University, Ithaca, N.Y.
- H. Hea.**—Herbert Heaton. Professor of Economic History, University of Minnesota, Minneapolis, Minn. Author of *The Yorkshire Woollen and Worsted Industries; The British Way to Recovery; Economic History of Europe*.
- H. Her.**—Harold Heron. Analytical and Consulting Chemist. Lecturer on Malting and Brewing Chemistry, Sir John Cass Technical Institute, London.
- H. H. G.**—Herbert H. Grimwood. Principal, School of Wood-carving, South Kensington.
- H. Hh.**—Helmut Hirsch. Associate Professor of History, Roosevelt College, Chicago, Ill.
- H. H. H.**—The Rt. Rev. Herbert Hensley Henson, Hon. D.D. Lord Bishop of Durham, 1920-39. Author of *Anglicanism*; etc.
- H. H. Hr.**—H. H. Holscher. General Research Laboratory, Owens-Illinois Glass Company, Toledo, O., 1937-.
- H. Hi.**—Henry Higgs. Lecturer in Economics, University College of North Wales, 1925-29. Author of *Financial System of United Kingdom; National Economy*; etc.
- H. H. J.**—Sir Harry Hamilton Johnston. Special Commissioner, Commander in Chief and Consul-General for the Uganda Protectorate, 1899-1901. Consul General in the Regency of Tunis, 1897-99. Commissioner and Consul General in British Central Africa, 1891. Author of *British Central Africa; The Uganda Protectorate; The Nile Quest*; etc.
- H. H. Jo.**—Helen Haiman Joseph. Director of Helen Haiman Joseph Marionettes. Author of *Book of Marionettes*; etc.
- H. H. L.**—Herbert H. Lehman. U.S. Senator, 1949-. Director General, United Nations Relief and Rehabilitation Administration, Washington, D.C., 1943-46.
- H. H. L. B.**—Hugh Halé Leigh Bellot. Sometime Acting Professor of Constitutional Law, University of London, and Secretary, Breaches of the Laws of War Committee. Author of *Commerce in War*; etc.
- H. H. Mn.**—Hugh H. Mottern. Senior Chemist in Charge, Apple Utilization Section, Eastern Regional Research Laboratory, U.S. Department of Agriculture, Wyndmoor, Pa.
- H. H. N.**—H. H. Newman. Emeritus Professor of Zoology, The University of Chicago. Author of *The Biology of Twins; The Physiology of Twinning; Multiple Human Births*.
- Hh. O.**—Hugh Odishaw. Assistant to the Director, National Bureau of Standards, U.S. Department of Commerce.
- H. Hol.**—Horace Holley. Secretary, National Spiritual Assembly of Bahais of United States and Canada, 1924-30 and 1932-48. Author of *Bahaism*; etc. Editor, *Bahai Scriptures*. Former Editor, *Bahai World*.
- H. Hp.**—Henry Harap. Associate Director, Division of Surveys and Field Services, George Peabody College for Teachers, Nashville, Tenn. Author of *Economic Life and the Curriculum; The Technique of Curriculum Making*.
- H. H. R.**—Herbert Holdsworth Ross. Systematic Entomologist, Illinois State Natural History Survey. Author of *The Caddis Flies or Trichoptera of Illinois*.
- H. Hs.**—Hermann Helms. Publisher, *American Chess Bulletin*, New York, N.Y. Former Chess Editor, *Brooklyn Eagle*. Former Chess Editor, *New York Sun*.
- H. H. S.**—Sir Henry Harold Scott, M.D. Former President, Royal Society of Tropical Medicine and Hygiene. Examiner for Diplomas in Tropical Medicine and Tropical Hygiene, Liverpool University, Liverpool, England. Director, Bureau of Hygiene and Tropical Diseases, London, 1935-42. Author of *A History of Tropical Medicine*; etc.
- H. H. Sd.**—Howard Hayes Scullard. Reader in Ancient History, University of London. Author of *A History of the Roman World, 753-146 B.C.; Roman Politics, 220-150 B.C.; Scipio Africanus*.
- H. H. Sh.**—Henry H. Storch. Chief, Research and Development Division, Office of Synthetic Liquid Fuels, Bureau of Mines, U.S. Department of the Interior, Pittsburgh, Pa.
- H. H. Sk.**—Helmuth H. Schrenk. Chief, Health Division, U.S. Bureau of Mines, Central Experiment Station, Pittsburgh, Pa.

- H. Hy.**—Henri Simon Hymans. Former Keeper of the Bibliothèque Royale de Belgique, Brussels. Author of *Rubens: sa vie et son oeuvre*.
- H. H. Y.**—Harland Harry Young. Assistant Director of Research, Swift and Company, Chicago, Ill.
- H. I.**—H. Inwards. Former President of the Chamber of the town of Luton, England. Author of *Straw Hats*.
- H. I. B.**—Sir Harold Idris Bell. Keeper of the MSS. and Egerton Librarian, British Museum, London, 1929-44. Honorary Fellow of Oriel College, Oxford. Honorary Reader in Papyrology, Oxford.
- Hi. Br.**—Henri Brenier. Director General of the Chamber of Commerce, Marseilles, France. General Secretary to the National Colonial Exhibition at Marseilles, 1922, and to the Colonial Organization Congress, 1922.
- H. J.**—Harold Jeffreys. Plumian Professor of Astronomy and Experimental Philosophy, Cambridge University. Fellow of St. John's College, Cambridge. Author of *The Earth: Its Origin, History, and Physical Constitution; The Future of the Earth*; etc.
- H. Ja.**—Sir Herbert Jackson. Former Director of Research, British Scientific Instruments Research Association. Former Professor of Chemistry, University of London. Former Daniell Professor of Chemistry, King's College, University of London.
- H. J. A.**—Harry J. Anslinger. United States Commissioner of Narcotics, Bureau of Narcotics, Washington, D.C.
- H. J. B.**—H. J. Butler. Technical expert of *The Electric Railway and Tramway Journal*. Former Technical Editor of *The Automobile and Carriage Builders' Journal*. Author of *Motor Bodies and Chassis*; etc.
- H. J. B. D.**—H. J. B. Drew. Director of Publicity for New Zealand.
- H. J. Bn.**—Henry J. Bruman. Associate Professor of Geography, University of California at Los Angeles, Los Angeles, Calif.
- H. J. Br.**—Hermann Justus Braunholtz. Keeper, Department of Ethnography, British Museum, London. Former President, Royal Anthropological Institute.
- H. J. C.**—Henry Joel Cadbury, D.D. Hollis Professor of Divinity, Harvard University. Secretary, American Schools of Oriental Research. Director, Andover-Harvard Theological Library. Author of *Style and Literary Method of Luke*.
- H. J. D.**—Harry J. Daniels. Former Editor of *The Casket and Sunnyside*, New York, N.Y.
- H. J. De.**—Herman Julius Deutsch. Professor of History and Political Science, State College of Washington, Pullman, Wash.
- H. Je.**—Sir Hilary Jenkinson. Deputy Keeper of Public Record Office and Keeper of Land Revenue Records and Enrolments. F. W. Maitland Lecturer, Cambridge University, 1911-35 and 1938. Reader in Diplomatic Archives, University of London, 1925-47.
- H. J. E.**—H. Julius Eggeling. Professor of Sanskrit and Comparative Philology, Edinburgh University, Scotland, 1875-1914. Former Secretary and Librarian to Royal Asiatic Society.
- H. J. E. P.**—Harold John Edward Peake. Former Vice-President of the Royal Anthropological Institute of Great Britain and Ireland. Author of *The Bronze Age and the Celtic World*; etc.
- H. J. F.**—Herbert John Fleure. Honorary Secretary, Geographical Association and Honorary Editor of *Geography*, 1917-47. Professor of Geography, Manchester University, 1930-44. Author of *Human Geography in Western Europe*; etc.
- H. J. F. G.**—H. J. F. Gourley. Of Binnie, Deacon and Gourley, chartered civil engineers, London.
- H. J. Fn.**—Henry James Franklin. Director of Cranberry Station, East Wareham, Mass. Research Professor, University of Massachusetts, Amherst, Mass. Author of *Cape Cod Cranberry Insects*; etc.
- H. J. G.**—Herbert John Gough. Engineer in Chief, Lever Brothers and Unilever Ltd., 1945- . Superintendent of the Engineering Department, National Physical Laboratory, Teddington, England, 1930-38. Director-General of Scientific Research and Development, Ministry of Supply, 1942-45.
- H. J. L.**—Harold J. Laski. Former Professor of Political Science, University of London. Former Member of Council of Institute of Public Administration. Author of *A Grammar of Politics; Communism*; etc.
- H. J. M.**—Hermann Joseph Muller. Professor of Zoology, Indiana University, Bloomington, Ind. Senior Geneticist, Institute of Genetics of the Academy of Science, U.S.S.R., 1933-37. Nobel Laureate in Physiology and Medicine, 1946. Author of *The Mechanism of Mendelian Heredity* (with others); *Out of the Night*; etc.
- H. J. Ma.**—Rt. Hon. Sir Halford John Mackinder. Vice-President, Royal Geographic Society, 1933-36. Reader and afterward Professor of Geography, University of London, 1900-25. Author of *Britain and the British Seas*; etc.
- H. J. Mac.**—Horace James Macintire. Professor of Refrigeration, University of Illinois, Urbana, Ill., 1920-48. Author of *Handbook of Mechanical Refrigeration*; etc.
- H. J. Ml.**—Harrison J. Merrill. Chief, Physical Optics Section, Applied Physics Branch, Evans Signal Laboratory, Signal Corps Engineering Laboratories, Fort Monmouth, N.J.
- H. J. M. R.**—H. J. M. Rundle. Commander, R.N. Former Deputy Chief Inspector, H.M. Coastguard.
- H. J. Mu.**—Hans J. Morgenthau. Professor of Political Science, The University of Chicago. Author of *In Defense of the National Interest; Politics Among Nations*; etc.
- H. Jn.**—Henry Jackson. Former Regius Professor of Greek in Cambridge University and Fellow of Trinity College. Author of *Texts to Illustrate the History of Greek Philosophy from Thales to Aristotle*; etc.
- H. J. R.**—Herbert Jennings Rose. Professor of Greek, United College, St. Andrews University, Scotland. Professor of Latin, University College of Wales, Aberystwyth, 1919-27. Author of *A Handbook of Greek Mythology*; etc.
- H. J. Re.**—Henry Joseph Reilly. Brigadier General. Author of *Why Preparedness? America's Part*; etc.
- H. Js.**—Harlean James. Executive Secretary, American Planning and Civic Association, Washington, D.C. Author of *The Building of Cities*; etc.
- H. J. S.**—Howard James Savage. Treasurer, Carnegie Foundation for the Advancement of Teaching, New York, N.Y. Author of *Games and Sports in British Schools and Universities*; etc.
- H. J. Sy.**—Howard John Shaughnessy. Chief, Division of Laboratories, Illinois Department of Public Health. Associate Professor of Bacteriology and Public Health, College of Medicine, University of Illinois, Chicago, Ill.
- H. J. T. E.**—H. J. T. Ellingham. Imperial College of Science and Technology, University of London.
- H. J. V. C.**—Harley Jones Van Cleave. Professor of Zoology, University of Illinois, Urbana, Ill. Author of *Invertebrate Zoology*; (with Henry R. Linville and Henry A. Kelly) *A Textbook in General Zoology*; etc.
- H. J. W.**—H. J. Whittle. Lieutenant Colonel. Contributor to *The Field*.
- H. J. W. T.**—Henry Julius Wetenhall Tillyard. Professor of Greek, University College, Cardiff, Wales, 1926-46. Author of *Byzantine Music and Hymnography*; etc.
- H. K.**—Holloway Kilborn. Vice-President and Treasurer, The Kilborn and Bishop Company, New Haven, Conn. Author of *Iron Age; Hardware Age*.
- H. K. C.**—Henry King Carroll. Author of *Religious Forces in the United States; Missionary Growth of the Methodist Episcopal Church*.
- H. K. G.**—Howard K. Gloyd. Director, Museum of Natural History, The Chicago Academy of Sciences, Chicago, Ill.
- H. Kl.**—Heinrich Klüver. Professor of Experimental Psychology, The University of Chicago. Associate Editor, *Journal of Psychology*.
- H. Kn.**—Hans Kelsen. Professor of Political Science, University of California, Berkeley, Calif. Author of *Society and Nature; General Theory of Law and State*.
- H. Ko.**—Hans Kohn. Professor of History, City College, New York, N.Y., 1949- . Author of *The Idea of Nationalism; Prophets and Peoples; The Twentieth Century*; etc.
- H. Kr.**—Harald Kreutzberg. German ballet dancer.
- H. K. S.**—Harold Knox-Shaw. Radcliffe Observer, Oxford University. Former Director of Helwan Observatory, Egypt.
- H. La.**—Herbert Lapworth. Former President of the Institution of Water Engineers, London.
- H. Lab.**—Henri Labouret. Professor of African Languages, École Nationale des Langues Orientales Vivantes, Paris. Director (Paris) of the International Institute of African Languages and Cultures.
- H. L. A. F.**—Sir Henry Lancelot Aubrey-Fletcher. Major, formerly with the Grenadier Guards. Author of *A History of the Foot Guards to 1856*; etc.
- H. L. Bk.**—Henry Lowe Brownback. Brownback Motor Laboratories, Norristown, Pa.
- H. L. C.**—Hugh Longbourne Callendar. Former Professor of Physics, Imperial College of Science, University of London.
- H. L. Cr.**—Harold L. Cross. Of the firm of Brown, Cross and Hamilton, lawyers, New York, N.Y.
- H. L. Cs.**—Harvey L. Curtis. Principal Physicist, Chief of the Inductance and Capacitance Section, National Bureau of Standards, U.S. Department of Commerce, Washington, D.C., 1928-46. Author of *Electrical Measurements*.
- H. Le.**—Henry Lewis. Professor of Welsh Language and Literature in University College, Swansea, Wales.

H. L. E.—Helen L. Eddy. Bureau of Agricultural Economics, U.S. Department of Agriculture, Washington, D.C.

H. L-H.—Hellmut Lehmann-Haupt. Bibliographical Consultant, the H. P. Kraus Company, New York, N.Y. Lecturer, the New School for Social Research, New York, N.Y. Co-author of *The Book in America*; *Book-binding in America*.

H. L. Ha.—Harold Le Roy Haywood. Editor, *New York Masonic Outlook*, New York, N.Y., 1925-30. Author of *Great Teachings of Masonry*; etc. Co-author of *A History of Freemasonry*.

H. L. He.—Harriet L. Hennessy, M.D. Licentiate of the Royal College of Surgeons, Ireland.

H. Li.—Hans Lietzmann. Former Professor of Church History, University of Berlin.

H. L. K.—Helen Lois Koch. Professor of Child Psychology, The University of Chicago.

H. L. Ln.—Harold Lloyd Lyon. Director of Hawaiian Sugar Planters' Association Experimental Station, Hawaii.

H. L. M.—Henry Louis Mencken. Former Editor of *American Mercury*. Author of *The American Language*; *Prejudices*; *A Book of Prefaces*; etc.

H. L. Mo.—H. L. Morrow. Assistant Editor, *John O'London's Weekly*.

H. Ln.—Helge Larsen. Teacher at Nykøbing Kathedralskole, Denmark. Author of *Liberalisme og Socialisme*, *Politiske Grundtanker*.

H. Lo.—Henry Louis. Professor of Mining, Armstrong College, University of Durham, England, 1896-1923.

H. L. O.—Herbert Levi Osgood. Former Professor of History, Columbia University. Author, *The American Colonies in the Seventeenth Century*, etc.

H. L. Sh.—Homer LeRoy Shantz. Chief, Division of Wildlife Management, Forest Service, U.S. Department of Agriculture, 1936-44. President, University of Arizona, Tucson, Ariz., 1928-36. Co-author of *Vegetation of the United States*.

H. L. Ss.—Hazel Lee Shands. Associate Professor, Department of Agronomy, University of Wisconsin, Madison, Wis.

H. L. St.—Herbert Lawrence Stone. Editor of *Yachting*, New York, N.Y. Author of *America's Cup Races*; *The Yachtman's Handbook* (with others); etc.

H. L. Sti.—Henry Lewis Stimson. U.S. Secretary of War, 1911-13, 1940-45. U.S. Secretary of State, 1929-33. Chairman of U.S. Delegation to the London Naval Conference, 1930.

H. L. Str.—H. L. Straus. President, Automatic Calculating Machine Company of Maryland. Vice-President and Treasurer, American Totalisator Company, Baltimore, Md.

H. L. Tl.—Harlan L. Trumbull. Assistant to the Vice-President in Charge of Research, The B. F. Goodrich Company Research Center, Brecksville, O.

H. L. We.—Helene L. Wentzel. Editor of Publications, Colorado State Planning Commission, Denver, Colo.

H. Ma.—Henry Margenau. Professor of Natural Philosophy and Physics, and Fellow of Silliman College, Yale University. Author of *Foundations of Physics*; etc.

H. MacC.—Henry MacCormac, M.D. Former Consulting Physician, Skin Department, and former Lecturer on Dermatology, Middlesex Hospital, London.

H. M. B.—H. M. Bridgewater. Of the American Chain Company, Inc.

H. M. Br.—Henry M. Brinckerhoff. Former Consulting Engineer, Parsons, Brinckerhoff, Hall and MacDonald, New York, N.Y.

H. M. C.—Hector Munro Chadwick. Former Elrington and Bosworth Professor of Anglo-Saxon, 1912-41, Cambridge University. Author of *Studies in Anglo-Saxon Institutions*; *The Heroic Age*; etc.

H. M. D.—H. M. Dawson. Professor of Physical Chemistry in the University of Leeds, England, 1919-39.

H. Me.—Herman Merker. Vice-President, Pressed Steel Tank Company, Milwaukee, Wis.

H. M. F.—Harry Morton Fitzpatrick. Professor of Plant Pathology, New York State College of Agriculture, Cornell University. Associate Editor of *Mycologia*.

H. M. J. L.—Herbert Martin James Loewe. Former Reader in Rabbis, Cambridge University, and University Lecturer in Rabbinic Hebrew, Oxford University. Former Honorary Fellow of Queen's College.

H. M. K.—Horace Meyer Kallen. Professor of Philosophy and Psychology, The New School for Social Research, New York, N.Y. Author of *William James and Henri Bergson*; etc.

H. M. Kl.—Henry M. Kendall. Professor of Geography, Syracuse University, Syracuse, N.Y., 1948-

H. Mo.—Harold Moore. Director of the British Non-Ferrous Metals Research Association, 1932-44.

H. M. R.—Hugh Munro Ross. Former Exhibitor of Lincoln College, Oxford. Author of *British Railways*.

H. M. Re.—Henry M. Reed. Former Chairman of the Board and President, American Radiator and Standard Sanitary Corporation, New York, N.Y.

H. M. Ro.—Henry M. Robinson. Former Chairman of the Board of Security, First National Bank, Los Angeles, Calif.

H. M. S.—Henry Martin Snow. Former Agent-General, Cie des Wagons-Lits et des Grands Expresses Internationaux.

H. M. Sn.—Harris Martin Sullivan. Assistant Director, Research and Development, Central Scientific Co., Chicago, Ill.

H. M. St.—Henry Morse Stephens. Former Professor of History, University of California. Author of *History of the French Revolution*; etc.

H. M. T.—Horace Mann Towner. Former Governor of Puerto Rico.

H. M. V.—Herbert Millingchamp Vaughan. Formerly of Kettle College, Oxford. Author of *The Last of the Royal Stuarts*; *The Last Stuart Queen*; etc.

H. M. Wn.—Field Marshal Henry Maitland Wilson, 1st Baron Wilson. Head, British Joint Staff Mission, Washington, D.C., 1945-47. Supreme Allied Commander, Mediterranean Theatre, 1944.

H. N.—H. Nisbet. Textile technologist and consultant. Author of *Grammar of Textile Design*.

H. N. D.—Henry Newton Dickson. Former Professor of Geography, University College, Reading, England. Author of *Meteorology*; *Papers on Oceanography*; etc.

H. N. H.—Harry Nicholas Howard. Professor of History, Miami University, Oxford, O. Member of Board of Editors of *Journal of Modern History*. Author of *The Partition of Turkey*; *A Diplomatic History, 1913-1923*; etc.

H. Ni.—Hon. Harold Nicolson. A Governor of the B.B.C., 1941-46. Parliamentary Secretary to Ministry of Information, 1940-41. Member of Parliament for West Leicester, England, 1935-45. Author of *Paul Verlaine*; etc.

H. Nn.—Hoffman Nickerson. Major, U.S. Army (retired). Intelligence Section General Staff, G.H.Q., A.E.F., March-Dec. 1918. Author of *Warfare* (in collaboration with Colonels O. L. Spaulding and John W. Wright, U.S.A.); *Can We Limit War?*; *The Armed Horde, 1793-1939*.

H. N. P.—H. N. Perham. Commander (E), U.S. Coast Guard.

H. N. R.—Henry Norris Russell. Emeritus Research Professor of Astronomy, Princeton University. Author of *The Solar System and Its Origin*; etc. Co-author of *Astronomy*.

H. Nz.—Hans Nabholz. Honorary Professor, University of Zürich, Zürich, Switz. Author of *History of Switzerland Till 1516*; *History of Switzerland 1874-1914*; *Medieval Agrarian Society in Transition*.

H. O.—Hermann Oelsner. Former Taylorian Professor of the Romance Languages in Oxford University. Author of *Frederic Mistral*; *A History of Provençal Literature*; etc.

Ho. B.—Horatio Bond. Chief Engineer, National Fire Protection Association. Author of *Municipal Fire Administration*.

H. O. B.—Harry Oliver Buckman. Professor of Soil Technology, Cornell University. Co-author of *The Nature and Properties of Soils*; etc.

Ho. Bm.—Howard Bingham. Information Specialist, Office of Aviation Information, Civil Aeronautics Administration, Washington, D.C.

Ho. F.—Holden Furber. Associate Professor of History, University of Pennsylvania, Philadelphia, Pa., 1948-. Author of *Henry Dundas, 1st Viscount Melville 1742-1811*; etc.

Ho. Me.—Horst Mendershausen. Economist, Federal Reserve Bank of New York, N.Y. Author of *The Economics of War*; *Changes in Income Distribution during the Great Depression*.

H. Or.—Hilda Ormsby. Lecturer in Economic Geography, London School of Economics and Political Science.

H. Ow.—Hamilton Owens. Editor in Chief, the *Sun*-papers, Baltimore, Md. Author of *Baltimore on the Chesapeake*.

H. O. Y.—H. O. Yates. Director of Floriculture, Camden County Vocational School, Camden, N.J.

H. P.—Hans Przibram. Professor of Experimental Zoology, University of Vienna.

H. Pa.—Sir Harold George Parlett. Japanese Counsellor of H.M. Embassy in Tokyo, 1919-27. Former Assistant Japanese Secretary at H.M. Legation in Tokyo and Vice-Consul at Dairen, China. Joint compiler of *An English-Japanese Dictionary of the Spoken Language*.

H. Pal.—Howard Palmer. Assisted in organizing Mt. Logan Expedition to Alaska, 1925. Author of *Mountaineering and Exploration in the Selkirk; A Pioneer of the Canadian Alps*.

H. P. B.—Henry Penn Burke. President, National Association of Amateur Oarsmen, 1925–45. Chairman, American Olympic Rowing Committee, 1920, 1924, 1928, 1932 and 1936.

H. Pe.—Hayford Peirce. Specialist in Egyptian, Byzantine and Islamic art and art in the middle ages. Author (with Royall Tyler) of *Byzantine Art*.

H. P. F.—Henry Pratt Fairchild. Emeritus Professor of Sociology, New York University, New York, N.Y. Chairman, Department of Sociology, Graduate School of Arts and Science, New York University, 1938–45. Author of *Immigration; Outline of Applied Sociology*; etc. Editor of *Immigrant Backgrounds; The Obligation of Universities to the Social Order*.

H. P. H.—Henry Park Hollis. Assistant in the Royal Observatory, Greenwich, 1887–1920. Editor of *The Observatory Magazine*, 1893–1912.

H. P. Hu.—Hilda Phoebe Hudson. Former Lecturer and Fellow of Newnham College, Cambridge. Author of *Ruler and Compasses and Cremona Transformations in Plane and Space*.

H. Pi.—Henri Pirenne. Former Professor of Mediaeval History, University of Ghent, Belgium; Member of the Royal Academy of Belgium and the Institut de France. Author of *Histoire de Belgique*; etc.

H. P. J.—Henry Phelps Johnston. Former Professor of History, College of City of New York. Author of *Observations on Judge Jones's Loyalist History of the American Revolution; The Yorktown Campaign*; etc.

H. P. Js.—Hilger Perry Jenkins, M.D. Clinical Associate Professor of Surgery, College of Medicine, University of Illinois, Chicago, Ill. Author of *Terminology of Operations*.

H. P. K.—Harry P. Kelliher. Aviation writer, traveller and observer.

H. Pr.—Harry M. Prince. Supervising and Consulting Architect, New York City Housing Authority. Co-author of *Hotels; Planning and Furnishing Hotels*.

H. Ps.—Herman Pines. Division Coordinator, Universal Oil Products Company, Chicago, Ill. Research Assistant Professor of Chemistry, Northwestern University, Evanston, Ill.

H. P. St.—Hereward Philip Spratt. Deputy Keeper, Science Museum, London. Author of *Libraries for Scientific Research in Europe and America; Merchant Steamers and Motor-Ships; Outline History of Transatlantic Steam Navigation*.

H. P. V.—Hugh P. Vowles. Member of the American Academy of Political and Social Science.

H. P. Wk.—Herbert Percy Whitlock. Curator of Minerals and Gems, American Museum of Natural History, New York, N.Y., 1918–41. Author of *The Story of the Gems*; etc.

H. P. Wr.—Henry Paul Wheeler, Jr. Petroleum Engineer, United States Bureau of Mines, Washington, D.C.

H. Q.—Hugh Quigley. Economist and Chief Statistical Officer, Central Electricity Board, London, 1937–43. Author of *Electrical Power and National Progress; Housing and Slum Clearance in London* (with I. Goldie); *The Influence of English Philosophy and the Development of Aesthetics, Based on Imagination; A Plan for the Highlands*; etc.

H. R.—Sir Humphry (Davy) Rolleston, M.D. Physician in Ordinary to the King, 1923–36, and Physician Extraordinary to King George V, 1932–36. Consulting Physician to the Royal Navy, 1914–19. Author of *Clinical Lectures*; etc., and Co-editor (with Sir Clifford Allbutt) of second edition of *A System of Medicine*.

H. R. B.—Horace Robert Byers. Professor and Chairman of the Department of Meteorology, The University of Chicago. Author of *General Meteorology; Nonfrontal Thunderstorms*; etc.

H. Rd.—Herbert Read. Director, George Routledge and Sons, Ltd., Publishers. Assistant Keeper, Victoria and Albert Museum, London, 1922–31. Lecturer in Art, Liverpool University, 1935–36. Author of *The Meaning of Art; The Grass Roots of Art; Art and Society*; etc.

H. R. H.—Harry Reginald Holland Hall. Former Keeper of Egyptian and Assyrian Antiquities in the British Museum, London.

H. Ri.—Herbert Riehl. Associate Professor, Department of Meteorology, The University of Chicago, Chicago, Ill. Author of *Waves in the Easterlies and the Polar Front in the Tropics*.

H. R. M.—Henry R. Mussey. Former Professor of Economics, Wellesley College, Wellesley, Mass.

H. R. McI.—Henry Read McIlwaine. Former Librarian, Virginia State Library. Author of *The Struggle of Protestant Dissenters for Religious Tolerance in Virginia*; etc.

H. R. Mi.—Hugh Robert Mill. Rainfall Expert to Metropolitan Water Board, London, 1906–19. President, Royal Meteorological Society, 1907–08. Author of *Record of Royal Geographical Society*; etc.

H. Ro.—Herman Rosse. Architect, painter, lecturer.

H. R. T.—Harry Robert Tisdale. Director, United Dyewood Corp., Belleville, N.J.

H. R. W.—Rev. Hilary R. Werts, S.J. Prefect of Studies and Professor of Moral Theology, Alma College, Alma, Calif.

H. S.—Henri Eugène Sée. Former Professor of History in the University of Rennes, France.

H. S. A.—H. S. Altham. Assistant Master, Winchester College, England. Author of *History of Cricket*.

H. S. Bh.—Henry Simon Bloch. Chief of Section, Department of Security Council Affairs, United Nations, Lake Success, N.Y. Author of *La Théorie des Besoins de Carl Menger*; co-author of *Economics of Military Occupation*.

H. S. C.—Henry Seidel Canby. Chairman of the Board of Editors, the *Saturday Review of Literature*, New York, N.Y. Member of Department of English, Yale University. Chairman of the Board of Judges, Book-of-the-Month Club, 1926–. Author of *The Short Story in English; Literary History of the United States; Thoreau: A Biography; The Age of Confidence*; etc.

H. S. D.—Herbert Stanley Deighton. Fellow of Pembroke College, Oxford. Former Visiting Professor, Fuad Al-Awal University, Cairo, Egypt.

H. S. Di.—Harold S(heely) Diehl, M.D. Dean of the Medical Sciences and Professor of Public Health, University of Minnesota, Minneapolis, Minn. Author of *Healthful Living; A Textbook of Healthful Living*.

H. S. Dy.—Howard S. Dewey. Office of Public Information, Commander of Submarine Force, U.S. Atlantic Fleet.

H. S. F.—Herbert Sinclair Fairbank. Deputy Commissioner, Research, Public Roads Administration, Federal Works Agency, Washington, D.C. Editor, *Public Roads*, 1920–27.

H. Sg.—Haakon Shetelig. Emeritus Professor, University of Bergen, Bergen, Nor. Author of *Préhistoire de la Norvège; Scandinavian Archaeology*.

H. Sh.—Herman Shaw. Director and Secretary, London Science Museum, 1945–50; former Keeper, Department of Physics and Geophysics. Author of *Applied Geophysics: A Brief Survey of the Development of Apparatus and Methods Employed in the Investigation of Subterranean Structural Conditions and the Location of Mineral Deposits*.

H. S. H.—H. S. Harrison. Former Curator, The Horniman Museum, London.

H. S. Hd.—Herbert Spencer Harned. Professor of Chemistry, Yale University, New Haven, Conn. Author of *The Physical Chemistry of Electrolytic Solutions*.

H. S. H. S.—Henry Selby Hele-Shaw. Former Professor of Engineering, University of Liverpool, England.

H. Si.—Henry Sidgwick. Knightbridge Professor of Moral Philosophy, Cambridge University, 1883–1900. Author of *Outlines of the History of Ethics; Lectures on the Ethics*.

H. Sim.—Harry Simons. Former Technical Editor of *The Clothing Trade Journal*, New York, N.Y.

H. S. J.—Sir Henry Stuart-Jones. Principal of University College of Wales, Aberystwyth, 1927–34. Vice-Chancellor of the University of Wales, 1929–31. Former Camden Prof. of Ancient History, Oxford University.

H. S. Js.—Sir Harold Spencer Jones. Astronomer Royal, 1933–. President, British Horological Institute, 1939–. Author of *General Astronomy; Worlds Without End; Life on Other Worlds*.

H. S. K.—H. S. Kingsford. Former Assistant Secretary of the Society of Antiquaries, London.

H. S. Kn.—Hugh S. Knowles. President and Director of Research, Industrial Research Products, Inc., Franklin Park, Ill.

H. Sl.—Henri Speciael. Managing Director, Société Internationale d'Énergie Hydro-électrique.

H. S. L.—Herbert Sidney Langfeldt. Stuart Professor of Psychology and Director of Psychology Laboratory, Princeton University. Author of *The Aesthetic Attitude*; etc.

H. Sle.—Sir Henry Slessor. Member of Devon County Council. Lord Justice of Appeal, 1929–40. Author of *The Middle Ages in the West*; etc.

H. Sm.—Herbert Sidebotham. Formerly on editorial staff of *The Manchester Guardian*, Manchester, England. Author of *Pillars of the State*; etc.

H. S. M. C.—Harold Scott Macdonald Coxeter. Professor of Mathematics, University of Toronto, Toronto, Ont. Author of *The Real Projective Plane*; *Regular Polytopes*.

H. Sp.—Howard Spence. Managing Director, Peter Spence and Sons, Ltd., Manchester Alum Works.

H. S. P.—H. S. Pearson. Senior Assistant, Department of Zoology, University College, University of London.

H. Spe.—E. Harold Spender. Author of *A Briton in America*; *The Cauldron of Europe*; and biographies of David Lloyd George; etc.

H. Spr.—Harold Sprout. Professor of Politics in Princeton University. Co-author, with Margaret Tuttle Sprout, of *The Rise of American Naval Power, 1776-1918*; *Toward a New Order of Sea Power: American Naval Policy and the World Scene, 1918-1922*; etc.

H. S. Sh.—Harry S. Smith. Professor of Entomology, University of California, and Entomologist in the Agricultural Experiment Station, Riverside, Calif.

H. St.—Henry Sturt. Author of *Idola Theatri*; *The Idea of a Free Church*; *Personal Idealism*.

H. St. J. B. P.—Harry St. John Bridger Philby. Explorer in Arabia. Author of *The Heart of Arabia*; etc.

H. St. J. W.—Harold St. John Loyd Winterbotham. Brigadier, formerly with the Royal Engineers. Former General Secretary, International Geodetic and Geophysical Union. Author of *Ordnance Survey*; *A Key to Maps*; etc.

H. S. V.—Harry Shultz Vandiver. Professor of Pure Mathematics, University of Texas, Austin, Tex.

H. S. Vd.—Henry Serrano Villard. Deputy Director, Office of Near Eastern and African Affairs, U.S. Department of State, Washington, D.C., 1946- . Chief, Division of African Affairs, 1944-46.

H. Sw.—Henry Sweet. Author of *A History of English Sounds since the Earliest Period*; etc.

H. S. W.—Henry Seely White. Former Professor of Mathematics, Vassar College, Poughkeepsie, N.Y. Author of *Plane Curves of the Third Order*.

H. S. Wl.—Hubert Stanley Wall. Professor of Mathematics, University of Texas, Austin, Tex. Author of *Analytic Theory of Continued Fractions*.

H. T.—Henry Tetlow. Henry Tetlow Company Ltd., London.

H. T. A.—Herbert Thomas Andrews. Author of "The Commentary on Acts" in the *Westminster New Testament*; "The Apocryphal Books of the Old and New Testament," *Century Bible Handbooks*.

H. T. B.—Henry T. Bailey. Painter and illustrator. Former Director, the Cleveland School of Art and the John Huntington Polytechnic Institute. Author of *Art Education*; etc.

H. T. Be.—Herman Thompson Briscoe. Professor of Chemistry, Vice-President and Dean of the Faculties, Indiana University, Bloomington, Ind. Author of *General Chemistry for Colleges*; *Structure and Properties of Matter*.

H. T. D.—Harold Thayer Davis. Henry S. Noyes Professor of Mathematics and Chairman, Department of Mathematics, Northwestern University, Evanston, Ill. Author of *The Theory of Linear Operators*; etc.

H. Te.—Henry Taube. Associate Professor of Chemistry, The University of Chicago.

H. T. Es.—Harry Taylor Edwards. Senior Technologist, Bureau of Plant Industry, Soils, and Agricultural Engineering, U.S. Department of Agriculture, Washington, D.C., 1924-45.

Ht. F.—Herbert Filer. Partner of Filer, Schmidt & Co., New York, N.Y. Dealer in put and call options.

H. T. F.—Howard T. Francis. Supervisor, Electrochemistry Research, Metals Research Department, Armour Research Foundation, Illinois Institute of Technology, Chicago, Ill.

H. Th.—Huston Thompson. Former Chairman of Federal Trade Commission. Assistant Attorney General of United States, 1913-18. Author of *Co-Operative Marketing Abroad*; etc.

H. T. H.—Horace Terhune Herrick. Special Assistant to the Chief, Bureau of Agricultural and Industrial Chemistry, U.S. Department of Agriculture, Washington, D.C.

H. Tho.—Sir Henry Thomas. Former Principal Keeper of Printed Books in the British Museum, London.

H. T. M.—Hudson T. Morton. Standards Engineer, the Fafnir Bearing Company, New Britain, Conn. Author of *Textbook of Anti-Friction Bearings*.

H. To.—Henry Tonks. Former Professor of Fine Art in the University of London.

H. T. S.—Hugh Tempest Sheringham. Former Angling Editor of *The Field*. Author of *Elements of Angling*; *Coarse Fishing*; *Trout Fishing*; etc.

H. T. T.—Sir Henry Thomas Tizard. President of Magdalen College, Oxford, 1942-46.

Ht. W.—Hubert Walker. Manager, M. F. A. Sales Engineering Department, American-LaFrance-Foamite Corporation, Elmira, N.Y.

Hu. De.—Hubert Deschamps. Former French colonial governor. Professor at the École de la France d'Outremer and the Institut d'Études Politiques, University of Paris. Author of *Champlain*; *Madagascar*; *L'Union française*; etc.

Hu. S.—Hugh Shearman. Author of *Anglo-Irish Relations*; *Finland*; *Modern Ireland*; *Not an Inch, a Study of Northern Ireland*; *Ulster*.

H. U. S.—Harald Ulrik Sverdrup. Professor of Oceanography, University of California, and Director, Scripps Institution of Oceanography, La Jolla, Calif. Author of *Oceanography for Meteorologists*. Co-author of *The Oceans*; *Their Physics, Chemistry, and General Biology*.

H. Van D.—Henry Van Dyke, D.D. Professor of English Literature, 1900-23, Princeton University. Author of *The Spirit of America*; etc.

H. V. B. K.—Hibberd Van Buren Kline, Jr. Assistant Professor of Geography, Syracuse University, Syracuse, N.Y.

H. V. L.—Harold Victor Livermore. Educational Director, Hispanic and Lusobrazilian Council, London. Author of *A History of Portugal*.

H. V. T.—Harold Victor Taylor. Senior Educational and Advisory Officer, Ministry of Agriculture and Fisheries, London. Author of *The Apples of England*.

H. W. A.—Heinz Wolfgang Arndt. Professor of Economics, Canberra University College, Canberra, Austr. Author of *The Economic Lessons of the Nineteen-Thirties*.

H. W. B.—H. W. Bartleet. Writer on motoring and cycling topics.

H. W. Bea.—Henry Walter Bearce. Chief, Division of Weights and Measures, Bureau of Standards, Washington, D.C., 1940-45. Author of *A Fundamental Basis for Measurements of Length*; etc.

H. W. B. J.—Horace W. B. Joseph. Lecturer in Philosophy, Oxford University, 1927-32.

H. W. Bl.—Herbert William Blunt. Student, Tutor and Librarian, Christ Church, Oxford.

H. W. C.—Harvey Wiley Corbett. Lecturer in Architecture, Columbia University.

H. W. C. Br.—Harris Warren C. Browne. Editor and publisher, *The National Lithographer*, New York, N.Y.

H. W. C. D.—Henry William Carless Davis. Former Director, *Dictionary of National Biography*. Former Regius Professor of Modern History and Fellow and Tutor of Balliol College, Oxford. Fellow of All Souls, Oxford, 1895-1902.

H. W. F.—Sir Howard Walter Florey. Professor of Pathology, Oxford University. Nobel Prize for Medicine and Physiology, 1945.

H. W. G.—H. W. Griffin. Superintending Clerk, Board of Trade. First General Secretary, National Maritime Board.

H. W. Ga.—Heathcote William Garrod. Former Professor of Poetry, Oxford University. Author of *Wordsworth: Lectures and Essays*; *The Profession of Poetry*; *Byron*; etc.

H. W. Gn.—Howard Wright Gordon, Jr. Lieutenant Commander, U.S. Navy, Public Relations Branch.

H. W. H.—Hope W. Hogg. Former Professor of Semitic Languages and Literatures in the University of Manchester, England.

H. W. Hk.—Howard W. Hopkirk. Senior Consultant, Child Welfare League of America. Author of *Institutions Serving Children*.

H. W. H. K.—Henry William Howard Knott. Former Lecturer at the Law School of the University of Manitoba, Winnipeg, Canada.

H. Wit.—Hartley Withers. Editor of *The Economist*, London, 1916-21. Director of Financial Enquiries in the Treasury, 1915-16. Author of *Money*; *International Finance*; etc.

H. W. K.—Henry Wilder Keyes. U.S. Senator, 1919-37. Governor of New Hampshire, 1917-19.

H. W. L. E.—Herbert Walter Lloyd Evans. Former Superintendent of the Royal Mint (retired, 1939).

H. W. M.—Horace Winchell Magoun. Professor of Anatomy, School of Medicine, University of California, Los Angeles, Calif.

H. Wn.—Walter Hugh John Wilkinson. Former British Envoy at the Court of Nepal, India.

H. Wo.—Humbert Wolfe. Poet. Author of *London Sonnets*; *Cursory Rhymes*; *Humoresque*; etc.

H. W. P.—H. W. Parker. Keeper of Zoology, British Museum (Natural History), London.

H. W. Ph.—Henry Willis Phelps. Former Chairman of the Board of Directors, American Can Company.

H. W.—Harry Wexler. Chief, Division of Special Scientific Services, Weather Bureau, U.S. Department of Commerce, Washington, D.C.

H. W. R.—Rev. Henry Wheeler Robinson, Hon. D.D. Principal of Regent's Park College, Oxford, 1920-42. Author of *The Religious Ideas of the Old Testament*; etc.

H. Ws.—Howell Williams. Chairman, Department of Geological Sciences, University of California, Berkeley, Calif. Author of *Crater Lake: The Story of Its Origin*; co-author of *Methods in Geological Surveying*.

H. W. S.—Henry Wickham Steed. Lecturer on Central European History, King's College, University of London, 1925-38. Proprietor and Editor of *The Review of Reviews*, 1923-30. Editor of *The Times*, London, 1919-22. Author of *The Antecedents of Post-War Europe*; etc.

H. W. Sh.—Homer W. Smith. Professor of Physiology, New York University College of Medicine, New York, N.Y. Author of *The Kidney—Structure and Function in Health and Disease*.

H. W. Sr.—Herbert Wallace Schneider. Professor of Philosophy, Columbia University, New York, N.Y. Author of *Making the Fascist State: The Fascist Government of Italy*; *The Puritan Mind*.

H. W. Ss.—Henry W. Sams. Associate Professor of English and Director of the Summer Quarter, The University of Chicago. Author of *Problems in Reading and Writing*.

H. W. W.—Herbert Wrigley Wilson. Former Assistant Editor of *The Daily Mail* and Director of Associated Newspapers, Ltd. Author of *Ironclad, in Action*; etc.

H. W. Ws.—Harry Warren Wells. Physicist and Radio Engineer, Ionospheric Section, Department of Terrestrial Magnetism, Carnegie Institution of Washington, D.C.

H. W. W. Wil.—Sir Herbert William W. Wilberforce. Deputy Chairman of the County of London Sessions, 1926-38. Metropolitan Police Magistrate, 1914-26.

H. Y.—Sir Henry Yule. British Orientalist. Author of *Cathay and the Way Thither*; *The Book of Ser Marco Polo*.

I. A.—Israel Abrahams. Former Reader in Talmudic and Rabbinic Literature in Cambridge University. Author of *A Short History of Jewish Literature*; etc.

I. A. R.—Irma A. Richter. Artist and writer.

I. B.—Irving Brown. Former Assistant Professor of Romance Languages, Columbia University. Author of *Nights and Days on the Gypsy Trail*; *Gypsy Fires in America*.

I. B. B.—Sir Isaac Bayley Balfour, M.D. Former King's Botanist in Scotland, Regius Keeper of Royal Botanic Garden, Edinburgh, and Professor of Botany in the University of Edinburgh, Scot.

I. B. C.—I. Bernard Cohen. Instructor in Physics, Harvard University, 1941-. Author of *Benjamin Franklin's Experiments*; etc.

I. B. J.—Iral Brown Johns. Assistant Central Research Director, Monsanto Chemical Company, Dayton, O. Author of *Laboratory Manual of Microchemistry*.

I. B. K.—Irving B. Kravis. Assistant Professor of Economics, Wharton School of Finance and Commerce, University of Pennsylvania, Philadelphia, Pa.

I. Br.—Ivor Brown. Editor of *The Observer*. Director of Drama, Council for Encouragement of Music and the Arts, 1940-42. Shute Lecturer in the Art of the Theatre, Liverpool University, Liverpool, England, 1926. Author of *Now on View*; etc.

I. D.—Isaac Deutscher. Author of *Soviet Trade Unions*; *Stalin: A Political Biography*.

I. D. A.—Ira D. Anderson. Professor of Marketing and Chairman of the Marketing Department, Northwestern University School of Commerce, Evanston, Ill. Author of *Principles of Retailing*.

I. E. L.—Isabel Ely Lord. Editor and consultant. Author of *Getting Your Money's Worth*; Editor of *Everybody's Cookbook*.

I. E. M.—Irving E. Muskat. Director of Research, Vulcan Detinning Company, Seawaren, N.J.

I. F. D. M.—Ian F. D. Morrow. Former Senior Moderator, Trinity College, Dublin.

I. F. H.—Irving F. Hand. In Charge, U.S. Weather Bureau Solar Radiations Investigations, Blue Hill Observatory, Milton, Mass.

I. F. Hn.—I. Forest Huddleson. Research Professor, Michigan State College, East Lansing, Mich. Author of *Brucellosis in Man and Animals*.

I. Fr.—Sir Ian Fraser. Chairman of the Executive Council, St. Dunstan's (1921-). Member of the Executive Council, National Institute for the Blind. Governor, British Broadcasting Corporation (1947-46). Author of *Whereas I Was Blind*.

I. F. S.—Isabelle Florence Story. Former Chief of Information, National Park Service, U.S. Department of the Interior.

I. Fx.—Irving Fox. Assistant Professor of Entomology, School of Tropical Medicine, University of Puerto Rico, San Juan, P.R., and Columbia University. Author of *The Fleas of Eastern United States*; etc.

I. G.—Sir Israel Gollancz. Former Fellow and Secretary of the British Academy. Former Professor of English Language and Literature in the University of London.

I. Gg.—Isaac Gregg. Director of Press Relations, Office of the Postmaster General, Washington, D.C.

I. Gh.—Isidore Gersh. Professor of Anatomy, The University of Chicago.

Ig. M.—Ignazio Mormino. Director of the Banco di Sicilia.

I. Gy.—Ian Grey. Secretary to the Council, Royal Institute of International Affairs, London.

I. H.—Isaac Husik. Former Professor of Philosophy, University of Pennsylvania, Philadelphia, Pa. Author of *A History of Mediaeval Jewish Philosophy*; etc.

I. H. C.—Irving H. Crowne. Chief Engineer, Splitdorf-Bethlehem Electric Company, Newark, N.J. Author of *Theory of A.C. Circuits*.

I. H. F.—Irvin H. Fullmer. Senior Physicist, National Bureau of Standards, U.S. Department of Commerce, Washington, D.C.

I. H. H.—Ida Husted Harper. Author, *Life and Work of Susan B. Anthony*. Co-author, *History of Women's Suffrage*.

I. Hk.—Ives Hendrick, M.D. Instructor, Harvard Medical School, Cambridge, Mass. Author of *Facts and Theories of Psychoanalysis*; *Practitioner System of Medicine*; *Psychoanalysis*.

I. H. L.—Isaac H. Levin. Technical Director, Gas Industries Company, Pittsburgh, Pa. Honorary member, Gas Products Association.

I. J. C.—Isaac Joslin Cox. Emeritus Professor of History, Northwestern University, Evanston, Ill. Author of *Nicaragua and the United States*; etc.

I. J.-Ce.—Irène Joliot-Curie. Professor of General Physics and Radioactivity, University of Paris, France. Director of the Curie Laboratory. Commissioner for Atomic Energy. Co-winner of the Nobel Prize for Chemistry, 1935. Author of *Les Radioéléments naturels*; etc.

I. J. Ct.—Ira Judson Condit. Associate Professor of Subtropical Horticulture, University of California, and Associate Subtropical Horticulturist, Citrus Experiment Station, Riverside, Calif.

I. J. F.—Iler J. Fairchild. Secretary, Enameled Cast Iron Plumbing Fixtures Association and Vitreous China Plumbing Fixtures Association. Author of *The Grade Terminology Problem*; *Holding Power of Wood Screws*.

I. J. T.—Irene Joan Thirsk. Senior Research Fellow in Agrarian History, University College of Leicester, Leicester, Eng. Author of *Fenland Farming in the Sixteenth Century*.

I. L. Bl.—Irene L. Blunt. Secretary, The National Federation of Textiles, Inc., New York, N.Y.

I. L. G.—Iva Lillian Giachardi. Research Assistant, Foreign Office, London.

I. L. K.—Isaac Leon Kandel. Emeritus Professor of Education, Teachers College, Columbia University. Author of *Elementary Education in England*; *Federal Aid for Vocational Education*; etc.

I. McQ.—Irvine McQuarrie, M.D. Professor and Head of the Department of Pediatrics, University of Minnesota, Minneapolis, Minn. Author of *The Experiments of Nature and Other Essays*.

I. M. L.—I. M. Labovitz. Group Head, Fiscal Division, U.S. Bureau of the Budget, Washington, D.C.

I. M. St.—I. M. Stainback. Governor of Hawaii.

I. N. G.—Ira Noel Gabrielson. President, Wildlife Management Institute. Former Director, Fish and Wildlife Service, U.S. Department of the Interior, Washington, D.C. Author of *Wildlife Conservation*; *Wildlife Refuges*; etc.

I. R.—Irving Rappaport. Director, the Long Island College Hospital, Brooklyn, N.Y.

I. R. Wh.—Irma Lenore Reed White. Free-lance writer.

I. S.—I. Schapera. Lecturer in Anthropology, London School of Economics and Political Science.

I. S. R.—I. S. Ravdin, M.D. Director, Harrison Department of Surgical Research, and John Rhea Barton Professor of Surgery, School of Medicine, University of Pennsylvania, Philadelphia, Pa. Author of *American Edition of Kirschner's Operative Surgery*.

I. S. S.—Ivan Stephan Sokolnikoff. Professor of Mathematics, University of California, Los Angeles, Calif. Chief Technical Aide, Applied Mathematics Panel, National Defense Research Committee, Office of Scientific Research and Development, 1944-45. Author of *Higher Mathematics for Engineers and Physicists*; *Advanced Calculus*; etc.

I. W. S.—**I. W. Shklovsky.** Author, *Literary Characteristics*; etc.

J. A.—**Rt. Hon. Sir John Anderson.** Chancellor of the Exchequer, 1943-45. Secretary, Ministry of Shipping, 1917-19. Permanent Undersecretary of State, Home Office, 1922-32. Governor of Bengal, 1932-37.

J. Ab.—**Jesse P. Abramson.** Sports writer, *New York Herald Tribune*, New York, N.Y.

J. A. B.—**James Alexander Beattie.** Professor of Physical Chemistry, Massachusetts Institute of Technology, Cambridge, Mass., 1938-

Ja. Br.—**James Brewster.** Connecticut State Librarian.

J. A. Br.—**James A. Baker, D.V.M.** Director, Veterinary Virus Research Institute, Snyder Hill New York State Veterinary College, Cornell University, Ithaca, N.Y.

J. A. Bw.—**Joseph A. Bourdow.** Assistant Editor, *Officer's Call*, Troop Information and Education Division, U.S. Department of the Army.

J. A. C.—**Sir Joseph Archer Crowe.** English consular officer and art critic. Author (with Cavalcaselle) of *Early Flemish Painters*; etc.

J. A. Ca.—**John Anthony Carroll.** Professor of Natural Philosophy, University of Aberdeen, Scotland, 1930-45. Assistant Director, Solar Physics Observatory, Lecturer in Astrophysics, Cambridge University, 1924-30.

J. A. Co.—**Jay Allen Cassino.** Special Consultant on Public Relations to the Secretary, U.S. Department of the Army, and to the Chief of Staff, Washington, D.C.

J. A. D.—**James A. Dunnage.** Author of *How to Import Goods*; *The Importer's Handbook*; etc.

J. A. E.—**Sir (James) Alfred Ewing.** Principal and Vice-Chancellor of Edinburgh University, Scotland, 1916-29. Professor of Mechanism and Applied Mechanics in Cambridge University, 1890-1903. President of the Royal Society of Edinburgh, 1924-29. Author of *Thermodynamics for Engineers*; *The Steam Engine and Other Heat Engines*; *Magnetic Induction in Iron and Other Metals*; etc.

J. A. Ed.—**Sir John Augustine Edgell.** Vice-Admiral, R.N. (retired). Admiralty Representative on the Port of London Authority. Hydrographer of the Royal Navy, 1932-45.

J. A. F.—**Sir John Ambrose Fleming.** Former consulting electrical engineer. Professor in University College, University of London, 1885-1926. Author of *The Principles of Electric Wave Telegraphy and Telephony*; etc.

J. A. Fa.—**James A. (ugustine) Farrell.** President of the United States Steel Corporation, New York, N.Y., 1911-32.

J. A. F.-M.—**John Alexander Fuller-Maitland.** Author of *Life of Robert Schumann*; *The Musician's Pilgrimage*; *Masters of German Music*; etc.

Ja. G. M.—**James Grier Miller, M.D.** Chairman and Professor, Department of Psychology, The University of Chicago, Chicago, Ill. Author of *Unconsciousness*.

Ja. H.—**James Hillier.** Research Physicist in charge of Electron Microscope Research, RCA Laboratories, Princeton, N.J.

J. A. H.—**John Allen Howe.** Former Assistant Director, Geological Survey, England. Author of *The Geology of Building Stones*; *Stones and Quarries*; etc.

Ja. Hn.—**James Hogan.** Professor of History, University College, Cork, Ire. Editor of *Analecta Hibernica*. Author of *Election and Representation*; *Ireland in the European System*; *The Irish Law of Kingship*.

J. A. K.—**Julius A. Krug.** Secretary, U.S. Department of the Interior, Washington, D.C., 1946-49.

J. Al.—**John Allan.** Keeper, Department of Coins and Medals, British Museum, London, 1931-. Vice-President, Royal Archaeological Institute.

J. A. Lo.—**John Avery Lomax.** Vice-President, Republic National Company, Dallas, Texas, 1925-32. President, American Folklore Society, 1912-13. Associate editor, *Southwest Review*, 1943-. Author of *Cowboy Songs*; etc.

J. A. M.—**James Alexander Manson.** Author of *The Bowler's Handbook*; etc.

J. A. Mi.—**John Anderson Miller.** Editor, *Transit Journal*, 1930-42.

J. A. P.—**James Alexander Paterson, D.D.** Former Professor of Hebrew and Old Testament Exegesis, New College, Edinburgh, Scot. Author of *The Period of the Judges*; Translator of Schultz's *Old Testament Theology*.

J. A. R.—**James Alexander Robertson.** Archivist, Hall of Records, Annapolis, Md., 1935-39. Professor of American History, John B. Stetson University, De Land, Fla., 1923-33. Co-editor of Blair and Robertson's *The Philippine Islands*.

J. A. R. M.—**Sir John Arthur Ransome Marriott.** Honorary Fellow, former Fellow and Lecturer of Worcester College, Oxford. Author of *The Remaking of Modern Europe*; etc.

J. A. Ry.—**John Alfred Ryle, M.D.** Professor of Social Medicine, Oxford University, 1943-50. Physician Extraordinary to the King. Regius Professor of Physic, Cambridge University, 1935-43.

J. A. S.—**John Addington Symonds.** Author of *Renaissance in Italy*; etc.

J. A. Sc.—**J. A. Scott, M.D.** Deputy Medical Officer of Health and Deputy School Medical Officer, London County Council, London, Eng. Author of *The National Health Service Act, 1946*; etc.

J. A. Si.—**Judith Ann Silburn.** Former Trade Investigator, Ministry of Labour, London.

J. A. Sk.—**Julian A. Steyermark.** Curator of the Herbarium, Department of Botany, Chicago Natural History Museum, Chicago, Ill. Author of *Contributions to the Flora of Venezuela*; *Spring Flora of Missouri*; co-author of *Flora of Guatemala*.

J. A. Sm.—**John Alexander Smith.** Former Waynflete Professor of Moral and Metaphysical Philosophy, Oxford University.

J. A. Sp.—**J. Alfred Spender.** Editor of the *Westminster Gazette*, 1896-1922; author of *Fifty Years of Europe*; *A Short History of Our Times*; etc.

J. A. Sr.—**Joseph Alois Schumpeter.** Former Professor of Economics, Harvard University. Author of *The Theory of Economic Development*; etc.

J. A. S. R.—**John Anthony Sydney Ritson.** Professor of Mining in the University of London at the Royal School of Mines, Imperial College, London.

J. A. St.—**James Andrew Strahan.** Former Professor of Jurisprudence, University of Belfast; Reader of Equity, Inns of Court, London, 1897-1929. Author of *The Bench and Bar of England*; etc.

J. A. S. W.—**James A. Scott Watson.** Chief Scientific and Agricultural Adviser to Ministry of Agriculture and Director-General, National Agricultural Advisory Service, 1948-. Sibthorpe Professor of Rural Economy, Oxford University, 1925-44. Editor of *Journal of Royal Agricultural Society*, 1931-45. Agricultural Attaché, British Embassy, Washington, D.C., 1942-44. Co-author of *Farm Live Stock of Great Britain*; etc.

J. A. T.—**John Aiton Todd.** Special Officer (Jute), Government of Bengal, India. Author of *The Cotton World*.

J. A. Th.—**Sir John Arthur Thomson.** Regius Professor of Natural History in the University of Aberdeen, Scotland, 1890-1930. Gifford Lecturer, St. Andrews, Scotland, 1915. Terry Lecturer, Yale University, 1924. Author of *The Study of Animal Life*; *Outlines of Zoology*; *Heredity*; etc.

J. A. To.—**James Alner Tobey.** Director of Nutrition, American Institute of Baking, 1937-43. Lecturer on public health law, Massachusetts Institute of Technology, Yale School of Medicine, Harvard School of Public Health, and Columbia University. Associate editor of *American Journal of Public Health*. Author of *The National Government and Public Health*.

J. A. Tr.—**James A. Tower.** Associate Professor of Geography, Birmingham-Southern College, Birmingham, Ala., 1936-. Instructor, American University of Beirut, Lebanon, 1928-31.

J. Ay.—**Joseph Anthony.** Public relations consultant, journalist and editor.

J. B.—**John Brownlee, M.D.** Director of Statistics, National Institute for Medical Research, London.

J. Ba.—**Jean Babelon.** Keeper, Department of Coins and Medals in the Bibliothèque Nationale, Paris, 1937-. Chief Editor of the *Gazette des Beaux-Arts*, 1928-39.

J. Bai.—**Jacques Bainville.** Former Editor of the monthly review, *Action Française*. Author of *Histoire de France*; etc.

J. Bar.—**Sir Joseph Barcroft, M.D.** Former Lecturer, King's College, Cambridge. Professor of Physiology, Cambridge University, 1926-37. Fullerian Professor of Physiology, Royal Institution, 1923-26. Former Director of Unit of Animal Physiology (Agricultural Research Council). Author of *The Respiratory Function of the Blood*; etc. Editor of the sixth edition of Huxley's *Physiology*. Co-editor of the *Cambridge Comparative Physiology*.

J. B. B.—**John Bagnell Bury.** Regius Professor of Modern History, Cambridge University, 1902-27; Regius Professor of Greek, Trinity College, Dublin, 1898-1902. Author of *History of the Roman Empire 27 B.C.-180 A.D.*; etc. Editor of Gibbon's *Decline and Fall of the Roman Empire* (1896-1900).

J. B. Ba.—**Sir James B. Baillie.** Vice-Chancellor, University of Leeds, England, 1924-38. Professor of Moral Philosophy, University of Aberdeen, Scotland, 1902-24.

J. B. Bi.—**Joseph Bucklin Bishop.** Former Secretary to the Panama Canal Commission. Author of *The Panama Gateway*; etc.

J. B. C.—**J. B. Crane.** Former Mechanical Engineer, Combustion Engineering Company, Inc., New York, N.Y.

J. B. Ce.—**John B. Condliffe.** Professor of Economics, University of California, Berkeley, Calif. Author of *The Commerce of Nations*; *The Reconstruction of World Trade*.

- J. Bf.**—**J. Badeff.** Dramatic Adviser at the National Theatre, Bulgaria.
- J. B. F.**—**John B. Firth.** Author of *Augustus Caesar*; *Constantine the Great*; etc.
- J. B. Fh.**—**James Burgess Fitch.** Professor and Chief of the Dairy Division, University of Minnesota, Department of Agriculture, St. Paul, Minn.
- J. B. Fo.**—**John B. Foster.** Former Editor of *Spalding's Official Base Ball Guide*, New York, N.Y. Author of *A History of National Association of Professional Base-Ball Leagues*.
- J. B. G.**—**James Bert Garner.** Professor and Senior Fellow, Mellon Institute of Industrial Research, Pittsburgh, Pa. Former Director of Research for Hope and affiliated natural gas companies.
- J. B. H.**—**James Brents Hill.** President of the Louisville and Nashville Railroad Company, Louisville, Ky., 1934-50.
- J. B. Hr.**—**John B. Heffernan.** Rear Admiral, U.S. Navy (retired). Director of Naval History (Op-29), Office of the Chief of Naval Operations, U.S. Department of the Navy, Washington, D.C.
- J. B.-J.**—**John Buettner-Janusch.** National Science Foundation Fellow in Anthropology, The University of Chicago.
- J. B. Jl.**—**James Byssie Joll.** Fellow of St. Antony's College, Oxford. University Lecturer in Modern History, Oxford University. Joint Editor in Chief, *Documents on German Foreign Policy*.
- J. B. Kr.**—**Joseph B. Kirsner, M.D.** Professor of Medicine, The University of Chicago.
- J. Bl.**—**Joshua Bloch.** Chief of the Jewish Division, New York Public Library, New York, N.Y.
- J. B. L.**—**John Barger Leighly.** Professor of Geography, University of California, Berkeley, Calif., 1943-. Meteorologist, United States Army Air Forces Weather Service, 1944-46. Councillor, American Meteorological Society, 1937-39.
- J. B. Mu.**—**James Bass Mullinger.** Former Lecturer in History, St. John's College, Cambridge. Author of *History of the University of Cambridge*; etc.
- J. B. P.**—**J. B. Pearman.** Author of *Heel-and-Toe Walking*.
- J. B. Pr.**—**John Boynton Priestley.** Author and journalist. United Kingdom delegate to U.N.E.S.C.O.
- J. B. Ps.**—**James Bayard Parsons.** Associate Professor of Chemistry, The University of Chicago. Co-author of *The Study of the Physical World*.
- J. Br.**—**Sir John Brown.** Lieutenant General. Deputy Director-General of Territorial Army, 1937-39. Director-General of Territorial Army and Inspector-General of Welfare and Education, War Office, England, 1940-41.
- J. B. R.**—**John Bernard Reeside, Jr.** Chief, Section of Paleontology and Stratigraphy, U.S. Geological Survey, Washington, D.C.
- J. Bry.**—**James Bryce, 1st Viscount Bryce.** Statesman, jurist and author. Author of *The American Commonwealth*; etc.
- J. B. Se.**—**John B. Spore.** Editor, *Combat Forces Journal*.
- J. B. S. H.**—**John Burdon Sanderson Haldane.** Professor of Biometry, University College, University of London. Fullerton Professor of Physiology, Royal Institution, 1930-32; Professor of Genetics, University of London, 1933-37. Author of *Animal Biology* (with J. S. Huxley); *The Causes of Evolution*; etc.
- J. Bt.**—**James Bartlett.** Former Lecturer on Construction, Architecture, Sanitation, Quantities, etc., King's College, University of London. Author of *Quantities*.
- J. B. T.**—**John Brande Trend.** Professor of Spanish, Cambridge University. Author of *A Picture of Modern Spain*; *Alfonso the Sage*; etc.
- J. B. van U.**—**J. Blan van Urk.** Author of *The Story of American Foxhunting and Little Charlie, The Fox*.
- J. B. Wa.**—**John Barker Waite.** Professor of Law, University of Michigan, Ann Arbor, Mich. Author of *Patent Law*; etc.
- J. C.**—**John Cadman, 1st Baron Cadman.** Former Professor, Birmingham University, Birmingham, England; Chairman, Anglo-Iranian Oil Company; Consulting Petroleum Adviser, H.M. Government.
- J. C. A.**—**James Coats Auchincloss.** Congressman. Former President, The Better Business Bureau of New York, N.Y.
- J. Car.**—**Jacques Cartier.** Chairman of Cartier, Ltd.
- J. C. B.**—**J. C. Brooke.** Squadron Leader, R.A.F. Attached British Naval Mission, Ministry of Marine, Athens.
- J. C. Br.**—**John Christian Bailar, Jr.** Professor of Chemistry and Secretary of the Chemistry Department, University of Illinois, Urbana, Ill.
- J. C. Bt.**—**John C. Bisset.** Chairman, Billiards Association and Control Council. Editor of the *Billiard Player*, London.
- J. C. By.**—**John Cary Bellamy.** Former Assistant Professor of Meteorology, The University of Chicago.
- J. C. D.**—**Jack Cecil Drummond.** Adviser on Nutrition, Control Commissions for Germany and Austria (British Element), 1945-46. Professor of Biochemistry, University College, University of London, 1922-45.
- J. C. E.**—**James Chidester Egbert.** Professor of Latin, 1906-42, and Director, University Extension, 1910-42, Columbia University. General Editor of Macmillan's Series of Latin Classics. Author of *Introduction to the Study of Latin Inscriptions*; etc.
- J. C. Em.**—**John C. Emison.** Vice-President and Treasurer, American Smelting and Refining Company, New York, N.Y.
- J. C. G. J.**—**J. C. Griffith Jones.** Journalist and broadcaster. Welsh Correspondent, the *Observer*, London.
- J. C. H.**—**Rt. Rev. John Cuthbert Hedley, O.S.B., D.D.** Former R.C. Bishop of Newport, England. Author of *The Holy Eucharist*; etc.
- J. C. Hr.**—**Jerome Clarke Hunsaker.** Professor of Aeronautical Engineering, Massachusetts Institute of Technology, Cambridge, Mass. Co-author of *Engineering Applications of Fluid Mechanics*.
- J. Ck.**—**James Chadwick.** Professor of Physics, University of Liverpool, England. Author of *Radiations from Radioactive Substances*; etc.
- J. C. M.**—**Jonathan Campbell Meakins, M.D.** Former Professor of Medicine, McGill University, Montreal, Que. Author of *Practice of Medicine*; *Symptoms in Diagnosis*.
- J. C. Ma.**—**James Clerk Maxwell.** Author of *Electricity and Magnetism*; *On Faraday's Lines of Force*.
- J. C. Mr.**—**Jacob Conrad Meyer.** Associate Professor of History, Western Reserve University, Cleveland, O. Author, *Church and State in Massachusetts from 1740 to 1833*.
- J. C. Ms.**—**J. Clyde Marquis.** American Representative and Vice-President, International Institute of Agriculture, Rome, Italy, 1935-41. Former Director of Economic Information, U.S. Department of Agriculture.
- J. C. My.**—**Rev. John Courtney Murray, S. J.** Editor, *Theological Studies*.
- J. C. Ns.**—**Joseph C. Nichols.** Sports Department, the *New York Times*.
- J. C. O.**—**James C. Olson.** Superintendent, Nebraska State Historical Society. Author of *J. Sterling Morton*.
- J. C. Os.**—**John Clyde Oswald.** Former President of the New York Employing Printers Association, Inc. Former Editor of *The American Printer*.
- J. C. S.**—**John C. Sacks.** Captain, formerly with the Northampton Regiment, Lecturer to the Draper's Summer School, Cambridge, 1926. Author of *Furs and the Fur Trade*.
- J. C. Sh.**—**James C. Shaw.** Commander, U.S.N. Naval Historian, U.S. Naval War College, Newport, R.I. Former Instructor in Strategy and Tactics, U.S. Naval General Line School, Monterey, Calif.
- J. C. Sm.**—**James Cruickshank Smith.** Former Senior Chief Inspector of Schools in Scotland, 1927-32. Editor of Spenser's *Faerie Queen* and (with Professor E. de Selincourt) of Spenser's *Poetical Works*.
- J. C. Smu.**—**Jan Christiaan Smuts.** Field Marshal. Prime Minister and Minister of External Affairs and Defense of South Africa, 1939-48. Author of *Holism and Evolution*; *Plans for a Better World*; etc.
- J. C. Van D.**—**John Charles Van Dyke.** Professor of the History of Art, Rutgers College, New Brunswick, N.J., 1889-1932. Former Editor, *Studio and Art Review*. Author of *Art for Art's Sake*; *History of Painting*; etc.
- J. C. W.**—**Sir John Charles Walton.** Deputy Undersecretary of State for Burma, 1942-46. Assistant Undersecretary of State for India, 1936.
- J. C. We.**—**James Claude Webster.** Barrister-at-Law, Middle Temple.
- J. C. Wn.**—**John Clare Whitehorn, M.D.** Henry Phipps Professor of Psychiatry and Director of the Department of Psychiatry, The Johns Hopkins University, Baltimore, Md. Psychiatrist in Chief, The Johns Hopkins Hospital, Baltimore, Md.
- J. C. Wr.**—**John Christian Wenger.** Assistant Professor of Bible and Philosophy, Goshen College, Goshen, Ind. Treasurer, The Mennonite Historical Society of Goshen College. Associate Editor, *The Mennonite Quarterly Review*. Author of *History of the Mennonites of the Franconia Conference*; *Glimpses of Mennonite History*.
- J. C. W. R.**—**John Charles Walsham Reith, 1st Baron of Stonehaven.** Captain, R.N.V.R. Director of Combined Operations Material Department, Admiralty, 1943. Director-General, British Broadcasting Corporation, 1927-38. Chairman, Imperial Airways, Ltd., 1938-39. First Chairman of British Overseas Airways Corporation, 1939-40. Minister of Information, 1940.

J. Da.—Rev. James Davies. Former Head Master of Ludlow Grammar School and Prebendary of Hereford Cathedral, England. Translated classical authors for Bohn's "Classical Library." Author of volumes in Collins' *Ancient Classics for English Readers*.

J. D. B.—James David Bouchier. Former Correspondent of *The Times*, London, in southeastern Europe.

J. D. Be.—John Desmond Bernal. University Professor of Physics, Birkbeck College, University of London, 1938—. Assistant Director of Research in Crystallography, Cambridge University, 1934–37.

J. D. Bl.—John Donald Black. Professor of Economics, Harvard University, 1927—. Chief Economist, Federal Farm Board, 1931–32. Consulting Economist, U.S. Department of Agriculture, 1937–40; War Food Administration, 1943; Tennessee Valley Authority, 1940—. Former Professor of Agricultural Economics and Chief of the Division, University of Minnesota, Minneapolis, Minn. Author of *Agricultural Reform in the United States*; etc.

J. D. F.—John Donnelly Fage. Senior Lecturer and Head of the Department of History, University College of the Gold Coast, Achimota, Gold Coast.

J. D. H.—John Donald Hicks. Morrison Professor of American History, University of California, 1942—. Professor of History, 1932–42, and Chairman, Department of History, 1938–42, University of Wisconsin, Madison. Author of *The American Nation*; etc.

J. D. Hd.—Joseph Douglas Hood. Associate Professor of Biology, Cornell University, Ithaca, N.Y.

J. D. H. D.—Joseph Désiré Hubert Donnay. Professor of Crystallography and Mineralogy, The Johns Hopkins University, Baltimore, Md. Author of *Spherical Trigonometry After the Cesàro Method*.

J. D. L.—James Douglas Lambert. Foreign Office Research Department, London. Author of *The Overbureaucratic Characters; Parliament in Debate*.

J. D. M.—John David Mabbott. Tutor and Lecturer in Philosophy, St. John's College, Oxford. Author of *The State and the Citizen*.

J. D. M. S.—J. D. Main Smith. Former Research Assistant to the Professor of Chemistry, University of Birmingham, England, and Examiner in Chemistry, University of London. Author of *Chemistry and Atomic Structure*; etc.

J. D. Pr.—John Dyneley Prince. Former Professor of East European Languages at Columbia University.

J. Dr.—James Drever. Emeritus Professor of Psychology, University of Edinburgh, Scotland. Chairman, Royal Blind Asylum and School, Edinburgh, and Scottish National Institute for Blinded Soldiers, 1941–44. Editor of *Journal of General Psychology*. Assistant Editor, *British Journal of Psychology*. Author of *Instinct in Man*; etc.

J. D. R.—J. D. Ryder. Professor and Head of the Department of Electrical Engineering, University of Illinois, Urbana, Ill. Author of *Electronic Engineering Principles; Electronic Fundamentals and Applications; Networks, Lines, and Fields*.

J. D. S.—John Duncan (Ernst) Spaeth. First President, University of Kansas City, Mo., 1933–36. Amateur Coach and Director of Rowing, Princeton, 1910–25. Murray Professor of English Literature, Princeton University, 1930–35. Author of *Camp Reader for American Soldiers*; etc.

J. D. Sn.—James Docking Stranathan. Professor of Physics and Chairman, Department of Physics and Astronomy, University of Kansas, Lawrence, Kan. Author of *The "Particles" of Modern Physics*.

J. Dz.—Rev. Jean Delanglez, S.J. Former Professor of History, Loyola University, Chicago, Ill. Author of *El Rio del Espiritu Santo; Hennepin's Description of Louisiana; Life and Voyages of Louis Jolliet*; etc.

J. E. B. G.—John Evelyn Bury Gray. Lecturer in Sanskrit, School of Oriental and African Studies, London.

J. E. C.—Janet Elizabeth Courtney. Member of Executive Committee, Carnegie United Kingdom Trust, 1913—. Author of *Recollected in Tranquillity; The Women of My Time*; etc.

J. E. E.—Sir James Edward Edmonds. Brigadier General. Officer in Charge of Military Branch, Historical Section, Committee of Imperial Defense, London. Served in South African and European wars. Author of *A Handbook of the German Army; Official History of the War*; etc.

J. E. F.—James Everett Frame. Baldwin Professor of Sacred Literature in Union Theological Seminary, New York, N.Y., 1919–38. Author of *Purpose of New Testament Theology*.

J. E. Fi.—Joel E. Fisher. Former President, American Alpine Club.

J. E. Fr.—James Earle Fraser. Director, Art Students League, New York, N.Y.

J. E. Gg.—John Eldon Giesekeing. Professor of Soil Physics, University of Illinois, Urbana, Ill., and Chief, Illinois Soil Survey, 1945—.

J. E. H.—John Edgar Hoover. Director, Federal Bureau of Investigation, United States Department of Justice.

J. E. Hl.—John Eric Hill. In Charge, Department of Comparative Anatomy, 1941–47, Assistant Curator, Department of Mammals, 1935–41, The American Museum of Natural History, New York, N.Y.

J. E. H. W.—John Eryl Hall Williams. Barrister-at-law. Lecturer in Law, London School of Economics and Political Science, University of London.

J. E. K.—James Edward Knott. Professor of Truck Crops and Head of Division, College of Agriculture, University of California, 1940—.

J. E. L.—Sir John Edward Lloyd. Emeritus Professor of History, University College of North Wales, Bangor, 1930–47. Former President of the Welsh Language Society. Author of *A History of Wales to the Edwardian Conquest*; Editor of Hubert Lewis' *Ancient Laws of Wales*.

J. E. Lr.—John Everts Lamar. Geologist and Head of the Industrial Minerals Division, Illinois State Geological Survey.

J. E. M.—James Elvins McCartney, M.D. Major, R.A.M.C. Director of Research and Pathological Services, London County Council. Former Lecturer in Bacteriology, University of Edinburgh, Scotland. Co-author of *A Handbook of Practical Bacteriology*.

J. E. Me.—Joseph Earle Moore, M.D. Associate Professor of Medicine, The Johns Hopkins University, 1916–45; Physician-in-charge, Syphilis Division, Medical Clinic, The Johns Hopkins Hospital, Baltimore, Md. Author of *The Modern Treatment of Syphilis*; etc.

J. -E. -M. -G. D.—Joseph-Edouard-Marie-Ghislain Delmelle. Honorary President of Jeunes Écrivains Belges. Author of *Histoire des lettres belges d'expression française; Panorama de la jeune poésie française en Belgique; Profondeur de la mer*; etc.

J. E. Mu.—John E. Muhlfeld. Author of *Locomotives of Great Power; New Era for Steam Locomotives*; etc.

J. E. My.—James Edward McMurtrey, Jr. Principal Physiologist, Division of Tobacco Investigations, Bureau of Plant Industry, Soils, and Agricultural Engineering, U.S. Department of Agriculture.

J. En.—Jeannette Eckman. Historian and Director, New Castle Tencentenary Commission.

J. E. S.—John Edward Sears. Former Superintendent of Metrology Department, National Physical Laboratory, England.

J. E. Sa.—Sir John Edwin Sandys. Former Public Orator, Cambridge University. Author of *History of Classical Scholarship*.

J. E. Spr.—J. E. Springmeyer. Legislative Counsel, State of Nevada, Carson City, Nev.

J. E. S. S.—Jocelyn Edward Salis Simon. King's Counsel, London.

J. E. T. H.—John Ernest Troyte Harper. Vice-Admiral, R.N. Director of Navigation at the Admiralty, 1919–21. Author of *The Royal Navy at War*; etc.

J. Ev.—Joan Evans. External Examiner in History of Art, University of London, 1938–46. Author of *English Jewellery*; etc.

J. E. W.—James Edward West. Chief Scout, Boy Scouts of America, 1943–48. Author of *The Lone Scout of the Sky*; etc.

J. E. Ws.—John Elliott Wills. Associate Professor of Farm Management, College of Agriculture, University of Illinois, Urbana, Ill.

J. F.—John Fiske. Sometime History Tutor at Harvard University. Author of *The American Revolution*; etc.

J. F. C.—James Ford Cairns. Lecturer in Economic History, University of Melbourne, Melbourne, Austr.

J. F. C. F.—John Frederick Charles Fuller. Major General (retired). Former Military Assistant to the Chief of the Imperial General Staff. Chief General Staff Officer, Tank Corps, 1917–18. Author of *The Reformation of War*; etc.

J. F. Do.—James F. Doster. Assistant Professor of History, University of Alabama, University, Ala. Author of *Alabama's First Railroad Commission, 1881–1885*.

J. F. Fy.—Joseph F. Farley. Commandant, United States Coast Guard.

J. F. G. P.—Sir James Frederick George Price. Deputy Secretary, Ministry of Labour, London, 1935–38.

J. Fi.—Jack Filman. Hockey Department, Madison Square Garden, New York, N.Y.

J. F. -K.—James Fitzmaurice-Kelly. Former Gilmour Professor of Spanish Language and Literature, University of Liverpool, England. Author of *A History of Spanish Literature*.

J. F. Ki.—James F. King. Assistant Professor of History, University of California, Berkeley, California.

J. F. M.—James Fullarton Muirhead. Former Editor of many of Baedeker's Guide Books. Author of *America, the Land of Contrasts*; etc.

J. F. Md.—J. F. Madden. Member of the Sudan Political Service.

J. F. Mi.—John F. Mitchell. Assistant Professor of History, American International College, Springfield, Mass.

J. Fn.—Jack Fulton. Director, International Recreation Association.

J. Fo.—Sir John William Fortescue. Librarian at Windsor Castle, 1905–26. Author of *Wellington; History of the 17th Lancers*; etc.

J. F. P.—Joseph Frank Payne, M.D. Former Harveian Librarian, Royal College of Physicians. Author of *Lectures on Anglo-Saxon Medicine*; etc.

J. F. R.—James Frederick Rees. Principal of University College of South Wales and Monmouthshire, Cardiff. Professor of Commerce, University of Birmingham, England, 1925–29.

J. Fra.—John Fraser. Former Jesus Professor of Celtic, and Fellow of Jesus College, Oxford University.

J. F. Ri.—Joseph Fels Ritt. Professor of Mathematics and Executive Officer, Department of Mathematics, Columbia University, 1942–45. Author of *Differential Equations from the Algebraic Standpoint*.

J. F. S.—John Frederick Stenning. Warden of Wadham College, Oxford, 1927–38. Former University Reader in Aramaic.

J. F. Sm.—Rev. John Frederick Smith. Author of *Studies in Religion under German Masters*; etc.

J. F. Ss.—John F. Simmons. Chief of Protocol, U.S. Department of State, Washington, D.C.

J. F. Sy.—Rev. John F. Sweeney, S.J. Professor of Humanities, Woodstock College, Woodstock, Md.

J. F. W.—John Forbes White. Co-author of *Life and Art of G. P. Chalmers, R.S.A.*

J. F. Wr.—J. Frederic Walker. Research Supervisor, Technical Division, Electrochemicals Department, E. I. du Pont de Nemours & Co., Inc., Perth Amboy, N.J.

J. Gai.—James Gairdner. English historian and Sometime Assistant Keeper of the Public Records. Editor of the *Paston Letters*; *Letters and Papers Illustrative of the Reigns of Richard III, Henry VII, and Henry VIII*. Author of *The House of Lancaster and York*; etc.

J. Gal.—Jean Gallotti. Supervisor of Native Moroccan Arts. Instructor of History of Mohammedan Art, University of Bordeaux, France.

J. G. B.—J. G. Bullocke. Civilian Lecturer, Royal Naval College, Greenwich, Eng.

J. G. B.-C.—John Gilbert Beebe-Center. Lecturer on Psychology and Tutor in the Department of Psychology, Harvard University.

J. G. Be.—J. Gould Bearn. Chemist, Messrs. Walter Carson and Sons, Battersea, London.

J. G. Br.—Sir Joseph Guinness Broodbank. President of the Institute of Transport, 1923–24. Chairman of the Dock and Warehouse Committee of the Port of London Authority, 1909–20. Author of *History of the Port of London*.

J. G. C.—John Grenfell Crawford. Secretary, Department of Commerce and Agriculture, Canberra, Austr. Co-author of *National Income of Australia*.

J. G. D.—J. G. Dollman. Captain. Assistant Keeper, Department of Zoology, British Museum (Natural History), London.

J. G. De.—John Gilbert Dean. Assistant Supervisor, Development and Research Division, Industrial Chemicals Section, The International Nickel Company, Inc., New York, N.Y.

J. G. F.—Justus George Frederick. Founder and President, The Business Bourse, International, New York, N.Y. Author of *Modern Sales Management*; etc.

J. G. Fr.—Sir James George Frazer. Author of *The Golden Bough*.

J. G. G.—Jean Gabriel Goulinat. Sociétaire et Membre du Comité du Salon de la 5th Nationale des Beaux Arts.

J. G. Hh.—J. G. Hardenbergh, V.M.D. Executive Secretary and Managing Editor, American Veterinary Medical Association.

J. G. Ho.—J. G. Horner. Author of *Plating and Boiler Making; Practical Metal Turning*.

J. Gi.—Jekuthiel Ginsburg. Professor and Head of the Department of Mathematics, Yeshiva College, New York, N.Y.

J. Gir.—Jean Giraud. Of the Fondation Emile et Louise Deutsch de la Meurthe, University of Paris.

J. G. K.—Sir John Graham Kerr, M.P. (Nat. Govt.), Scottish Universities, 1935–. Regius Professor of Zoology, University of Glasgow, Scotland, 1902–36. Author of *Textbook of Embryology*; etc.

J. G. Kd.—John Gamble Kirkwood. Todd Professor of Chemistry, Cornell University, Ithaca, N.Y.

J. G. Kn.—Jerome Gregory Kerwin. Professor of Political Science, The University of Chicago. Chairman, Chicago Institute of Social and Religious Studies, Chicago, Ill., 1944–. Author of *Federal Water Power Legislation*.

J. G. L.—Jacob Goodale Lipman. Former Dean of Agriculture and Director of the Agricultural Experiment Station, Rutgers University, New Brunswick, N.J. Author of *Bacteria in Relation to Country Life*; etc.

J. G. M.—J. G. Mitchell. Principal Scientific Officer, Chemical Research Laboratory, Teddington, Middlesex, England.

J. G. McD.—James Grover McDonald. Member, Anglo-American Committee of Inquiry on Palestine, 1946. President, Brooklyn Institute of Arts and Sciences, 1938–42.

J. G. M. McH.—J. G. M. McHardy. Commander, R.N. Formerly with Department of Chief Inspector of Naval Ordnance, Admiralty, London.

J. G. N. G.—John George Noel Gaskin. Principal Scientific Officer, Department of the Government Chemist, London.

J. G. R.—John George Robertson. Former Professor of German Language and Literature, University of London. Author of *The Literature of Germany*.

J. Gra.—John Graham. Chairman of the Tonic Sol-Fa Association.

J. G. R-S.—John Graham Royde-Smith. Writer.

J. G. S.—John Garibaldi Sargent. Former Attorney-General of the U.S. Department of Justice, Washington, D.C.

J. G. V.—Joseph Gordon Vaeth. Lieutenant, U.S.N.R. (inactive). Scientific Research Administrator, Special Devices Center, Office of Naval Research. Former Official Historian, U.S. Navy Lighter-than-Air Organization.

J. G. W.—Jane G. Wheeler. Specialist, Near East and Africa Section, Division of Territorial Studies, Department of State, Washington, D.C.

J. H.—John Hilton. Professor of Industrial Relations, Cambridge University, 1931–43. Director of Statistics, Ministry of Labour, London, 1919–31. Author of *Why I Go In for the Pools*. Co-author of *Are Trade Unions Obstructive?*

J. Ha.—Jeannette Halford. Founder and Honorary Secretary, Cookham Child Welfare and Nursery Centres, England, 1939–46. Honorary Secretary, National Association for the Prevention of Infant Mortality and Association of Maternity and Child Welfare Centres, 1909–37.

J. Hac.—Joseph Hackin. Archaeologist and administrator. Former Curator, Musée Guimet, Paris.

J. H. A. H.—John Henry Arthur Hart. Former Fellow, Lecturer and Librarian of St. John's College, Cambridge.

J. Har.—Jiro Harada. Of the Imperial Household Museums, Japan; former Professor in the Nagoya College of Technology. Author of *The Gardens of Japan*.

J. H. Arn.—J. H. Arnold. Former Secretary of Westminster Bank Limited.

J. Has.—J. Hasselkus. Chairman and Managing Director, Ross, Ltd., Optical Works, London. President of the British Optical Instrument Manufacturers Association, 1928–29.

J. Hau.—Jean Haust. Former Professor of Walloon Dialects in the University of Liège, Belgium.

J. H. B.—Joseph H. Bonneville. Professor of Finance, Department of Banking and Finance, New York University School of Commerce, Accounts and Finance, New York, N.Y. Author of *Elements of Business Finance*.

J. H. Ba.—Joab H. Banton. Former District Attorney, State of New York for County of New York.

J. H. Be.—Joseph Henry Beale. Royall Professor of Law, Harvard University, 1912–37. Author of *Cases on Criminal Law; Conflict of Laws*; etc.

J. H. Br.—James Henry Breasted. Former Professor of Egyptology and Oriental History and Chairman of the Department of Oriental Languages, The University of Chicago.

J. H. Bz.—J. Harlen Bretz. Professor of Geology, The University of Chicago. Author of *The Grand Coulee; Vadose and Phreatic Features of Limestone Caverns*.

J. H. Cb.—James Harrel Cobb. Lecturer, School of Religion, Vanderbilt University, Nashville, Tenn. Author of *Principles and Methods in General Adult Education*.

J. H. Co.—Julius Henry Cohen. Former Special Attorney General, State of New York, in Housing Cases. Author of *Law and Order in Industry*; etc.

J. H. Cs.—Joseph Hardy Chivers, M.D. Medical Director, Crane Company, Chicago, Ill.

- J. H. D.**—J. H. Driberg. Author of *The Lango, A Nilotic Tribe of Uganda*.
- J. H. Df.**—James H. Duff. Governor of Pennsylvania, 1946—.
- J. He.**—John Hoye. Instructor, Straubemuller Textile Evening High School, New York, N.Y. Author of *Staple Cotton Fabrics*.
- J. H. F.**—John Henry Freese. Former Fellow of St. John's College, Cambridge.
- J. H. Gd.**—John H. Garland. Professor of Geography, University of Illinois, Urbana, Ill.
- J. H. H.**—John Henry Hutton. William Wyse Professor of Social Anthropology, Cambridge University.
- J. H. Hd.**—Joel Henry Hildebrand. Professor of Chemistry, University of California, Berkeley, Calif. Author of *Principles of Chemistry*; *Solubility of Non-Electrolytes*.
- J. H. Hes.**—John Henry Hessels. Author of *Gutenberg*; *An Historical Investigation*.
- J. H. J.**—Sir James Hopwood Jeans. Former Professor of Astronomy in the Royal Institution, London. Secretary of the Royal Society, 1919–29. Professor of Applied Mathematics, Princeton University, 1905–09. Author of *The Dynamical Theory of Gases*; *Atomicity and Quanta*; etc.
- J. H. Jn.**—John Hampden Jackson. Staff Tutor, Cambridge University Board of Extra-Mural Studies. Author of *The Between-War World*; *Finland*.
- J. Hl.**—Jerome Hall. Professor of Law, Indiana University, Bloomington, Ind. Author of *Living Law of Democratic Society*; *Theft, Law and Society*.
- J. H. L.**—John Howland Lathrop, D.D. Pastor, First Unitarian Congregational Church, Brooklyn, N.Y. Author of *Toward Discovering a Religion*.
- J. H. M.**—J. Hamish Miles. Author (with R. Mortimer) of *The Oxford Circus*.
- J. H. MacD.**—J. H. MacDonald. Budget Officer, National Broadcasting Company. Author of *Practical Budget Procedure*; etc.
- J. H. McG.**—James Howard McGregor. Associate in Human Anatomy, American Museum of Natural History, New York, N.Y., 1916—; Professor of Zoology, Columbia University, 1924–42.
- J. H. Mi.**—John Henry Middleton. Art Director, Victoria and Albert Museum, London, 1892–96. Slade Professor of Fine Art, Cambridge University, 1886–95. Director of the Fitzwilliam Museum, Cambridge, 1899–92. Author of *The Engraved Gems of Classical Times*; etc.
- J. H. Mn.**—John Holmes Martin. Senior Agronomist in charge of Sorghum and Broomcorn Investigations, Bureau of Plant Industry, Agricultural Research Administration, U.S. Department of Agriculture, 1925—.
- J. H. Mo.**—John Hartman Morgan. Brigadier General. Honorary Adviser to American War Crimes Commission, Nuernberg, Germany, 1947. Emeritus Professor of Constitutional Law in the University of London.
- J. H. Mu.**—John Henry Muirhead. Former Professor of Philosophy in the University of Birmingham, England. Author of *Elements of Ethics*; etc. Editor of *Library of Philosophy*.
- J. H. My.**—John H. Manley. Professor of Physics, University of Washington, Seattle, Wash.
- J. Hn.**—Julie Helen Heyneman. Portrait painter.
- J. H. Nu.**—Joseph Henry Nuelle. President, Member of Executive Committee and Director, The Delaware and Hudson Company, New York, N.Y., 1938—.
- J. Ho.**—Josef Hoffmann. Professor at the School of Industrial Arts at Vienna. Art Director of the Wiener Werkstätte.
- J. H. Os.**—J. H. Osborne. Chairman, Merryweather and Sons, Ltd., London.
- J. H. Oy.**—John Hollowell Ohly. Law Clerk, Office of the Secretary, U.S. Department of Defense, Washington, D.C.
- J. H. Par.**—Julius Hall Parmelee. Vice-President, Association of American Railroads (1947—). Author of *The Modern Railway*.
- J. H. Pe.**—John H. Paige. President, United States Intercollegiate Lacrosse Association. Member, Lacrosse Referees Association.
- J. Hr.**—John Hightower. Kennel Editor and Manager of "Where to Go" department, and member of the general editorial staff of *Field & Stream*.
- J. H. R.**—John Horace Round. Former Historical Adviser to the Crown. President, Essex Archaeological Society, 1916–21. Author of *Feudal England*; *Peage and Pedigree*; etc.
- J. H. Rn.**—John Henry Richardson. Professor of Industrial Relations, University of Leeds, Leeds, Eng. Author of *British Economic Foreign Policy*; *Industrial Relations in Great Britain*.
- J. H. Ro.**—John Holland Rose. Vere-Hamsworth Professor of Naval History, Cambridge University, 1919–33. Reader in Modern History, Cambridge, 1911–19. Author of *The Development of the European Nations, 1870–1900*; etc.
- J. H. Rob.**—James Harvey Robinson. Former Professor of History, Columbia University. Author of *The Mind in the Making*; etc.
- J. H. Rs.**—James Hardy Ropes, D.D. Former Professor of Divinity and Dexter Lecturer on Bible Literature, Harvard University.
- J. H. Ry.**—Most Rev. James Hugh Ryan, S.T.D. Bishop of Omaha, Neb., 1935–47. Former Professor of Philosophy and Rector, Catholic University of America, Washington, D.C. Author of *Directory of Catholic Colleges and Schools*; etc.
- J. H. Sd.**—Julian H. Steward. Graduate Research Professor of Anthropology, University of Illinois, Urbana, Ill. Editor of *Handbook of South American Indians*.
- J. H. Sr.**—J. H. Sinclair. Geologist and explorer. Author of *Explorations in Eastern Ecuador*.
- J. H. Ss.**—John Harrison Sachs. Former Manager, Development Division, Organic Chemicals Department, E. I. du Pont de Nemours & Company, Wilmington, Del.
- J. Ht.**—James Hart. Professor of Political Science, University of Virginia, Charlottesville, Va. Author of *Tenure of Office Under the Constitution*; etc.
- J. Hu.**—John Hutchinson. Keeper of Museums of Botany, Royal Botanic Gardens, Kew, England. Author of *A Botanist in South Africa*; etc.
- J. Hud.**—Joseph Hudnut. Professor of Architecture and Dean of the Faculty of Design, Harvard University. Author of *Modern Sculpture*; etc.
- J. H. Van A.**—J. H. Van Alstyne. Former President, Otis Elevator Company, New York, N.Y.
- J. H. V. C.**—John Henry Verinder Crowe. Brigadier General. Commandant of the Royal Military College of Canada, 1909–13. Former Chief Instructor in Military Topography and Military History and Tactics, Royal Military Academy, Woolwich, England. Author of *Epitome of the Russo-Turkish War, 1877–78*; etc.
- J. H. V. V.**—John H. Van Vleck. Professor of Mathematical Physics and Chairman of the Physics Department, Harvard University.
- J. H. W.**—J. H. Walker. Superintendent of Central Heating, The Detroit Edison Company, Detroit, Mich. Co-author of *Heating and Air Conditioning*.
- J. H. Wi.**—John H. Wigmore. Colonel. Professor of Law, 1893–1943, and former Dean of Faculty of Law, Northwestern University, Evanston, Ill. Author of *Panorama of the World's Legal Systems*; etc.
- J. H. Wn.**—John Harold Wellington. Professor of Geography, University of the Witwatersrand, Johannesburg, U. of S. Af. Author of *Southern Africa: A Geographical Study*.
- J. H. Y.**—John H. Yoe. Professor of Chemistry, University of Virginia, University, Va. Author of *Photometric Chemical Analysis*; *Chemical Principles*; *Qualitative Analysis*; etc.
- J. H. Z.**—John Henry Zeller. Senior Animal Husbandman, in charge of Swine Investigations, Bureau of Animal Industry, Agricultural Research Administration, U.S. Department of Agriculture, Washington, D.C.
- J. I.**—Jules Isaac. Professor of History at the Lycée of Lyons, France.
- J. I. C.**—John I. Cooper. Assistant Professor of History, McGill University, Montreal, Quebec, Canada.
- J. I. G.**—John Inkster Goodlad. Professor of Education and Director of the Division of Teacher Education, Emory University, Ga.
- J. I. P.**—John Isaac Platt. Lecturer in Geology, University College of Wales, Aberystwyth.
- J. Is.**—Jacob Isaacs. Professor of English Language and Literature, University of Jerusalem, 1942—. Lecturer in English Literature at King's College, University of London, 1928–42. Author of *Shakespeare as Man of the Theatre*; etc.
- J. Ja.**—Joseph Jacobs. Former Professor of English Literature in the Jewish Theological Seminary, New York, N.Y. Author of *Jews of Angevin England*.
- J. J. C.**—John J. Collyer. Brigadier General. Former Officer of the Legion of Honour. Former Chief of the General Staff, Union of South Africa.
- J.-J. Ds.**—Jean-Jacques Despois. Professor of Geography, Faculty of Letters, University of Algiers, Algeria.
- J. J. F.**—John Jacob Fox. Former Superintending Chemist, Government Laboratory, London.
- J. J. H.**—Rev. John J. Healy, S.J. Professor of Fundamental Theology, Alma College, Alma, Calif.
- J. J. Ky.**—John Joseph Kennedy. Chemical and Mining Engineer, Maywood Chemical Works, Maywood, N.J.
- J. J. Le.**—James J. Lingane. Professor of Chemistry, Harvard University. Co-author of *Polarography*.

J. J. M.—James Joseph Mallon. Warden of Toynbee Hall, London. Honorary Secretary of Trade Boards Advisory Council. Honorary Adviser to the Minister of Food on feeding in air raid shelters.

J. J. McC.—John Jay McCloy. U.S. High Commissioner in Occupied Germany, 1949–52. U.S. Assistant Secretary of War, 1941–45.

J. Jn.—John Jackson. H.M. Astronomer, Cape of Good Hope, 1933–.

J. J. O'N.—John Johnston O'Neill. Dean of Engineering and Vice-Principal of McGill University, Montreal, Que.

J. J. P.—John Joseph Pershing. General of the Armies of the United States. Chief of Staff, U.S. Army, 1921–24. Commander-in-Chief, American Expeditionary Forces in Europe, 1917–19. Author of *My Experiences in the World War*.

J. J. R.—Joseph James Runner. Professor of Geology, State University of Iowa, Iowa City, Ia. Senior Geologist, U.S. Geological Survey, 1942–.

J. J. R. MacL.—John J. R. MacLeod. Former Regius Professor of Physiology, University of Aberdeen, Scotland. Former Professor of Physiology, University of Toronto, Canada. Winner of Nobel Prize for Medicine, 1923.

J. J. Si.—J. J. Simpson. Formerly with City of Liverpool Public Museums, Liverpool, England.

J. J. T.—John James Tigert. President of the University of Florida, Gainesville, Fla. United States Commissioner of Education, 1921–28. Author of *Philosophy of the World War*; etc.

J. J. Th.—Sir Joseph (John) Thomson. Master of Trinity College, Cambridge, 1918–40. Nobel Prize for Physics, 1906. Cavendish Professor of Experimental Physics, Cambridge University, 1884–1918. Author of *Conduction of Electricity Through Gases*; etc.

J. K.—John King. Former Chairman of the National Light Castings Association.

J. K. F.—J. K. Fotheringham. Former Reader in Ancient Astronomy and Chronology in Oxford University. Honorary Assistant in the University Observatory, Oxford, 1925–36.

J. K. H.—John Knowles Herr. Major General, U.S.A. (retired). Chief of Cavalry, Washington, D.C., 1938–42. Assistant Chief of Staff, American Forces in Germany, 1921–22. Director G-2, Army War College, 1932.

J. K. H. W.—J. K. H. Wilde. Chief Veterinary Officer of Nigeria.

J. K. I.—John Kells Ingram. Former Regius Professor of Greek, Professor of Oratory and English Literature and Librarian, Trinity College, Dublin.

J. K. R.—John Kerr Rose. Geographer, Library of Congress, Washington, D.C.

J. K. S.—James Kellum Smith. Lieutenant Colonel. President, The American Academy in Rome. U.S. Army Air Forces, General Staff Corps, World War II.

J. K. Sk.—James Keane Stack, M.D. Assistant Professor of Bone and Joint Surgery, Northwestern University Medical School, Evanston, Ill.

J. K. So.—Judith Katrina Sollenberger. Pamphlet Librarian, Indianapolis Public Library, Indianapolis, Ind.

J. L.—Julien Luchaire. General Inspector of Public Instruction, 1920–. Director of the International Institute of Intellectual Cooperation, Paris, 1925–31.

J. La.—Sir Joseph Larmor. Former Fellow of St. John's College, Cambridge. Lucasian Professor of Mathematics in Cambridge University, 1903–32. Professor of Natural Philosophy, University College, Galway, and in the Queen's University of Ireland, 1880–85. Author of *Ether and Matter*; etc.

J. L. A.—James Luther Adams. Professor of Theology, Meadville Theological School and Federated Theological Faculty, The University of Chicago, Chicago, Ill. Author of *On Being Human—The Liberal Way*.

J. L. A. B.—Jean Louis Auguste Brachet, M.D. Professor at the Sciences Faculty, University of Brussels, Belgium. Author of *Embryologie Chimique*.

J. LaF.—The Reverend John LaFarge, S.J. Associate Editor, *America*. Author of *Interracial Justice; Jesuits in Modern Times; No Postponement*.

J. L. Ba.—Joseph Louis Baer, M.D. Rush Clinical Professor Emeritus of Obstetrics and Gynaecology, University of Illinois College of Medicine, Chicago, Ill. Senior Attending Gynaecologist and Obstetrician, Michael Reese Hospital, Chicago, Ill.

J. L. Bl.—John L. Brill. Technical Director, Film Department, E. I. du Pont de Nemours & Company, Wilmington, Del.

J. L. Bm.—J. Lyman Bingham. Executive Director, United States Olympic Association.

J. L. C.—James L. Calver. Geologist, Florida Geological Survey, Tallahassee, Fla.

J. Le.—James Legge. Former First Professor of Chinese Language and Literature, Oxford University. Author of *The Life and Teaching of Confucius*; etc.

J. Lec.—John Leckie. Head of Sales Promotion Bureau, Joseph Dixon Crucible Company, Jersey City, N.J.

J. L. Ee.—Juan Labadie-Eurite. Chief, Division of Statistics, Bureau of the Budget, San Juan, P.R.

J. L. G.—James Louis Garvin. Editor of *The Observer*, London, 1908–42. Editor in Chief, *Encyclopædia Britannica*, 1926–29. Author of *The Economic Foundations of Peace*; etc.

J. L. Gr.—J. L. Greaves. Editor in Chief of Philips' Trade and Technical publications, 1910–. Member of Society of Chemical Industry, London.

J. L. H.—John Lawrence Le Breton Hammond. On editorial staff, *Manchester Guardian*, 1939–49. Co-author of *The Village Labourer*, 1760–1832; *The Town Labourer*, 1760–1832; *The Skilled Labourer*, 1760–1832; etc.

J. L. Ha.—John L. Haughton. Senior Assistant in the Metallurgy Division, National Physical Laboratory, Teddington, England.

J. L. He.—John L. Hervey. Former special writer on racing for the *Sportsman*; *The Thoroughbred Record*; *Daily Racing Form*. Author of *American Race Horses*; *Racing in America*; etc.

J. L. Hh.—Jack L. Hough. Professor of Geology, University of Illinois, Urbana, Ill.

J. L. I. F.—John Lister Illingworth Fennell. Reader in Russian and Head of the Department of Slavonic Languages, University of Nottingham, University Park, Eng.

J. L. Ky.—John Lyon Kennedy. Associate Professor of Psychology, Tufts College, Medford, Mass.

J. L. L.—John Livingston Lowes. Former Professor of English and Dean of the Graduate School of Arts and Sciences, Harvard University. Author of *Convention and Revolt in Poetry*.

J. L. La.—Jesse L. Lasky. Associate Producer, RKO Radio Pictures, Inc. Former Vice-President, Paramount-Public Corporation, and President, Pickford-Lasky Productions, Inc.

J. L. Lh.—Jay Laurence Lush. Professor of Animal Breeding, Iowa State College, Ames, Iowa. Author of *Animal Breeding Plans*.

J. L. M.—J. Leask Manson. Sometime Technical Officer, Department of Scientific and Industrial Research, London.

J. L. My.—Sir John (Linton) Myres. Chairman, British School at Athens, 1934–47. Fellow and Librarian of New College, Oxford. General Secretary, International Congress Anthropological and Ethnological Sciences, 1934–47. Wykeham Professor of Ancient History in Oxford University, 1910–39. Frazer Lecturer, Cambridge University, 1943. Author of *The Dawn of History*; *The Political Ideas of the Greeks*; etc.

J. L. N.—John Lloyd Newcomb. President, University of Virginia, Charlottesville, Va., 1933–46.

J. L. S.—Julian Larcombe Schley. Major General. Former Director of Transportation, Office Coordinator Inter-American Affairs. Chief of Engineers, U.S. Army, 1937–41. Governor Panama Canal, 1932–36; Director Panama Railroad Company, 1928–.

J. L. T.—John L. Thornton. Librarian, St. Bartholomew's Hospital Medical College, London. Author of *A Chronology of Librarianship*; *Medical Books, Libraries and Collectors*; *A Mirror for Librarians*; etc.

J. L. W.—Jessie L. Weston. Author of *Arthurian Romances*.

J. L. We.—Joseph Lee Weiner. Director of Civilian Supply, War Production Board, 1941–43. Director Public Utilities Division, Securities and Exchange Commission, 1939–41.

J. Ly.—John Lansbury, M.D. Associate Professor of Medicine, School of Medicine, Temple University, Philadelphia, Pa.

J. M.—James MacKinnon, D.D. Professor of Ecclesiastical History in the University of Edinburgh, Scotland, 1908–30. Author of *The Origins of the Reformation*; *Luther and the Reformation*; etc.

J. M. A.—John Morris Arthur. Biochemist, Boyce Thompson Institute for Plant Research, Yonkers, N.Y., 1921–.

J. Mac.—Sir John MacDonell. Former Master of Supreme Court, Quain Professor of Comparative Law, University College, University of London, and Editor of *State Trials*; *Civil Judicial Statistics*; etc. Author of *Survey of Political Economy*; etc.

J. M. At.—John Murray Atwood, D.D. Dean, Theological Department, St. Lawrence University, Canton, N.Y. 1914–51. President of New York State Convention of Universalists, 1927–29 and 1940–42.

J. M. Bl.—John Mann Beal. Professor of Botany, The University of Chicago.

J. M. C.—Rev. John Martin Creed. Former Ely Professor of Divinity, Cambridge University. Former Canon of Ely.

J. McG.—J. E. M. McGregor. Office of the Engineer-in-Chief, General Post Office, London, Eng.

- J. M. Cy.**—John M. Carmody. Member, General Review Board, War Assets Administration, 1947-48. Chairman, Maritime War Emergency Board, 1946-47. Member, Maritime Commission, 1941-46. Administrator, Federal Works Agency, Washington, D.C., 1939-41.
- J. M. D.**—John M. Davis. Former President, Delaware, Lackawanna and Western Railroad Co., New York, N.Y. President, Manning, Maxwell, & Moore, Inc., 1920-25.
- J. M. de N.**—J. M. de Navarro. Former Fellow of Trinity College, Cambridge.
- J. M. F. R.**—J. M. F. Romein. Former Member of Transit Section, League of Nations, Geneva, Switzerland.
- J. M. G.**—John Merriman Gaus. Professor of Government, Harvard University. Author of *Reflections on Public Administration*; co-author of *Frontiers of Public Administration*.
- J. M. Gy.**—Sir John Milner Gray. Former Chief Justice of Zanzibar. Author of *Biographical Notes of the Mayors of Cambridge*; *A History of the Perse School, Cambridge*; *The School of Pythagoras*.
- J. M. Hs.**—John Moore Hills. Consulting geologist.
- J. M. Hy.**—Joan Mervyn Hussey. Professor of History, University of London. Author of *Church and Learning in the Byzantine Empire, 867-1185*.
- J. M. K.**—James Moss Ketch. Illuminating Engineer; National Lamp Works of General Electric Company, Cleveland, O. Author of *Cotton Mill Lighting*.
- J. M. Ku.**—James M. Kurn. Former Trustee, St. Louis-San Francisco Railway Company, St. Louis, Mo.
- J. M. L.**—James Miller Leake. Professor and Head of the Department of History and Political Sciences, University of Florida, Gainesville, Fla., 1919-50. Author of *History of Florida*.
- J. M. La.**—James McCauley Landis. Chairman, Civil Aeronautics Board, 1946-. Dean of the Faculty of Law, Harvard University, 1937-46. Director, U.S. Office of Civilian Defense, 1942-43. Director of American Economic Operations and Minister to Middle East, 1943-45. Co-author of *The Business of the Supreme Court*; Author of *Cases on Labor Law*; etc.
- J. M. M.**—John Malcolm Mitchell. Secretary, Carnegie United Kingdom Trust, 1919-39. President, Library Association, 1931-32. Author of *The Public Library System of Great Britain and Ireland*; editor of *The Rural Libraries Handbook*.
- J. M. Ma.**—John Matthews Manly. Head of the Department of English, The University of Chicago, 1898-1933. Former Managing Editor of *Modern Philology*. Author of *The Language of Chaucer's Legend of Good Women*; etc. Editor of *Specimens of the Pre-Shakespearean Drama*; *English Prose, 1137-1890*; etc.
- J. M. Mag.**—John MacArthur Maguire. Professor of Law, Harvard University. Author of *The Lance of Justice, a Semi-Centennial History of the Legal Aid Society*; etc.
- J. M. Me.**—James Malcolm Milne. Barrister-at-Law.
- J. Mn.**—John MacPherson, M.D. Former Inspector-General of Hospitals, Bengal, India.
- J. M. N.**—John Macarthur Nicolle. Secretary of Trinity House Corporation, London, 1935-46.
- J. Mo.**—John Morley, 1st Viscount Morley of Blackburn. Lord President of the Council, 1910-14. Secretary of State for India, 1905-10. Author of *Edmund Burke*; etc.
- J. Mof.**—Rev. James Moffatt, D.D. Washburn Professor of Church History, Union Theological Seminary, New York, N.Y., 1927-39. Yates Professor of Greek and New Testament Exegesis, Mansfield College, Oxford, 1911-15. Professor of Church History, United Free College, Glasgow, Scot., 1915-27. Former Editor of the *Expositor*. Author of *Critical Introduction to New Testament Literature*; etc.
- J. Mos.**—John Moss. Public Assistance Officer for Kent, Eng. Author of *Health and Welfare Services Handbook*.
- J. M. P. S.**—J. M. Powis Smith. Professor of Oriental Languages and Literature, The University of Chicago, 1915-32. Former Editor of the *American Journal of Semitic Languages and Literature*.
- J. M. R.**—John Mackinnon Robertson. Author of *Montaigne and Shakespeare*; *Modern Humanists*; *The Problems of the Shakespeare Sonnets*.
- J. M. Re.**—John Morgan Rees. Lecturer in Economics and Political Science, University College of Wales, Aberystwyth, Wales.
- J. M. Rn.**—John Monteath Robertson. Gardiner Professor of Chemistry, University of Glasgow, Glasgow, Scot. Author of *Organic Crystals and Molecules*.
- J. M. Rs.**—John Morris Roberts. Fellow of Magdalen College, Oxford.
- J. Ms.**—Rt. Rev. Monsignor J. Moyes, D.D. Former Canon of Westminster Cathedral, London. Former Editor of *The Dublin Review* and Domestic Prelate to H.H. Pope Benedict XV.
- J. M. S.**—James M. Spaight. Principal Assistant Secretary of the Air Ministry, England, 1934-37. Author of *Aircraft in Peace and the Law*; etc.
- J. M. Sc.**—J. M. Scammell. Former Assistant in History and Lecturer in Political Science, University of California.
- J. Mt.**—Jean Martet. Private Secretary to M. Clemenceau.
- J. M. T.**—James Matthew Thompson. Honorary Fellow of Magdalen College, Oxford. Author of *The French Revolution*; *Leaders of the French Revolution*; *Napoleon Bonaparte*; *Robespierre*.
- J. Mu.**—John Mulholland. Member of Society of American Magicians. Author of *Quicker Than the Eye*; *Story of Magic*; etc. Editor of *The Sphinx*, professional magazine of magic.
- J. M. W-H.**—John Michael Wallace-Hadrill. Fellow and Tutor of Merton College, Oxford. Author of *The Barbarian West, 400-1000*.
- J. M. Wr.**—J. Marvin Weller. Professor of Invertebrate Palaeontology, The University of Chicago.
- J. M. Wt.**—James Muir Watt. Joint Assistant Secretary, The Chartered Auctioneers' and Estate Agents' Institute, London. Author of *The Agriculture Act, 1947*; *The Agricultural Holdings Act, 1948*; *The Landlord and Tenant (Rent Control) Act, 1949*; *The Leasehold Property (Temporary Provisions) Act, 1951*.
- J. N.**—John Nichol. Professor of English Literature, Glasgow University, Glasgow, Scotland, 1862-89. Author of *Robert Burns*; *Carlyle*; etc.
- J. Na.**—James Naismith, M.D. Formerly with Department of Physical Education, University of Kansas, Lawrence, Kan. Author of *Basketball Rules*. Originator of the game of basketball.
- Jn. B.**—John Blackmore. General Church Historian, Reorganized Latter Day Saints Church.
- J. Ne.**—Joseph Needham. Director of the Section of Natural Sciences, U.N.E.S.C.O. Fellow of Gonville and Caius College and Sir William Dunn Reader in Biochemistry, Cambridge. Author of *Chemical Embryology*; etc.
- J. N. H.**—John Newbold Hazard. Professor of Public Law, Columbia University, New York, N.Y. Author of *Soviet Housing Law*.
- J. N. K.**—John Noble Kennedy. Major General, Governor of Southern Rhodesia, 1946-. War Office, London, 1940. Assistant Chief of Imperial General Staff, 1943-45.
- J. N. P.**—John Norman Pring. Principal Senior Officer, Armament Research Department, Woolwich, England. Former John Hastings Professor in Physics and Reader in Electro-Chemistry, Victoria University, Manchester. Author of *The Electric Furnace*; etc.
- J. Ns.**—Jerome Namias. Chief, Extended Forecast Section, U.S. Weather Bureau, Washington, D.C. Author of *An Introduction to the Study of Air Mass and Isentropic Analysis*; etc.
- Jn. W. G.**—John W. Gruner. Professor of Geology and Mineralogy, University of Minnesota, Minneapolis, Minn.
- J. O.**—Josiah Oldfield, M.D. Lieutenant Colonel. Founder of the Humanitarian Hospital of St. Francis. Former Warden of and Senior Physician to the Lady Margaret Fruitarian Hospital, Sittingbourne, Eng. Author of *Eat and Keep Well*; *Flesh-Eating a Cause of Consumption*; etc.
- J. O. B.**—John Oliver Borley. Former Principal Naturalist, Ministry of Agriculture and Fisheries, London.
- J. O. D.**—J. O. Dahl. Former Editorial Director, *Restaurant Management*. Author of *Kitchen Management*.
- Jo. G.**—Joseph Gilbert. Technical Editor, *Society of Automotive Engineers Journal*, New York, N.Y.
- Jo. Gr.**—John Glaister, M.D. Regins Professor of Forensic Medicine, University of Glasgow, Glasgow, Scot. Author of *Medical Jurisprudence and Toxicology*; co-author of *Medico-Legal Aspects of the Ruxton Case*.
- J. O. K.**—John Otto Kraehenbuehl. Professor of Electrical Engineering, University of Illinois, Urbana, Ill. Author of *Electrical Illumination*.
- J. O. M. B.**—Jan O. M. Broek. Associate Professor in Geography, University of California, Berkeley, Calif. Research Associate, American Council, Institute of Pacific Relations, New York, N.Y.
- J. O. McC.**—John Oppie McCall, D.D.S. Associate in Public Health and Preventive Medicine, Cornell University Medical College. Director, Murry and Leonie Guggenheim Dental Clinic, 1931-46. Former Professor of Periodontia, New York University College of Dentistry, New York, N.Y. Author of *Fundamentals of Dentistry in Medicine and Public Health*.

- Jo. M. L.**—John M. Letiche. Assistant Professor of Economics, University of California, Berkeley, Calif. Visiting Professor of Economics, University of Aarhus, Aarhus, Den., 1951–52. Author of *Reciprocal Trade Agreements in the World Economy*.
- Jo. P.**—John Pantin. Superintendent, American Printing Ink Company, Chicago, Ill.
- J. P.**—John Percival. Professor of Agricultural Botany, University of Reading, England, 1903–32. Author of *The Wheat Plant*; etc.
- J. Pa.**—John Leslie Palmer. Author of *Peter Paragon*; *The Happy Fool*; *The Future of the Theatre*; etc.
- J. P. B.**—James Penderel-Brodhurst. Former Consulting Editor, Editor of *The Guardian*, London.
- J. P. Bo.**—John Poland Bowen. Engineer in Chief, Corporation of Trinity House, London.
- J. P. Bt.**—John Paul Blewett. Research Physicist, Research Laboratory, General Electric Company, Schenectady, N.Y.
- J. P. D.**—James P. Dawson. Former Boxing Editor, the *New York Times*.
- J. Pe.**—Jean Perrin. Former Professor of Physical Chemistry at the Sorbonne, Paris. Nobel Prize for Physics, 1926.
- J. P. E.**—Jean Paul Hippolyte Emmanuel Adhémar Esmein. Former Professor of Law, University of Paris. Author of *Cours élémentaire d'histoire du droit français*.
- J. P. Ea.**—John P. Earnest. Former Professor of Criminal Law, George Washington University, Washington, D.C.
- J. Per.**—Janet Perry. Lecturer in the Department of Spanish Studies, King's College, University of London. Editor of Juan de Valdes' *Diálogo de las lenguas*.
- J. P. G.**—John P. Gillin. Professor of Anthropology and Research Professor, University of North Carolina, Chapel Hill, N.C. Author of *The Barama River Caribs of British Guiana*; *The Ways of Men*.
- J. P. Hy.**—James Philip Hyatt. Professor of Old Testament, Vanderbilt University, Nashville, Tenn. Author of *Prophetic Religion*.
- J. Pi.**—Jacques Pirenne. Formerly Secretary to King Leopold III. Professor of History of Civil Law, University of Brussels, 1924–. Tutor to Prince Leopold of Belgium (later King Leopold III), 1920–24. Author of *A History of Europe*.
- J. P. L.**—James P. Leake, M.D. Former Medical Director, U.S. Public Health Service.
- J. P. L. S.**—Jacobus Petrus Lodewicus Snyman. Lecturer in English, Northern Cape Technical College, Kimberley, U. of S. Af. Author of *A Bibliography of South African Novels in English*; *The South African Novel in English*.
- J. P. M.**—James Philip Mills. Former Assistant Commissioner, Makeoheung, Assam. Fellow of Royal Asiatic Society of Bengal, India. Author of *The Lhota Nagas*.
- J. P. Me.**—John Percy Moore. Emeritus Professor of Zoology, University of Pennsylvania, Philadelphia, Pa. Author of *Leeches of Minnesota*.
- J. P. Mn.**—John P. Maxton. Institute of Agrarian Affairs, Oxford, England.
- J. P. Mt.**—John Perry Moffett. Principal Assistant Secretary, the Secretariat, Tanganyika. Co-author of *Tanganyika: A Survey of Its Resources and Their Development*.
- J. P. P.**—John Percival Postgate. Former Professor of Latin in the University of Liverpool, England. Former Editor, *Classical Quarterly*. Former Editor in Chief, *Corpus Poetarum Latinorum*; etc.
- J. Pr.**—Joseph Proudman. Professor of Oceanography, University of Liverpool, England, 1940–46. Pro-Vice-Chancellor and Director of Liverpool Observatory and Tidal Institute, 1919–45.
- J. Pre.**—John Price. Secretary, Research Department, Transport and General Workers' Union, London, England. Author of *Organised Labour in the War*; etc.
- J. P. Sp.**—John Philip Spielman. Professor of Metallurgy, Montana School of Mines, Butte, Mont.
- J. Pt.**—Joseph Prescott. Associate Professor of English, Wayne University, Detroit, Mich.
- J. P. T. B.**—John Patrick Tuer Bury. Fellow and Librarian of Corpus Christi College, Cambridge. University Lecturer in History, Cambridge University. Author of *Gambetta and the National Defence*; etc.
- J. Pz.**—John Petrov Plamenatz. Fellow of Nuffield College, Oxford. Author of *The English Utilitarians*; *The Revolutionary Movement in France (1815–71)*.
- J. R.**—J. Romanes. Petroleum geologist.
- J. R. A.**—James Russell Andrus. Former Visiting Professor, University of Redlands, California. Professor of Economics, University of Rangoon, Burma, 1936–40.
- J. R. A. N.**—John Ramsey Allardyce Nicoll. Professor of English, Birmingham University, Birmingham, Eng. Author of *A History of Early Eighteenth Century Drama*; *Studies in Shakespeare*; *World Drama*; etc.
- J. R. Cn.**—Joan R. Cushman. Research Analyst, United Service Organizations.
- J. R. Dy.**—J. R. Dymond. Professor of Systematic Zoology, University of Toronto, Canada. Director, Royal Ontario Museum of Zoology, Toronto.
- J. Rei.**—Jacob Reighard. Former Professor in Zoology, University of Michigan, 1927–42. Director of the Biological Survey of the Great Lakes for the U.S. Fish Commission, 1898–1901.
- J. R. F.**—John Ritchie Findlay. Author of *Personal Recollections of De Quincey*.
- J. Ri.**—James Ritchie. Professor of Natural History and Dean of the Faculty of Science, Edinburgh University, Scotland. Keeper of the Natural History Department, Royal Scottish Museum, Edinburgh, 1921–30. Author of *Influence of Man on Animal Life in Scotland*. Editor of the *Scottish Naturalist*.
- J. Rk.**—John Rock, M.D. Director of the Fertility, Endocrine and Rhythm Clinics and Visiting Surgeon, Free Hospital for Women, Brookline, Mass. Research Associate in Obstetrics and Gynaecology, Harvard Medical School, Boston, Mass.
- J. Rm.**—J. Ramsbottom. Keeper of Botany, British Museum (Natural History), London. Co-editor of the *Journal and Transactions of the British Mycological Society*.
- J. R. M.**—Rt. Hon. James Ramsay MacDonald. Prime Minister and First Lord of the Treasury, 1929–35. Prime Minister, First Lord of the Treasury and Secretary of State for Foreign Affairs, Jan.–Nov. 1924. Chief British Delegate to and Chairman of the London Naval Conference, 1930. Author of *Socialism and Society*; *Labour and the Empire*; etc.
- J. R. Mag.**—John Robert Magness. Head Horticulturist in Charge of Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, U.S. Department of Agriculture, 1941–.
- J. R. Mar.**—John Richardson Marrack, M.D. Professor of Chemical Pathology, University of London. Author of *The Chemistry of Antigens and Antibodies*; *Food and Planning*.
- J. R. Ms.**—Jacob Rader Marcus. Professor of Jewish History, Hebrew Union College, Cincinnati, O. Author of *Rise and Destiny of the German Jew*; etc.
- J. Ros.**—Julius Rosenwald. Former Chairman of the Board, Sears, Roebuck and Company, Chicago, Ill.
- J. R. P.**—James Riddick Partington. Professor of Chemistry, East London College, University of London. Author of *A Textbook of Inorganic Chemistry for University Students*; etc.
- J. R. Pk.**—J. Roland Pennock. Professor and Chairman, Department of Political Science, Swarthmore College, Swarthmore, Pa. Author of *Administration and the Rule of Law*.
- J. R. R.**—John R. Riddell. Former Principal of the London School of Printing and Kindred Trades. Author of *The Training of the Printer*.
- J. R. Rn.**—John Reginald Richardson. Physicist, Radiation Laboratory, University of California, Berkeley, Calif.
- J. R. Ro.**—James Rennell Rodd, 1st Baron Rennell. H.M. Ambassador to the Court of Italy, 1908–19; Secretary of Legation, Cairo, 1894–1901; Counsellor of Embassy at Rome, 1901–14.
- J. R. T.**—Joseph Robson Tanner. Lecturer in History at St. John's College, University of Leeds, England, 1883–1921. Author of *Pepys's Naval Minutes*; etc.
- J. R. Th.**—Sir James Richard Thursfield. Former Dean, Fellow, Lecturer and Tutor of Jesus College, Oxford. Author of *Peel*; etc.
- J. R. Tu.**—John R. Tunis. Writer on sporting subjects.
- J. R. W.**—James Robert Wilson, M.D. Secretary, Council on Foods and Nutrition, American Medical Association.
- J. S.**—Josiah Charles Stamp, 1st Baron Stamp. Former Chairman and President of the Executive, London, Midland and Scottish Railway. Former Director of the Bank of England. Author of *Wealth and Income of the Chief Powers*; etc.
- J. Sa.**—John Sankey, 1st Viscount of Moreton. Lord Chancellor, 1929–35. Lord Justice of Appeal, 1928–29.
- J. S. B.**—John Sutherland Black. Former Co-editor of *The Encyclopaedia Biblica*.
- J. S. Be.**—Rev. Canon James Stanley Bezzant. Canon Residentiary and Chancellor of Liverpool Cathedral, Liverpool, England.
- J. S. By.**—John Sherman Beekley. Chemical Director, Ammonia Department, E. I. du Pont de Nemours & Co., Wilmington, Del.
- J. S. Co.**—James Sutherland Cotton. Former Editor of *The Imperial Gazetteer of India*. Author of *India in the "Citizen" Series*.

- J. S. D.**—J. S. Davis. Secretary to the Education Authority for the County of Norfolk, England, and former Vice-Principal and Master of Method to the Culham Training College.
- J. S. F.**—Sir John Smith Flett. Director, Geological Survey of Great Britain and Museum of Practical Geology, 1920-35. Former Lecturer on Petrology in Edinburgh University, Scotland.
- J. S. Fa.**—John Shields Fairbairn, M.D. Former Consulting Obstetric Physician and Gynaecologist, St. Thomas's Hospital. Former Consulting Physician, General Lying-in-Hospital, London. Author of *Gynaecology, with Obstetrics*; etc. Former Editor of *Journal of Obstetrics and Gynaecology of the British Empire*.
- J. S. Fr.**—J. S. Fraser. Lecturer in Laryngology, Otolaryngology and Rhinology, Edinburgh University, Scotland.
- J. S. H.**—Julian Sorell Huxley. Honorary Lecturer, King's College, University of London, 1927-35. Former Fullerian Professor of Physiology in the Royal Institution. Author of *Essays of a Biologist*; *Evolution, The Modern Synthesis*; etc.
- J. Si.**—J. Sime. Author of *A History of Germany*.
- J. Sib.**—Rev. James Sibree, D.D. Former missionary of London Missionary Society. Author of *Madagascar and Its People*; etc.
- J. S. K.**—Sir John Scott Keltie. Secretary, Royal Geographical Society, 1892-1915. Former Editor of *Statesman's Year-Book*; *Geographical Journal*.
- J. S. L.**—John Silas Lundy, M.D. Senior Consultant, Section on Anaesthesiology, Mayo Clinic, Rochester, Minn. Professor of Anaesthesiology, Mayo Foundation for Medical Education and Research, University of Minnesota, Minneapolis, Minn. Author of *Clinical Anesthesia: A Manual of Clinical Anesthesiology*.
- J. S. McD.**—J. S. McDaniel. Secretary, Cordage Institute, New York, N.Y.
- J. S. M. W.**—John Sebastian Marlow Ward, D.D. Father Superior of Confraternity of the Kingdom of Christ (Orthodox Catholic Church in England), and Director of the Abbey Folk Park and Museum. Author of *An Outline History of Freemasonry*; etc.
- J. S. No.**—John Samuel Noffsinger. Director, National Home Study Council, Washington, D.C. Author of *Correspondence Schools, Chautauquas and Lyceums*; etc.
- J. Sp.**—John Sparrow, Fellow of All Souls College, Oxford.
- J. S. P.**—J. S. Prendergast. Formerly with Worcester College, Oxford.
- J. S. R.**—James Smith Reid. Former Professor of Ancient History in Cambridge University and Fellow and Tutor of Gonville and Caius College. Former Editor of *Cicero's Academic*; etc.
- J. S. Rb.**—Jane Sands Robb, M.D. Associate Professor of Pharmacology, College of Medicine, Syracuse University, Syracuse, N.Y.
- J. Ss.**—Joel Stebbins. Director, Washburn Observatory and Professor of Astronomy, University of Wisconsin, Madison, Wis. Research Associate, Mount Wilson Observatory, Pasadena, Calif.
- J. S. S.**—John Stuart Scrimgeour. Barrister-at-Law of the Middle Temple.
- J. S. Sm.**—John Samuel Stamm, D.D. Vice-President of Executive Committee, World Council of Churches. Senior Bishop and President of Board of Bishops of the Evangelical Church in the Eastern Area of the Church, 1936-46. President, Evangelical School of Theology, 1935-41.
- J. S. So.**—J. Salwyn Schapiro. Professor of History, City College, New York, N.Y. Author of *Modern and Contemporary European History*; etc.
- J. S. T.**—John Spencer Thompson. President, Mutual Benefit Life Insurance Company of Newark, N.J., 1946-.
- J. Sw.**—Joseph Swire. Former Member of the Royal Institute of International Affairs, and of the Balkan Committee.
- J. S. W.**—Sir John Stephen Willison. Former Editor of the *News*, Toronto, Canada. Author of *Sir Wilfrid Laurier and the Liberal Party*; etc.
- J. T. A.**—James Truslow Adams. Editor in Chief, *Atlas of American History*, 1943. Author of *Founding of New England*; etc.
- J. T. B.**—John T. Bowen. Senior Electrical Engineer, U.S. Department of Agriculture, Washington, D.C. Author of *Dairy Engineering*.
- J. T. Be.**—John Thomas Bealby. Co-author of Stanford's *Europe*; former Editor of the *Scottish Geographical Magazine*. Translator of Sven Hedin's *Through Asia, Central Asia and Tibet*.
- J. T. Bz.**—John Theodore Buchholz. Former Professor of Botany, University of Illinois, Urbana, Ill.; Head of the Department, 1938-42. Former President of the Botanical Society of America.
- J. Te.**—Rev. John Telford. Wesleyan Methodist Connexion Editor, 1905-36. Editor of *Wesleyan Methodist Magazine*; *Preacher's Magazine*; etc. Author of *Life of John Wesley*; etc.
- J. T. F.**—John Thomson Faris, D.D. Director, Editorial Division of the Board of Christian Education of the Presbyterian Church in U.S.A., 1923-37. Author of *Where Our History Was Made*; etc.
- J. T. Hl.**—John Thomas Howell. Assistant Curator, Department of Botany, California Academy of Science, San Francisco, Calif.
- J. T. M.**—John Torrey Morse, Jr. Author of *The Life and Letters of Oliver Wendell Holmes*; etc.
- J. T. Ma.**—John Thomas Madden. Dean, New York University School of Commerce, Accounts and Finance, New York, N.Y., 1925-48. Former Director, Institute of International Finance. Co-author of *Elementary Accounting Problems*; etc.
- J. T. McG.**—John Terrence McGovern. Lawyer, and Promoter of Public Recreation and Counsellor to Carnegie Foundation for the Advancement of Teaching. Director, Pan-American Sports Congress and U.S. Sports Federation, 1941.
- J. T. W.**—John Tracy Winterich. Author, editor and critic. Author of *Early American Books and Printing*; *Twenty-three Books and the Stories Behind Them*.
- J. T. N.**—John T. Nichols. Curator of Fishes, The American Museum of Natural History, New York, N.Y. Author of *Freshwater Fishes of China*.
- J. T. Nn.**—James T. Nicholson. Executive Vice-President, American National Red Cross.
- J. T. P.**—Joseph Thomas Pardee. Geologist.
- J. T. S.**—James Thomson Shotwell. President, Carnegie Endowment for International Peace, New York, N.Y. Emeritus Bryce Professor of History of International Relations, Columbia University. Chairman, National Committee of U.S.A. on International Intellectual Co-operation of League of Nations, 1932-43.
- J. U.**—Joseph Urban. Architect, decorator and scenic designer. Author of *A Book of Theatres*.
- Ju. H.**—Julius Hays Hess, M.D. Emeritus Professor of Pediatrics, University of Illinois College of Medicine, Chicago. Member advisory committee, Children's Bureau, Federal Security Agency, Washington, D.C. Former President, Chicago Medical Society.
- J. V.**—Jules Viard. Former Archivist of the National Archives, Paris.
- J. Van Br.**—John Van Brunt. Vice-President in charge of Engineering, Combustion Engineering Company, Inc., New York, N.Y. (1933-48).
- J. V. B.**—James Vernon Bartlet, D.D. Former Professor of Church History, Mansfield College, Oxford. Author of *The Apostolic Age*; etc.
- J. V. C.**—James V. Cunningham. Assistant Professor of English, The University of Chicago. Author of *The Helmsman*; *The Judge Is Fury*.
- J. V. D.**—James Viner Delahaye. Colonel. President, No. 1 War Office Selection Board (Experimental), 1942-43. General Staff, War Office, 1925-28.
- J. V. H.**—J. Vincent Higginson. Managing Editor, the *Catholic Chieftain*. Member of the faculty, Pius X School of Liturgical Music, New York, N.Y. Secretary, Society of St. Gregory of America.
- J. Vi.**—Jonas Viles. Former Professor of American History, University of Missouri, Columbia, Mo. Author of *Archives of Missouri*; *History of Missouri*.
- J. V. M.**—J. V. Morton. Editor, *Wine Trades Review*, London.
- J. W.**—John Westlake. Professor of International Law, Cambridge University, 1888-1908. Author of *A Treatise on Private International Law, or the Conflict of Laws*.
- J. Wa.**—James Walker. Clerk of Judiciary, Scotland, 1940- . Author of *Intestate Succession in Scotland*; etc.
- J. W. A.**—James Wendell Alexander. Professor, Institute for Advanced Study, Princeton University.
- J. Wal.**—Jan Walch. Former Lecturer on Drama, University of Leyden, Netherlands.
- J. War.**—James Ward. Former Professor of Mental Philosophy and Logic in Cambridge University.
- J. W. B.**—J. W. Buckley. Research Department, Metropolitan Vickers Electric Co., Ltd., Manchester, England.
- J. W. Bs.**—Jesse Wakefield Beams. Professor of Physics, University of Virginia, Charlottesville, Va.
- J. W. C.**—John William Cobb. Former Livesey Professor of Coal, Gas and Fuel Industries, University of Leeds, Leeds, Eng.
- J. W. Ck.**—James Wilfred Cook. Regius Professor of Chemistry, University of Glasgow, Glasgow, Scot.

J. W. Ct.—John Winter Crowfoot. Former Chairman, Palestine Exploration Fund. Former Director, British School of Archaeology in Jerusalem. Author of *Early Churches in Palestine*; *Samaria-Sebesh I and II*.

J. W. En.—Joseph Wechsler Eaton. Director of Research, Rural Settlement Institute, New York, N.Y. Author of *Research Guide to Cooperative Group Farming*; etc.

J. W. Ev.—J. W. Evans. Lecturer in Petrology, Imperial College of Science and Technology, University of London, 1912-27.

J. W. F.—John Watson Foster. Former Professor of American Diplomacy, George Washington University, Washington, D.C. Former U.S. Secretary of State. Author of *Diplomatic Memoirs*; etc.

J. W. Fe.—J. Walter Ferrier. Translated Kaufmann's *George Eliot and Judaism*. Author of *Mottiscliffe*.

J. W. G.—John Walter Gregory. Professor of Geology, University of Glasgow, Scotland, 1904-29. Author of *The Foundation of British East Africa*; etc.

J. Wh.—Joshua Whatmough. Professor and Chairman of the Department of Comparative Philology, Harvard University. Sometime Faulkner Fellow of the University of Manchester and Research Student (Craven Award) of Cambridge University. Author of *The Prae-Italic Dialects of Italy*. Editor of *Harvard Studies in Classical Philology*, 1932-34 and 1941-44.

J. W. Hh.—Joel Walker Hedgpeth. Marine Biologist, Texas Game, Fish and Oyster Commission, Rockport, Tex.

J. W. H. M.—James Wycliffe Headlam-Morley. Former Historical Adviser to the Foreign Office, London. Former Fellow of King's College, Cambridge. Assistant Director, Political Intelligence Department of the Foreign Office, 1918-20. Author of *The History of Twelve Days*; *The Issue*; etc.

J. W. Ho.—J. W. Holloway, Jr. Director, Bureau of Legal Medicine and Legislation, American Medical Association, 1942-.

J. Wi.—James Williamson. Member of the firm of Sir Alexander Gibb and Partners, London.

J. Wil.—James Williams. Former All Souls Reader in Roman Law, Oxford University, and Fellow of Lincoln College, Oxford.

J. W. J.—James Weldon Johnson. Former Secretary of the National Association for Advancement of Colored People and Director of the American Fund for Public Service. U.S. Consul to Puerto Cabello, 1906; Corinto, 1909-12. Author of *The Book of American Poetry*; etc.

J. W. J. C.—J. W. J. Carpender, M.D. Associate Professor of Radiology, The University of Chicago.

J. W. Js.—Jenkin William Jones, Senior Agronomist, in charge of Rice Production and Improvement Project, Division Cereal Crops and Diseases, Bureau of Plant Industry, U.S. Department of Agriculture, Washington, D.C.

J. W. K.—Joseph W. Krutch. Brander Matthews Professor of Dramatic Literature, Columbia University, New York, N.Y. Author of *Samuel Johnson*; *The Twelve Seasons*.

J. W. L.—J. W. Luce. Production Manager, The Fleischmann Distilling Corporation, New York, N.Y.

J. W. Le.—James W. Lane. Research Assistant, National Gallery of Art, Washington, D.C. Author of *Masters in Modern Art*; *Whistler*.

J. W. M.—John William Moyer. Staff Taxidermist, Chicago Natural History Museum, Chicago, Ill. Author of *Lessons in Museum Taxidermy*.

J. W. McL.—James Walter McLeod. Brotherton Professor of Bacteriology, University of Leeds, Leeds, Eng.

J. W. M. D.—Jesse William Monroe Du Mond. Professor of Physics, California Institute of Technology, Pasadena, Calif., 1946-.

J. W. Mw.—Joseph W. Marlow. Lawyer. Editor and Research Analyst, Military Intelligence Service, U.S. Department of War, Washington, D.C., 1944-46.

J. W. R.—Jackson W. Riddle, M.D. Associate Professor of Medical Bacteriology and Preventive Medicine, Ohio State University, Columbus, O.

J. Ws.—Joseph Wells. Warden of Wadham College, Oxford, 1913-27. Vice-Chancellor, Oxford University, 1923-26. Author of *Oxford and Its Colleges*; etc.

J. W. S.—John Waugh Scott. Professor of Logic and Philosophy, University College of South Wales and Monmouthshire, Cardiff, 1920-44. Author of *Syndicalism and Philosophical Realism*; *Kant on the Moral Life*; etc.

J. W. Sc.—James W. Schade. Director of Research, B. F. Goodrich Co., Akron, O.

J. W. Sr.—John W. Snyder. Secretary, U.S. Department of the Treasury, Washington, D.C.

J. W. Ss.—J. W. Severs. Vice-President, Chicago, Milwaukee, St. Paul and Pacific Railroad Company, Chicago, Ill.

J. W. T.—John William Tibble. Professor of Education and Director of the Institute of Education, University College of Leicester, Leicester, Eng. Author of *John Clare: A Life*; *The Letters of John Clare*; *The Poems of John Clare*; etc.

J. W. Y.—John W. Young. Professor of Mathematics, Dartmouth College, Hanover, N.H., 1911-32. Former President of Mathematical Association of America. Author of *Projective Geometry*; etc.

J. Z.—Joseph Zubin. Instructor in Psychiatry, Columbia University, New York, N.Y. Associate Research Psychologist, New York State Psychiatric Institute and Hospital, New York, N.Y. Co-author of *Handwriting Analysis*.

K. A. Eck.—Karl August Eckhardt. Former Professor in the Faculty of Law, University of Göttingen; Germany.

K. B. M.—Kenneth Ballard Murdock. Professor of English, Harvard University. Dean of Faculty of Arts and Sciences, 1931-36. Author of *Portraits of Increase Mather*; etc.

K. B. Mn.—Karl Boyer McEachron. Assistant Works Engineer, General Electric Co., Pittsfield, Mass. Author of *Playing with Lightning*.

K. B. W.—K. B. Wiklund. Former Professor of Finno-Ugrian Languages, University of Uppsala, Sweden.

K. C.—Kent Cooper. Executive Director, The Associated Press, New York, N.Y. Author of *Barriers Down*.

K. C. B.—Kenneth Caron Buss. Air Commodore. Head of Middle East Section, Research Department, Foreign Office, London.

K. C. D. H.—Kenneth Claude Devereux Hickman. Vice-President in Charge of Research, Distillation Products, Inc., Rochester, N.Y.

K. C. L.—K. C. Law. Of the Alliance Assurance Company, Ltd., London.

K. C. M. S.—Kenneth Charles Morton Sills. President of Bowdoin College, Brunswick, Me.

K. Co.—Karl Cohen. Head of Theoretical Physics Group, Development Division, Standard Oil Development Company.

K. D. D. H.—K. D. D. Henderson. Governor of Darfur, Anglo-Egyptian Sudan, 1949-.

K. E.—Katherine Esau. Associate Professor of Botany and Associate Botanist, College of Agriculture, University of California.

K. E. B.—Kenneth E. Boulding. Associate Professor of Economics, Iowa State College, Ames, Ia. Author of *Economic Analysis*; etc.

K. E. E.—Kenneth Edward Eckenstein. Consul of Monaco in London.

K. E. H.—Kenneth Edward Hunt. University Demonstrator, Oxford University.

K. Es.—Kathleen Edwards. Lecturer in Mediaeval History, University of Aberdeen, Aberdeen, Scot. Author of *The English Secular Cathedrals in the Middle Ages*.

K. F. L.—Katharine Fredrica Lenroot. Chief, Children's Bureau, United States Federal Security Agency, Washington, D.C.

K. F. M.—Kenneth Fuller Maxcy, M.D. Professor of Epidemiology, The Johns Hopkins University, Baltimore, Md.

K. G.—Karl Friedrich Geldner. Former Professor of Indian Philology, University of Marburg, Germany.

K. G. J.—Kingsley Garland Jayne. Sometime Scholar of Wadham College, Oxford. Author of *Vasco da Gama and His Successors*.

K. G. St.—Kurt G. Stern. Adjunct Professor of Biochemistry, Polytechnic Institute, Brooklyn, N.Y. Co-author of *General Enzyme Chemistry*; etc.

K. Hi.—Karl Hildebrand. President of the Swedish National Debt Board. Editor of the *Stockholm Dagblad*, 1904-73. Member of Swedish Parliament, 1907-18.

K. H. P.—Kirk Harold Porter. Professor and Head of Department of Political Science, State University of Iowa, Iowa City, Ia. Author of *State Administration*; etc.

K. I.—Kenneth Ingham. Senior Lecturer in History, Makerere College, University College of East Africa, Kampala, Uganda.

K. J. L.—Karl Joseph Leyser. Tutor in Modern History and Senior Dean of Arts, Magdalen College, Oxford.

K. K.—K. Krumbacher. Former Professor of Greek Language and Literature in the University of Munich, Germany; etc.

K. K. D.—Karl Kelchner Darrow. Research Physicist, Bell Telephone Laboratories, New York, N.Y. Author of *Renaissance of Physics*; etc.

K. L.—Karl Loewenstein. Professor of Political Science and Jurisprudence, Amherst College, Amherst, Mass. Special Assistant to the Attorney General of the United States.

K. Le.—Kirsopp Lake. Professor of History, Harvard University, Cambridge, Mass., 1932-38. Author of *The Historical Evidence for the Resurrection of Jesus Christ*; etc.

K. L. W.—Karl Leland Wildes. Associate Professor of Electrical Engineering, Massachusetts Institute of Technology, Cambridge, Mass. Author of *Electrical Power System Analysis*.

- K. M.**—Kenneth Macgowan. Professor of Theatre Arts and Chairman of the Department of Theatre Arts, University of California, 1947— . Director, Greenwich Village Theatre, 1925–27. Producer, 20th Century-Fox Film Corporation, 1942–46. Author of *The Theatre of Tomorrow*; etc.
- K. M. W.**—Kenneth M. Watson. Professor of Chemical Engineering, University of Wisconsin, Madison, Wis. Author of *Industrial Chemical Calculations*.
- K. N. L.**—Karl Nickerson Llewellyn. Betts Professor of Jurisprudence, Columbia University. Author of *Cases and Materials on the Law of Sales*; etc.
- K. P. S.**—Karl Patterson Schmidt. Chief Curator of Zoology, Chicago Natural History Museum, Chicago, Ill. Co-author of *Ecological Animal Geography*; *Principles of Animal Ecology*.
- K. P. W.**—Katherine Pokan Whitaker. Lecturer in Chinese, School of Oriental and African Studies, London.
- K. R. Bp.**—Karl R. Bopp. Director of Research, Federal Reserve Bank of Philadelphia, Pa. Author of *The Government and the Bank of France*; etc.
- K. R. C.**—K. Ruth Collins. The Association of Drop Forgers and Stampers, Birmingham, England.
- K. S.**—Kathleen Schlesinger. Author of *The Instruments of the Orchestra*; etc.
- K. S. C.**—Kenneth S. Carlston. Professor of Law, University of Illinois, Urbana, Ill. Attorney, Mexican Claims Commissions, Washington, D.C., 1928–31. Author of *The Process of International Arbitration*; etc.
- K. S. D.**—Kenneth S. Davis. Author of *In the Forests of the Night*; *The Years of the Pilgrimage*; *Morning in Kansas*; *Soldier of Democracy* (biography of Dwight D. Eisenhower).
- K. S. L.**—Kenneth Scott Latourette, D.D. D. Willis James Professor of Missions and Oriental History and Director of Graduate Studies, Department of Religion, Yale University. Author of *The Chinese: Their History and Culture*; etc.
- K. S. Ly.**—Karl S. Lashley. Research Professor of Neuropsychology, Harvard University. Director, Yerkes Laboratories of Primate Biology, Orange Park, Fla., 1942— .
- K. Sm.**—Kazimierz Maciej Smogorzewski. Foreign correspondent. Founder and Editor, *Free Europe*, London. Author of *Poland's Access to the Sea*; *The United States and Great Britain*.
- K. S. P.**—Koppel S. Pinson. Assistant Professor of History, Queen's College, University of London. Co-editor of *Jewish Social Studies*; Assistant Editor of the *Encyclopaedia of the Social Sciences*. Author of *Pietism and the Rise of German Nationalism*; etc.
- K. T.**—Kojiro Tomita. Keeper of Japanese Art, Museum of Fine Arts, Boston, Mass. Lecturer on Chinese and Japanese art.
- K. T. K.**—Kaufman Thuma Keller. President, Chrysler Corporation, Detroit, Mich.
- K. von O.**—Karl Ludwig von Oertzen. Former Chief of the Intelligence Branch of the personal staff of the Ministry of Defense, Berlin.
- K. W. K.**—Katherine W. Kumler. Former Director of Home Economics, Skidmore College, Saratoga Springs, N.Y.
- K. W. Mac.**—Kenneth Wulsten MacKinnon. Barrister-at-law. Joint Editor, *Halsbury's Laws of England*, vol. 5, *Companies*.
- K. Y.**—Kimball Young. Chairman, Department of Sociology, Northwestern University, Evanston, Ill. Author of *Social Psychology and Personality and Problems of Adjustment*.
- L. A.**—Lascelles Abercrombie. Former Reader in English, Oxford University. Professor of English Literature, University of Leeds, England, 1922–29. Author of *Thomas Hardy, A Critical Study*.
- L. A. G.**—Lois Angell Green. Resident Fellow, Radcliffe College, Cambridge, Mass.
- L. A. T.**—Laurence A. Turner. Past Master, Art Workers' Guild. Past President, Master Carvers' Association. Author of *Decorative Plaster Work in Great Britain*.
- L. A. Tu.**—Leon Arthur Tulin. Former Assistant Professor of Law, Yale University.
- L. A. W.**—Lee A. White. Former Associate Professor of Rhetoric, University of Michigan, Ann Arbor, Mich.
- L. A. Wa.**—Laurence Austine Waddell. Lieut. Col., formerly with the Indian Civil Service. Author of *Lhasa and Its Mysteries*; etc.
- L. A. Wd.**—Lionel Albert Walford. Former Aquatic Biologist, Fish and Wildlife Service, U.S. Department of the Interior, Stanford University, Stanford, Calif. Author of *Marine Game Fishes of the Pacific Coast*; etc.
- L. A. Wn.**—Lincoln A. Werden. Sports staff, *The New York Times*. Co-editor, *The Golfer's Year Book*, 1930–32.
- L. B.**—Louis M. Brandin. Former Professor of French and of Romance Philology in the University of London.
- L. B. B.**—Lionel Bailey Budden. Roscoe Professor of Architecture, University of Liverpool, England.
- L. B. Br.**—Lester Burbank Bridaham. Public Relations Counsel and Secretary, Art Institute, Chicago. Author of *Gargoyles, Chimerae and the Grotesque in French Gothic Sculpture*.
- L. B. He.**—Lloyd B. Holsapple. Professor of Latin and Greek, Manhattanville College, New York, N.Y. Author of *Constantine the Great*.
- L. Bi.**—Laurence Binyon. Keeper of sub-department of Oriental Prints and Drawings, British Museum, London, 1913–33. Author of *Chinese Painters in English Collections*; etc.
- L. B. L.**—Leonard Benedict Loeb. Professor of Physics, University of California, Berkeley, Calif. Author of *Atomic Structure*; *Fundamentals of Electricity and Magnetism*; etc.
- L. B. M.**—L. B. Macurdy. Chief, Mass Section, National Bureau of Standards, U.S. Department of Commerce, Washington, D.C.
- L. Bo.**—Lorraine Bouthilet. Managing Editor, *The American Psychologist*.
- L. Bt.**—Libby Benedict. Author of *The Refugees*.
- L. Ca.**—Luis Cabrera. Author of *The Heritage of Carranza*, published under the pseudonym Lic. Blas Urrea.
- L. C. A.**—Lincoln Clark Andrews. Brigadier General (retired). Formerly in charge U.S. Coast Guard and Prohibition Unit charged with enforcing the Volstead Act. Author of *Fundamentals of Military Service*; etc.
- L. Cam.**—Rev. Lewis Campbell. Professor of Greek and Gifford Lecturer, University of St. Andrews, Scotland, 1863–94.
- L. C. C.**—LaMont C. Cole. Assistant Professor of Zoology, Cornell University, Ithaca, N.Y.
- L. C. D.**—L. C. Dunn. Professor of Zoology, Columbia University, New York, N.Y. Executive Head, Department of Zoology, 1940–46. Author of *Heredity and Variations*; etc.
- L. C. L.**—Lionel Charles Liddell. Sometime British Consul at Copenhagen. Secretary, Grand Committee on War Trade, 1914–18.
- L. C. M.**—Sir Leo Chiozza Money. Member of the War Trade Advisory Committee, 1915–18. Parliamentary Secretary to the Ministry of Shipping, 1916–18. Chairman of the Tonnage Priority Committee, 1917–18. Chairman of the National Maritime Board, 1917–18. Author of *The Nation's Wealth*; *Product Money*; etc.
- L. C. P.**—Linus Carl Pauling. Professor of Chemistry and Chairman, Division of Chemistry and Chemical Engineering, Director of Gates and Crellin Laboratories of Chemistry, California Institute of Technology, Pasadena, Calif. Author of *Nature of the Chemical Bond*; etc.
- Ld.**—Edward Arthur Henry Pakenham, Earl of Longford. Director of the Dublin Gate Theatre, Dublin, Ire. Author of *The Dove in the Castle*; *Poems From the Irish*; *More Poems From the Irish*.
- L. D.**—Louis Marie Olivier Duchesne. Former Professor at the Catholic Institute in Paris. Former Director of the French School of Archaeology at Rome. Author of *Origines du culte chrétien, étude sur la liturgie latine avant Charlemagne*; etc.
- L. D. B.**—Leon Dexter Batchelor. Director, University of California Citrus Experiment Station.
- L. D. C.**—Lotus Delta Coffman. Former President of the University of Minnesota, Minneapolis, Minn.
- L. de B. H.**—Louis de Breda Handley. Author of *Swimming and Watersmanship*; *Crawl Stroke Swimming*; etc.
- L. D. S.**—Laurence Dudley Stamp. Research Professor of Social Geography, University of London, 1948—. Chief Adviser to the Ministry of Agriculture on Rural Land Use, 1943—. Author of *An Introduction to Stratigraphy*; etc.
- L. Du. P.**—Lamont Du Pont. Former Chairman of the Board E. I. du Pont de Nemours and Company, Wilmington, Del.
- L. D. W.**—Leonard Duple White. Professor of Public Administration, The University of Chicago. Author of *Whitley Councils in the British Civil Service*; etc.
- L. E.**—Louis Eisenmann. Ernest Denis Professor in Slavonic History, University of Paris. Author of *Le compromis austro-hongrois de 1867*; etc.
- L. E. Bh.**—Lloyd E. Blauch. Chief, Education in the Health Professions, Office of Education, Federal Security Agency, Washington, D.C. Author of *A Course of Study in Dentistry*; *Teaching in Colleges and Universities With Special Reference to Dentistry*; etc.
- L. E. Bo.**—LeRoy E. Bowman. Director, United Parents' Association, New York, N.Y., 1935–38. Department of Social Science, Columbia University, 1917–31. Author of *Community Programs of Summer Play Schools*; etc.
- L. E. E.-B.**—Leonard Elliott Elliott-Binns, D.D. Vicar of St. Newlyn East and Honorary Canon of Truro, England, 1943–45.

L. E. F.—Laurence E. Falls. Secretary-Treasurer, Insurance Institute of America, Inc., New York, N.Y.

L. E. G.—Linton E. Grinter. Dean of the Graduate School, University of Florida, Gainesville, Fla. Author of *Design of Modern Steel Structures*; *Engineering Mechanics*; *Theory of Modern Steel Structures*.

L. E. H.—Sir Leonard Erskine Hill. Director of Research, St. John Clinic and Institute of Physical Medicine. Former Director of Applied Physiology, National Institute of Medical Research, Mount Vernon, Hampstead, England. Author of *Science of Ventilation and Open Air Treatment*; etc.

L. E. M.—L. E. Moffatt. Former Managing Editor of *Electrical Merchandizing*, New York, N.Y.

L. E. T.—Leon E. Truesdell. Chief Demographer, Bureau of the Census, U.S. Department of Commerce, Washington, D.C. Author of *The Canadian Born in the United States*; *Farm Population of the U.S.*; etc.

L. E. V. C.—Louis Emilien Victor Cordonnier. General. Commanded the French Army in the East under General Sarraill. Author of *The Japanese in Manchuria*.

L. F.—Lion Feuchtwanger. German novelist and dramatist. Author of *The Ugly Duchess*; etc.

L. F. A.—Ludwig Frederick Audrieth. Professor of Chemistry, University of Illinois, Urbana, Ill. Editor in Chief of *Inorganic Synthesis*, 1946.

L. F. B.—Lewellys F. Barker, M.D. Former Professor of Medicine, The Johns Hopkins University, Baltimore, Md.

L. F. G.—Laurence Frederick Graber. Head of Agronomy Department, University of Wisconsin, Madison, Wis. Author of *Agronomy, Principles and Practices*; etc.

L. F. M.—Louis F. Marr. Staff Member, Industrial Department (Labour Relations), Detroit Board of Commerce, Detroit, Mich.

L. F. S.—Louis Francis Salzman. Editor, *Victoria County Histories*. Author of *English Industries of the Middle Ages*; etc.

L. F. Sh.—Leo F. Smith. Chairman, Educational Research Office, and Director of Counseling Center, Rochester Institute of Technology, Rochester, N.Y. Co-author of *How to Read in Science and Technology*.

L. F. Sl.—Lyndon Frederick Small. Scientist Director, National Institute of Health, Washington, D.C. Author of *Chemistry of the Opium Alkaloids*.

L. F. Sr.—Laurance F. Shaffer. Head of the Department of Guidance, Teachers College, Columbia University, New York, N.Y. Author of *The Psychology of Adjustment*.

L. F. Sz.—L. F. Szilagy. Managing Director, Messrs. Siemens-Schukert (Great Britain), Ltd.

L. F. V. H.—Leveson Francis Vernon-Harcourt. Professor of Civil Engineering, University College, University of London, 1882-1905. Author of *Rivers and Canals*; *Harbours and Docks*; etc.

L. G.—Linda Gardiner. Secretary of the Royal Society for Protection of Birds, 1900-35. Former Editor of *Bird Notes and News*.

L. G. B.—Lottie Genevieve Bishop. Executive Secretary in the University Secretary's Office and in the School of Medicine, Yale University.

L. G. C. L.—L. G. Carr Laughton. Author of *Old Ship Figureheads and Sterns*.

L. G. N.—Leo George Nunes. Board of Governors, Amateur Fencers League of America. Chairman, Fencing Committee, New York Athletic Club, New York, N.Y.

L. G. R.—Leander Gaspard Roussin. Former British delegate on the International Financial Commission, Athens, Greece.

L. Gs.—Leo Gross. Professor of International Law, Fletcher School of Law and Diplomacy, Medford, Mass. Author of *Pazifismus und Imperialismus*.

L. Gu.—Luther Halsey Gulick. President, Institute of Public Administration, New York, N.Y. Executive Director, Mayor's Committee on Management Survey of the City of New York. Author of *Education for American Life*.

L. H.—Lewis Hodous, D.D. Head of the Chinese Department of the Kennedy School of Missions, Hartford Seminary Foundation, Hartford, Conn., 1917-45. Professor, History and Philosophy of Religion, Hartford Theological Seminary, 1928-41. Former President of Foochow Theological Seminary.

L. Ha.—Louis Halphen. Professor of History, École des Hautes Études at the Sorbonne, Paris, 1928.

L. H. Ba.—Liberty Hyde Bailey. Director, Bailey Hortorium, and Dean of College of Agriculture, Cornell University, 1903-13. Editor, *Standard Cyclopedia of Horticulture*.

L. H. D. B.—L. H. Dudley Buxton. Former Reader in Physical Anthropology in Oxford University. Author of *Peoples of Asia*.

L. H. H.—Libbie Henrietta Hyman. Research Associate, Department of Invertebrates, The American Museum of Natural History, New York, N.Y. Author of *The Invertebrates: Protozoa Through Ctenophora*; *Comparative Vertebrate Anatomy*.

L. H. L.—Lewis Harper Leech. Columnist and editorial writer on *Chicago Daily News*, 1937-51.

L. Hn.—Leon Henderson. Chief Economist, Research Institute of America. Former Administrator, Office of Price Administration, Washington, D.C.

L. H. R.—Lloyd H. Reyerson. Professor of Chemistry and Assistant Dean of the Institute of Technology, University of Minnesota, Minneapolis, Minn.

L. J.—Sir Louis (Charles) Jackson. Major General. Assistant Director of Fortifications and Works, War Office, 1907-10; reappointed, 1914-46.

L. J. B.—Lawrence Johnston Burpee. Former Secretary for Canada, International Joint Commission. Author of *Bibliography of Canadian Fiction*.

L. J. C.—Leslie John Comrie. Superintendent of H.M. Nautical Almanac Office, Royal Naval College, Greenwich, 1930-36.

L. J. Ce.—Leon Jacob Cole. Professor of Genetics, University of Wisconsin, Madison, Wis., 1918-47.

L. J. K.—Lloyd J. Kiernan. Manager, Special Studies, Public Relations Department, Association of American Railroads.

L. J. N.—L. J. Norton. Professor of Agricultural Economics and Chief in Marketing, Agricultural Experiment Station, University of Illinois, Urbana, Ill., 1936.

L. J. P.—Louise Jenison Peet. Professor and Head of Department of Household Equipment, Iowa State College, Ames, Ia.

L. J. S.—Leonard James Spencer. Editor, *Mineralogical Magazine*, 1900- , and *Mineralogical Abstracts*. Keeper of Mineralogy, British Museum (Natural History), London, 1927-35. President of the Mineralogical Society, 1936-39. Author of *The World's Minerals*; etc.

L. J. T.—L. J. Trinterud. Professor of Church History, McCormick Theological Seminary, Chicago, Ill. Author of *The Forming of an American Tradition*.

L. J. V.—Lee J. Vance. Publisher of the *Beverage News*.

L. K.—Lawrence Kolb, M.D. Director, Medical Department, California Department of Mental Hygiene, 1945- . Assistant Surgeon-General and Chief, Division of Mental Hygiene, U.S. Public Health Service, 1938-44.

L. Ka.—Leo Karpen. President, S. Karpen and Bros., Chicago, Ill.

L. K. B.—Lester K. Born. Co-ordinator of Microreproduction Projects, Library of Congress, Washington, D.C. Secretary-General, International Council on Archives. Author of *Erasmus: The Education of a Christian Prince*.

L. K. D.—Louis Klein Diamond, M.D. Associate Professor of Pediatrics, Harvard Medical School. Physician and Haematologist, Children's Medical Center. Director, Haematology Research Laboratory, and Director, Blood Grouping Laboratory, Children's Hospital, Boston, Mass.

L. K. Fk.—Lawrence K. Frank. Former Director, Caroline Zachry Institute of Human Development, New York, N.Y. Author of *Nature and Human Nature*; *Projective Methods*; *Society as the Patient*; *Understanding Children's Play*.

L. K. J.—Lee K. Jaffe. Director of Public Relations, Port of New York Authority.

L. K. S.—Lewis Ketcham Silcox. Executive Vice-President, New York Air Brake Company, Watertown, N.Y. Author of *Mastering Momentum*.

L. L.—Libero Lenti. Professor of Statistics at Pavia University, Pavia, It. Contributor on Economics to *Corriere della Sera*, Milan, It. Author of *Analisi di statistica economica*; *Statistica economica*.

L. Len.—Leo Lentelli. Sculptor. Member, National Sculptors Society. Member, Architectural League of New York. Associate of the National Academy Studio, New York, N.Y.

L. Li.—L. Liegler. Author of *Karl Kraus und sein Werk*.

L. Lip.—Leslie Lipson. Professor of Political Science and Public Administration, Victoria University College, University of New Zealand, Wellington, N.Z. Author of *The American Governor: From Figurehead to Leader*; *Politics of Equality: New Zealand's Adventures in Democracy*.

L. L. L.—Lewis L. Lorwin. Economic Adviser, Office of International Trade, United States Department of Commerce, 1945- . Author of *Post-War Plans of the United Nations*; etc.

L. L. Ms.—Lynn L. Means. Meteorologist, United States Weather Bureau, Chicago, Ill. Author of *The Nocturnal Maximum Occurrence of Thunderstorms in the Midwestern States*.

L. Lo.—Laurence Lockhart. Orientalist. Author of *Nadit Shah*; *Famous Cities of Iran*.

L. L. W.—Lorande Loss Woodruff. Colgate Professor of Protozoology, 1922-47, and former Director of the Osborn Zoological Laboratory, Yale University.

L. M.—Laurence Montague. Sports Editor, the *Manchester Guardian*.

L. M. B.—L. M. Buchanan. Member of the Sudan Political Service.

L. Me.—Leila Mechlin. Editor, the *American Magazine of Art*, 1909-31.

L. M. F.—Leonard M. Fanning. Director of Public Relations, Victor A. Bennett Co., New York, N.Y. Author of *American Oil Operations Abroad*; *The Rise of American Oil*.

L. M. G.—Lawrence Murray Graves. Professor of Mathematics, The University of Chicago. Vice-President, American Mathematical Society, 1943-44.

L. M. Gh.—Leland M. Goodrich. Professor of International Organization and Administration, Columbia University, New York, N.Y. Co-author of *Charter of the United Nations: Commentary and Documents*.

L. M. M.—Louis Melville Massey. Professor of Plant Pathology and Head of Department, Cornell University, Ithaca, N.Y.

L. M. P.—Lillian Margery Penson. Professor of Modern History, Bedford College, University of London. Author of *The Colonial Agents of the British West Indies*.

L. Ms.—Leonor Michaelis. Former Member, the Rockefeller Institute for Medical Research, New York, N.Y. Former Member, National Academy of Science. Author of *Hydrogen Ion Concentration*; *Oxidation-Reduction Potentials*.

L. M. T.—Leonard Monteath Thomson. Senior Lecturer in History, University of Cape Town, Cape Town, U. of S. Af. Author of *The Cape Coloured Franchise*.

L. Mu.—Lewis Mumford. Member of Executive Committee, Regional Planning Association of America. Author of *The Golden Day*; etc.

L. N. R.—Louis Nicot Ridenour, Jr. Dean of the Graduate School, University of Illinois, Urbana, Ill., 1947-. Professor of Physics, University of Pennsylvania, Philadelphia, 1946-47.

L. O. B.—Lawrence Olin Brockway. Professor of Chemistry, University of Michigan, Ann Arbor, Mich.

L. of F.—Arthur Hamilton Lee, 1st Viscount Lee of Fareham. Chairman of the Board of Governors, Sulgrave Manor, Northamptonshire, England, 1925-27.

L. O. H.—Leland Ossian Howard. Principal Entomologist, U.S. Department of Agriculture, Bureau of Entomology, Washington, D.C., 1927-31.

Lo. L.—Léo Loewenson. Deputy Librarian and Tutor in Russian History, School of Slavonic Studies, University of London.

L. Or.—Louise Overacker. Professor of Political Science, Wellesley College, Wellesley, Mass. Author of *The Presidential Primary*.

L. P.—Louise Pound. Professor of English Literature, University of Nebraska, Lincoln, Neb., 1912-45.

L. P. A.—Leonard Porter Ayres. Former Vice-President, The Cleveland Trust Company, Cleveland, O. Author of *Seven Great Foundations*; etc.

L. P. E.—Luther Pfahler Eisenhart. Dean of the Graduate School, Princeton University, 1933-45. Editor of *Annals of Mathematics*. Author of *Differential Geometry of Curves and Surfaces*.

L. P. S.—Lybrand P. Smith, Jr.

L. R.—Sir Leonard Rogers, M.D. Major General (retired). Former President, Medical Board, India Office, London. Former Physician, London Hospital for Tropical Medicine. Author of *Recent Advances in Tropical Medicine*; etc.

L. R. D.—Lawrence Robert Dicksee. Former Head of Sellars, Dicksee & Co. Sir Ernest Cassel Professor of Accountancy and Business, Organization in the University of London, 1919-26.

L. R. Dt.—Lester R. Dragstedt, M.D. Professor and Chairman of the Department of Surgery, The University of Chicago.

L. R. F.—Lewis Richard Farnell. Vice-Chancellor, Oxford University, 1920-23. Former University Lecturer in Classical Archaeology; and Wilde Lecturer in Comparative Religion. Author of *Cults of Greek States*; *Evolution of Religion*; etc.

L. R. Fd.—Lester R. Ford. Professor of Mathematics, Illinois Institute of Technology, Chicago, Ill. Former President, Mathematical Association of America. Author of *Automorphic Functions*; *Differential Equations*; *Alignment Charts*.

L. Ri.—Louis Ripault. Private Secretary to the President of the Chamber of Deputies, Paris, France. Author of *Histoire du Canada*.

L. R. L.—Lenox Riley Lohr. President, Museum of Science and Industry, Chicago, Ill. Author of *Fair Management*; *Magazine Publishing*; *Television Broadcasting*.

L. R. Ma.—L. R. Marti. Head, Men's Physical Education, University of North Dakota, Grand Forks, N.D.

L. Ro.—Lennox Robinson. Manager of the Abbey Theatre, Dublin, 1910-14, 1919-23. Director, Abbey Theatre, 1923.

L. Rs.—Laszlo Rostas. Research Statistician, Board of Trade, London. Former Research Associate, National Institute of Economic and Social Research, London. Author of *Productivity, Prices and Distribution in Selected British Industries*; etc.

L. R. T.—L. Reed Tripp. Lecturer in Economics, University of Wisconsin, Madison, Wis.

L. R. W.—Leonidas Rutledge Whipple. Professor of Journalism, New York University, New York, N.Y., 1930-46. Author of *The Story of Civil Liberty in the United States*; etc.

L. S.—Sir Leslie Stephen. English biographer and literary critic. Editor, *Dictionary of National Biography*, 1882-91.

L. S. B.—Lawrence Sabin Brodie. Senior Scientific Officer in Royal Naval Scientific Service.

L. S. Bd.—Lawrence S. Brodd. Office Engineer, Portland Cement Association.

L. Sc.—Rt. Hon. Sir Leslie (Frederic) Scott. Lord Justice of Appeal, 1935-48. Represented His Majesty's Government at International Conferences on Maritime Law, Brussels, 1909, 1910, 1922 and 1926.

L. S. C.—Lee S. Crandall. General Curator, Mammals and Birds, New York Zoological Park, New York, N.Y. Author of *Pets: Their History and Care and Paradise Quest*.

L. Sco.—Lester Scott. Of the Sports Department, *New York World-Telegram*, New York, N.Y.

L. S. D.—Louis Serle Dederick. Head Mathematician, Aberdeen Proving Ground, Aberdeen, Md.

L. S. H.—Leta S. Hollingworth. Former Professor of Education, Teachers College, Columbia University. Author of *Psychology of Subnormal Children*; *Children above 180 I. Q.*, *Stanford-Binet: Origin and Development*; *Psychology of the Adolescent*; etc.

L. Si.—Lee Simonson. Director of Theatre Guild, Inc., New York, N.Y., 1919-40. Former Editor, *Creative Art*. Author of *The Stage is Set*; *Theatre Art*; *Part of a Lifetime: Drawings and Designs*, 1919-1940.

L. Sk.—Louis Skidmore. Chief of Design, A Century of Progress Exposition, Chicago, Ill., 1933-34. Consultant for New York World's Fair, 1939.

L. S. K.—Lawrence Schlesinger Kubie, M.D. Associate in Neurology, College of Physicians and Surgeons, Columbia University, New York, N.Y. Faculty, New York Psychoanalytic Institute, New York. Author of *Practical Aspects of Psychoanalysis*.

L. S. Kl.—Louis S. Kassel. Assistant Executive Vice-President, Universal Oil Products Company, Chicago, Ill. Author of *Kinetics of Homogeneous Gas Reactions*.

L. Sl.—Leverett Saltonstall. U.S. Senator, 1945-; Governor of Massachusetts, 1939-45. Overseer of Harvard University.

L. S. Ma.—Lionel Simeon Marks. Emeritus Professor of Mechanical Engineering, Harvard University. Editor in Chief of *Mechanical Engineers' Handbook*. Author of *The Airplane Engine*; etc.

L. Sn.—Ludwik Silberstein. Mathematical Physicist, Research Laboratory, Eastman Kodak Co., Rochester, N.Y., 1920-29. Author of *Vectorial Mechanics*; etc.

L. S. O'M.—L. S. O'Malley. Author of *History of Bengal*; *Bihar and Orissa Under British Rule*; etc.

L. S. R.—Leo S. Richardson. Assistant to the Chief, Section of Information, Bureau of Dairy Industry, U.S. Department of Agriculture.

L. S. Rl.—Lewis S. Ramsdell. Professor and Chairman of the Department of Mineralogy, University of Michigan, Ann Arbor, Mich. Co-author of *Mineralogy*.

L. S. Ro.—Leo S. Rowe. Former Director General, Pan American Union, Washington, D.C. Co-author of *Report of the United States Commission to Revise the Laws of Porto Rico*; etc. Author of *The United States and Porto Rico*; etc.

L. S. S.—L. Susan Stebbing. Professor of Philosophy in the University of London, 1933-43.

L. S. Sd.—Lucy Stuart Sutherland. Principal of Lady Margaret Hall, Oxford. Author of *A London Merchant, 1695-1774*; *The East India Company in Eighteenth Century Politics*.

L. St.—Leonard Stein. President, Anglo-Jewish Association. Author of *Zionism*.

L. T.—Lorado Taft. Sculptor. Author of *History of American Sculpture*; etc.

L. T. A.—Lyle Thomas Alexander. Soil Scientist, U.S. Department of Agriculture, Washington, D.C.

L. T. Co.—Lowell T. Coggeshall, M.D. Dean, Division of Biological Sciences, The University of Chicago.

- L. T. E.**—Leon Theodore Eliel. Vice-President, Fairchild Aerial Surveys, Inc., Los Angeles, Calif.
- L. T. G.**—Laura T. Griggs. Wife of Robert F. Griggs, the discoverer of the Valley of Ten Thousand Smokes and Author of *The Valley of Ten Thousand Smokes*.
- L. T. H.**—Lancelot T. Hogben. Professor of Medical Statistics, 1947–, Mason Professor of Zoology, 1942–47, University of Birmingham, England. Regius Professor of Natural History, University of Aberdeen, Scotland, 1937–41. Author of *The Nature of Living Matter*; etc.
- L. T. Ho.**—Leonard T. Hobbhouse. Former Professor of Sociology, University of London.
- L. Tr.**—Lev Trotsky. Former Head of the Central Committee for Concessions, Union of Soviet Republics, and People's Commissar for Foreign Affairs, and Commissar for War, Moscow, U.S.S.R.
- L. Ts.**—Lorie Tarshis. Professor of Economics, Stanford University, Stanford, Calif. Co-author of *Elements of Economics: Mobilizing Resources for War*.
- L. T. Se.**—Lucy Taxis Shoe. Associate Professor of Art and Archaeology, Mount Holyoke College, South Hadley, Mass. Author of *Profiles of Greek Mouldings*.
- L. Tu.**—Louis Tuft, M.D. Assistant Professor of Medicine, Temple University School of Medicine, Philadelphia, Pa. Chief of Allergy Clinic, Temple University Hospital, Philadelphia, Pa. Author of *Clinical Allergy*; *Clinical Immunology*, *Biotherapy and Chemotherapy*.
- Lu.**—Frederick Dealtry Lugard, 1st Baron Lugard of Abinger. British Member of Permanent Mandates Commission, League of Nations, 1922–36. Commander of Legion of Honour, 1917. Author of *The Dual Mandate in British Tropical Africa*; etc.
- L. U.**—Lyndall Urwick. Lieutenant-Colonel, Petroleum Warfare Department, 1942–44. Consultant to H.M. Treasury, 1940–42. Co-author of *Factory Organization*; etc.
- L. Un.**—Louis Untermeyer. Author, critic and editor. Editor of *Modern American Poetry*; *Modern British Poetry*; etc. Author of *American Poetry since 1900*; etc.
- L. V.**—Luigi Villari. Official in the Royal Italian Foreign Office (retired). Author of *Italian Life in Town and Country*; etc.
- L. V. F.**—Leon V. Foster. Chief Microscope Engineer, Bausch & Lomb Optical Co., Rochester, N.Y.
- L. V. H.**—Lewis Victor Heilbrunn. Professor of Zoology, University of Pennsylvania, Philadelphia, Pa. Author of *The Colloid Chemistry of Protoplasm*; etc.
- L. V. J.**—Lewis Van Hagen Judson. Chief, Length Section and Senior Physicist, Division of Weights and Measures, National Bureau of Standards. Author, *Testing of Line Standards of Length*.
- L. von M.**—Ludwig von Mises. Visiting Professor, Graduate School of Business Administration, New York University. Author of *Socialism*; etc.
- L. V. P.**—Ludvig von Pastor. Former Professor of History in the University of Innsbruck, Austria, and Director of the Austrian Institute of Historical Studies in Rome.
- L. V. Po.**—Leroy V. Porter. Former Assistant Vice-President and Comptroller, New York Central System.
- L. W.**—Lucien Wolf. Former President of the Jewish Historical Society of England. Author of *Diplomatic History of the Jewish Question*.
- L. Wa.**—Lina Waterfield. Foreign Correspondent of the Kemsley Press, 1946–. Author of *Home Life in Italy*; *The Story of Rome*; etc.
- L. W. B.**—Lewis Warrington Baldwin. Former President, Member of Executive Committee and Chief Executive Officer, Missouri Pacific Railway Company.
- L. W. Be.**—Lewis W. Bealer. Berkeley, California. Former Assistant Professor of History, University of Oklahoma, Norman, Okla.
- L. W. D.**—Leon W. Dean. Assistant Professor of English and Vermont History, University of Vermont, Burlington, Vt.
- L. W. F.**—Lionel Wray Fox. Chairman, Prison Commission for England and Wales. Author of *The Modern English Prison*.
- L. W. H.**—Lawrence Whitaker Harrison. Colonel. Former Special Medical Officer (Venereal Disease), Ministry of Health, London. Editor, 1925–42, *British Journal of Venereal Diseases*.
- L. W. Hg.**—Lowry W. Harding. Professor of Education, Ohio State University, Columbus, O. Author of *Anthology in Education*; *Functional Arithmetic: Photographic Interpretations*; *Student Teaching in the Elementary School*.
- L. W. Hu.**—Leroy W. Hutchins. Writer on outdoor sports.
- L. Wi.**—Louis Wiley. Business Manager, *The New York Times*, 1906–35.
- L. W. J.**—Lloyd W. Josselyn. Librarian, Albert A. Wells Memorial Library, Lafayette, Ind.
- L. W. Ms.**—Lloyd W. Mints. Associate Professor of Economics, The University of Chicago.
- L. Wr.**—Laurence Wray. Editor, *Electrical Merchandising*. Author of *Electrical Appliance Sales Handbook*.
- L. Ws.**—Lou Williams. Instructor in Geology, The University of Chicago. Author of *A Dipper Full of Stars*.
- L. W. S.**—Louis Wendlin Sauer, M.D. Assistant Professor of Pediatrics, Northwestern University Medical School, Chicago, Ill. Author of *Nursery Guide*; *From Infancy Through Childhood*.
- L. W. T.**—Lloyd William Taylor. Head of Department of Physics, Oberlin College, Oberlin, O., 1924–48. Author of *Fundamental Physics*; etc.
- L. W. V. H.**—L. W. Vernon-Harcourt. Author of *His Grace the Steward and the Trial of Peers*.
- Lz.**—Count Lutzow. Author of *The Life and Times of Master John Hus*; etc.
- M.**—Thomas Babington Macaulay, 1st Baron Macaulay of Rothley. English statesman, essayist and historian. Author of *The History of England*; etc.
- M. A.**—Mary Hunter Austin. Author and former lecturer at Yale University. Translator of American Indian poetry. Author of *The Basket Woman*; etc.
- Ma. Bg.**—Baroness Maura Budberg. Story Editor, London Films, London.
- M. A. C.**—Morse Adams Cartwright. Professor of Education and Executive Officer, Institute of Adult Education, Columbia University.
- M. A. F.**—Mildred Adams Fenton. Co-author of *The Rock Book*; *Story of the Great Geologists*.
- M. A. H.**—Mary Agnes Hamilton. Alderman of London County Council, 1937–40. M.P. for Blackburn, 1929–31. Under the pen name of "Iconoclast" wrote *J. Ramsay MacDonald*; etc.
- M. A. Hn.**—M. A. Hein. Senior Agronomist, Bureau of Plant Industry, Soils, and Agricultural Engineering, United States Department of Agriculture.
- M. A. J.**—Morley Allan Jull. Professor of Poultry Husbandry and Head of the Department, University of Maryland, College Park, Md. Author of *Poultry Husbandry and Successful Poultry Management*.
- M. A. L.**—Morris Albert Linton. President, Provident Mutual Life Insurance Company of Philadelphia, Pa. Former President, Actuarial Society of America.
- M. A. M.**—Margaret Alice Murray. Former Assistant Professor of Egyptology, University of London. Author of *Witch Cult in Western Europe*; etc.
- M. A. Ml.**—Max A. Michael. Office of Public Relations, U.S. Department of the Navy, Washington, D.C.
- Ma. S.**—Maurice Saunders. Chairman of the Board of Directors, the Lithographers National Association Inc.
- Ma. Si.**—Marcel Simon. Professor and Dean of the Faculty of Arts and former Lecturer in Alsatian History, University of Strasbourg, Strasbourg, Fr. Author of *Verus Israel: Etude sur les Relations entre Chrétiens et Juifs dans l'Empire Romain*; *Vues Générales sur l'Histoire de l'Alsace*.
- M. A. W.**—Martha Annie Whiteley. Assistant Professor, Chemical Department, Imperial College of Science and Technology, University of London, 1920–34. Editor of *Thorpe's Dictionary of Applied Chemistry*.
- M. A. Wa.**—Mary A. Ward (Mrs. Humphry Ward). Author of *Robert Elsmere*; etc., and contributor to *Dictionary of Christian Biography*.
- M. B.**—Millar Burrows. Professor of Biblical Theology, Yale University Divinity School. Co-editor of *Journal of Biblical Literature*. Author of *Founders of Great Religions*; etc.
- M. Be.**—Marcu Beza. Former Consul General at the Rumanian Legation, London. Former Lecturer on Rumanian, King's College, University of London. Author of *Rumanian People and Literature*.
- M. Bf.**—Max Beloff. Reader in the Comparative Study of Institutions, University of Oxford. Professorial Fellow, Nuffield College, Oxford. Author of *The Foreign Policy of Soviet Russia*.
- M. Bg.**—Hon. Maurice Baring. Wing-Commander. English diplomat. Sometime correspondent for the *Morning Post* (London) in Manchuria, Russia and Constantinople, and for *The Times*, London, in the Balkans.
- M. B. H.**—Milton B. Herr. Major, U.S. Army. Information Office, Chief of Staff, Washington, D.C.

- M. Bo.**—Moritz Julius Bonn. Visiting Professor, University of California, 1935—. Lecturer, London School of Economics, 1933. Author of *Die Englische Kolonisation in Irland*; etc.
- M. Bra.**—Mary N. L. Bradshaw. Mary Ewart Travelling Student of Newnham College, Cambridge, 1915. Sometime Lecturer in Classics, East London College and University of Birmingham, England.
- M. Bt.**—Michael Brett. Barrister-at-Law, formerly at Middle Temple.
- M. Bu.**—Millard Buckley. Publicity Manager of Rolls-Royce Ltd., London.
- M. C.**—Max Cary. Emeritus Professor of Ancient History in the University of London. Author of *A History of the Greek World from 323 to 146 B.C.*; etc.
- M. C. B.**—Miles Crawford Burkitt. University Lecturer on the Faculty of Archaeology and Anthropology, Cambridge University. Author of *Prehistory*; etc.
- M. C. Bl.**—Margaret C. Bristol. Associate Professor of Social Work, School of Social Welfare, Florida State University, Tallahassee, Fla.
- M. C. Js.**—Milton Carl James. Assistant Director, Fish and Wildlife Service, U.S. Department of Interior, Washington, D.C. Co-author of *Fish Stocking as Related to the Management of Inland Waters*.
- M. C. L.**—M. C. Lamb. Analytical chemist and consulting expert to the leather trades.
- M. C. M.**—Max Cornils Mangels. Legal member of the department for administering the Kiel Canal.
- M. C. Mi.**—Max C. Miller. Knitting Engineer, Manville, R.I.
- M. C. Ml.**—Matthew Cargill Mitchell. Associate Professor of Political Science, Brown University, Providence, R.I.
- M. C. R.**—Mabel Mary Cheveley Rayner. Formerly engaged in forestry research in collaboration with Research Department of Forestry Commission. Sometime Head of Department of Botany, University College, Reading, Pa. Author of *Mycorrhiza*; etc.
- M. C. S.**—Malcolm Charles Salaman. Former Dramatic and Art Critic of *The Sunday Times*, London. Author of *Old English Colour-Prints*.
- M. D.**—Marcus Dods, D.D. Former Principal of New College, Edinburgh. Editor of *Lange's Life of Christ* and author of *The Epistle to the Seven Churches*; etc.
- M. D. A.**—Milo Don Appleman. Associate in Soil Biology, University of Illinois, Urbana, Ill.
- M. D. C.**—Sir Mackenzie Dalzell Chalmers. Permanent Under-Secretary of State for Home Department, 1902-08. First Parliamentary Counsel to Treasury, 1902-03. Author of *Digest of the Law of Bills of Exchange*; etc.
- M. D. D.**—Mary Dabney Davis. Specialist in Nursery-Kindergarten-Primary Education, Office of Education, Federal Security Agency, Washington, D.C. Author of *Schools for Children Under Six*; *Schools for Young Children in Twenty-Seven Countries*.
- M. Dk.**—(John) Michael Derrick. Assistant Editor, *Tablet*. Editor, *Catholic Year Book*. Author of *Eastern Catholics Under Soviet Rule*; etc.
- M. D. K.**—M. D. Kennedy. Captain. Tokyo correspondent, Reuters, Ltd.
- M. D. Km.**—Marshall D. Ketchum. Associate Professor of Finance, School of Business, The University of Chicago. Author of *The Fixed Investment Trust*.
- M. D. Ks.**—Max Davis Kossoris. Officer in Charge, Regional Office, Bureau of Labor Statistics, San Francisco, Calif. Author of *Manual on Industrial Injury Statistics*; etc.
- M. Dn.**—Mitchell Dawson. Lawyer, writer, former Editor, *Chicago Bar Record*, Chicago, Ill.
- Me.**—James Scorgie Meston, 1st Baron Meston. Chancellor of Aberdeen University, Scotland, 1928. Finance Member of Governor-General's Council, 1919. Lieut. Governor, United Provinces of Agra and Oudh, 1912-18.
- M. E. A. B.**—Marian Ellen Alberta Bowley. Lecturer, Department of Political Economy, University College, London. Author of *Nassau Senior and Classical Economics*; *Housing and the State 1919-1944*.
- M. E. D.**—Malvin E. Davis. Actuary, Metropolitan Life Insurance Company, New York, N.Y. Author of *Industrial Life Insurance*.
- M. E. Dn.**—Mary Earhart Dillon. Chairman, Department of Political Science, Queens College, Flushing, N.Y. Author of *Frances Willard: From Prayers to Politics*; *Wendell Willkie*.
- M. E. G.**—Marjorie E. Green. Secretary, The Family Endowment Society, London.
- M. E. He.**—Mary Emogene Hazeltine. Principal, Library School, University of Wisconsin, Madison, Wis., 1906-38. Author of *Anniversaries and Holidays*; etc.
- M. E. M.**—Sir Mervyn Edmund Macartney. Architect to the Dean and Chapter of St. Paul's Cathedral, 1906-31. Editor of the *Architectural Review*, 1906-20. Co-author of *Later Renaissance Architecture in England*.
- M. E. P.**—Marlen Edwin Pew. Former Editor and Vice-President, *Editor and Publisher*, New York, N.Y.
- M. E. Pa.**—Marion Edwards Park. Emeritus President, Bryn Mawr College, Bryn Mawr, Pa.
- M. E. Se.**—M. Edmund Speare. Educational Director, Bituminous Coal Institute, The National Coal Association, Washington, D.C.
- M. E. W.**—Mary Emma Woolley. President of Mount Holyoke College, South Hadley, Mass., 1900-37. President, 1927-33, American Association of University Women.
- M. E. Wn.**—Morley Evans Wilson. Geologist, Geological Survey of Canada.
- M. Fa.**—Michael Farbman. Former Editor of the *Europa Year Book*.
- M. F. Bé.**—M. F. Béhar. Consulting engineer, Pittsburgh, Pa.
- M. F. de C.**—Morris F. de Castro. Governor of the Virgin Islands of the U.S.A.
- M. F. G.**—Michael Frederic Guyer. Emeritus Professor of Zoology, University of Wisconsin, Madison, Wis. Author of *Animal Biology*; etc.
- M. Fi.**—Morris Fishbein, M.D. Editor, *Excerpta Medica*; Contributing Editor, *Postgraduate Medicine*.
- M. Fn.**—Margaret White Fishenden. Reader in Applied Heat, Mechanical Engineering Department, Imperial College of Science and Technology, University of London.
- M. F. N.**—Meyer F. Nimkoff. Chairman of the Department of Sociology, Florida State University, Tallahassee, Fla. Author of *Marriage and the Family*; co-author of *Sociology*.
- M. G.**—Moses Gaster. Chief Rabbi of the Sephardic Communities of England, 1887-1919. Ilchester Lecturer at Oxford on Slavonic and Byzantine Literature, 1886, 1891. Vice-President, Zionist Congress, 1898, 1899 and 1900. Author of *A New Hebrew Fragment of Ben Sira*; etc.
- M. G. B. A.**—Mildred Gwinn Barnwell Andrews. Cotton and textile consultant. Author of *Cotton Magic*; *Faces We See*.
- M. G. D.**—Rt. Hon. Sir Mountstuart Elphinstone Grant Duff. Governor of Madras, 1881-86. Under-Secretary of State for the Colonies, 1880-81. Under-Secretary of State for India, 1868-74. Author of *Studies in European Politics*; etc.
- M. G. F.**—Dame Millicent G. Fawcett. Author of *Women's Suffrage*; etc.
- M. G. G.**—Martin Gustave Glaeser. Professor of Economics, University of Wisconsin, Madison, Wis. Former Statistician, Railroad Commission of Wisconsin. Chief Power Planning Engineer, Tennessee Valley Authority, 1937-38. Author of *Outlines of Public Utility Economics*.
- M. Gi.**—Morris Ginsberg. Martin White Professor of Sociology in the University of London, London School of Economics. Co-editor of *Sociological Review*. Author of *The Psychology of Society*; etc.
- M. Go.**—Margaret Goldsmith (Mrs. Fritz A. Voigt). Journalist. Author of *Franz Anton Mesmer*; *Studies in Aggression*; etc.
- M. G. P.**—Mary Gray Peck. Instructor and Assistant Professor of English Literature, University of Minnesota, Minneapolis, Minn., 1899-1909. Author of *Carrie Chapman Catt, A Biography*.
- M. Gr.**—Major Greenwood. Former Professor of Epidemiology and Vital Statistics, London School of Hygiene and Tropical Medicine, University of London. Former Medical Officer, Ministry of Health. Author of *Epidemics and Crowd-Diseases*; etc.
- M. G. R.**—Margaret G. Reid. Professor of Economics, University of Illinois, Urbana, Ill. Author of *Food for People*; *Consumers and the Market*.
- M. Gt.**—Milton Gilbert. Chief, National Income Division, Office of Business Economics, U.S. Department of Commerce, Washington, D.C. Author of *Currency Depreciation and Monetary Policy*; *Export Pricing Policy of U.S. Corporations*.
- M. Gu.**—M. Guillaume. Managing Director of *Le Petit Journal*, Paris.
- M. H.**—Max Hüber. President, International Red Cross Committee, 1928-44. Judge of the Permanent Court of International Justice and Member of the Permanent Court of Arbitration.
- M. Ha.**—Mannel Hahn. Editor, *Postal Markings*. Author of *U.S. Post Office, 1851-60*; *U.S. Postal Markings, 1847-51*; *So You're Collecting Stamps!*; etc.
- M. H. C.**—Montague Hughes Crackanthorpe. Former member of the General Council of the Bar and Council of Legal Education, England.
- M. H. De.**—Maurice H. Decker. Writer on outdoor sports in numerous magazines and periodicals.
- M. H. En.**—Milton Hyland Erickson, M.D.

- M. H. F.**—Martin Henry Fischer, M.D. Professor of Physiology, University of Cincinnati, Cincinnati, O. Author of *Oedema and Nephritis; Death and Dentistry; The Lymphatic Colloids; In Praise of Man*; etc.
- M. H. L.**—Margaret Helen Longhurst. Keeper, Department of Architecture and Sculpture, Victoria and Albert Museum, London, 1938-42.
- M. H. M.**—Mabel H. Mills. Editor of *The Pipe Roll for 1295; Surrey Record Society*; and author of articles on the chequer in *The English Historical Review*; etc.
- M. H. Me.**—Mary Hume Maguire. Tutor in History, Radcliffe College, Cambridge, Mass., 1925-45. Author of "Attack of the Common Lawyers on the Oath ex officio as Administered in the Ecclesiastical Courts in England," in *Essays in History and Political Theory*.
- M. Hn.**—Martin Heinemann, M.D. Associate Clinical Professor of Medicine, Yale University, New Haven, Conn.
- M. H. S.**—Marion Harry (Alexander) Spielmann. Former editor of the *Magazine of Art*. Member of Fine Arts Committee of International Exhibitions of Brussels, Paris, Buenos Aires, Rome and the Franco-British Exhibition, London. Author of *British Portrait Painting to the Opening of the 19th Century; British Sculpture and Sculptors of To-day*; etc.
- M. H. Sl.**—M. H. Sherrill. Investigating Chemist, California and Hawaiian Sugar Refining Corporation, Ltd., Crockett, Calif.
- M. Hy.**—Marion Hathway. Director of the Graduate Department of Social Economy, Bryn Mawr College, Bryn Mawr, Pa. Author of *Migratory Worker and Family Life*; co-author and editor of *Education for the Public Social Services*.
- Mi. C.**—Mildred Campbell. Professor of History, Vassar College, Poughkeepsie, N.Y., 1937-.
- M. I. G.**—Morton I. Grossman, M.D. Associate Professor of Physiology, University of Illinois College of Medicine, Chicago, Ill.
- Mi. M.**—Michel Mollat. Professor, University of Lille, Lille, Fr. Author of *Le Commerce maritime normand à la fin du Moyen Age; La Comptabilité du Port de Dieppe au XV^e siècle; Séquestre et vente des biens de Jacques Coeur*.
- M. I. N.**—Marion I. Newbigin. Former editor of the *Scottish Geographical Magazine*. Author of *Mediterranean Lands*; etc.
- M. J. C.**—Michael John Curry. President and Treasurer, The Western Pacific Railroad Corporation, New York, N.Y.
- M. J. de G.**—Michael Jan de Goeje. Former Professor of Arabic at Leyden; Membre de l'Institut. Editor of the *Encyclopaedia of Islam* (vol. I-III). Author of *Fragmenta historicorum Arabicorum*; etc.
- M. Je.**—Mark Jefferson. Former Professor of Geography and Head of the Department, State Normal College, Ypsilanti, Mich. Author of *Peopling the Argentine Pampa*; etc.
- M. J. G.**—Rev. Michael Joseph Gruenther, S.J., Associate Professor of Sacred Scripture, Catholic University, Washington, D.C., 1946- . Professor of Sacred Scripture, St. Mary's College, St. Marys, Kan. Editor in Chief, *The Catholic Biblical Quarterly*.
- M. J. H.**—Max John Herzberg. Literary editor, *Newark Evening News*; Principal, Weequahic High School, Newark, N.J. President, Stephen Crane Association, 1924-30.
- M. Jol.**—Maria Jolas (Mrs. Eugène Jolas).
- M. J. Py.**—Merlo J. Pusey. Associate Editor, *Washington Post*, Washington, D.C. Author of *Big Government: Can We Control It?; Charles Evans Hughes*.
- M. J. R.**—M. J. Ryan. Professor of Constitutional Law, University College, Dublin.
- M. J. T.**—Dame Margaret Jansson Tuke. Former Principal, Bedford College for Women, University of London. Author of *A History of Bedford College*.
- M. J. To.**—Maurice J. Tobin. Former Secretary, U.S. Department of Labour, Washington, D.C.
- M. J. V.**—Melvin J. Vincent. Head of the Sociology Department, University of Southern California, Los Angeles, Calif. Author of *The Accommodation Process in Industry*; co-author of *Analyzing Social Problems*.
- M. J. Z.**—Michael J. Zigler. Professor and Chairman of Psychology Department, Wellesley College, Wellesley, Mass.
- M. K.**—Meave Kenny, M.D. University Reader in Obstetrics and Gynaecology, Postgraduate Medical School of London. Author of *I'll Change the Colour*.
- M. K. E.**—Maxim K. Elias (Elias Levich of Russia prior to naturalization). Palaeontologist. Professor, Graduate College, University of Nebraska, Lincoln, Neb.
- M. K. S.**—Malcolm K. Scott. Secretary of Lloyd's Register of Shipping.
- M. L. A.**—Mary Langs Argo. Research worker in physics.
- M. L. F.**—Mary L. Farley. Secretary-Treasurer, American Milk Goat Record Association.
- Ml. Fe.**—Michael Ference, Jr. Chief Scientist, Signal Corps Engineering Laboratory. Author of *Analytical-Experimental Physics*.
- M. L. H.**—Maurice Leslie Hartung. Associate Professor of Education, The University of Chicago. Co-author of *Mathematics in General Education*.
- M. L. Hs.**—Maurice Loyal Huggins. Research Chemist, Eastman Kodak Company, Rochester, N.Y.
- M. L. M.**—Max L. Moorhead. Assistant in History, University of California.
- M. Loc.**—Margery Locket. Education manager, British Instructional Films Ltd., London.
- M. L. T.**—Miriam Louise Tildesley. Leverhulme Research Fellow, 1939. Former Research Worker in Craniology, Royal College of Surgeons of England.
- M. M.**—Sir Murdoch MacDonald. Consulting civil engineer. Former Advisor and Under-Secretary of State for Public Works, Egypt.
- M. Macd.**—Michael Macdonogh. Formerly on the staff of *The Times*, London. Author of *The Reporters' Gallery; The English King*; etc.
- M. M. B.**—Marcelle M. Bresson. A librarian of Conservatoire National des Arts et Metiers, Paris. Former Assistant in Geography, Sorbonne, and member of the staff of *Annales de Géographie*.
- M. M. Bh.**—Sir Mancherjee Merwanjee Bhowanagare. Former Fellow of Bombay University, India. M.P. Bethnal Green, North-East, 1895-1906. Author of *History of the Constitution of the East India Company*.
- M. M. C.**—Margaret Monteith Carlyle. Editor, *Documents on International Affairs, 1947-1948, 1949-1950*.
- M. M. D.**—M. M. Durkee. Superintendent of oil department, A. E. Staley Manufacturing Company, Oil Division, Decatur, Ill.
- M. M. E.**—Martha May Eliot, M.D. Associate Chief, U.S. Children's Bureau, Social Security Administration, Federal Security Agency, Washington, D.C.
- M. M. F.**—Myrtle Meritt French. Head of Ceramic Division, School of Art Institute of Chicago, Ill.
- M. M. G.**—Margaret M. Green. Assistant editor, International Section of *The Contemporary Review, 1921; The New Leader, 1923-26*; and *Foreign Affairs, 1926-28*.
- M. M. H.**—M. M. House, D.D.S. Research and development, S. S. White Dental Manufacturing Company, Philadelphia, Pa. Formerly with Extension Course Division, Dental Department, University of Minnesota.
- M. M. Hn.**—Mildred McAfee Horton. Captain. President, Wellesley College, Wellesley, Mass., 1936-49. Head of the Women's Reserve, U.S.N.R. (Waves), 1942-46.
- M. M. L.**—Morris M. Leighton. Chief, Illinois State Geological Survey. Co-author of *The Cahokia Mounds; The Iowan Drift*.
- M. Nr.**—Mabel Newcomer. Professor and Chairman of the Department of Economics, Vassar College, Poughkeepsie, N.Y. Author of *Separation of State and Local Revenues in the United States*; etc. Co-author of *Facing the Tax Problem*; etc.
- M. N. T.**—Marcus Niebuhr Tod. Fellow of Oriol College, Oxford, Vice-Provost, 1934-45. Reader in Greek Epigraphy. Co-author of *Catalogue of the Sparta Museum*; etc.
- M. O. E.**—Morris O. Edwards. Lieutenant Colonel, U.S. Army. Co-author of *Soldier and the Law*.
- M. of B.**—John Walter Edward Douglas Scott-Montagu, and Baron Montagu of Beaulieu. Advisor on mechanical transport services to Government of India, 1915-19. Founder and former Editor of *The Car*.
- M. O. P.**—Mildred Othmer Peterson. Special Assistant, American Library Association.
- M. O'R.**—M. O'Reilly. Formerly with University Museum of Archaeology and Ethnology, Cambridge.
- M. P.**—Léon Jacques Maxime Prinét. Directeur d'Études à l'École Pratique des Hautes Études. Auxiliary of the Institute of France (Academy of Moral and Political Sciences). Author of *L'Industrie du sel en Franco-Comté*.
- M. Pa.**—Rev. Mark Pattison. Rector of Lincoln College, Oxford, 1861-84. Author of *Isaac Casaubon*.
- M. Pac.**—Marcel Pierre Pacaut. Assistant Professor, University of Paris.
- M. Pal.**—Maurice Paléologue. French ambassador to Russia, 1914-17.
- M. P. B.**—Marland P. Billings. Professor of Geology, Harvard University. Author of *Structural Geology*.
- M. P. N.**—Martin P. Nilsson. Former Professor of Classical Archaeology and Rector of the University of Lund, Sweden. Author of *Primitive Time Reckoning*; etc.
- M. Po.**—(César) Marcel Poëte. Director of the Institute of History, Geography and Civics, Paris. Author of *L'Enfance de Paris*; etc.

- M. P. O'B.**—Morrrough P. O'Brien. Dean, College of Engineering, University of California, Berkeley, Calif. Author of *Applied Fluid Mechanics*.
- M. Pol.**—Michael Polanyi, M.D. Professor of Physical Chemistry, Victoria University of Manchester, Manchester, Eng. Author of *Atomic Reactions*.
- M. R.**—Maude Robinson. Director, Greenwich House Pottery Classes. Consultant in Ceramic Technique, Metropolitan Museum of Art, New York, N.Y.
- M. R. B.**—Max Russell Brunstetter. Associate Professor of Education and Managing Editor, Bureau of Publications, Teachers College, Columbia University. Author of *How to Use the Educational Sound Film*; etc.
- M. Re.**—Max Reinhardt. Austrian theatrical producer. Producer of *The Miracle*; *Oedipus Rex*; etc.
- M. R. J.**—Montague R. James. Provost of Eton College, England, 1918–36. Author, *Eton and King's*, 1875–1925.
- M. R. P. M.**—Martin Rawson Patrick McGuire. Professor of Greek and Latin and Dean of the Graduate School of Arts and Sciences, Catholic University of America, Washington, D.C. Author of *St. Ambrose*.
- M. R. W.**—M. R. Werner. Noted U.S. biographer. Author of *Tammany Hall*; etc.
- M. S.**—Morton Snyder. Head Master of the Rye Country Day School, and member of the Progressive Education Association, England.
- M. S. A.**—Sir Maurice Sheldon Amos. Judicial Adviser to the Government of Egypt, 1919–25. Judge of Native Court of Appeal, 1906.
- M. S. D.**—Mabel S. Douglass. Former Dean, New Jersey College for Women, Rutgers University, New Brunswick, N.J.
- M. S. Dr.**—Margaret Stefana Drower. Lecturer in Ancient History, University College, London.
- M. S. En.**—Morton Scott Enslin. Professor of New Testament Literature and Exegesis, Crozer Theological Seminary, Chester, Pa. Editor of *Crozer Quarterly*. Author of *The Ethics of Paul*; *Christian Beginnings*.
- M. Si.**—Max Silberschmidt. Assistant Professor, Cantonal Technical School, Winterthur, Switzerland.
- M. Sie.**—Karl Manne Georg Siegbahn. Director, Research Institute for Physics, Royal Academy of Sciences, Stockholm, 1937–. Professor of Physics, University of Uppsala, 1923–36. Nobel Prize in Physics, 1924. Author of *The Spectroscopy of X-Rays*; etc.
- M. S. L.**—M. S. Lombardini. Secretary, Pirelli, Ltd., London.
- M. Sm.**—May Smith. Lecturer in Applied Psychology, Birkbeck College and Bedford College for Women, England.
- M. S. N.**—Morris Neiburger. Assistant Professor of Meteorology, University of California, Los Angeles, Calif.
- M. S. N.**—Melvin Spencer Newman. Professor of Chemistry, the Ohio State University, Columbus, Ohio.
- M. Sp.**—Mortimer Spiegelman. Assistant Statistician, Metropolitan Life Insurance Company, New York, N.Y.
- M. Spi.**—Matthew Spinka. Professor of Church History, Hartford Theological Seminary, Hartford, Conn. Author of *A History of Christianity in the Balkans*; *The Church and the Russian Revolution*; etc.
- M. Spr.**—Margaret (Tuttle) Sprout. Co-author of *The Rise of American Naval Power, 1776–1918*; *American Naval Policy and the World Scene, 1918–1922*.
- M. S. S.**—Matthew Scott Sloan. Former lecturer in Engineering, Union College, Schenectady, N.Y. President and Director of The New York Edison Company, 1928–32.
- M. S. Sn.**—Maurice Sommer Shahan. Veterinarian, Pathological Division, Bureau of Animal Industry, U.S. Dept. of Agriculture, Washington, D.C.
- M. S. V.**—Manuel Sandoval Vallarta. General Director, National Polytechnical Institute, Mexico, D.F. Chief Representative of Mexico, U.N. Atomic Energy Commission, 1946. Research Professor of Physics, University of Mexico, 1947. Author of *An Outline of the Theory of the Allowed Cone of Cosmic Radiation*.
- M. Ta.**—Milton Tabor. Managing Editor of the *Topeka Daily Capital*. Author of the *Story of Kansas*.
- M. T. Bi.**—Millicent Todd Bingham. Fellow, American Geographical Society. Author of *Peru, Land of Contrasts*; etc.
- M. Tr.**—Mildred Trotter. Professor of Gross Anatomy, Washington University School of Medicine, St. Louis, Mo.
- Mu. B.**—Sir Muirhead Bone. Etcher and painter. Official artist, Admiralty, 1940–43.
- M. V. B.**—Mark V. Brunson. Lieutenant-Colonel, Quartermaster Corps, U.S. Army.
- M. V. S.-W.**—M. V. Seton-Williams. Joint Director, Archaeological Expedition to Cyprus sponsored by Ashmolean Museum, Oxford University, and Sydney University, Sydney, Austr. Author of *Britain and the Arab States*; *Palestinian Temples, Iraq*; *Excavations at Saucé Gözü, Iraq*.
- M. V. W.**—Miriam Van Waters. Superintendent, State Reformatory for Women, Framingham, Mass. Director, Juvenile Delinquency section, Harvard Law School Crime Survey. Referee, Los Angeles County Juvenile Court, Los Angeles, Calif., 1920–30. Author of *Youth in Conflict*; *Parents on Probation*.
- M. W.**—Maurice Henry Woods. Private secretary to Lord Beaverbrook, 1916–29. Private secretary to Earl of Birkenhead, 1911–14.
- M. W. C.**—Mary W. Calkins. Former Professor of Philosophy and Psychology, Wellesley College, Wellesley, Mass. Author of *A First Book of Psychology*; etc.
- M. W. Ch.**—Marquis William Childs. Columnist, United Feature Syndicate, Washington, D.C. Author of *Sweden: The Middle Way*; *I Write from Washington*.
- M. W. Cl.**—Martin W. Clement. Chairman of the Board and former President of the Pennsylvania Railroad.
- M. W. J.**—Martin Wiggo Johnson. Professor of Marine Biology, Scripps Institution of Oceanography, University of California, La Jolla, Calif. Co-author of *The Oceans*; *Their Physics, Chemistry and General Biology*.
- M. W. S.**—Max W. Salvadori. Sometime member of the faculty of the University of Geneva, Switzerland; sometime member of the faculty of St. Lawrence University, Canton, N.Y.
- M. W. T.**—Morris William Travers. Emeritus Professor and Fellow in Applied Physical Chemistry in the University of Bristol, England. Director, Indian Institute of Science, 1906–14. Technical Consultant, Ministry of Supply, 1940. Author of *The Liquefaction of Hydrogen*; etc.
- M. W. v. B.**—M. W. von Bernewitz. Formerly with Federal Bureau of Mines. Author of *Cyanide Process, 1910–1913*; *Handbook for Prospectors*.
- M. Y.**—Mahonri (Mackintosh) Young. Sculptor, painter and etcher.
- My. S. S.**—Mary S. Sherman, M.D. Associate Professor of Orthopaedic Surgery, Tulane and Ochsner Clinic, New Orleans, La.
- N.**—William Richard Morris, 1st Viscount Nuffield. Chairman of Morris Motors Ltd.
- N. A.**—Nels Anderson. Formerly with Department of Sociology, Columbia University. Author of *The Hobo*.
- Na. Br.**—Nathan Brewer, D.V.M. Research Associate in Physiology (Assistant Professor) and Superintendent of Animal Quarters, Illinois Society for Medical Research, Chicago, Ill.
- N. A. C.**—Nelson Antrim Crawford. Editor in Chief of *The Household Magazine*, Topeka, Kan. Director of Information, U.S. Department of Agriculture, Washington, D.C., 1925–28. Co-author of *Agricultural Journalism*.
- N. A. Cn.**—Norman Alexander Cameron, M.D. Professor of Psychology and Chairman of the Department of Psychology, and Professor of Psychiatry, University of Wisconsin, Madison, Wis. Author of *Reasoning, Regression and Communication in Schizophrenics*.
- N. Al.**—Sir Norman Angell. Member, Council, Royal Institute of International Affairs, 1928–. Member, House of Commons, England, 1929–31. Awarded Nobel Peace Prize, 1933. Author of *The Great Illusion*; *Preface to Peace*; etc.
- Na. L.**—Nathan Levinson. Chief Engineer, Warner Bros. Studio, Burbank, Calif. Vice-President, Research Council, Academy of Motion Picture Arts and Sciences, 1942.
- N. A. T.**—Nicolas A. Transehe. Commander, formerly with the Russian Navy. Member of the staff of the American Geographical Society. Author of *Problems of Polar Research*; etc.
- N. B.**—Niels Henrik David Bohr. Director of the Institute of Theoretical Physics at Copenhagen, Denmark. Nobel Prize for Physics, 1922. President, Royal Danish Academy of Science.
- N. B. G.**—Norman Bel Geddes. Scenic artist. Designer of *The Miracle*; *The School for Scandal*; etc.
- N. B. J.**—Norman Brooke Jopson. Professor of Comparative Philology, Cambridge University, 1937–. Fellow of St. John's College, Cambridge, 1937–. Professor of Comparative Slavonic Philology, University of London, 1936–37. Co-author of *Spoken Russian*.
- N. B. M.**—Norman B. McCullough, M.D. Chief of Clinical Research, National Microbiological Institute, National Institutes of Health, Bethesda, Md.
- N. Br.**—Norton Breton. Messrs. Henckell du Buisson, London.

- N. C. R.**—Nathan Chamberlain Rockwood. Editorial Consultant, *Rock Products*. President, Tradepress Publication Corporation, 1931-39. Compiler of *Cumulative Index of Engineering News*, Chicago, Ill., 1910-17.
- N. C. S.**—Norman Clemens Schultze. Technical Representative, Mathieson Chemical Corp., Baltimore, Md.
- N. C. V.**—Nina C. Vandewalker. Specialist in Kindergarten Education, United States Bureau of Education, Washington, D.C. Author of *The Kindergarten in American Education*; etc.
- N. D. M.**—Norris Dewar McWhirter. Athletics Correspondent, the *Observer*, London. Co-author of *Get to Your Marks*.
- N. E. C.**—Norman E. Crump. City Editor, *The Sunday Times*, London, England. Joint author of *Clare's A.B.C. of the Foreign Exchanges*.
- N. F.**—Norman French. Editor, *The Hardware Trade Journal*, London.
- N. F. B.**—Neil Freeborn Beardsley. Former Assistant Professor of Physics, The University of Chicago.
- N. F. M.**—Nevill Francis Mott. Melville Wills Professor of Theoretical Physics, University of Bristol, England. Co-author of *Electronic Processes in Ionic Crystals*; etc.
- N. G.**—Nathan Greene. Practising lawyer in association with the firm of Cook, Nathan, Lehman and Greenman, New York. Co-author of *The Labour Injunction*.
- N. G. G.**—Nicholas George Gedy. Former Consulting civil engineer. Former Regional Works Adviser to Regional Commissioner for S.W. England.
- N. G. M.**—N. G. Mavris, M.D. President of the Dodecanesian National Council. Author of *The Historical Archives of the Island of Cassos in the Dodecanese*; etc. Editor, *The Greek Dodecanese*.
- N. G. S.**—Norman G. Shidle. Executive Editor, *S.A.E. Journal*, and Automotive Editor, *Forbes*, New York, N.Y.
- N. H. E.**—Nathanael Howard Engle. Director, Bureau of Business Research, University of Washington, Seattle, Wash. Assistant Director, in charge of Research and Statistics, Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D.C., 1933-39. Author of *Housing Conditions in the United States*; etc.
- N. H. Mc.**—Neil Hartley McLean. Publications Department, the Broken Hill Proprietary Company Limited, Newcastle, Austr.
- N. I. M.**—Nicholas Ivan Momtchiloff. Economic Adviser to the Industrial and Commercial Finance Corporation, London. Author of *Ten Years of Controlled Trade in South-Eastern Europe*.
- N. J.**—Nathan Jacobson. Former Associate Professor of Mathematics, The Johns Hopkins University, Baltimore, Md. Author of *The Theory of Rings*.
- N. J. B.**—N. J. Berrill. Professor of Zoology, McGill University, Montreal, Quebec.
- N. J. K.**—Nicolaas Johannes Krom. Former Professor of the History and Archaeology of the East Indies, University of Leyden, Netherlands. Director of the Institute of Indian Archaeology.
- N. J. T.**—Rev. Neil J. Twombly, S.J. Professor of Classics and Director, Department of Classical Humanities, Woodstock College, Woodstock, Md.
- N. L.**—Nathaniel Lloyd. Former lecturer on architecture. Author of *A History of English Brickwork*; etc.
- N. Le.**—Nathan Levi. Former Assistant Editor of *Die Volkstem*, Pretoria, South Africa.
- N. L. F.**—Norman L. Forter. Translator and archivist to H.M. Legation in Rumania.
- N. L. H.**—Nina L. Hills (Hon. Mrs. Eustace Hills). Chairman of the Council of the National Society of Day Nurseries, England.
- N. L. Hl.**—Norman Llewellyn Hill. Professor of International Law and Relations, University of Nebraska, Lincoln, Neb. Author of *Claims to Territory in International Law and Relations*; *International Administration*.
- N. M.**—Neil Munro. Author and journalist.
- N. Ma.**—Sir Neill Malcolm. Major General (retired). Served N.W. Frontier, India, South African War and World War I. Editor of *The Science of War*.
- N. M. B.**—Nicholas Murray Butler. President, Columbia University, 1901-45. Nobel Peace Prize, 1931. Author of *The Meaning of Education*; etc.
- N. M. F.**—Nevin M. Fenneman. Former Professor of Geology, University of Cincinnati, O. Author of *Physiography of Western United States*; etc.
- N. M'L.**—Norman M'Lean. Master of Christ's College, Cambridge, 1927-36, and Former University Lecturer in Aramaic.
- N. M. P.**—Norman Mosley Penzer. Author of *Non-Ferrous Metals and other Minerals*; etc.
- N. N. D.**—Nellis Norman Dalton. Consultant, Association of American Soap and Glycerine Producers.
- No. B.**—Norman de Mattos Bentwich. Professor of International Relations, Jerusalem University. Author of *Judaea Lives Again*; *From Geneva to San Francisco*; etc.
- No. Br.**—Norman Bauer. Research Chemist, California Research Corp., Berkeley, Calif.
- N. R.**—Nicolai Rubinstein. Lecturer in History, Westfield College, University of London.
- N. R. E.**—Norman Robson Elliott. Research Student and Demonstrator, King's College, University of Durham, Durham, Eng.
- N. S. A.**—Nathaniel S. Apter, M.D. Head and Associate Professor of Psychiatry, The University of Chicago.
- N. S. B.**—Norman Sharpe Buchanan. Associate Director, Rockefeller Foundation, 1947-. Author of *Economics of Corporate Enterprise*; *International Investment and Domestic Welfare*.
- N. Sm.**—Normand Stulman. Chief, Applied Physics Section, Engineering and Technical Division, U.S. Army Signal Corps.
- N. S. T.**—Prince N. S. Trubetzkoy. Former Professor of Slavonic Philology, University of Vienna.
- N. S. Tf.**—Nicholas S. Timasheff. Professor of Sociology, Fordham University, New York, N.Y. Author of *Introduction to the Sociology of Law*; *One Hundred Years of Probation*.
- N. Sy.**—Nicolas Slonimsky. Writer, musician and teacher. Author of *Music since 1900*; *Music of Latin America*.
- N. Tr.**—Norman Taylor. Assistant Curator at the New York Botanical Garden, 1905-11. Director of Cinchona Products Institute, Inc., New York, N.Y. Editor of *The Garden Dictionary*; botanical and horticultural editor of *Webster's Dictionary*. Author of *Botany: The Science of Plant Life*.
- N. T. R.**—Nellie Tayloe Ross. Director of the United States Mint.
- N. U.**—Norman Underwood. Chemist, U.S. Bureau of Engraving and Printing, Washington, D.C. Co-author of *Chemistry and Technology of Printing Inks*.
- N. U. M.**—Nicholas Ulrich Mayall. Associate Astronomer, Lick Observatory, Mount Hamilton, Calif.
- N. V. McC.**—Nancy Vincent McClelland. Author, decorator and lecturer on interior decoration.
- N. V. S.**—Nevil Vincent Sidgwick. Professor of Chemistry, Oxford University, 1933-45. Author of *Electronic Theory of Valency*; etc.
- N. W. B.**—Norman Wood Beck. Lecturer in Political Science, Hunter College of the City of New York.
- N. W. S.**—Nathaniel W. Stephenson. Former Professor of History and Biography in Scripps College and in the Graduate School of Claremont College, Claremont, Calif. Author of *Abraham Lincoln and the Union*; etc.
- N. W. T.**—Northcote^{*} Whitbridge Thomas. Government Anthropologist to Southern Nigeria. Author of *Thought Transference*; etc.
- N. Z.**—Nathaniel Zalowitz. Former Editor, English section, *Jewish Daily Forward*, Chicago.
- O. A.**—Osmund Airy. Former H.M. Divisional Inspector of Schools and Inspector of Training Colleges, Board of Education, London. Author of *Louis XIV and the English Restoration*; *Charles II*; etc.
- O. B.**—Oswald Barron. Editor of *The Ancestor*, 1902-05.
- O. C. A.**—Oswald C. Allen. Principal Assistant Under-Secretary of State, Civil Defence Department, Home Office, England. Under-Secretary, Ministry of Home Security, 1944-45. Former Assistant Secretary, Ministry of Labour, London.
- O. C. S.**—Oscar Clemen Stine. Assistant Chief in Charge of Price and Marketing Research, Bureau of Agricultural Economics, U.S. Department of Agriculture, Washington, D.C., 1946-. ; Head Agricultural Economist, in charge of Statistical and Historical Research, 1922-46.
- O. C. Sh.**—Otto C. Sommerich. Member of the Bar of the State of New York. Member of the Bar of the Supreme Court of the United States.
- O. D. E.**—Owen David Evans. Superintendent of Mechanical School, Girard College, Philadelphia, Pa. Author of *Educational Opportunities for Young Workers*.
- O. D. Y.**—Owen D. Young. Chairman, Advisory Council, National Broadcasting Company. Chairman of the Experts' Committee on Reparations, Paris, 1929. Associated with General Dawes on the experts' Committee which drew up the Dawes Plan.
- O. E.**—Oliver Elton. King Alfred Professor of English Literature, University of Liverpool, England, 1900-25. Author of *Survey of English Literature from 1730 to 1830*; etc.

- O. E. E.**—Orland E. Esval. Director Aeronautical Instrument Research, Sperry Gyroscope Company, Inc., Garden City, N.Y.
- O. E. M.**—Oscar Edward Meinzer. Chief, Ground Water Division, U.S. Geological Survey, U.S. Department of the Interior, 1912-46.
- O. E. R.**—Ollie Ezekiel Reed. Chief of Bureau of Dairy Industry, U.S. Department of Agriculture, Washington, D.C.
- O. E. W.**—Orland Emile White. Professor of Agricultural Biology and Director of the Blandy Experimental Farm, University of Virginia, Charlottesville, Va.
- O. F. G. S.**—O. F. G. Schilling. Associate Professor in Mathematics, The University of Chicago, Chicago, Ill.
- O. F. K.**—Ole Ferdinand Knudsen. Assistant Press Attaché, Royal Norwegian Embassy, London.
- O. G. S.**—Orrin G. Sherman. Recording and Statistical Corporation, New York, N.Y. Past President of the National Office Management Association.
- O. G. S. C.**—Osbert Guy Stanhope Crawford. Archaeology Officer of the British Ordnance Survey. Author of *Man and His Past*; *Air Survey and Archaeology*; etc.
- O. G. So.**—O. G. Sonneck. Former Vice-President of G. Schirmer, Inc., New York, N.Y.
- O. H.**—Oscar Hardman, D.D. Chaplain of St. Monica's Home, Westbury-on-Trym, Bristol, 1944-. Professor of Pastoral and Liturgical Theology, King's College, University of London, 1932-44. Author of *The Ideals of Asceticism*; etc.
- O. Ha.**—Oskar Halecki. Professor, Eastern European History, Graduate School, Fordham University, New York, N.Y., 1944-. Professor of Slavonic History, University of Montreal, Canada, 1944-. Director of the Polish Institute of Arts and Science, New York. Professor of History in University of Warsaw, 1919-39.
- O. H. B.**—Oswald H. Brownlee. Professor of Economics, University of Minnesota, Minneapolis, Minn. Author of *Economics of Public Finance*.
- O. H. K. S.**—Oskar Hermann Khristian Spate. Professor of Geography, Australian National University, Canberra, Austr. Joint editor of *The Changing Map of Asia*.
- O. Hn.**—Olga Hartman. Research Associate, Allan Hancock Foundation, University of Southern California.
- O. Ho.**—Otto Holstein. Former Secretary, American Chamber of Commerce of Mexico. Author of *Chan-Chan, the Capital of the Grand Chimú*; etc.
- O. H. S.**—Ogle Hesse Sears. Professor of Soil Biology, University of Illinois, Urbana, Ill.
- O. H. T. R.**—O. H. T. Rishbeth. Professor and Head of the Department of Geography, University College, Southampton, England.
- O. J.**—Otto Jespersen. Professor of English in the University of Copenhagen, Denmark, 1893-1925. Former Corresponding Fellow of British Academy; Member of Academies of Copenhagen, Oslo, Lund, Helsingfors and Ghent. Author of *Growth and Structure of the English Language*; etc.
- O. J. L.**—Sir Oliver Joseph Lodge. Principal of the University of Birmingham, England, 1900-19. Professor of Physics, University College, Liverpool, 1881-1900. Albert Medallist of the Royal Society of Arts for pioneer work in wireless telegraphy, 1919. Author of *Ether and Reality*; *Evolution and Creation*; *Energy*; etc.
- O. J. R. H.**—Osbert John Radclyffe Howarth. Curator of the Darwin Memorial Down House, Downe, England. Secretary of the British Association for the Advancement of Science, 1909-46. Member of Geographical Section, Naval Intelligence Department, London, 1915-19.
- O. K.**—Otto Kinkeldey. Emeritus Professor of Musicology and Emeritus University Librarian, Cornell University, Ithaca, N.Y. Lecturer in Musicology, Faculty of Philosophy, Königliches akademisches Institut für Kirchenmusik, University of Breslau, Ger., 1910-14.
- O. L.**—Oscar Levy, M.D. Editor of the authorized English translation of Nietzsche's works. Translator (into German) of Disraeli's novels *Tancred or the New Crusade* and *Contarini Fleming*.
- O. M. D.**—Ormonde Maddock Dalton. Former Keeper, Department of British and Mediaeval Antiquities, British Museum, London.
- O. M. J.**—O. M. Johnson. Senior Agricultural Economist, U.S. Department of Agriculture, Washington, D.C.
- O. M. T.**—Owen Meredith Tweedy. Retired British government officer. Author of *By Way of the Sahara*; *Russia at Random*; *Cairo to Persia and Back*.
- O. P.**—Orlando Park. Professor of Zoology, Northwestern University, Evanston, Ill. Co-author of *Introduction to Animal Ecology and Taxonomy*; *Principles of Animal Ecology*.
- O. P. R.**—O. Preston Robinson. Assistant General Manager, Deseret News Publishing Co., Salt Lake City, Utah. Author of *Retail Store Operation and Management*; *Successful Retail Salesmanship*.
- O. R. A.**—Olivia Rossetti Agresti. Writer, lecturer and interpreter to the Assemblies of the League of Nations and the International Economic Conference. Author of *Giovanni Costa, His Life and Times*.
- O. R. H.**—Oscar Rudolf Hobson. City Editor, *News Chronicle*, London. Author of *Does Money Matter?*; *How the City Works*; *Talks with a Banker*.
- O. R. M.**—Oscar Roland Mathews. Senior Agronomist, Division of Dry Land Agriculture, U.S. Department of Agriculture, 1909-.
- O. S.**—Osvold Sirén. Keeper of Pictures and Sculptures, National Museum, Stockholm, Swed., 1928-45.
- O. S. A.**—Olaf Sverre Aamodt. Head of the Division of Forage Crops and Diseases, U.S. Department of Agriculture, Plant Industry Station, Beltsville, Md., 1939-. Professor of Agronomy and Chairman of Department, University of Wisconsin, Madison, Wis., 1935-39.
- O. S. D.**—Ozora Stearns Davis, D.D. Former President, The Chicago Theological Seminary; Professor of Practical Theology; Moderator, The National Council of Congregational Churches, Chicago, Ill. Author of *International Aspects of Christianity*; etc.
- O. Sk.**—Otis Skinner. Actor. Author of *Footlights and Spotlights*; *Mad-folk of the Theatre*; etc.
- O. St.**—Otto Struve. Director, Yerkes Observatory, The University of Chicago, Williams Bay, Wis., 1932-47, and Director, McDonald Observatory, University of Texas, Mount Locke, Tex., 1932-47. Editor, *Astrophysical Journal*.
- O. T.**—Oswald Tippo. Assistant Professor of Botany, University of Illinois, Urbana, Ill. Associate Biologist, Wood Section, Testing Laboratory, U.S. Navy Yard, Philadelphia.
- O. Td.**—Ordway Tead. Editor of social and economic books, Harper & Brothers, New York, N.Y. Chairman of the Board of Higher Education, New York, N.Y. Author of *The Art of Leadership*.
- O. V.**—Oswald Veblen. Professor, Institute for Advanced Study, Princeton University. Member, National Academy of Sciences, Washington, D.C. President, American Mathematical Society, 1923-24. Author of *Foundations of Differential Geometry* (with J. H. C. Whitehead).
- O. v. F.**—Otto v. Friesen. Professor of Swedish Language, University of Uppsala, Sweden.
- O. Vo.**—Otakar Vočadlo. Professor of English Language and Literature, Comenius University, Bratislava, Czechoslovakia, 1933-39.
- O. W.**—Orville Wright. Former Chairman, Advisory Commission, Daniel Guggenheim School of Aeronautics, New York University. Former Director, Wright Aeronautical Laboratory, Dayton, O.
- O. W. H.**—O. W. Holmes. Reference Staff, New York Public Library (American History Division).
- O. W. Rs.**—Oscar W. Richards. Research Biologist, Spencer Lens Company, Buffalo, N.Y.
- O. W. T.**—O. W. Tiegs. Associate Professor of Zoology, University of Melbourne, Melbourne, Australia.
- P.**—Walter George Frank Phillimore, 1st Baron Phillimore. Judge of Queen's Bench Division of High Court of Justice, 1897-1913; Lord Justice of Appeal, 1913. Author of *International Law*; etc.
- P. A.**—Sir Percy Alden. Bursar of the Sir Richard Stapley Educational Trust; Former Chairman of the British Institute of Social Service. Former Commissioner to Board of Agriculture for Cultivation of Vacant Lands. Author of *Housing*; *Democratic England*; etc.
- P. Ai.**—Peter Ainslie, D.D. Author of *If Not a United Church, What?*
- P. A. K.**—Prince Peter Alexeivitch Kropotkin. Former Editor for the Jura Federation of *Le Révolté*. Author of *L'Anarchie: sa philosophie, son idéal*; etc.
- P. Al.**—Paul Daniel Alphonse. Professor of the History of Dogma, École Pratique des Hautes Études, Sorbonne, Paris. Author of *Les Idées morales chez les hétérodoxes latines au début du XIII^e Siècle*.
- P. A. M.**—Percy A. Martin. Professor of History, Stanford University, Stanford, Calif., 1923-41. Secretary of the Brazil Committee of the Pan-American Financial Conference, Washington, D.C., 1920. Author of *The Republics of Latin America* (with H. G. James); *Latin America and the War*; *Simon Bolívar, the Liberator*; etc.

- P. An.**—Phyllis Ackerman. Professor of Iconography, Textiles, School of Asiatic Studies, New York, N.Y. Assistant Editor of *A Survey of Persian Art*. Author of *Tapestry—Mirror of Civilization*; etc.
- P. A. S.**—Percy Alfred Scholes. Inspector of Music in Schools, University of London. Former music critic of *The Observer*, and the British Broadcasting Corporation. Author of *The Book of Great Musicians*; etc.
- P. A. Sn.**—Pitirim Alexandrovitch Sorokin. Professor of Sociology, Harvard University and Radcliffe College, Cambridge, Mass. Author of *Contemporary Sociological Theories*; etc.
- P. A. T.**—P. A. Tiele. Former Librarian, Utrecht University, Utrecht, Netherlands. Author of *Biographical and Historical Memoir on the Voyages of the Dutch Navigators*; etc.
- P. B.**—Pierre Bernus. Former Foreign Editor, *the Journal des Débats*. Former Paris Correspondent, *the Journal de Genève*.
- P. B. B.**—Philip Boswood Ballard. Inspector, Education Department, London County Council, 1906–30. Author of *Mental Tests*; *The New Examiner*; etc.
- P. Bd.**—Philip Bard. Professor of Physiology, The Johns Hopkins University, Baltimore, Md.
- P. Be.**—Paul Beaujon. Pen name of Mrs. Beatrice L. Warde. Writer and lecturer on typography. Co-author, *Books American*.
- P. B. F.**—Philip B. Fleming. U.S. Ambassador to Costa Rica. Former Undersecretary of Commerce for Transportation.
- P. B. H.**—Paul B. Halstead. Secretary-Treasurer, The Cotton-Textile Institute, Inc., New York, N.Y.
- P. B. Hn.**—Patrick Bruce Hepburn. Secretary, the Booksellers Association of Great Britain and Ireland.
- P. B. I.**—P. B. Ingham. Director of the London School of Dalcroze Eurhythmics.
- P. B. N.**—Pierrepoint Burt Noyes. President, Oneida Ltd., Oneida, N.Y.
- P. Bo.**—Walter Percy Bordwell. Professor of Law, Harvard University, 1947. Acting Dean, State University of Iowa, Iowa City, Ia., 1943–46. Author of *The Law of War between Belligerents*; etc.
- P. B. P.**—Pitman Benjamin Potter. Grozier Professor of International Law, American University, Washington, D.C. Managing Editor of the *American Journal of International Law*. Author of *Introduction to the Study of International Organization*; etc.
- P. B. S.**—Paul Bigelow Sears. Professor of Botany, Oberlin College, Oberlin, O. Author of *Deserts on the March*; etc.
- P. By.**—Paul Bellamy. Editor, *the Cleveland Plain Dealer*, Cleveland, O.
- P. C.**—Pierre Champion. Author of *Procès de condamnation de Jeanne d'Arc*; etc.
- P. C. By.**—Paul C. Bucy, M.D. Professor of Neurology and Neurological Surgery, College of Medicine, University of Illinois, Chicago, Ill. Author of *The Precerebral Motor Cortex*; co-author of *Neurology*.
- P. C. H.**—Paul C. Hodges, M.D. Professor of Radiology, in charge of the Section of Radiology, The University of Chicago. Co-author of *Diseases of Bones and Joints*.
- P. C. K.**—Peter C. Kronfeld, M.D. Professor of Ophthalmology, College of Medicine, University of Illinois, Chicago, Ill.
- P. C. M.**—Sir Peter Chalmers Mitchell. Secretary to the Zoological Society of London, 1903–35. Author of *Outlines of Biology*; etc.
- P. C. Me.**—Paul C. Melrose. Correspondent of *South China Morning Post*, Hong Kong, China, 1921–38.
- P. C. Mf.**—Paul Christoph Mangelsdorf. Professor of Botany and Director of the Botanical Museum, Harvard University. Co-author (with R. G. Reeves) of *The Origin of Indian Corn and Its Relatives*.
- P. C. Y.**—Philip Chesney Yorke. Magdalen College, Oxford.
- P. D. C.**—Paul D. Converse. Professor of Business Organization and Operation, University of Illinois, Urbana, Ill. Author of *Marketing Methods and Policies*; etc.
- P. D. M.**—Patrick Denis Mehigan. Freelance journalist and author, Dublin, Ire. Author of *History of Hurling*; *History of Irish Athletics*; *History of Gaelic Football*; etc.
- P. Ds.**—Porphyrios Dikaïos. Curator, Cyprus Museum, Nicosia, Cyprus. Author of *Khrokotia*; *Guide to Cyprus Museum*.
- P. D. T.**—Parker Davies Trask. Geologist, U.S. Geological Survey, U.S. Department of the Interior.
- P. Du.**—Paul Dumas. Vice-President, Standard Technical Company. Member, National Technical Committee Conference Board, American Automobile Association.
- P. E. Ch.**—P. E. Church. Professor and Executive Officer, Department of Meteorology and Climatology, University of Washington, Seattle, Wash., 1947–.
- P. Eg.**—Paul Einzig. Political Correspondent, *The Financial Times*, London, England. Author of *The Theory of Forward Exchange*; etc.
- P. E. Jn.**—Paul E. Johnston. Professor of Agricultural Economics, University of Illinois, Urbana, Ill.
- P. E. K.**—Paul Ernest Klopsteg. Professor of Applied Science and Director of Research, Northwestern Technological Institute, Evanston, Ill. Author of *Turkish Archery and the Composite Bow*.
- P. E. L.**—Peter Edwin Lewis. Practising Barrister of the Honourable Society of the Inner Temple, London.
- P. E. R.**—Peter Edward Russell. King Alfonso XIII Professor of Spanish Studies, Oxford University. Fellow of Queen's College, Oxford.
- P. F. P.**—Rev. Paul F. Palmer, S.J. Professor of Dogmatic Theology and Lecturer in the History of Penance, Woodstock College, Woodstock, Md.
- P. F. W.**—Park F. Wollam. Former Assistant in History, University of California, Berkeley, Calif.
- P. G.**—Percy Perceval Gardner. Professor of Classical Archaeology, University of Oxford, 1887–1925.
- P. G. B.**—Peter Gordon Brown. Fellow of the Institute of Actuaries. Assistant Actuary, Government Actuary's Department, London.
- P. G. Ds.**—P. G. Davies. Colonel R.A.O.C. Former Secretary, The Croquet Association, London.
- P. Ge.**—Pieter Geyl. Professor of Modern History, University of Utrecht, Utrecht, Netherlands. Professor of Dutch History and Institutions, University of London, 1919–35. Author of *The Revolt of the Netherlands, 1555–1609*; etc.
- P. G. F.**—Peter Godfrey Foote. Lecturer in Old Scandinavian, University College, London.
- P. G. H. B.**—Percy George Hammall Boswell. Emeritus Professor of Geology in the University of London, Imperial College of Science and Technology.
- P. Gi.**—Peter Giles. Vice-Chancellor of Cambridge University, 1919–21; Master of Emmanuel College, Cambridge, and University Reader in Comparative Philology, 1911–35. Author of *The Aryans* (Cambridge History of India).
- P. G. K.**—Paul G. Konody. Former Art Critic of *The Observer* and *The Daily Mail*, London. Author of *Velasquez, His Life and Work*; etc.
- P. Gm.**—Percy Groom. Professor of the Technology of Woods and Fibres, Imperial College of Science and Technology, 1911–31. Author of *Trees and Their Life Histories*; etc.
- P. Go.**—Philip Gosse, M.D. Author of *The Pirates' Who's Who*; *The History of Piracy*; etc.
- P. Gr.**—Philip Graves. Former Assistant Foreign Editor of the *Times*, London. Author of *The Land of Three Faiths*; etc.
- P. G. Rs.**—Philip George Rogers. Former Lecturer in German History and Institutions, School of Military Intelligence, British Army of the Rhine.
- P. G.-S.**—Rev. P. Gardner-Smith. Fellow and Dean of Jesus College, Cambridge.
- P. G. Sr.**—Paul George Stecher. Chemist, Research and Development Laboratory, Merck & Co., Inc., Rahway, N.J.
- P. G. T.**—Peter Guthrie Tait. Professor of Natural Philosophy, Edinburgh University, Scotland, 1860–1901.
- P. Gu.**—Right Rev. Monsignor Peter Guilday. Former Professor of American Church History, Catholic University of America, Washington, D.C. Founder of Catholic Historical Association, 1919. Made Domestic Prelate by Pius XI. Former Editor of *Catholic Historical Review* (founder).
- P. H. B.**—Percy Holmes Boynton. Former Professor of English; Dean in College of Arts, Literature and Science, 1912–23, The University of Chicago. Author of *History of American Literature*; etc.
- P. H. H.**—Paul H. Holinger, M.D. Professor of Bronchoesophagology, Department of Otolaryngology, College of Medicine, University of Illinois, Chicago, Ill.
- P. H. J.**—Percy Herbert Jones. General Secretary, the Cremation Society. Secretary-General, the International Cremation Federation. Author of *Cremation in Great Britain*; *Pioneers of Cremation*.
- P. H. M.-B.**—Sir Philip Henry Manson-Bahr, M.D. Consulting Physician, Hospital for Tropical Diseases and Albert Dock Hospital, London, Eng. Former Director, Clinical Division, London School of Hygiene and Tropical Medicine. Author of *The Dysenteric Disorders*; etc.
- P. H. O.**—Paul H. Oehser. Editor, Department of Engineering and Industries, U.S. National Museum, Washington, D.C.
- P. H. O. R.**—P. H. Otto Reinmuth. Research Fellow in Chemistry, The University of Chicago.
- P. H. P.-S.**—Philip Henry Pye-Smith. Former Consulting Physician to Guy's Hospital, London, and Vice-Chancellor of the University of London. Co-author of *A Text Book of Medicine*; etc.

- P. Hu.**—Prevost Hubbard. Chemical Engineer, The Asphalt Institute, New York, N.Y. Author of *Dust Preventives and Road Binders*; etc.
- P. H. W.**—Sir Percy Henry Winfield. Rouse Ball Professor of English Law, Cambridge University, 1928-43. Former Editor in Chief, *Cambridge Law Journal*.
- P. I. D.**—Philipp Ignaz Dengel. Former Professor of Modern History in the University of Innsbruck, Austria. Director of the Austrian Institute of History in Rome.
- P. Ja.**—Paul Jamot. Honorary Curator, Louvre Museum, Paris.
- P. J. D.**—Rev. Philip J. Donnelly, S.J. Professor of Dogmatic Theology, Weston College, Weston, Mass. Doctor of Sacred Theology, Pontifical Gregorian University, Rome, 1939.
- P. J. J.**—Philip James Jones. Lecturer in Mediaeval History, University of Leeds, Leeds, Eng.
- P. J. N.-B.**—Philip J. Noel-Baker. Secretary of State for Commonwealth Relations, 1947-. Sir Ernest Cassel Professor of International Relations in the University of London, 1924-29. Joint Parliamentary Secretary to Ministry of War Transport, 1942-45. Minister of State 1945-46. Secretary of State for Air, 1946-47. Author of *Disarmament*; etc.
- P. K.**—Philip Henry Kerr, Marquess of Lothian. British Ambassador to the United States of America, 1939-40. Secretary of Rhodes Trust, 1925-29.
- P. K. H.**—Philip Khuri Hitti. Professor of Semitic Literature and Chairman of the Department of Oriental Languages and Literatures, Princeton University, Princeton, N.J. Author of *History of the Arabs*; etc.
- P. K. L.**—Patrick K. Lynch. Lecturer in Economics, University College, Dublin, Ire.
- P. Kr.**—Paul Kircher. Assistant Professor of Accounting, The University of Chicago. Author of *Accounting for Investments*; co-author of *Management Planning for Corporate Taxes*.
- P. L.**—Percy Longhurst. Honorary Secretary and Treasurer, International Amateur Wrestling Federation. Author of *Wrestling*; etc.
- P. La.**—Philip Lake. Former Lecturer on Physical and Regional Geography in Cambridge University. Formerly of the Geological Survey of India. Author of *Monograph on British Cambrian Trilobites*.
- P. L. A.**—Philip Langdon Alger. Staff Assistant to Vice-President in Charge of Engineering, General Electric Company, Schenectady, N.Y. Chairman, General Standardizing Committee, General Electric Company.
- P. L.-B.**—Percy Lazarus-Barlow, M.D. Pathologist to the East Sussex Hospital, Hastings, Eng.; former Assistant Bacteriologist, Metropolitan Asylums Board.
- P. Le.**—Philip Levine. Director of Biologic Division, Ortho Research Foundation, Raritan, N.J. Research Associate, Columbia University, New York, N.Y.
- P. Leb.**—Philéas Lebesgue. Editor, *Mercur de France*, 1896-1940. Author of *La Grèce littéraire d'aujourd'hui*; etc.
- P. L. G.**—Paul L. Gerhardt. Former Vice-President and General Manager and Member of Board of Directors, Bush Terminal Company, New York, N.Y.
- P. L. Go.**—Paul L. Goering. Associate Secretary, National Service Board for Religious Objectors, Washington, D.C.
- P. L. K.**—Paul L. Kirk. Professor of Biochemistry, University of California, Berkeley, Calif.
- P. L. M.**—Philip L. Miller. First Assistant, Music Division (in charge of Record Archive), New York Public Library, New York, N.Y.
- P. Lo.**—Percy Longmuir. Former President, Institute of British Foundrymen, and Sheffield Foundry Trades Technical Society.
- P. L. T.**—Philip Livingston Thomson. President, Audit Bureau of Circulations.
- P. M.**—Paul Milyukov. Former member of the 3rd and 4th Dumas. Former Minister of Foreign Affairs in the first Provisional Government of Prince Lvov.
- P. M. A. F.**—Pierre Marie Auguste Pilon. French man of letters. Author of *Le Théâtre Anglais*; etc.
- P. Man.**—Paul Manship. Sculptor. Works: "Prometheus Fountain," Rockefeller Center, New York, N.Y.; "Dancer and Gazelles," Art Institute of Chicago, Ill.; etc.
- P. M. C.**—Paul M. Chamberlain. Consulting mechanical engineer.
- P. M. F.**—Peter Marshall Fraser. Lecturer in Hellenistic History, Oxford University.
- P. M. H.**—Peter Martin Heldt. Engineering Editor of *Automotive Industries*. Author of *Automotive Engines*; *High-Speed Diesel Engines*; etc.
- P. M. Ha.**—Philip M. Hauser. Professor of Sociology and Associate Dean, Division of the Social Sciences, The University of Chicago. Co-author of *Government Statistics for Business Use*.
- P. M. M.**—Philip M. Marston. Professor and Chairman of the Department of History, University of New Hampshire, Durham, N.H.
- P. Mn.**—Parry Moon. Associate Professor of Electrical Engineering, Massachusetts Institute of Technology, Cambridge, Mass.
- P. M. P.**—Paul Martin Pearson. Founder and President (1912-30), Swarthmore Chautauqua Association, Swarthmore, Pa. Former President, The International Lyceum Chautauqua Association. Author of *Intercollegiate Debates*; etc.
- P. M. R.**—Percy Maude Roxby. Professor of Geography in University of Liverpool, 1917-44. Member of China Education Commission, 1921-22. Visiting Professor, Egyptian University, Cairo, 1930. Author of *The Far Eastern Question in its Geographical Setting*; etc.
- P. M. S.**—Sir Percy Molesworth Sykes. Brigadier General. G.O.C., Southern Persia, 1916-18. Consul-General for Khurasan, 1905-13. Consul-General for Chinese Turkestan, 1915. Author of *History of Persia*; with Ella Sykes, *Through Deserts and Oases of Central Asia*; etc.
- P. M. T.**—Prentice M. Thomas. Editor, *Textile World*.
- P. P. C.**—Philip Putnam Chase. Lecturer in History, Harvard University.
- P. P. Cr.**—Paul Philippe Cret. Former Professor of Architectural Design, University of Pennsylvania, Philadelphia. Architect of Pan American Union, Washington, D.C.; Valley Forge Memorial Arch, Philadelphia; etc.
- P. Pe.**—Pierre Peissi. Secretary, Comité des Forges.
- P. P. Gt.**—Philip Porter Gott. President, National Confectioners' Association, 1941-. Former Manager, Trade Association Department, U.S. Chamber of Commerce.
- P. P. P.**—Pascal P. Parente. Professor of Ascetical and Mystical Theology, Catholic University of America, Washington, D.C. Author of *The Ascetical Life*; etc.
- P. P. S.**—Peter Platou Stabell. Supreme Court Advocate (barrister). Partner in the firm of Herman Christian, Wilhelm Bugge and Peter P. Stabell.
- P. R. B.**—Paul Ryan Byrne. University Librarian and Director of University Libraries, University of Notre Dame, South Bend, Ind.
- P. R. Br.**—Paul Rufus Burkholder. Eaton Professor of Botany and Fellow of Silliman College, Yale University. Secretary, Botanical Society of America.
- P. R. C.**—Philip R. Coursey. The Dubilier Condenser Company, Ltd., London, 1925.
- P. Re.**—Paul Reboux. Directeur Littéraire, *Les Éditions de Laurier*, Paris.
- P. R. E. L.**—P. R. Elsa Lewkowitsch. Associate, Royal College of Science.
- P. R. S.**—Paul Roscoe Stillman, D.D.S. Clinical Professor of Periodontia, New York University. Post Graduate Lecturer, Harvard University, 1928. Co-author of *Text Book of Clinical Periodontia*.
- P. S.**—Preserved Smith. Professor of Mediaeval History, Cornell University, Ithaca, N.Y., 1922-41. Author of *The Age of the Reformation*; etc.
- P. S. G.**—Paul S. Galtsoff. In charge, Shellfishery Investigations, Fish and Wildlife Service, United States Department of the Interior, College Park, Md. Scientific Observer, Bikini Atom Bomb Tests, 1946.
- P. Si.**—Percy Simpson. Former Reader in English Textual Criticism and Fellow of Oriel College, Oxford. Author of *Shakespearean Punctuation*; etc.
- P. S. L.**—Paul S. Lomax. Chairman, Department of Business Education, School of Education, New York University, New York, N.Y. Author of *Commercial Teaching Problems*.
- P. Sr.**—Paul Sollenberger. Principal Astronomer, U.S. Naval Observatory, Washington, D.C.
- P. Ss.**—Percy Stebbings. Insurance Editor and Correspondent to the *Financial Times*, *Bankers' Magazine* and *Investors Chronicle*, London.
- P. T. Eh.**—Paul Theodore Ellsworth. Professor of Economics, University of Wisconsin, Madison, Wis., 1944-. Senior Economist, United States Treasury Department, 1935-36. Economic Adviser, United States Department of State, 1943-44. Author of *International Economics*; *Chile: An Economy in Transition*.
- P. Tn.**—Procter Thomson. Assistant Professor of Economics and of Education, The University of Chicago. Author of *Economics in the Modern World*.
- P. Tt.**—Philip Taft. Professor and Chairman of the Department of Economics, Brown University, Providence, R.I. Author of *Economics and the Problems of Labor*; *Movements for Economic Reform*.
- P. T. Y.**—Paul Thomas Young. Professor of Psychology, University of Illinois, Urbana, Ill. Author of *Emotion in Man and Animal*; *Motivation of Behavior*.
- P. V.**—Pasquale Villari. Italian historian and statesman. Author of *I primi due secoli della storia di Firenze*; etc.
- P. V. B.**—Percy V. Bradshaw. Principal, the Press Art School, London.

P. Vi.—Sir Paul Vinogradoff. Former Corpus Professor of Jurisprudence, Oxford University, and Honorary Professor of History, University of Moscow. Author of *Village in England*; etc.

P. Vt.—Pierre Viot. Auditor of the Cour des Comptes, Paris, Fr.

P. W. B.—Percy Williams Bridgman. Hollis Professor of Mathematics and Natural Philosophy, Harvard University, 1926-. Nobel Prize for Physics, 1946. Author of *The Logic of Modern Physics*; *The Physics of High Pressure*; *The Nature of Physical Theory*; *The Intelligent Individual and Society*; *The Nature of Thermodynamics*.

P. We.—Perc Westmore. Director of Make-up, Warner Brothers First National Studios.

P. W. I.—Philip Willard Ireland. First Secretary and Consul, Cairo, Egypt, 1945-. Author of *Iraq: A Study in Political Development*; etc.

P. Wo.—Philippe Wolff. Maître de Conférences à l'Université de Toulouse, Toulouse, Fr.

P. W. S.—Pierce Wilson Selwood. Professor of Chemistry, Northwestern University, Evanston, Ill. Author of *Magnetochemistry*.

P. W. Wg.—P. W. Whiting. Professor of Zoology, University of Pennsylvania, Philadelphia, Pa.

P. W. Z.—Percy White Zimmerman. Plant Physiologist, Boyce Thompson Institute for Plant Research, Yonkers, N.Y. Author of *Vegetative Plant Propagation*.

P. Z. C.—Sir Percy Zachariah Cox. Major General. High Commissioner in Mesopotamia, 1920-23. Acting British Minister to Persia, 1918-20. Secretary, Foreign Department, Government of India, 1914.

Q. W.—Quincy Wright. Professor of International Law, The University of Chicago, Chicago, Ill. Author of *A Study of War*; etc.

R.—John William Strutt, 3rd Baron Rayleigh. President of the Royal Society, 1905-08. Former Chancellor of Cambridge University. Professor of Natural Philosophy at the Royal Institution of Great Britain, 1887-1905. Nobel Prize for Physics, 1904. Author of *The Theory of Sound* and numerous scientific memoirs.

R. A.—Robert Adamson. Philosopher, Professor of Logic, University of Glasgow, Scotland, 1895-1902. Author of *The Development of Modern Philosophy, with Other Lectures and Essays*.

R. A. Bn.—Roger Avery Barton. Editor, *Advertising Agency* magazine. Lecturer in Advertising, Graduate School of Business, Columbia University, New York, N.Y. Editor, *Advertising Handbook*.

R. A. Br.—Rt. Hon. Richard A. Butler. Member of Parliament. Minister of Labour, 1945. Minister of Education, 1947-48.

R. A. D.—Reginald Aldworth Daly. Sturgis Hooper Professor Emeritus of Geology, Harvard University. Author of *Igneous Rocks and the Depths of the Earth*; *Strength and Structure of the Earth*.

R. A. F.—Ronald Aylmer Fisher. Arthur Balfour Professor of Genetics, Cambridge University, 1943-. Author of *The Genetical Theory of Natural Selection*; etc.

R. A. Ga.—Ruth Augusta Gallaher. Associate Editor and Librarian of the State Historical Society of Iowa. Author of *Legal and Political Status of Women in Iowa*; etc.

Ra. J. M.—Raymond Joseph Miller. Professor of Sociology, Redemptorist Fathers Seminary, Oconomowoc, Wis.

R. A. L.—R. A. Langworthy. Vice-President and General Manager of Ruths Accumulator Company, Inc., New York, N.Y.

R. A. Le.—Sir Rudolf Alexander Little. Director-General, General Post Office, London.

R. All.—Ray Allister. Journalist. Author of *Friese-Greene: Close-Up of an Inventor*.

R. A. Lo.—Robert A. Long. Former Chairman of the Board of Long-Bell Lumber Company, Kansas City, Mo.

R. A. Lr.—Robert A. Lubker. Associate Manager, Metals Research, Armour Research Foundation, Illinois Institute of Technology, Chicago, Ill.

R. A. Lu.—R. A. Lundell. Ingersoll-Rand Company, New York, N.Y.

Ra. Ms.—Ralph Marcus. Associate Professor of Hellenistic Culture, The University of Chicago. Author of *Law in the Apocrypha*; *Works of Josephus*.

R. An.—Robert Anchel. Archivist, National Archives, Paris.

R. A. R.—Raymond A. Ruge. Secretary, Eastern Ice Yachting Association, 1938-42.

R. A. S.—Ralph Allen Sampson. Astronomer-Royal, Scotland, 1910-37. Former Professor of Astronomy, University of Durham, England. Author of *Tables of the Four Great Satellites of Jupiter*; etc.

R. A. Sm.—Reginald Allender Smith. Keeper of British and Mediaeval Antiquities, British Museum, London, 1928-38.

R. A. S. M.—Robert Alexander Stewart Macalister. Professor of Celtic Archaeology, University College, Dublin, 1909-43. Author of *The Archaeology of Ireland*; etc.

R. A. W.—Richard A. Wilkins. Vice-President and Director of Research, Revere Copper and Brass, Inc., Rome, N.Y.

R. Ay.—Robert Auty. Fellow of Selwyn College and University Lecturer in German and Czech, Cambridge University.

R. B.—Ralph Bown. Director of Research, Bell Telephone Laboratories, New York, N.Y., 1946-.

R. B. Be.—Robert Bigham Brode. Professor of Physics, University of California.

R. B. D.—Roland Burrage Dixon. Former Professor of Anthropology at Harvard University. Author of *Racial History of Man*; etc.

R. Be.—Riccardo R. Bertelli. Former President and Director, Roman Bronze Works, Inc., Long Island City, N.Y.

R. B. F.—Raymond Blaine Fosdick. President and Trustee, Rockefeller Foundation and General Education Board. Former Under-Secretary General of the League of Nations. Author of *American Police Systems*; *European Police Systems*; etc.

R. B. Fm.—Royal Bailey Farnum. President, National Association of Schools of Design, New York, N.Y. Author of *Learning More about Pictures*; *Fine and Applied Arts*.

R. B. G.—R. B. Gray. Principal Agricultural Engineer in Charge of Division of Farm Power and Machinery, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, U.S. Department of Agriculture, Beltsville, Md.

R. B. H.—Robert Burnett Hall. Colonel, A.U.S. Professor of Geography, 1938-; and Director, Center for Japanese Studies, 1947-, University of Michigan, Ann Arbor, Mich. Director of Pacific Coast Office, Office of Strategic Services, 1942-43. Co-author of *Elementary College Geography*; etc. Author of *A Geography of Primary Production*; etc.

R. B. Ha.—Richard B. Hall. Executive Secretary, The American Title Association, Kansas City, Mo.

R. B. Hr.—Robert Brinton Harper. Former Vice-President in charge of Research and Testing, The Peoples Gas Light and Coke Company, Chicago, Ill. Former Director and Treasurer, Research Foundation of Armour Institute of Technology.

R. B. I.—Robert Benjamin Irwin. Former Executive Director, American Foundation for the Blind. Co-author of *Blind Relief Laws*.

R. B. K.—Roy Bernard Kester. Professor of Accounting, School of Business, Columbia University. Author of *Accounting Applications in Business and Industry*.

R. B. Kr.—R. B. Koeber. Manager, Research Department, San Francisco Chamber of Commerce.

R. B. M.—R. Borlase Matthews. Editor of the Journal *Electro-Farming*.

R. B. Mc.—Robert B. McBane. Major, U.S. Army.

R. B. McC.—Ronald Buchanan McCallum. Senior Tutor, Pembroke College, Oxford. Author of *The British General Election of 1945*; *Public Opinion and the First Peace*.

R. B. McK.—Ronald Brunlees McKerrrow. Former Honorary Lecturer in English Bibliography, King's College, London.

R. B. My.—Raymond Braislin Montgomery. Physical Oceanographer, Woods Hole Oceanographic Institution, Woods Hole, Mass. Editor, *Journal of Meteorology*.

R. Bo.—Robert Boutruche. Professor at the Faculty of Letters, University of Strasbourg, Strasbourg, Fr. Director of Studies, École Pratique des Hautes-Études, Paris. Author of *L'Allee en Bordelais et en Bazadais du XI^e au XVIII^e siècle*; *La Crise d'une société: seigneurs et paysans du Bordelais pendant la Guerre de Cent Ans*.

R. B. P.—Lord Baden-Powell of Gilwell. Lieutenant General. Founder of the Boy Scout and Girl Guide Movement.

R. B. Pi.—Robert Brindley Pitt. Colonel. Managing Director of Stothert and Pitt, Ltd., Engineers, Bath, England.

R. B. R.—Richard Biddle Richter, M.D. Professor of Neurology, The University of Chicago.

R. B. Wh.—Roy Barton White. President, Baltimore and Ohio Railroad Company, 1941-. President, The Western Union Telegraph Company, 1933-41.

R. B. Wm.—Richard Bruce Wernham. Professor of Modern History, Oxford University. Fellow of Worcester College, Oxford.

R. B. Ws.—Russell Byron Williams. Former advertising executive, writer and lecturer. Author of *Potpourri*.

- R. C.—Rhys Carpenter.** Professor of Classical Archaeology, Bryn Mawr College, Bryn Mawr, Pa.
- R. C. A.—Raymond Clare Archibald.** Emeritus Professor of Mathematics, Brown University, Providence, R.I.
- R. C. An.—Roy Chapman Andrews.** Hon. Director (formerly Director), American Museum of Natural History, New York, N.Y. Author of *Camps and Trails in China*; *Across Mongolian Plains*; etc.
- R. C. B.—R. C. Brooks.** Former Professor of Political Science, Swarthmore College, Swarthmore, Pa. Author of *Political Parties and Electoral Problems*; etc.
- R. C. Bd.—Robert Cecil Bald.** Professor of English, Cornell University, Ithaca, N.Y., 1937-.
- R. C. C. C.—R. C. C. Clay.** Fellow of the Society of Antiquaries and Fellow of the Royal Anthropological Institute.
- R. C. D.—Ramesh Chunder Dutt.** Author of *Economic History of India in the Victorian Age, 1837-1900*; etc.
- R. C. E. L.—Richard C. E. Long.** Author of *Maya and Christian Chronology*; etc.
- R. C. F.—R. C. Farmer.** Former Chief Chemist, Explosives Department, Ministry of Supply. Author of *Manufacture and Uses of Explosives*; etc.
- R. C. G.—R. C. Grant.** Brigadier General. General Secretary of Toc H.
- R. C. Gl.—Richard Cochran Gill.** President, Gill, Miller Co., Ecuador, 1930-. Field Manager in Ecuador, Peru and Bolivia for B. F. Goodrich Rubber Corp., 1928-30. Author of *The Other America*; etc.
- R. C. Gn.—Robert C. Goodwin.** Director, Bureau of Employment Security, U.S. Department of Labor, Washington, D.C.
- R. Ch.—Robert Chambers.** Research Professor of Biology, Washington Square College, New York University, New York, N.Y.
- R. C. J.—Sir Richard Claverhouse Jebb.** Public Orator, Cambridge University, 1860-75, and Professor of Greek, 1889-1905. Author of *Translations into Greek and Latin Verse*; etc.
- R. Ck.—Robert Cruikshank, M.D.** Professor of Bacteriology, University of London, at St. Mary's Hospital Medical School, London. Joint Editor, *Control of Common Fevers*; sectional editor, *Recent Advances in Clinical Pathology*.
- R. C. O.—Raymond C. Osburn.** Emeritus Professor of Zoology, Ohio State University, Columbus, Ohio. Research Associate, University of Southern California, Los Angeles, Calif.
- R. Cr.—Robert Charr, M.D.** Assistant Professor of Medicine, Jefferson Medical College, Philadelphia, Pa. Director of X-Ray Surveys, Philadelphia Tuberculosis and Health Association. Associate Physician, Pennsylvania Hospital, Philadelphia.
- R. C. R.—Reed C. Rollins.** Associate Professor of Botany and Director of the Gray Herbarium, Harvard University. Author of *The Guayule Rubber Plant and Its Relatives*.
- R. C. S.—Ralph C. Smith.** Assistant Secretary, American Association of Museums. Author of *A Bibliography of Museums and Museum Work*; etc.
- R. C. Sma.—Raymond Charles Smail.** Fellow and Tutor of Sidney Sussex College, Cambridge.
- R. D.—Randall (Robert Henry) Davies.** Sometime Art Critic to the *Academy*, *Westminster Gazette*, *New Statesman* and *Queen*, London. Secretary to the late Joseph Pulitzer, owner of *New York World*. Author of *Six Centuries of Painting*; etc.
- Rd. A. K.—Richard Arthur Kahn.** Chief, Economic Facilities Branch, Defense Fisheries Administration, U.S. Department of the Interior.
- R. D. Ca.—Robert Daniel Carmichael.** Professor of Mathematics and Emeritus Dean of the Graduate School, University of Illinois, Urbana, Ill. Author of *Theory of Numbers*; etc.
- R. D. D.—Ralf Davidson Davies.** Captain, Royal Engineers. Experimental Officer, Experimental Bridging Establishment, Christchurch, Hants., England.
- R. De.—Ruth Dean.** Practising landscape architect, New York, N.Y. Author of *The Livable House—Its Garden*.
- R. d'E.—Raul d'Eca.** Assistant Chief, East Coast Area, Office of the Public Affairs Adviser, Bureau of Inter-American Affairs, U.S. Department of State, Washington, D.C. Co-author of *Outline History of Latin America*.
- R. de R.—Raymond de Roover.** Associate Professor of Economics, Wells College, Aurora, N.Y.
- R. de T. E.—Romain de Tiroff-Erté.** Artist and painter. Contributor to *Harper's Bazaar*; *L'Illustration*; *Vogue*; *Sketch*; etc.
- R. de W. C.—Robert de Wolf Coghill.** Director of Research, Abbott Laboratories, North Chicago, Ill., 1946-.
- R. D. H.—R. Dawson Hall.** Engineering Editor, *Coal Age*, New York, N.Y.
- R. D. Hi.—R. D. Hicks.** Former Fellow and Classical Tutor, Trinity College, Cambridge.
- R. D. Hn.—Richard David Hahn, M.D.** Instructor in Medicine, The Johns Hopkins School of Medicine, Baltimore, Md. Senior Medical Supervisor, Venereal Disease Division, Baltimore City Health Department.
- R. D. Hu.—Rockwell Dennis Hunt.** Emeritus Dean of the Graduate School and Professor of Economics, University of Southern California, Los Angeles. Author of *California the Golden*; etc.
- R. D. Le.—Ralph D. Lillie, M.D.** Chief, Laboratory of Pathology and Pharmacology, National Institute of Arthritis and Metabolic Diseases, National Institutes of Health, Bethesda, Md. Author of *Histopathologic Technic*; *Pathology of Experimental Vaccinia in Rabbits*; *Pathology of Psittacosis*; *Pathology of Rocky Mountain Spotted Fever*; *Pathology of Tularemia*.
- R. Do.—Robert Dowson.** Engineer, Messrs. C. A. Parsons Co., Ltd., Heaton Works, Newcastle-on-Tyne, England.
- R. Don.—Sir Robert Donald.** Chairman, Empire Press Union, 1915-26. Editor of the *Daily Chronicle*, 1902-18. Managing Director of United Newspapers, Ltd., to 1918.
- R. D. P.—Ralph Edward Drake Parker.** Telegraph Development Director, Bell Telephone Laboratories, New York, N.Y.
- R. Dt.—Roger Doucet.** Rector of the Academy of Besançon, University of Besançon, Besançon, Fr. Author of *Les Institutions de la France au XVI^e siècle*; *Le Parlement de Paris et François I.*
- R. D. W.—Ralph D. Wyckoff.** Staff Geophysicist, Gulf Research and Development Co., Pittsburgh, Pa.
- R. Dy.—Roman Dyboski.** Former Professor of English Literature in the University of Cracow, Poland. Author of *Poland Old and New*; etc.
- R. E.—Ralph R. Enfield.** Chief Economic Adviser, Ministry of Agriculture and Fisheries, London.
- R. E. B.—Richard Evelyn Byrd.** Naval officer (retired) and aviator. In command of South Polar Expeditions, 1928-30, 1933-35, 1939, 1947. Commander, Aviation Unit of Navy-MacMillan Polar Expedition, 1925. Made flight over North Pole, 1926. Made transatlantic flight with three companions from New York to France, 1927.
- R. E. Bn.—Ray E. Brown.** Superintendent, The University of Chicago Clinics, Chicago, Ill.
- R. E. C.—Dame Rachel Eleanor Crowdy.** Regions' Adviser, Ministry of Information, 1939-46. Chief of Social Questions and Opium Traffic Section, League of Nations, 1919-31.
- R. E. Ck.—Robert Elwell Connick.** Assistant Professor of Chemistry, University of California, Berkeley, Calif.
- R. Ed.—Ralph Edwards.** Keeper, Department of Woodwork, Victoria and Albert Museum, London. Co-author of *The Dictionary of English Furniture*.
- R. E. E.—Richard Edgar Evans.** Assistant Superintendent, Production Engineering and Control, Remington Arms Company, Bridgeport, Conn.
- R. E. F.—Robert Elliott Freer.** Chairman, Federal Trade Commission, 1939, 1944 and 1948.
- R. E. G.—Reginald E. Gillmor.** Vice-President, Sperry Gyroscope Company, Inc., Brooklyn, N.Y.
- R. E. Gm.—Ralph Early Grim.** Principal Geologist, Illinois Geological Survey, Urbana, Ill. Author of *The Bonding Action of Clay*; *Modern Concepts of Clay Materials*.
- R. E. J.—Robert Edmond Jones.** American theatrical designer. Author of *Drawings for the Theatre*; *The Dramatic Imagination*.
- R. E. L.—Rudolph Ernest Langer.** Professor of Mathematics and Chairman, Department of Mathematics, University of Wisconsin, Madison, Wis.
- R. E. M.—Robert E. Martin.** Associate Professor of Government, Howard University, Washington, D.C. Author of *Negro Disfranchisement in Virginia*; *Negro-White Participation in the A.A.A. Program*.
- R. E. O.—Ralph Edward Oesper.** Professor of Chemistry, University of Cincinnati, Cincinnati, O.
- R. E. R.—Richard Ellis Roberts.** Author of *A Roman Pilgrimage*; *Henrik Ibsen*; *The Other End*; etc.
- R. E. W.—Robert E. Wood.** Brigadier General. Chairman of the Board, Sears, Roebuck and Company, Chicago. Acting Quartermaster General, United States Army, during World War I.
- R. E. Wy.—Robert E. Wyllie.** Brigadier General, U.S.A. (retired). Author of *Orders, Decorations and Insignia*.

R. F.—Raymond William Firth. Professor of Anthropology, University of London. Leverhulme Research Fellow in Malaya, 1939-40. Author of *Primitive Economics of the New Zealand Maori*.

R. F. A.—Robert Franz Arnold. Former Professor of German Literature in the University of Vienna.

R. F. Ft.—Richard Foster Flint. Professor of Geology, Yale University.

R. F. H.—R. F. Harrod. Member of the Council, Royal Economic Society. Fellow of the British Academy. Author of *International Economics, the Trade Cycle; Life of J. M. Keynes; Towards a Dynamic Economics*.

R. F. K.—Robert F. Kelley. Assistant Secretary, United States Polo Association.

R. F. L.—Raymond Fernand Loewy. Head of Raymond Loewy Associates, Industrial Designers, New York, N.Y. Author of *The Locomotive (Its Esthetics)*.

R. F. Ls.—René Felix Lissens. Flemish critic and literary historian. Author of *Brieven van Albrecht Rodenbach; Het Impressionisme in de Vlaamsche Letterkunde*.

R. F. M.—Robert Foster Moore. Consulting Ophthalmic Surgeon. St. Bartholomew's Hospital, London. Consulting Surgeon, Moorfields Eye Hospital. Author of *Medical Ophthalmology*; etc.

R. F. N.—Roy Franklin Nichols. Professor of History, University of Pennsylvania, Philadelphia, Pa. Author of *The Democratic Machine (1850-1854)*; etc.

R. Fr.—Roger Fry. Artist. Honorary Fellow, King's College, Cambridge, 1927. Author of *Giovanni Bellini*.

R. Fs.—Robert Foss. Publicity Director and Editor, University of Wisconsin News Bureau, Madison, Wis.

R. G.—Richard Garnett. Former Superintendent of the Reading Room and Keeper of the Printed Books, British Museum, London. Co-editor with Edmund Gosse of *English Literature*. Author of *Emerson; Milton*; etc.

R. G. A.—Robert Greenhalgh Albion. Professor of History, Princeton University, Princeton, N.J. Assistant Director of Naval History, U.S. Department of the Navy, Washington, D.C. Author of *Forests and Sea Power; Rise of New York Port*.

R. G. D. A.—Roy George Douglas Allen. Professor of Statistics, University of London. Author of *Statistics for Economists*.

R. G. H.—Ralph George Hawtrey. Assistant Secretary to the Treasury, London. Author of *Currency and Credit*; etc.

R. G. Hu.—Ray Garland Hulbert. Director of Information and Statistics, American Osteopathic Association, 1924-47. Former Editor of *The Journal of the American Osteopathic Association*.

R. Gi.—Sir Robert Giffen. Former Assistant Editor, with Walter Bagehot, of the *Economist*. Controller-general (1892-97) to the British Board of Trade. Author of *Essays on Finance*; etc.

R. Git.—Roy Gittinger. Regents' Professor of History, 1946-. Dean of Administration, 1926-41, Dean of Admission, 1941-46, University of Oklahoma, Norman, Okla. Author of *The Formation of the State of Oklahoma*; etc.

R. Gl.—Ralf Gall. Former Assistant Financial Editor, *Chicago Daily News*.

R. G. Rr.—Robert George Raymer. Former Associate Professor of History, University of Redlands, Redlands, Calif. Author of *Montana, the Land and the People*.

R. G. S.—Robert Gordon Sproul. President, University of California, Berkeley, Calif.

R. G. Se.—Robert Granville Stone. Meteorologist, Headquarters, Air Weather Service (A.A.F.). Editor, *Bulletin of the American Meteorological Society*. Author of *Meteorology of the Virgin Islands*; etc.

R. G. Sr.—Ralph G. Sanger. Professor and Head of the Department of Mathematics, Kansas State College, Manhattan, Kansas. Author of *Synthetic Projective Geometry*.

R. Gt.—Raleigh Gilchrist. Senior Chemist, National Bureau of Standards, U.S. Department of Commerce, Washington, D.C.

R. Ha.—Sir Robert A. Hadfield. Former Chairman and Managing Director of Hadfields, Ltd.; Director of Sheffield Gas, Mond Nickel and other companies; Member of Arbitration Panel, Senate and Court of Governors of University of Sheffield, England. Author of *Metallurgy and Its Influence on Modern Progress*; etc.

R. H. Bt.—Ralph Henry Bassett. Retired Permanent Secretary, Ministry of Industries and Fisheries, Ceylon Government. Author of *The Rare Romances of Nariya the Jackal; Romantic Ceylon*.

R. H. C.—Sir Reginald Henry Craddock. Member of the Royal Commission on the Civil Services of India, 1923-24. Lieutenant-Governor of Burma, 1917-22.

R. H. Ch.—Robert Henry Charles, D.D. Former Archdeacon of Westminster. Former Fellow of Merton College, Grinfield Lecturer and Lecturer in Biblical Studies, Oxford. Author of *Lectures on the Apocalypse; Studies in the Apocalypse*; etc.

R. H. D.—Sir Robert H. Davis. Governing Director of Siebe, Gorman & Co., Ltd., submarine engineers, London. Author of *Deep Diving and Submarine Operations*; etc.

R. He.—Richard Hesse. Professor of Zoology and Director Zoological Institute in the University of Berlin, 1926-36.

R. H. E.—Robert H. Ebert, M.D. Chief of Division of Pulmonary Diseases, Billings Hospital, The University of Chicago.

R. H. Fe.—Ralph Holmes Ferguson. In charge of the Physical Chemical Research Laboratory, Procter and Gamble Co.

R. H. Fg.—Richard Howell Fleming. Assistant Professor of Oceanography, Scripps Institute of Oceanography, La Jolla, Calif. Co-author of *The Oceans; Their Physics, Chemistry, and General Biology*.

R. H. Ga.—Ralph Henry Gabriel. Professor of History, Yale University. Author of *The Evolution of Long Island*; etc. Editor, *Christianity and Modern Thought*; etc.

R. H. Gr.—R. H. Gretton. Lecturer in Modern History, Oxford University.

R. H. L.—Robin Humphrey Legge. Music Critic for *The Daily Telegraph*, London, 1908-31. Author of *Annals of the Norwich Festivals*; etc.

R. H. Le.—Richard Henry Leigh. Admiral, United States Navy. Former Chief of Bureau of Navigation, Washington, D.C.; Commander in Chief, U.S. Fleet.

R. H. Lo.—Robert Harry Lowie. Professor of Anthropology, University of California, Berkeley, Calif. Former President, American Anthropological Association. Author of *Introduction to Cultural Anthropology; The History of Ethnological Theory*; etc.

Rh. P.—Ralph Pemberton, M.D. Professor of Medicine, Graduate School of Medicine, University of Pennsylvania, Philadelphia, Pa. Author of *Arthritis and Rheumatoid Conditions*; co-author of *Medical and Orthopaedic Management of Chronic Arthritis*.

R. H. P.—Rupert Howard Porter. Seed Technologist, American International Association, Rio de Janeiro, Brazil, 1947-. Professor of Botany, Research Professor of Agronomy and Director of Seed Laboratory, Iowa State College, Ames, Iowa, 1932-46.

R. H. Q.—Rev. Robert Hebert Quick. Former Lecturer on Education, Cambridge University. Author of *Essays on Educational Reformers*.

R. H. R.—Sir (R.) Henry Rew. Chairman, Inter-Departmental Committee on Unemployment Insurance in Agriculture, 1925-26. Board of Agriculture and Fisheries, 1898, Assistant Secretary, 1906-18. Secretary to the Ministry of Food, 1916-17. Author of *A Primer of Agricultural Economics*; etc.

R. H. Ra.—Robert Heron Rastall. Attached to War Office, 1915-19. Author of *Geology of the Metalliferous Deposits; Physico-Chemical Geology*. Co-author of *Textbook of Geology and Petrology of Sedimentary Rocks*; etc. Former Editor of the *Geological Magazine*.

R. H. Rn.—Robert Henry Ralston. Research Chemist, Hercules Powder Co., Wilmington, Del.

R. H. Rs.—Ray Harland Roberts. Professor of Horticulture, University of Wisconsin, Madison, Wis.

R. H. S.—Richard Haviland Smythe. Architect.

R. H. Sh.—Robert Hale Shields. Assistant in History, University of California, Berkeley, Calif.

R. Hu.—Sir Robert Hunter. Author of *The Preservation of Open Spaces and of Footpaths and other Rights of Way*.

R. H. W.—Robert Hendry Weir. Assistant Director, Directorate of Engine Research and Development, Ministry of Supply, London.

R. H. Y.—Richard Hugh Young. Assistant Public Relations Adviser, Development and Welfare Organization in the West Indies.

R. I.—Roger Ingpen. Editor of *Letters of Percy Bysshe Shelley; A Selection of Shelley's Writings in the Regent Library*. Co-editor of Julian Edition of Shelley's complete works.

R. I. P.—Reginald Innes Pocock. Temporary Assistant in the Zoological Department of the British Museum, London, 1923-47, and former Natural History Editor of *The Field*. Author of *Arachnida of British India and Mammalia of British India*, Vol. I, II.

R. I. T.—Robert I. Tenney. President, Wahl-Henius Institute, Chicago, Ill.

R. Ja.—Roland Godfrey Janson. New York, N.Y.

R. J. Be.—Ralph J. Bunche. Director, Department of Trusteeship and Information from Non-Self-Governing Territories, United Nations; Acting U.N. Mediator on Palestine, 1948-49. Nobel Prize for Peace, 1950.

- R. J. G.**—Reginald John Gladstone, M.D. Former Reader in Anatomy and Lecturer in Embryology, King's College, University of London.
- R. J. H. K.**—Robert John Herman Kiphuth. Professor of Physical Education and Head Coach of Swimming, Yale University, New Haven, Conn. United States Olympic Coach, 1928, 1932, 1936, 1940, 1948. Author of *Swimming*; co-author of *Basic Swimming*.
- R. J. K.**—Raymond John Kelly. National Commander, The American Legion, 1939-40.
- R. J. Mi.**—R. J. Milbourne. Member of the Council and Chairman (1928-29) of the Society of British Gas Industries. Author of *Gasholder Design and Construction*.
- R. J. Mr.**—Robert J. Maurer. Associate Professor of Physics, Carnegie Institute of Technology, Pittsburgh, Pa.
- R. Jn.**—Raymond Johnson. Sports Editor, *The Nashville Tennessean*, Nashville, Tenn. President, Amateur Softball Association of America.
- R. J. Sn.**—R. J. Stephenson. Professor and Head of the Department of Physics, College of Wooster, Wooster, O. Author of *Exploring in Physics; Mechanics and Properties of Matter*.
- R. J. T.**—Richard John Tabor. Retired Assistant Professor of Botany, Imperial College of Science and Technology, University of London.
- R. J. Tr.**—Robert Julius Trumpler. Professor of Astronomy, University of California, Berkeley, Calif.
- R. K.**—Rollin Kirby. Former Cartoonist, *Look Magazine*. Political Cartoonist, the *New York Post*, 1939-42.
- R. K. B.**—Ralph Klaus Blumenau. Assistant Master at the King's School, Canterbury, Eng.
- R. K. D.**—Sir Robert Kennaway Douglas. Former Keeper of Oriental Printed Books and MSS. at the British Museum, London, and Professor of Chinese, King's College, London. Author of *The Language and Literature of China*; etc.
- R. Ke.**—Rudolf Kingslake. Head of Optical Design Department, Eastman Kodak Co., Rochester, N.Y.
- R. K. E.**—Richard Kempton Estelow. Research Chemist, Columbian Carbon Company, Brooklyn, N.Y.
- R. K. G.**—Ralph Kalb Ghormley, M.D. Professor in Orthopaedic Surgery, Mayo Foundation, and Head of Orthopaedic Section, Mayo Clinic, Rochester, Minn. Co-author of *Diagnosis in Joint Disease*.
- R. L. A.**—Sir Reginald Laurence Antrobus. Member of Central Board of Finance of Church of England, 1925-35, and National Assembly, 1920-25. Governor of St. Helena, 1889-90.
- R. L. Be.**—Richard L. Beyer. Department of History, State University of Iowa, Iowa City, Ia.
- R. Ld.**—Robert Lynd. Formerly on staff of the *News Chronicle*, London. Author of *Books and Authors*; etc.
- R. L. E.**—Richard L. Evans. Editor, writer, church official. Author of *At This Same Hour; The Spoken Word; This Day and Always; Tonic for Our Times; Unto the Hills*.
- R. Lev.**—Reuben Levy. Lecturer in Persian, Cambridge University.
- R. L. F.**—Rachel Louise Fitch. Dean of Women, Cornell University, Ithaca, N.Y., 1926-41.
- R. L. H.**—Richard Lionel Hippisley. Colonel. Formerly employed in the Trigonometrical Survey of Cyprus. Deputy Director, Army Signals, Central Force, 1914-16.
- R. L. Ha.**—Robert Lee Hale. Professor of Law, Columbia University. Author of *Valuation and Rate Making*; etc.
- R. L. Ho.**—Robert Lockhart Hobson. Former Keeper of Department of Oriental Antiquities and Ethnography, British Museum, London. Author of *Worcester Porcelain; Chinese Pottery and Porcelain*; etc.
- R. L. Ht.**—R. L. Hallett. Former Chief Chemist, National Lead Company, New York, N.Y. Author of Paint Industry Section of *Representative Industries in the United States*; etc.
- R. L. Ne.**—R. L. Neyman. Commander, U.S. Navy. Bureau of Ordnance, U.S. Department of the Navy, Washington, D.C.
- R. L. P.**—Reginald Lane Poole. Former Honorary Fellow of Magdalen College, Oxford. Lecturer in Diplomatics in the University, 1896-1927. Keeper of the University Archives, 1909-27. Curator of the Bodleian Library, 1914-26. Author of *Wycliffe and Movements for Reform*.
- R. L. Pn.**—Robert L. Pendleton. Principal Soil Technologist, Office of Foreign Agricultural Relations, U.S. Department of Agriculture, Washington, D.C., 1942-.
- R. L. S.**—Robert Louis Stevenson. Novelist, essayist and poet. Author of *Kidnapped; Treasure Island*; etc.
- R. L. S.-R.**—Reginald Leslie Smith-Rose. Director, Radio Research, Department of Scientific and Industrial Research, London.
- R. L. T.**—Ralph Lilley Turner. Director, School of Oriental and African Studies; Professor of Sanskrit, University of London. Author of *Gujarati Phonology*; etc.
- R. L. W.**—Ray Lyman Wilbur, M.D. Former Chancellor of Stanford University, Stanford, Calif. Former Secretary of the Interior, Washington, D.C.
- R. L. Wi.**—Raymond Louis Wilder. Research Professor of Mathematics, University of Michigan, Ann Arbor, Mich. Former Research Worker, Institute for Advanced Study.
- R. L. Wl.**—Rupert L. Wenzel. Assistant Curator of Insects, Chicago Natural History Museum, Chicago, Ill.
- R. Ly.**—Richard Lydekker. Member of staff of Geological Survey of India, 1874-82. Author of *Catalogues of Fossil Mammals, Reptiles and Birds in British Museum*; etc.
- R. Ma.**—Robert Mackintosh, D.D. Professor at Lancashire Independent College and Lecturer in the University of Manchester, England, 1904-30. Author of *Essays Towards a New Theology; First Primer of Apologetics*; etc.
- R. M. A.**—Rudolph M. Anderson. Chief of Division of Biology, National Museum of Canada, Ottawa, 1920-46. Author of *Birds of Iowa*.
- R. MacD.**—Robert MacDonald, Jr. Vice-President and Director, General Abrasive Company, Inc., Niagara Falls, N.Y.
- R. M. B.**—Richard Milton Bozorth. Research Physicist, Bell Telephone Laboratories, Murray Hill, N.J.
- R. McK.**—Roderick MacKenzie. Former Fereday Fellow of St. John's College, Oxford, and Assistant Editor of the 9th edition of Liddell and Scott's *Greek-English Lexicon*.
- R. M. F.**—R. M. Fleming. Librarian, The Geographical Association, Aberystwyth. Author of *Ancient Tales from Many Lands*; etc.
- R. M. Fy.**—Raymond Michael Foley. Administrator, Housing and Home Finance Agency, Washington, D.C.
- R. M. He.**—Robert Mitchell Henry. Professor of Humanity, St. Andrews University, Scotland. Honorary Professor of Classical Literature, Trinity College, Dublin. Professor of Latin, 1907-38.
- R. M. Hu.**—Rowland M. Hussey. Superintendent, Wire Department, Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
- R. M. L.**—Russell Mortimer Luckock. Major General. Commander, 54th Division, T. A., 1934-38. Former Commandant, Small Arms Schools, India, and O.C. 163rd Infantry Brigade, Territorial Army, 1926-28. Brigadier, General Staff, Southern Command, Salisbury, 1928-32.
- R. M. Le.**—Robert MacDonald Lester. Secretary, Carnegie Corporation of New York, N.Y. Author of *Forty Years of Carnegie Giving*; etc.
- R. M. O.**—Robert M. Ormerod. Director of John Ormerod and Sons, Ltd., manufacturers of leather belting, etc.
- R. Mr.**—Roland Émile Mousnier. Professor of Modern History in the Faculty of Letters, University of Strasbourg, Strasbourg, Fr. Author of *La Vénalité des offices sous Henri IV et Louis XIII; Le XVII^e Siècle, révolution intellectuelle, technique, politique*.
- R. M. R.**—R. Marion Robb. Research Group Leader, E. I. du Pont de Nemours & Company, Inc., Wilmington, Del.
- R. M. T.**—R. M. Tryon. Chemical Warfare Development Laboratory of the Massachusetts Institute of Technology.
- R. Mu.**—Ramsay Muir. Former Lecturer in Modern History at Owens College, Manchester, England.
- R. M. W.**—Robert Mark Wenley. Former Professor of Philosophy in the University of Michigan, Ann Arbor, Mich.
- R. M. Wr.**—Russell M. Wilder, M.D. Director, National Institute of Arthritis and Metabolic Diseases, Bethesda, Md. Former Professor and Chief of the Department of Medicine, Mayo Foundation for Medical Education and Research, Rochester, Minn. Author of *Clinical Diabetes Mellitus and Hyperinsulinism; A Primer for Diabetic Patients*.
- R. My.**—Raymond Massey. Actor of the stage, screen and radio; director and producer in the theatre.
- R. N. B.**—Robert Nisbet Bain. Assistant Librarian, British Museum, London, 1883-1909. Author of *Scandinavia: The Political History of Denmark, Norway and Sweden, 1513-1900; Slavonic Europe: The Political History of Poland and Russia from 1469 to 1796*; etc.
- R. N. Ba.**—Robert Nesham Bax. Admiral, R.N. (retired). Director of the Mobilization Department at the Admiralty, 1924-26. Naval A.D.C. to the King, 1922-23.
- R. N. C.**—Ram Nath Chopra, M.D. Director, Drug Research Laboratory, Jammu and Kashmir, India. Author of *Anthelmintics and Their Uses in Medical and Veterinary Practice; Indigenous Drugs of India; Poisonous Plants of India; Tropical Therapeutics*.

R. Ne.—Ragnar Nurkse. Professor of Economics, Columbia University, 1947— . Member, Economic, Financial and Transit Department, League of Nations, 1934-45. Author of *Internationale Kapitalbewegungen*.

R. N. R.-B.—R. N. Rudmose-Brown. Emeritus Professor of Geography, University of Sheffield, England. Member of the Scottish National Antarctic Expedition, 1902-04, and of the Scottish Arctic Expeditions, 1909, 1914 and 1919. Author of *Spitsbergen*.

R. N. S.—R. Norris Shreve. Professor of Chemical Engineering, Purdue University, Lafayette, Ind. Author of *Chemical Process Industries*; *Selected Process Industries*; *Dyes Classified by Intermediates*; etc.

R. N. W.—Ralph Nicholson Wornum. Keeper of the National Gallery, London, 1854-77. Author of *The Epochs of Painting*; etc.

Ro. F.—Robert Ferber. Research Associate Professor, Bureau of Economic and Business Research, Department of Economics, University of Illinois, Urbana, Ill. Author of *Statistical Techniques in Market Research*.

Ro. P. Be.—Roland P. Blake. Principal Safety Engineer, United States Department of Labour. Author of *Industrial Safety*.

R. P.—René Poupardin. Secretary of the Ecole des Chartes; Honorary Librarian at the Bibliothèque Nationale, Paris.

R. Pa.—Sir Richard Arthur Surttees Paget. Assistant Secretary, Admiralty Board of Invention and Research, 1915-18.

R. Par.—Raymond Parmer. Of the firm of Kirlin, Campbell, Hickox and Keating, lawyers, New York, N.Y.

R. P. B.—Rudolf P. Berle. Former law secretary to the Justices of the Massachusetts Supreme Judicial Court.

R. P. Br.—Ralph Paul Bieber. Professor of History, Washington University, St. Louis, Mo. Author of *The Lords of Trade and Plantations*.

R. P. Bs.—Robert P. Brooks. Dean of Faculties, 1945— , and Director, Institute of Public Affairs, University of Georgia, Athens, Ga. Author of *A History of Georgia*; *The Agrarian Revolution in Georgia*.

R. P. C.—Robert Pierce Casey. Professor and Head of Department of Biblical Literature and History of Religion, Brown University, Providence, R.I., 1934— .

R. P. Co.—Richard Pope Cowl. Former Professor of English at Bristol University, England. Author of *Poetic Theory in England*; Editor of *Henry the Fourth, Pts. I and II* in Ardenne Shakespeare.

R. Pe.—Robert Peele. Former Professor of Mining Engineering, School of Mines, Columbia University. Editor of *Mining Engineers' Handbook*; *Compressed Air Plant*, 5th edition.

R. P. F.—Roland Post Falkner. Statistician, Research Staff, National Industrial Conference Board, 1926-40. Assistant Director of the Census, 1911-12.

R. P. H.—Raymond Prunty Holland. President, American Game Protective Association. Editor of *Field and Stream*, 1924-41. Writer of shooting stories under the name of "Bob White."

R. Pi.—Rudolf Pintner. Former Professor of Education, Teachers College, Columbia University. Author of *A Scale of Performance Tests*; *Intelligence Testing*; etc.

R. Pl.—Raymond Pearl. Professor of Biology, 1923-40, and Director, Institute of Biological Research, 1925-30, The Johns Hopkins University, Baltimore, Md.

R. Pn.—Ralph Pearson. Etcher and designer. Author, *Fifty Prints of the Year*; etc.

R. Pr.—Robert Priebsch. Professor of German Language and Literature in the University of London, 1902-31. Author of *Deutsche Handschriften in England*; etc.

R. P. S.—Ralph Pray Seward. Associate Professor of Chemistry, The Pennsylvania State College, State College, Pa.

R. P. Sp.—Robert Phillip Sharp. Professor of Geology, California Institute of Technology, Pasadena, Calif.

R. R.—Sir Richard Augustine Studdert Redmayne. Member, Past President of Institute of Mining and Metallurgy; Honorary Member, Surveyors' Institute; H.M. Chief Inspector of Mines, 1908-20. Author of *The British Coal Industry during the War*; etc.

Rr. C. An.—Roger Charles Anderson. Author of *The Rigging of Ships, 1600-1720*; *The Sailing Ship*.

R. Rd.—Robert Redfield. Professor of Anthropology and Dean, Division of the Social Sciences, The University of Chicago. Author of *Tepoztlan, a Mexican Village*; *Chan Kom, a Maya Village*; *The Folk Culture of Yucatan*.

R. Re.—Raymond Régamey. Artist and designer. Author of *Géricault*.

R. R. E.—Richard R. Ely. Chief, Division of Philippine Affairs, U.S. Department of State, Washington, D.C.

R. Ret.—Robert Retzer. Director, Life Insurance Training Course, School of Commerce, Accounts and Finance, New York University, New York, N.Y., 1928-29.

R. R. G.—Roy R. Grinker, M.D. Chairman, Department of Neuropsychiatry, Michael Reese Hospital, Chicago, Ill. Author of *Neurology*; *Men Under Stress*.

R. R. L.—Robert R. Linton, M.D. Assistant Clinical Professor of Surgery, Harvard Medical School, Cambridge, Mass.

R. R. M.—Robert Ranulph Marett. Rector of Exeter College, Oxford, 1928-43. Former University Reader in Social Anthropology. Editor of *Anthropology and the Classics*. Author of *Anthropology*; *Psychology and Folklore*; etc.

R. Rob.—Sir Robert Robinson. Waynflete Professor of Chemistry, Oxford University, 1930— . Nobel Prize for Chemistry, 1947.

R. R. P.—Raye R. Platt. Head of Department of Hispanic American Research, American Geographical Society of New York.

R. Rs.—R. Ross. Ministry of Agriculture and Fisheries, London.

R. R. Sh.—Robert Ross Smith. Historian, Pacific Section, Office of the Chief of Military History, U.S. Department of the Army, Washington, D.C.

R. Rt.—Reinhold Rost. Editor of Wilson's *Essays on the Religions of the Hindus*; Hodgson's *Essays on Indian Subjects*.

R. R. Th.—Reuben R. Thompson. Editor, *Tobacco*.

R. R. V.—Richard Rockhill Vogt. Professor of Chemistry, University of Notre Dame, Notre Dame, Ind. Co-author of *The Chemistry of Acetylene*.

R. R. W.—Russell Randolph Waesche. Admiral, U.S.N. Former Commandant, United States Coast Guard.

R. Ry.—Robert Ridgway. Former Chief Engineer, Board of Transportation, New York, N.Y.

R. S.—Richard Seligman. Sometime Chief Chemist to the British Aluminium Co., Ltd., London. Technical Managing Director of the Aluminium Plant and Vessel Company, Limited, London.

R. S. Ba.—Ralph Samuel Bates. Instructor in English and History, Massachusetts Institute of Technology, Cambridge, Mass. Author of *Scientific Societies in the United States*.

R. S. C.—Rev. Richard Seymour Cripps. Vicar of Horingsea, Cambs., Eng.

R. Sch.—Robert Schmidt. Former Director, Schlossmuseum, Berlin. Author of *Brandenburgische Gläser*; *Das Glas*; *Möbel*; etc.

R. S. Cl.—Reginald S. Clay. President of the Royal Microscopical Society, 1937-38. Principal, Northern Polytechnic, Holloway, London, 1902-31. Author of *Practical Exercises in Light*; etc.

R. S. Cn.—Ronald Stephenson Cogdon. Engineer, River Wear Commissioners, Sunderland, Eng.

R. S. Co.—Robert Seymour Conway. Former Professor of Latin and Indo-European Philology in the University of Manchester, England.

R. S. Cy.—Robert S. Casey. Chief Chemist, W. A. Sheaffer Pen Company, Fort Madison, Ia.

R. S. H.—Robert Selph Henry. Vice-President, Association of American Railroads. Author of *This Fascinating Railroad Business*; *Portraits of the Iron Horse*.

R. S. L.—Robert Strong Lewis. Professor of Mining, University of Utah, Salt Lake City, Utah. Author of section on Boring, *Peele's Mining Engineers' Handbook*; *Elements of Mining*.

R. Sm.—Reed Smoot. Former Senator from Utah and member of the World War I Foreign Debt Commission.

R. S. M.—R. S. Morrell. Research Chemist, Mander Bros., Ltd., Wolverhampton, England.

R. S. Me.—Richard Stetson Morse. President and Director of Research, National Research Corporation, Boston, Mass.

R. S. Mn.—Robert Swain Morison, M.D. Assistant Director for the Medical Sciences, the Rockefeller Foundation, New York, N.Y. Former Assistant Professor of Anatomy, Harvard Medical School.

R. S. P.—Reginald Stuart Poole. Former Keeper of the Department of Coins and Medals, British Museum, London.

R. S. Pa.—Richard S. Patterson. Assistant to the Editor of the Treaties, Department of State, Washington, D.C.

R. S. Pn.—Sir Ralph Sneddy Pearson. Director, Forest Product Research Laboratories, Department of Scientific and Industrial Research, Princes Risborough, Bucks., England, 1925-33.

R. S. R.—Sir Robert Sangster Rait. Principal and Vice-Chancellor of the University of Glasgow, Scotland, 1929-36.

R. S. S.—Robert Sidney Smith. Associate Professor of Economics, Duke University, Durham, N.C. Author of *The Spanish Guild Merchant*; etc.

- R. S. Sh.**—Raymond Stratton Smith. Chief of State Soil Survey and Emeritus Professor of Soil Physics, University of Illinois, Urbana, Ill.
- R. S. Sr.**—Russell Scott Stauffer. Assistant Professor of Soil Physics, University of Illinois, Urbana, Ill.
- R. St.**—Ray Strachey (Mrs. Oliver Strachey). Former Secretary, Women's Employment Federation. Author of *The Cause: a Brief History of the Woman's Movement*.
- R. S. T.**—Robert S. Thomas. Military Historian, Historical Section, Army War College, Washington, D.C.
- R. Su.**—Ronald Sutcliffe. Principal Officer, British Government Chemist's Department, London.
- R. T.**—Royall Tyler. Author of *Byzantine Art*; etc.
- R. Ta.**—R. Taylor. Assistant, Chemical Research Laboratory, Teddington, Middlesex, England.
- R. Tay.**—Richard Taylor. U.S. cartoonist. Contributor to *The New Yorker* magazine, 1935-.
- R. T. B. F.**—Roger Thomas Baldwin Fulford. Co-editor of *The Greville Memoirs*; author of *The Prince Consort*; *Queen Victoria*; *Royal Dukes*.
- R. T. C.**—R. T. Colgate. Chief Chemist at Huntley and Palmers, Ltd., Reading, England.
- R. T. D.**—Reginald Trevor Davies. University Lecturer in Spanish History, Oxford University. Tutor of St. Catherine's Society, Oxford. Author of *Four Centuries of Witch-belief*; *The Golden Century of Spain*.
- R. T. E.**—Richard Theodore Ely. Research Professor of Economics, Northwestern University, Evanston, Ill., 1925-33. Author of *Taxation in American States and Cities*; etc.
- R. T. F.**—Russell Todd Fisher. Former President, National Association of Cotton Manufacturers, Boston, Mass.
- R. T. G.**—Robert Theodore Gunther. Former Tutor in Natural Science and Librarian of Magdalen College, Oxford; Curator of the Lewis Evans Collection of Scientific Instruments, Oxford, 1924. Author of *Early Science in Oxford*; etc.
- R. T. Gl.**—Sir Richard Tetley Glazebrook. Former Fellow of Trinity College, Cambridge, and Chairman Aeronautical Research Committee. Director of the National Physical Laboratory, 1899-1919. Zaharoff Professor of Aviation and Director of the Department of Aeronautics, Imperial College of Science and Technology, University of London, 1920-23. Editor of *Dictionary of Applied Physics*.
- R. T. Go.**—Rupert Thomas Gould. Lieutenant Commander, R.N. Former member of the British Horological Institute. Author of *The Marine Chronometer: its History and Development*; etc.
- R. T. McK.**—Robert Tait McKenzie, M.D. Former Research Professor of Physical Education, University of Pennsylvania, Philadelphia, Pa. Author of *Exercise in Education and Medicine*; etc.
- Rt. P.**—Robert Price. Professor of Language and Literature, Otterbein College, Westerville, O. Co-author of *Johnny Appleseed: A Voice in the Wilderness*.
- R. T. P.**—Roger Tory Peterson. Author of *Field Guide to the Birds*; *Junior Book of Birds*; etc. Co-author of *The Audubon Guide to Attracting Birds*.
- R. Tu.**—Ray Tucker. Washington Columnist, "The National Whirligig," McClure Newspaper Syndicate, New York, N.Y. Author of *Mirrors of 1932*; *Sons of the Wild Jackass*.
- R. T. W.**—Robert T. Williams. Specialist in Printing and Lithography, Carrier Engineering Corporation, Newark, N.J. Author of *Manufactured Weather in the Printing and Lithographic Industries*.
- R. T. Wa.**—Ralph Thomas Walker. Architect, Voorhees, Walker, Foley and Smith, New York, N.Y.
- Ru. H.**—Rupert Hughes. Author of *George Washington*; etc.
- R. U. S.**—R. U. Sayce. Lecturer in Material Culture and Physical Anthropology, Cambridge University. Former Lecturer in Geology and Geography, Natal University College, Pietermaritzburg, Natal.
- R. van O.**—R. van Overstraeten. Major. Member of the Order of Leopold and of the Legion of Honour. Former Aide-de-Camp to His Majesty the King of the Belgians.
- R. von H.-G.**—Robert von Heine-Geldern. Research Associate, The American Museum of Natural History, New York, N.Y. Former Professor of Anthropology, University of Vienna. Author of *The Archaeology and Art of Sumatra*; etc.
- R. V. S.**—Sir Richard Vynne Southwell. Rector of Imperial College of Science and Technology, University of London. In charge of Non-Rigid Airships Design at Royal Navy Air Station, Kingsnorth, 1915-18, and of Aerodynamic and Structural Experiments at the Royal Aircraft Establishment, Farnborough, 1918-19. Professor of Engineering Science, 1929-42, and Honorary Fellow of Brasenose College, Oxford.
- R. V. W.**—Ralph Vaughan Williams. Author of *National Music*.
- R. W. B.**—Robert Wilbur Burgess. Statistician and economist, Western Electric Co. Author of *Introduction to the Mathematics of Statistics*.
- R. W. Bd.**—Raymond Walter Barnard. Associate Professor of Mathematics, The University of Chicago, Chicago, Ill.
- R. W. Br.**—Roland Wilbur Brown. Geologist, Geological Survey, U.S. Department of the Interior, Washington, D.C.
- R. W. Bt.**—R. W. Bennett. Former Manager, Bureau of Publicity, Chamber of Commerce of the City of Newark, N.J.
- R. W. C.**—The Very Rev. Richard William Church, D.D. Former Dean of St. Paul's. Author of *The Oxford Movement*; etc.
- R. W. Ch.**—Randolph W. Church. State Librarian, Virginia State Library, Richmond, Va. Editor of *Virginia School Boards*; joint editor of *Virginia Imprint Series*.
- R. W. Co.**—Robert William Cooper. Former Berlin Correspondent, the *Times*, London.
- R. W. Cy.**—Ralph Works Chaney. Professor of Palaeontology, and Curator, Museum of Palaeontology, University of California, Berkeley, Calif.
- R. Wd.**—Richardson Wood. Consultant on Public Opinion Research, New York, N.Y.
- R. We.**—Raymond Weeks. Professor of Romance Philology, Columbia University, 1909-29. Author of *Ode to France*; etc.
- R. Wer.**—Reinold Werrenrath. Former concert singer. Composer of *Cavaliers' Song*; etc.
- R. W. F. H.**—Robert William F. Harrison. Assistant Secretary of the Royal Society, London, 1896-1919.
- R. W. Fy.**—Richard W. Flournoy. Retired Assistant to the Legal Adviser, U.S. Department of State, Washington, D.C. Chairman of Committees on Nationality of the American Bar Association and the International Law Association.
- R. W. Hn.**—Robert W. Hansen. Editor, *Eagle Magazine*.
- R. W. L.**—Robert Warden Lee. Rhodes Professor of Roman-Dutch Law, Oxford University, and Fellow of All Souls College.
- R. W. M.**—Roy Waldo Miner. Emeritus Curator, Marine Life Section, American Museum of Natural History, New York.
- R. W. N.**—Roy Wesley Nixon. Associate Horticulturist, U.S. Department of Agriculture, U.S. Date Garden, Indio, Calif.
- R. W. P.**—Raymond William Postgate. Author of *The Bolshevik Theory*; etc. Editor and translator of *Pervigilium Veneris*.
- R. Wr.**—Raymond Wexler. Research Meteorologist, Harvard University.
- R. W. R.**—Robert William Reid, M.D. Former Regius Professor of Anatomy, University of Aberdeen, Scotland. Former Lecturer on Anatomy, St. Thomas's Hospital, London.
- R. W. Rd.**—Robert William Richardson. Chief Social Science Analyst, Office of Coordinator of Inter-American Affairs, Washington, D.C.
- R. W. S.**—Roy W. Steele. Of the Indianapolis, Ind., Chamber of Commerce.
- R. W. S.-W.**—Robert William Seton-Watson. Professor of Czechoslovak Studies, Oxford University, 1945-49. Masaryk Professor of Central European History at King's College, University of London, 1922-45. Author of *The Rise of Nationality in the Balkans*; etc.
- R. W. W.**—Robert Williams Wood. Emeritus Professor of Experimental Physics, 1938-; Research Professor of Physics, 1938-; The Johns Hopkins University, Baltimore, Md. Author of *Physical Optics*; *Researches in Physical Optics*; etc.
- R. Z.**—Raphael Zon. Professor of Forestry, University of Minnesota, Minneapolis, Minn. Director, Lake States Forest Experiment Station, U.S. Department of Agriculture, St. Paul, Minn., 1922-45. Co-author of *Forest Resources of the World*.
- S.**—Samuel Montagu, 1st Baron Swaythling. Founder, Firm of Samuel Montagu and Company, Bankers, London.
- S. A.**—Samuel Alexander. Honorary Fellow of Lincoln College, Oxford, 1918. Honorary Fellow of Balliol College, 1925. Professor of Philosophy, Manchester, 1893-1924. Author of *Moral Order and Progress*; etc.
- S. A. A.**—S. A. Aspell. Professor of Animal Physiology, Cornell University.
- S. A. C.**—Stanley Arthur Cook, D.D. Former Lecturer in Hebrew and Syriac, Cambridge University. Regius Professor of Hebrew, Cambridge, 1932-38. Author of *Religion of Ancient Palestine*; etc.
- S. A. H.**—S. A. Hurren. Lecturer on Technology of Pianoforte Construction at Northern Polytechnic Institute, London.
- S. A. S.**—Sergei A. Schelkunoff. Member, technical staff, Bell Telephone Laboratories, New York, N.Y. Author of *Electromagnetic Waves*.

- S. B.**—Standish Backus. Former President, Burroughs Adding Machine Company, Dayton, O.
- S. B. F.**—Sidney Bradshaw Fay. Professor of History, Yale University, 1945-46. Author of *Origins of the World War*; etc.
- S. B. H.**—Stanley B. Hunt. President, Textile Economics Bureau, Inc., New York. Editor, *Rayon Organon*.
- S. Bl.**—Sigfus Blondal. Lecturer on Modern Icelandic Language and Literature, University of Copenhagen, Denmark, 1931-46. Librarian in the University of Copenhagen, 1914-39.
- S. B. N.**—Seth Barnes Nicholson. Astronomer, Mount Wilson Observatory of the Carnegie Institution of Washington, Pasadena, Calif.
- S. Br.**—Samuel Brody. Professor of Dairy Husbandry and Chairman, Interdepartmental Committee on Growth and Metabolism, University of Missouri, Columbia, Mo. Author of *Bioenergetics and Growth*.
- S. B. S.**—Sydney Bernard Smith. Chief, Foreign Air Transport Division, Civil Aeronautics Board, Washington, D.C. Aviation Specialist, U.S. Department of State, 1936-41. Author of *Air Transport in the Pacific Area*.
- S. C.**—Sir Sydney Colvin. Former Slade Professor of Fine Art, Cambridge University, and Keeper of Prints and Drawings in the British Museum, London. Author of *Early History of Engraving in England*; etc.
- S. Ca.**—Stanley Casson. Sometime Assistant Director of the British School at Athens and Director of the Excavations carried out by the British Academy at Constantinople, 1928-29. Author of *Macedonia, Thrace and Illyria*; etc.
- S. C. H.**—S. C. Hammer. Oslo Correspondent of *The Times*, London. Editor of the *Norway Year Book*.
- S. C. H. D.**—S. C. H. Davis. Of *Autocar*, London.
- S. Che.**—Sheldon Cheney. Founder of *The Theatre Arts Magazine* and Editor until 1921. Author of *The Art Theatre*; etc.
- S. C. Hy.**—Samuel C. Harvey, M.D. Professor of Surgery, Yale University, New Haven, Conn. Author of *The History of Hemostasis*.
- S. C. I.**—S. C. Isaacs. Author of *The Laws Relating to Theatres, Music Halls and Other Public Entertainments*.
- S. C. M.**—S. C. Manning, Jr. Assistant to the Secretary, United States Maritime Commission, Washington, D.C.
- S. Cn.**—Sydney Chapman. Sedleian Professor of Natural Philosophy and Fellow of Queen's College, Oxford, 1946-. Professor of Mathematics, Imperial College of Science and Technology, University of London, 1924-46. President, International Association of Meteorology, 1936-48.
- S. C. R.**—Sydney Castle Roberts. Master of Pembroke College, Cambridge. Author of *The Story of Doctor Johnson; Boswell's Tour to Corsica*; etc.
- S. Cu.**—Stewart Culin. Formerly of Brooklyn Institute of Arts and Sciences, Brooklyn, N.Y. Author of *Korean Games; Games of the American Indians*.
- S. D.**—Rev. Samuel Davidson, D.D. Examiner in Scripture in the University of London, 1862-98. Author of *The Canon of the Bible; A Treatise on Biblical Criticism*.
- S. d'A.**—Silvio d'Amico. Dramatic Critic of the *Idea Nazionale*, Rome, 1914-25.
- S. D. C.**—Sanford D. Cole. Of the Middle Temple, Barrister-at-Law. Author of *Insurance Law*; etc.
- S. de M.**—Don Salvador de Madariaga. King Alfonso XIII Professor of Spanish Studies, Oxford University, 1928-31, and Honorary Fellow of Exeter College, Oxford. Author of *Shelley and Calderon*; etc.
- S. D. F. S.**—Rev. Stewart Dingwall Fordyce Salmon, D.D. Professor of Systematic Theology and Exegesis of the Epistles, United Free Church College, Aberdeen, 1876-1905. Author of *The Parables of Our Lord*; etc.
- S. Dt.**—Stuart Daggett. Professor of Transportation, University of California, Berkeley, Calif. Author of *Principles of Inland Transportation; The Structure of Transcontinental Railroad Rates*.
- S. Du.**—Saul Dushman. Director, Research Division, Edison Lamp Works, Harrison, N.J. Author of *Elements of Quantum Mechanics; High Vacuum*.
- S. E. Bm.**—Sara Elizabeth Branham, M.D. Senior Bacteriologist, National Institutes of Health, Bethesda, Md. Author of *Practical Bacteriology*; etc.
- S. E. By.**—Stanley E. Bradley, M.D. Associate Professor of Medicine, Columbia University, New York, N.Y. Associate Attending Physician, Presbyterian Hospital, New York, N.Y. Editor in Chief, *Journal of Clinical Investigation*.
- S. E. Ce.**—Sibyl Eyre Crowe. Tutor in Politics and Fellow of St. Hilda's College, Oxford. Author of *The Berlin West African Conference, 1884-5*.
- S. E. L.**—Simeon Elbridge Leland. Professor of Economics and Dean of the College of Liberal Arts, Northwestern University, 1946-. Professor of Government Finance, 1938-46; Chairman, Department of Economics, 1940-46, The University of Chicago. Author of *Taxation in Kentucky; The Classified Property Tax in the United States*; etc.
- S. E. S.**—Samuel Edward Sheppard. Assistant Director of Research, Eastman Kodak Company, Rochester, N.Y., 1923-48. Author of *Photochemistry*; etc.
- S. F. H.**—Sir Sidney Frederic Harmer. Former Tutor, Fellow and Lecturer, King's College, Cambridge. Director of Natural History Departments, British Museum, London, 1919-27. Co-editor of *The Cambridge Natural History*.
- S. F. Hd.**—Samuel Frederick Hildebrand. Senior Ichthyologist, U.S. Fish and Wildlife Service, Washington, D.C.
- S. Fn.**—Sidney Franklin. Matador de Toros.
- S. Fr.**—Sigmund Freud, M.D. Professor of Neurology, Vienna University, 1902-38. Former Director of *The International Journal of Psychoanalysis*.
- S. F. S.**—S. F. Staples. Partner in firm of Clark and Standfield, London.
- S. G.**—Stephen Lucius Gwynn. Author of *Irish Books and Irish People; The Irish Situation*; etc.
- S. Ga.**—Sir Stephen Gaselee. Librarian and Keeper of the Papers at the Foreign Office, 1920-43. Sanders Reader in Bibliography, Cambridge University, 1935. Author of *Anthology of Mediaeval Latin; Oxford Book of Mediaeval Latin Verse*.
- S. G. B.-B.**—Rev. S. Graham Brade-Birks. Lecturer in Zoology and Geology, South-Eastern Agricultural College, Wye, Kent, Eng.
- S. G. O.**—Sidney George Owen. Student and Tutor of Christ Church, Oxford, 1891-1926.
- S. G. P.**—S. G. Paine. Assistant Professor of Bacteriology, Imperial College of Science and Technology, London.
- S. G. T.**—Sir Stephen George Tallents. Principal Assistant Secretary, Ministry of Town and Country Planning, 1943-46. Secretary to the Empire Marketing Board, 1926-33.
- Sh.**—Thomas Shaw, 1st Baron Craigmyle of Craigmyle. Lord of Appeal, 1909-29. Lord Advocate for Scotland, 1905-09.
- S. H.**—Sydney Herbert. Lecturer in History and International Politics, University College of Wales, Aberystwyth.
- S. Ha.**—Somerville Hastings. Consulting Surgeon and Lecturer to the Ear and Throat Department, Middlesex Hospital, London.
- S. H. B.**—S. Howard Bartley. Professor of Psychology, Michigan State College, East Lansing, Mich. Author of *Beginning Experimental Psychology; Fatigue and Impairment in Man; Vision, A Study of Its Basis*.
- S. H. H.**—Sam Hield Hamer. Secretary of the National Trust for Places of Historic Interest or Natural Beauty, 1911-34. Author of *The Story of the Ring; The Jungle School*; etc.
- S. Hk.**—Sidney Hook. Professor and Chairman of the Department of Philosophy, New York University, Washington Square College, New York, N.Y. Author of *From Hegel to Marx; The Hero in History; Reason, Social Myths and Democracy*.
- S. H. M.**—Sydney Herbert Mellone. Minister, Lincoln Unitarian Church, 1930-39. Former Lecturer, Manchester College, Oxford. Author of *The New Testament and Modern Life; The Dawn of Modern Thought*; etc.
- S. Hn.**—Sven Henningsen. Assistant Professor, University of Copenhagen, Copenhagen, Den. Author of *Studier over den moderne liberalisemes gennembrud i Danmark; Detjerne Osten og magtens kamp*.
- S. H. N.**—S. H. Nerlove. Professor of Business Economics, The University of Chicago. Author of *A Decade of Corporate Incomes, 1920 to 1929*; etc.
- S. H. S.**—Silas Hardy Strawn. Senior Member, Winston, Strawn and Shaw 1918-46. Former President, The American Bar Association.
- S. I. H.**—S. I. Hayakawa. Editor, *ETC.: A Review of General Semantics*. Lecturer, University College, The University of Chicago. Author of *Language in Thought and Action; Oliver Wendell Holmes*.
- S. J.**—S. Jones. Assistant, Department of Phonetics, University College, University of London.
- S. J. B.**—S. Josephine Baker, M.D. Former Director, Bureau Child Hygiene, New York City Department of Health. Author of *Healthy Mothers; Healthy Babies*; etc.
- S. J. Br.**—Sidney J. Baker. Author of *The Australian Language; New Zealand Slang; Dictionary of Australian Slang*; etc.
- S. J. Bu.**—Solon Justus Buck. Archivist of the United States, 1941-. Professor of History, University of Minnesota, Minneapolis, Minn., 1921-31. Director of Publicity, National Archives and Secretary, National Historical Publication Committee, 1935-44. Co-author of *Stories of Early Minnesota*; etc.

- S. J. H.**—S. J. Hungerford. President, National Railways Munitions, Ltd. President of the Canadian National Railways, 1934-41.
- S. J. McK.**—Samuel Justus McKinley. Professor of History, Springfield College, Springfield, Mass., 1946-. Professor of History and Social Science, Emerson College, Boston, 1933-46.
- S. K.**—Sigurd Kolsrud. Professor of the Scandinavian Languages in the University of Oslo, Norway.
- S. K. L.**—Samuel Kirkland Lothrop. Research Associate, Harvard University. Author of *Pottery of Costa Rica and Nicaragua*; *Pottery Types and Their Sequence in El Salvador*; *Indians of Tierra del Fuego*; etc.
- S. Ku.**—Simon Kuznets. Professor of Economics, University of Pennsylvania, Philadelphia, Pa. Member of Research Staff, National Bureau of Economic Research, New York, N.Y. Author of *National Income and Commodity Flow and Capital Formation*.
- S. L.**—Stephen Herbert Langdon. Professor of Assyriology, Oxford University, 1919-37. Curator in the University Museum, Babylonian Section, Philadelphia, Pa., 1916-18. Director of the Weld-Blundell and Field Museum Expedition to Mesopotamia, 1923-32.
- S. L. A.**—Sewell Lee Avery. Chairman of the Board, Montgomery Ward & Company, Chicago, Ill.
- S. L. B.**—Stephen Leonard Baker, M.D. Reader in Pathology, University of London. Professor of Pathology, Manchester University.
- S. L. C.**—Stevenson Lyle Cummins, M.D. Colonel, Army Medical Service (retired). David Davies Professor of Tuberculosis, Welsh National School of Medicine, Cardiff, Wales, 1921-38.
- S. L. Co.**—Sherwin L. Cook. Author of *Boston, the 18th Century Town*.
- S. L. D.**—Sara L. Deese. Foreign Trade Analyst, Special Programs Branch, Office of International Trade, U.S. Department of Commerce, Washington, D.C.
- S. Le.**—Stuart Lewis. Professor of Law, New Jersey Law School. Author of *An Outline of American Federal Government*.
- S. Lea.**—Stephen Butler Leacock. Head of the Department of Economics, McGill University, Montreal, Canada. 1908-36. Author of *Elements of Political Science*; etc.
- S. Li.**—Stuart Little. Writer on industrial subjects, New York, N.Y.
- S. L.-P.**—Stanley Lane-Poole. Former Professor of Arabic, University of Dublin, Eire. Author of *The Life of Lord Stratford de Redcliffe*; etc.
- S. L. Ph.**—Sydney Lovell Phipson. Author of *The Law of Evidence*.
- S. L. Pk.**—Stephen L. Polyak, M.D. Professor of Anatomy, The University of Chicago. Author of *The Retina*; *The Human Ear in Anatomical Transparencies*.
- S. L. Py.**—Sidney L. Pressey. Professor of Psychology, Ohio State University, Columbus, O. Author of *Psychology and the New Education*; etc.
- S. Ls.**—Sir Stanley Mordaunt Leathes. Civil Service Commissioner, 1907; First Commissioner, 1910-27. One of the Editors of *Cambridge Modern History*; etc.
- S. M. C.**—Sonia Mary Cole. Author of *An Outline of the Geology of Kenya*; etc.
- S. McC.**—Shannon McCune. Professor of Geography, Colgate University, Hamilton, N.Y.
- S. McC. L.**—Samuel McCune Lindsay. Emeritus Professor of Social Legislation, Columbia University, New York, N.Y. Author of *Railway Labor in the United States*; etc.
- S. McG.**—Stuart McGregor. Associate Editor, the *Dallas Morning News*, Dallas, Tex. Editor, *The Texas Almanac*.
- S. M. LaM.**—Stewart M. LaMont. Former Third Vice-President, Metropolitan Life Insurance Company, New York, N.Y.
- S. M. M.**—Samuel Michael MacDougall. Author of *Card Mastery*; *Danger in the Cards*; *Gamblers Don't Gamble*; etc.
- S. Mo.**—Stanley Morison. Typographical Adviser to the Lanston Monotype Corporation in London, to the University Press, Cambridge, 1923-44, and to *The Times*, London. Editor of *The Fleuron*, London, 1926-30. Author of *Four Centuries of Fine Printings*; *First Principles of Typography*; etc.
- S. N.**—Simon Newcomb. Former Professor of Mathematics in the United States Navy. Former Professor of Mathematics and Astronomy, The Johns Hopkins University, Baltimore, Md. Editor of the *American Journal of Mathematics*, 1874-1909. Author of *The Stars*; etc.
- S. N. D.**—Samuel Newton Dicken. Professor and Head of Dept. of Geography and Geology, University of Oregon, Eugene, Ore.; Special Consultant, U.S. Army Air Forces, 1942-44.
- Sn. G.**—Strathearn Gordon. Librarian, House of Commons, London. Author of *Our Parliament*.
- S. N. M.**—S. N. Miller. Former Lecturer in Roman History and Antiquities, University of Glasgow, Glasgow, Scot.
- S. Nr.**—Stanley Nehmer. Office of International Materials Policy, U.S. Dept. of State, Washington, D.C. Lecturer in Economics, American University, Washington, D.C.
- S. O. D.**—Saidie Orr Dunbar. President of the General Federation of Women's Clubs, 1938-41.
- S. O'H.**—Seán O'Huadhaigh. Senior Partner, Seán O'Huadhaigh and Son, Solicitors, Dublin, Ire. Council Member and Past President, Incorporated Law Society of Ireland. Editor, Irish section, *Annuaire internationale des avocats*.
- S. O. L.**—Sidney O. Levinson, M.D. Executive Director, Michael Reese Research Foundation, Chicago, Ill. Director, Samuel Deutsch Convalescent Serum Center, Chicago. Assistant Professor, University of Illinois Medical School, Chicago.
- S. P.**—Seymour Pile. Consulting metallurgist. Specialist in nonferrous metals.
- S. Pe.**—Selig Perlman. Professor of Economics, University of Wisconsin, Madison, Wis. Co-author of *History of Labor in the U. S.*; etc.
- S. Ph.**—Sava Popovitch. Research Worker in Art and Aesthetics at Munich, Moscow, Florence, Paris, Rome and Cambridge.
- S. P. Jn.**—Stanley Percival Jackson. Senior Lecturer in the Department of Geography, University of the Witwatersrand, Johannesburg, U. of S. Af. Author of *Weather on the Coasts of Southern Africa*; etc.
- S. P. S.**—Samuel Peter Spreng, D.D. Bishop, Evangelical Church, 1907-30. Author of *Life of Bishop John Seybert*; *History of the Evangelical Church*; etc.
- S. P. T.**—Silvanus Phillips Thompson, M.D. Former Principal and Professor of Physics in the City and Guilds Technical College, Finsbury, London, England. Author of *Lectures on Light*; *Michael Faraday*; etc.
- S. P. V.**—Sir Sylvanus (Percival) Vivian. Principal Assistant Secretary, Ministry of Health, and Registrar General, 1921-45. Editor of *Campion's Works*.
- S. R.**—Sidney H. Ray. Former Lecturer in Polynesian, Melanesian, Micronesian and Papuan Languages, Cambridge University.
- S. Ra.**—Sir Sarvepalli Radhakrishnan. Spalding Professor of Eastern Religions and Ethics, Oxford University. Vice-Chancellor, Benares Hindu University. George V Professor of Philosophy, Calcutta University, 1921-31. Author of *The Reign of Religion in Contemporary Philosophy*; etc.
- S. Rad.**—Sheila Radice. Cofounder, St. George's Home for Officers' Children, 1920, and the Public Schools Careers Association. Author of *Home and School*; etc.
- S. R. B.**—Sona Rosa Burstein. Research Assistant at the Wellcome Historical Medical Museum, London. Member of the Folk-Lore Society.
- S. R. D.**—Samuel Rolles Driver, Hon. D.D. Regius Professor of Hebrew, Oxford University, 1883-1914. Author of *Isaiah, His Life and Times*; *Introduction to the Literature of the Old Testament*; etc.
- S. Rg.**—Saul Rosenzweig. Professor of Psychology and of Medical Psychology, Washington University, St. Louis, Mo.
- S. R. G.**—Samuel Rawson Gardiner. Sometime Editor of the *English Historical Review*. Author of *Student's History of England*; etc.
- S. R. L.**—Samuel Richard Lewis. Past President, American Society of Heating and Ventilating Engineers. Author of *Air Conditioning for Comfort*.
- S. Ron.**—Stephen Rothman, M.D. Professor of Dermatology, School of Medicine, The University of Chicago.
- S. R. R.**—Samuel R. Rosenbaum. Vice-President, Albert M. Greenfield and Company, Philadelphia, Pa. Author of *The Rule-Making Authority in the English Supreme Court*; etc.
- S. S.**—Sophy Sanger. Chief of section in the International Labour Office of the League of Nations, Geneva, 1920-24. Secretary of British section, International Association for Labour Legislation, 1906-19.
- S. S. B.**—Stanley S. Ballard. Officer in charge of Research and Development in Optics, Bureau of Ordnance, U.S. Navy Department, 1941-46.
- S. Sm.**—Sidney Smith. Keeper, Department of Egyptian and Assyrian Antiquities, British Museum, London. Hon. Lecturer in Assyriology, King's College, University of London, 1923-39. Professor of Near Eastern Archaeology, University of London, 1938-46. Author of *Early History of Assyria*; etc.
- S. Sn.**—Sidney Schulman, M.D. Assistant Professor of Neurology, School of Medicine, The University of Chicago.
- S. Sr.**—Sidney Spector. Research Director, Council of State Governments.
- S. S. R.**—Samuel Shelburn Robison. Admiral, U.S.N. (retired). Superintendent, Admiral Farragut Academy, Tom's River, N.J. Former Superintendent of U.S. Naval Academy, Annapolis, Md. Author of *History of Naval Tactics*.

S. S. W.—Samuel Stanley Wilks. Director, Section of Mathematical Statistics, and Professor of Mathematics, Princeton University, Princeton, N.J. Author of *Elementary Statistical Analysis*; *Mathematical Statistics*; etc.

St.—Gerald Strickland, 1st Baron Strickland. Head of the Ministry and Minister of Justice, Malta, 1927-32. Member of the Malta Legislative Assembly, 1921-30.

S. T.—Sarkis Topalian. Lecturer in Armenian and Turkish, School of Oriental Studies, London.

St. C.—Stafford Henry Northcote, Viscount St. Cyres. Lord Rector of Edinburgh University, 1883. Author of *Lectures and Essays*.

St. H.—Lord St. Helier (Sir Francis Henry Jeune). President of the Probate, Divorce and Admiralty Division of the High Court of Justice, 1892-1905.

S. T. H. W.—S. T. H. Wilton. Captain, Royal Navy (retired). Former Assistant Director of Naval Ordnance, Admiralty, London.

St. P.—Stanley Peat. Reader in Organic Chemistry, University of Birmingham, Birmingham, Eng.

S. T. P.—Stefan T. Possony. Professor of International Politics, Georgetown University, Washington, D.C.

Su. C.—Subrahmanyan Chandrasekhar. Professor of Theoretical Astrophysics, The University of Chicago, Yerkes Observatory, Williams Bay, Wis. Author of *An Introduction to the Study of Stellar Structure*; etc.

S. V.—Serge Voronoff, M.D. Former Director, Biological Laboratory, École Pratique des Hautes Études, Paris. Former Director of Experimental Surgery, Station Physiologique du Collège de France, Paris.

S. V. K.—S. V. Keeling. Lecturer in Philosophy, University College and Birkbeck College, University of London.

S. W. C.—Sydney W. Cole. Lecturer in Medical Chemistry, Trinity College, Cambridge.

S. Wf.—Stewart Wolf, M.D. Assistant Professor of Medicine, Cornell University Medical College, Ithaca, N.Y. Assistant Attending Physician, New York Hospital, New York, N.Y.

S. W. S.—Samuel Wesley Stratton. Former President of Massachusetts Institute of Technology, Cambridge, Mass.

S. Wt.—Sewall Wright. Burton Distinguished Service Professor of Zoology, The University of Chicago. Hitchcock Professor, University of California, 1943.

S. Y.—Samuel Yellin. Former Teacher in the Pennsylvania Museum and School of Industrial Art, Philadelphia. Master craftsman and an authority on art metal work.

T. A.—Thomas Ashby. Former Director of the British School at Rome. Author of *Turner's Visions of Rome*; etc. Revised *A Topographical Dictionary of Ancient Rome* (by the former Professor S. B. Platner).

T. A. A.—Thomas Andrew Archer. Author of *The Crusade of Richard I*; etc.

T. A. Co.—T. A. Coward. Ornithologist and journalist. Author of *Birds of the British Isles*; etc.

T. Ad.—Thomas Adams. Lecturer on Civic Design, Massachusetts Institute of Technology, Cambridge, Mass., 1921-36. First Town Planning Inspector of Local Government Board (now Ministry of Health) of England and Wales, 1909-14. Director of Plans and Surveys of Regional Plan of New York, 1923-30.

T. A. H.—Thomas Anderson Henry. Director of Wellcome Chemical Research Laboratories, London, 1919-43.

T. A. I.—Thomas Allan Ingram. Editor of *Hazell's Annual*, 1913-22.

T. A. J.—Thomas Athol Joyce. Sub-Keeper, Department of Ethnography, British Museum, London, 1902-38.

T. A. L.—Thomas Alexander Lacey, D.D. Former Canon of Worcester.

T. A. Ln.—Taft Alfred Larson. Associate Professor of History, University of Wyoming, Laramie, Wyo.

T. A. S.—Thomas Alan Stephenson. Professor of Zoology, University College of Wales, Aberystwyth, Wales.

T. A. W.—T. A. Weston. Author of *Practical Carnation Culture*; etc.

T. B.—Sir Thomas Barclay. Former Vice-President, International Law Assn.

T. Ba.—Thomas Baker. Chief Metallurgist and Head of Research Department, Messrs. Steel, Peech and Tozer, Limited.

T. B. M.—Thomas Byrd Magath, M.D. Chief, Division of Clinical Laboratories, Mayo Clinic, Rochester, Minn. Professor of Pathology and Parasitology, University of Minnesota School of Medicine, Rochester, Minn.

T. Bu.—Travers Buxton. Vice-Chairman, Anti-Slavery and Aborigines Protection Society, London.

T. Bw.—Thomas Burrow. Fellow of Balliol College, Oxford. Boden Professor of Sanskrit, University of Oxford.

T. C. I.—Thomas C. Izard. Associate Professor of English, Columbia University. Author of *George Whelstone: Mid-Elizabethan Gentleman of Letters*.

T. C. L.—Thomas Charles Lethbridge. Honorary Excavator, Cambridge Antiquarian Society.

T. Co.—Thomas Coulson. Major. Director, Technical Publicity, The Franklin Institute, Philadelphia, Pa.

T. C. O'D.—Thomas C. O'Donnell. Former Editor, *The New York Masonic Outlook*.

T. C. P.—Thomas Cruddas Porteus. Former Canon of Blackburn Cathedral. Author of *History of the Parish of Standish*; *Captain Myles Standish*; etc.

T. C. S.—T. C. Schneirla. Curator of Animal Behaviour, American Museum of Natural History, New York, N.Y. Co-author of *Principles of Animal Psychology*; etc.

T. C. W.—T. Carroll Wilson. Hills Bros. Coffee, Inc., San Francisco, Calif.

T. C. Wn.—Thomas C. Wasson. Former Assistant Chief, Division of African Affairs, Department of State, Washington, D.C.

T. C. Y.—T. Cuyler Young. Associate Professor of Persian Language and History, Princeton University, Princeton, N.J. Editor of *Near Eastern Culture and Society*.

T. D. E.—Thomas Dawes Eliot. Professor of Sociology, Northwestern University, Evanston, Ill. Author of *American Standards and Planes of Living*; *Outlines of Social Economy*; etc.

T. D. K.—Thomas Downing Kendrick. Keeper, Department of British and Mediaeval Antiquities, British Museum, London. Author of *History of the Vikings*; *Anglo-Saxon Art to A.D. 900*.

T. Dy.—Theodosius Dobzhansky. Professor of Zoology, Columbia University. Author of *Genetics and the Origin of Species*.

T. E. F.—Thomas E. French. Former Professor of Engineering Drawing, Ohio State University, Columbus, O. Author of *A Manual of Engineering Drawing*; etc.

T. E. G.—Sir Theodor E. G. Gregory. Economic Adviser to Government of India, 1938-46. Sir E. Cassel Professor of Economics in the University of London, 1927-37. Author of *Tariffs, A Study in Method*; *The Return to Gold*; etc.

T. E. H.—Thomas Edmund Harvey. M.P. for West Leeds, 1910-18, for Dewsbury, 1923-24 and for Combined English Universities, 1937-45. Author of *The Rise of the Quakers*; etc.

T. E. L.—Thomas East Lones. Former Senior Examiner in H.M. Patent Office, London. Author of *Zinc and Its Alloys*; etc.

T. E. La.—T. E. Lawrence. Colonel. Former Research Fellow of All Souls, Oxford. Assistant in the British Museum's Excavation of Caracemish, 1910-14. Author of *The Seven Pillars of Wisdom*; *Revolt in the Desert*.

T. E. P.—T. Eric Peet. Former Reader in Egyptology, Oxford University.

T. E. R. P.—Rev. Theodore Evelyn Reece Phillips. Secretary, Royal Astronomical Society, 1919-26; President, 1927 and 1928. Co-editor of the *Splendour of the Heavens*; etc.

T. F.—Tenney Frank. Former Professor of Latin, The Johns Hopkins University, Baltimore, Md. Author of *Roman Imperialism*; *A History of Rome*; etc.

T. F. C.—Theodore Freylinghuysen Collier. Emeritus Professor of History and International Relations and Head of the History Department, 1917-39, Brown University, Providence, R.I.

T. F. H.—Talbot Faulkner Hamlin. Instructor and Lecturer on the History and Theory of Architecture, Columbia University School of Architecture. Author of *Architecture Through the Ages*; etc.

T. F. McI.—Thomas Forsyth McIlwraith. Professor and Head of the Department of Anthropology in the University of Toronto, Canada. Associate Director and Keeper of the Ethnological Collections, Royal Ontario Museum of Archaeology.

T. Fr.—Thomas Francis, Jr., M.D. Professor and Chairman of Department of Epidemiology, University of Michigan, Ann Arbor, Mich.

T. F. T.—Thomas Frederick Tout. Former Honorary Professor, Manchester University; Professor of History, 1890-1925. Author of *The Place of the Reign of Edward II in English History*; *Edward the First*; etc.

T. G. B.—Thomas Gregor Brodie, M.D. Former Professor of Physiology at St. Thomas's Hospital Medical School, University of London.

T. G. C.—Thomas Gilbert Carver. Author of *On the Law Relating to the Carriage of Goods by Sea*.

T. G. G. H.—T. G. G. Heywood. Lieutenant Colonel, former General Staff Officer, British Territorial Army, Air Defense Formations.

T. G. H. S.—Theodor George H. Strehlow. Senior Research Fellow in Australian Linguistics, University of Adelaide, Adelaide, Austr. Author of *Aranda Phonetics and Grammar*; *Aranda Traditions*.

T. G. M.—Tomás Garrigue Masaryk. President of the Republic of Czechoslovakia, 1918–35. Author of *The Problem of Small Nations in the European Crisis*; etc.

T. G. S.—Thomas Gaskell Shearman. Author of *The Single Tax*; *Natural Taxation*; etc.

T. H.—Thomas Hodgkin. Author of *Italy and Her Invaders*; *Theodoric the Goth*; etc.

T. H. B.—Thomas Hannahan Burford, M.D. Associate Professor of Surgery, Washington University School of Medicine, St. Louis, Mo.

T. Her.—Thomas Herdman. Former Senior Lecturer in Geography and Education, the Training College, Dudley, Eng. Author of *Discovery Geography*, Books I and II; *Geography for To-Day—The World*.

T. H. H.—Sir Thomas Hungerford Holdich. Superintendent, Frontier Surveys, India, 1892–98. H.M. Commissioner for Perso-Baluch Boundary, 1896. Author of *The Indian Borderland*; *The Gates of India*; etc.

T. H. Hl.—Theodore H. Hubbell. Professor of Biology and Geology, University of Florida, Gainesville, Fla. Associate Curator of Orthoptera, University of Michigan Museum of Zoology, Ann Arbor, Mich.

T. H. Hr.—Turner Harcourt Hopper. Head of the Analytical, Physical-Chemical and Physics Division, Southern Regional Research Laboratory, New Orleans, La.

T. H. J.—Thomas Hope Johnson. Chairman, Physics Department, Brookhaven National Laboratory, Upton, N.Y. Chief Physicist, Ballistic Research Laboratory, Aberdeen Proving Ground, Md., 1942–47. Author of *Cosmic Ray Intensity and Geomagnetic Effects*.

T. H. M.—Thomas Hunt Morgan. Former Professor of Biology, California Institute of Technology, Pasadena, Calif. Former Professor of Experimental Zoology, Columbia University. Nobel Prize for Medicine, 1933. Author of *Evolution and Adaptation*; etc.

T. H. Ma.—Thomas H. Mawson. Former Consultant to the firm of T. H. Mawson & Sons. Author of *The Life and Work of an English Landscape Architect*; etc.

T. H. MacD.—Thomas Harris MacDonald. Commissioner of Public Roads in charge of Public Roads Administration, Federal Works Agency, Washington, D.C.

Th. N.—Theodor Nöldeke. Professor of Oriental Languages at Strasbourg, 1872–1906. Author of *Geschichte des Korans* and numerous essays.

T. H. P.—Tom Hatherley Pear. Professor of Psychology, University of Manchester, Manchester, Eng. Temporary Lecturer in Psychology, University of Liverpool, Liverpool, Eng. Author of *Remembering and Forgetting*; *Voice and Personality*; *The Psychology of Effective Speaking*.

T. H. R.—Theodore Henry Robinson, D.D. Professor of Semitic Languages, University College, Cardiff, 1927–44. Author of *An Introduction to the History of Religions*; etc.

T. H. Rd.—Thomas Harrison Reed. Municipal Government Counsellor, Connecticut Public Expenditure Council, Inc., 1943–47. Author of *Municipal Government in the United States*; etc.

T. H.-W.—Thomas Hudson-Williams. Emeritus Professor of Greek in the University College of North Wales, Bangor. Author of *The Elegies of Theognis*; etc.

T. H. Wr.—Thomas Huckle Weller, M.D. Associate Professor of Tropical Public Health, Harvard School of Public Health, Harvard University. Assistant Director, Research Division of Infectious Diseases, Children's Medical Center, Boston, Mass.

T. I.—Sir Thomas Innes of Learney. Lord Lyon King of Arms. Author of *Scots Heraldry*; editor of *Clans, Septs and Regiments of the Scottish Highlands*.

T. I. C.—Thomas Ira Cook. Professor, Political Science Department, University of Washington, Seattle, Wash. Author of *A History of Political Theory From Plato to Burke*.

T. J.—Thorkell Jóhannesson. Professor in Icelandic History at the University of Iceland, Reykjavik, Ice. Author of *Stellung der freier Arbeiter in Island bis zur Mitte des 16 Jahrhunderts 1933*; *Saga Íslendinga*, Vol. VI–VII (1750–1830).

T. J. A.—Thomas Joel Anderson, Jr. Associate Professor of Economics, New York University, New York, N.Y. Author of *Federal and State Control of Banking*; etc.

T. J. E.—T. J. Edwards. Major. Secretary to the Honours and Distinctions Committee, War Office, London. Author of *The Non-Commissioned Officer's Guide to Promotion in the Infantry*.

T. J. K.—Theodore J. Kreps. Professor of Business Economics, Graduate School of Business, Stanford University, Stanford, Calif. Author of *Economics of the Sulfuric Acid Industry*; *Some Measurements of the Social Performance of Business*; etc.

T. J. Sh.—Thomas J. Schoch. Research Group Leader, Corn Products Refining Company, Argo, Ill.

T. J. W.—Thomas J. Walsh. U.S. lawyer. Former Senator from Montana.

T. K.—Theodore Komisarjevsky. Former Producer and Art Director of the Moscow State and Imperial Theatre. Author of *The Theatre and Changing Civilization*; *The Art of the Actor*; etc.

T. K. C.—Thomas Kelly Cheyne, D.D. Oriel Professor of the Interpretation of the Scripture, Oxford University, and Canon of Rochester, 1885–1908. Author of *The Prophecies of Isaiah*; etc.

T. K. H.—Theodora Kimball Hubbard. Former Associate Editor, *Landscape Architecture*. Co-author of *Introduction to Study of Landscape Design*; *Landscape Design*; etc. Author of *Manual of Information on City Planning*; etc.

T. Ki.—Thomas Kirkup. Author of *An Inquiry into Socialism*; *Primer of Socialism*; etc.

T. K. R.—Sir Thomas Kirke Rose. Chemist and Assayer of the Mint, 1902–26. Author of *The Metallurgy of Gold*; *The Precious Metals*; etc.

T. L. B.—Rev. Timothy Lincoln Bouscaren, S.J. Procurator General, Society of Jesus, Rome, Italy. Author of *Canon Law Digest and Ethics of Ectopic Operations*.

T. L. Be.—Thomas L. Blakemore. Lawyer, Tokyo, Jap. Author of *Criminal Code of Japan*.

T. L. H.—Sir Thomas Little Heath. Controller-General, National Debt Office, 1919–26. Joint Permanent Secretary to the Treasury and Auditor of the Civil List, 1913–19. Author of *A History of Greek Mathematics*; *Archimedes*; *Aristarchus of Samos, the Ancient Copernicus*; etc.

T. M. C.—Thorne Martin Carpenter. Former Director, Nutrition Laboratory, Carnegie Institution of Washington, Boston, Mass.

T. M. F.—Thomas Macall Fallow. Editor of the *Antiquarian*, 1895–99. Author of *Memorials of Old Yorkshire*; *The Cathedral Churches of Ireland*.

T. M. Li.—Rev. Thomas Martin Lindsay, D.D. Former Principal of the United Free Church College, Glasgow, Scotland. Author of *History of the Reformation*; *Life of Luther*; translation of Ueberweg's *Logic*.

T. M. T.—T. Marston Till. Of the British Brush Manufacturers Association, London, England.

T. N.—Thomas North. Brigadier General, U.S. Army. Secretary, American Battle Monuments Commission, 1946–

T. N. E. G.—Thomas Nall Eden Greenville. Chief, Actuarial Analysis Branch, National Office of Vital Statistics, United States Public Health Service, Washington, D.C.

T. N. T.—T. N. Thomson. Sanitary and Heating Engineer. Consulting Engineer and Technical Editor, *Plumbers and Heating Contractors Trade Journal*, New York, N.Y.

T. O.—Thomas Okey. Former Professor of Italian, Cambridge University.

T. Ol.—Sir Thomas Oliver, M.D. Former Professor of Physiology and Vice-Chancellor, University of Durham, England. Author of *Lead Poisoning*; etc.

T. P.—Thomas Parran, M.D. Dean, Graduate School of Public Health, University of Pittsburgh, Pittsburgh, Pa. Author of *Shadow on the Land*.

T. Pk.—Thomas Park. Professor of Zoology, The University of Chicago.

T. P. K.—Truman Paul Kohman. Fellow in Chemistry, Institute for Nuclear Studies, The University of Chicago.

T. P. Ma.—Thomas Powderly Martin. Assistant Chief and Acting Chief, Manuscript Division, Library of Congress, Washington, D.C. Former Associate Professor of History, Boston University, Boston, Mass.

T. P. Mc.—Thomas Potter McCutcheon. Professor of Inorganic Chemistry, University of Pennsylvania, Philadelphia, Pa. Co-author of *General Chemistry*.

T. P. N.—Sir T. Percy Nunn. Former Professor of Education, University of London. Director, University of London Institute of Education, 1922–36. Author of *Education Reform*; etc.

T. Ra.—Terry Ramsaye. Editor, *Motion Picture Herald* and *Motion Picture Almanac*. Author of *A Million and One Nights—A History of the Motion Picture*.

T. R. P.—Thomas Reed Powell. Emeritus Professor of Law, Harvard University. Former Special Assistant to Attorney General of U.S. Author of *Separation of Powers*; etc.

T. R. P. G.—Thomas R. P. Gibb, Jr. Associate Professor and Director of Sponsored Research in Chemistry, Tufts College, Medford, Mass. Author of *A Bibliography of the Hydrides of Metals and Metalloids; Optical Methods of Chemical Analysis*.

T. R. Ph.—Thomas Raphael Phillips. Brigadier General, U.S.A. Department Chairman, Joint Export-Import Agency, United States—United Kingdom, Office of Military Government in Germany, 1941-47. Author of *Roots of Strategy; The New Face of War*; etc.

T. R. W.—Thomas R. Wilson. Director, Areas Division, Office of International Trade, Department of Commerce, Washington, D.C.

T. S.—Thomas Seccombe. Former Lecturer in History, East London and Birkbeck Colleges, University of London. Assistant Editor of *Dictionary of National Biography*, 1891-1901. Author of *The Age of Johnson*; etc.

T. S. Gy.—Theophilus Stephen Gregory. Producer, Talks Department, British Broadcasting Corporation, London. Author of *The Unfinished Universe*.

T. Sm.—Thomas E. Smith. Superintendent of Light Division, National Physical Laboratory, Teddington, England.

T. S. Pe.—Theodore Stephen Page. Barrister-at-law of the Inner Temple, London. Former Senior Press Censor, Ministry of Information, London.

T. S. R.—Tyler Stewart Rogers. Technical Director, Owens-Corning Fiberglass Corporation, Toledo, O. Author of *Plan Your Home to Suit Yourself*.

T. S. T.—Thomas Smith Tait. Director of Standardization, Ministry of Works and Buildings, 1940-42.

T. T.—Sir Travers Twiss. Former Professor of Political Economy and Civil Law, Oxford University, and of International Law, University of London. Author of *The Nations in Peace*; etc.

T. V. H.—Thomas V. Haney. Member of the Staff, *New York Times*, New York, N.Y.

T. W.—Thomas Woodhouse. Former Head of Weaving and Textile Designing Department, Technical College, Dundee, Scotland.

T. W. A.—Sir Thomas Walker Arnold. Former Professor of Arabic, University of London. Former Professor of Philosophy, Government College, Lahore, India.

T. W. C.—T. W. Casey. Assistant Secretary, Ministry of Pensions, London, Eng.

T. W.-D.—Theodore Watts-Dunton. Author of *The Renaissance of Wonder*; etc.

T. W. F.—Thomas W. Fox. Former Professor of Textiles in the University of Manchester, England. Author of *Mechanics of Weaving*.

T. Wi.—Thomas Wilfred. Founder of the Clavilux Laboratory, New York, N.Y. Inventor of the Clavilux.

T. W. J. T.—Sir Thomas Weston Johns Taylor. Principal, University College of the South-West of England, Exeter, Eng. Editor of the third English edition of Richter-Anschütz's *Chemie der Kohlenstoffverbindungen*.

T. W. R.—Theodore William Richards, M.D. Former Professor of Chemistry and Director of the Walcott Gibbs Memorial Laboratory, Harvard University. Nobel Prize for Chemistry, 1914.

T. W. R. D.—T. W. Rhys Davids. Former Professor of Comparative Religion in the University of Manchester, England. Former Professor of Pali and Buddhist Literature, University College, University of London. Author of *Buddhism, Its History and Literature*.

U. G. F.—Urban Gerard Flanagan. Lecturer, University College, Cork, Ire. Editor of *Calendar of Papal Registers* (P.R.O.).

U. R. E.—Ulrick Richardson Evans. Reader in the Science of Metallic Corrosion, Cambridge University. Author of *Metals and Metallic Compounds; Metallic Corrosion Passivity and Protection*.

U. W.—Ulrich F. Westphal. Chief, Protein Section, Biochemistry Department, Army Medical Research Laboratory, Fort Knox, Ky.

V. A. S.—Vernon Arthur Stenger. Analytical Research Chemist, Dow Chemical Company, Midland, Mich. Co-author of *Volumetric Analysis*, Vol. I and II.

V. Br.—Victor Branford. Chairman of Council (British) Sociological Society.

V. Bu.—Vannevar Bush. Chairman, Joint Research and Development Board, Joint Chiefs of Staff. Director, Office of Science Research and Development; President, Carnegie Institution of Washington. Professor of Electric Power Transmission, Massachusetts Institute of Technology, 1919-32, Vice-President and Dean of Engineering, 1932-38. Author (with W. H. Timbie), *Principles of Electrical Engineering; Operational Circuit Analysis*.

V. B. W.—V. B. Wigglesworth. Director of Agricultural Research Council, Unit of Insect Physiology. Former Reader in Entomology, University of London, 1936-44. Author of *The Principles of Insect Physiology*; etc.

V. C. As.—Vladimir C. Asmou. Assistant Librarian, Arnold Arboretum, Harvard University, Jamaica Plain, Mass.

V. C. C. C.—V. C. C. Collum. Fellow of the Royal Archaeological Institute of Great Britain and Ireland.

V. Cn.—Vern Countryman. Assistant Professor, Yale University Law School, New Haven, Conn.

V. Co.—Vaughan Cornish. President, Geographical Association, 1928, and of the Geographical Section of the British Association, 1923. Author of *Waves of the Sea and other Water Waves; Waves of Sand and Snow*.

V. C. T.—Victor Chandler Twitty. Professor of Biology, Stanford University, Stanford, Calif.

V. D.—Victor Donahey. United States Senator from Ohio, 1935-41; Governor, State of Ohio, 1923-29.

V. E. J.—Vincent E. Jakl. Regional Director, U.S. Weather Bureau Office, Chicago, Ill.

V. E. N.—Victor Ewings Negus. Surgeon, Ear, Nose and Throat Department, King's College Hospital, London. Former Lecturer at King's College Hospital Medical School.

V. F. M.—Vladimir F. Minorsky. Emeritus Professor of Persian in the University of London. Lecturer of Persian Literature, Turkish and Oriental History at the École Nationale des Langues Orientales Vivantes, Paris, 1923-34.

V. G. C.—V. Gordon Childe. University Professor of Prehistoric European Archaeology and Director of the Institute of Archaeology, London, 1946-. Librarian to Royal Anthropological Institute, 1925-27. Professor of Prehistoric Archaeology, Edinburgh, 1927-46. Author of *The Aryans*; etc.

V. G. G.—Vernon Guy Grove. Professor of Mathematics, Michigan State College of Agriculture and Applied Science, East Lansing, Mich.

V. H.—Viktor Hamburger. Professor of Zoology; Head, Department of Zoology, Washington University, St. Louis, Mo. Author of *Manual of Experimental Embryology*.

V. H. B.—Vernon Herbert Blackman. Chairman, Forest Products Research Board, 1939-47. Director of Research, Institute of Plant Physiology, Imperial College of Science and Technology, University of London, 1913-43.

V. J. S.—Vincent Joseph Schaefer. Research Chemist, General Electric Research Laboratory, Schenectady, N.Y.

V. K.—Vernon Kellogg. Former Secretary, National Research Council, Washington, D.C. Author of *Scientific Aspects of Luther Burbank's Works; Evolution*; etc.

V. Kr.—Victor Kramer. Laundry management consultant. Author of *Establishing and Operating a Laundry*.

V. K. Z.—Vladimir Kosma Zworykin. Vice-President and Technical Consultant, Electronic Research, RCA Laboratories Division, Radio Corporation of America, Princeton, N.J. Author of *Photocells and Their Applications*; etc.

V. L. K.—Vincent Lorne Kennedy. Professor, Greek and Christian Archaeology, St. Michael's College, University of Toronto, Canada. Professor, History of Christian Worship, Pontifical Institute of Mediaeval Studies, Toronto, 1935-43. Author of *The Saints of the Canon of the Mass*.

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V. M. Ra.—Vincent M. Rabuffo. Editor, *Ice Cream Trade Journal*. Author of *Packaged Profits*.

V. O. K.—V. O. Key, Jr. Alfred Cowles Professor of Government, Yale University, New Haven, Conn. Author of *The Administration of Federal Grants to States*; etc.

V. Pi.—Vivian Pierce. Director, American League to Abolish Capital Punishment.

V. R. B.—Victor Rickman Boswell. Principal Horticulturist and Assistant Head of Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, U.S. Department of Agriculture.

V. R. C.—V. R. Crosswell. Of the Hercules Powder Company, Wilmington, Del.

V. S.—Vilhjalmur Stefansson. Commander of the Canadian Arctic Expedition under the auspices of the American Museum of Natural History and the Geological Survey of Canada, 1908-12; and of several other expeditions to Arctic regions. Author of *My Life with the Eskimo*; etc.

- V. Sd.**—Vera Sanford. Professor of Mathematics, State Teachers College, Oneonta, N.Y.
- V. S. J.**—Vernon S. Jones. Member of firm of Kirlin, Campbell, Hickox and Keating, lawyers, New York, N.Y.
- V. Sn.**—Virgil Snyder. Emeritus Professor of Mathematics, Cornell University, Ithaca, N.Y.
- V. St.**—Verney Stott. Senior Scientific Officer, Metrology Department, National Physical Laboratory, Teddington, England.
- V. Sta.**—Vincent Starrett. Book Columnist, *Chicago Sunday Tribune*. Author of *The Private Life of Sherlock Holmes*; *Books Alive*; etc.
- V. T.**—V. Tolnai. Former Professor of History of Hungarian Literature, University of Pécs, Hungary.
- V. T. A.**—Victor Thomas Allen. Director, Geology Department, St. Louis University, St. Louis, Mo. Author of *This Earth of Ours*; *The Ione Formation of California*.
- V. Tn.**—Virginia Thompson. With Institute of Pacific Relations, 1936-42. Author of *French Indo-China*; *Postmortem in Malaya*; etc.
- V. W. B.**—Van Wyck Brooks. Author of *America's Coming-of-Age*; *The World of H. G. Wells*; *The Pilgrimage of Henry James*; *The Ordeal of Mark Twain*; *The Flowering of New England, 1815-1865*; etc.
- V. W. M.**—Villiers Willson Meloche. Professor of Chemistry, University of Wisconsin, Madison, Wis.
- V. Z. C.**—Vincent Zachary Cope, M.D. Consulting Surgeon to St. Mary's Hospital, Paddington, and to Bolingbroke Hospital, Wandsworth Common, London. Hunterian Professor, Royal College of Surgeons, 1916, 1920, 1925 and 1927. Author of *Some Principles of Minor Surgery*; etc.
- W. A. B.**—Wyndham A. Bewes. Barrister-at-Law. Former Honorary Secretary of the International Law Association and Grotius Society.
- W. A. Ba.**—Walter A. Bardgett. Manager of bicycle tracks and referee at cycle race meets.
- W. A. B. C.**—Rev. William Augustus Brevoort Coolidge. Former Fellow of Magdalen College, Oxford. Editor of *The Alpine Journal*, 1880-89, etc.
- W. A. Be.**—W. A. Bettesworth. Former Sports Editor of *The Field*.
- W. A. Ben.**—Wilson Alwyn Bentley. Author of many monographs relating to the subjects of snow, rain, dew, frost and clouds.
- W. A. Bn.**—W. A. Benton. Second Chief of the Research Department of Messrs. W. T. Avery, Ltd., Birmingham, England.
- W. A. Br.**—William Adams Brown, D.D. Former Professor of Theology, Union Theological Seminary, New York, N.Y. Author of *The Essence of Christianity*; *Christian Theology in Outline*; etc.
- W. A. Dn.**—William Aubrey Darlington. Drama Editor and Chief Drama Critic, the *Daily Telegraph*, London. London Drama Correspondent, the *New York Times*. Author of *The Actor and His Audience*; *J. M. Barrie*; *The World of Gilbert and Sullivan*; *Literature in the Theatre*; etc.
- W. A. F.**—William A. Flère. River Division, Port of London Authority, London.
- W. A. G.**—William Addleman Ganoe. Colonel, United States Army. Theatre Historian, European Theatre of Operations, 1943-46. Director, Public Relations Division, First Army, 1941. Author of *The History of the United States Army*; *Soldiers Unmasked*; etc.
- W. A. Go.**—William A. Good. Editor for the Associated Press, New York, N.Y.
- W. A. H.**—W. A. Hanton. Head of the weaving section, Textile Department, Manchester Municipal College of Technology, Manchester, England.
- W.* A. Ha.**—William Allen Hamor. Assistant Director of Mellon Institute of Industrial Research, Pittsburgh, Pa. Co-author of *The Examination of Petroleum*; etc.
- W. A. Har.**—William Andrew Hardenbergh. Colonel, Sanitation Corps, and Chief of Division of Sanitary Engineering, U.S. Army.
- W. A. Hh.**—William Aquinas Hinnebusch. Professor of Mediaeval History, Providence College, Providence, R.I.
- W. A. I.**—William A. Irwin. Emeritus Professor of Old Testament Language and Literature, The University of Chicago.
- W. A. J.**—Walter Albert Jessup. Former President, State University of Iowa, Iowa City. President, Carnegie Foundation for the Advancement of Teaching, 1934-44.
- Wa. L.**—Walter Lichtenstein. Adviser, United States Control Council, Germany.
- W. A. L. E.**—William Alexander Leslie Elmslie, Hon. D.D. Professor of Hebrew and Old Testament Literature and Principal in Westminster College, Cambridge. Author of *Five Great Subjects*; *How Came Our Faith*; etc.
- W. A. M.**—W. A. Mitchell. Brigadier General, U.S.A. Colonel of the Corps of Engineers during World War I. Former Professor of Military Engineering and Military Art at U.S. Military Academy, West Point, N.Y.
- W. A. N.**—William Allan Neilson. President, Smith College, Northampton, Mass., 1917-39. Author of *Essentials of Poetry*; etc.
- W. A. P.**—Walter Alison Phillips. Lecky Professor of Modern History, University of Dublin, Dublin, Ire., 1914-39. Former contributor to the *Cambridge Modern History*; etc.
- W. A. Ph.**—William A. Phair. Associate Editor, *The Iron Age*.
- W. A. Po.**—William A. Poucher. Consulting chemist in perfumery, cosmetics and industrial problems.
- W. A. R.**—William Alfred Reid. Former Foreign Trade Adviser, Pan American Union. Lecturer on Latin American Commerce at the School of Foreign Service, Georgetown University, Washington, D.C. Author of *Ports and Harbours of South America*; etc.
- W. A. Sh.**—William A. Smith. President, Advance-Independent Electrotype Company, Indianapolis, Ind.
- W. A. S. H.**—William Albert Samuel Hewins. Secretary of the British Tariff Commission, 1903-17. Former Director of the London School of Economics. Author of *Trade in the Balance*; *Empire Restored*; etc.
- W. A. Sr.**—Wilbur Augustus Sawyer, M.D. Director of Health, United Nations Relief and Rehabilitation Administration, 1944-47. Director, International Health Division, Rockefeller Foundation, New York, N.Y., 1935-44.
- W. A. St.**—William Aiken Starrett. President, The Starrett Corporation and Vice-President of Starrett Brothers, Incorporated, New York, N.Y., 1922-32. Author of *Sky-scrapers and the Men Who Build Them*.
- Wa. V. W.**—Walton Van Winkle, Jr. Director of Research, Ethicon Suture Laboratories Incorporated, New Brunswick, N.J.
- W. A. W.**—W. A. Wooster. Demonstrator in Mineralogy in Cambridge University.
- W. Ay.**—Wallace Ashby. Principal Agricultural Engineer in Charge of Farm Structures Investigations, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, U.S. Department of Agriculture, Beltsville, Md.
- W. B.**—Wilhelm Bousset. Former Professor of New Testament Exegesis in the University of Göttingen, Germany. Author of *The Antichrist Legend*; etc.
- W. Ba.**—William Bacher. Professor, Rabbinical Seminary, Budapest, Hungary.
- W. B. Bt.**—Wyatt Brearley Brummitt. Editor, Amateur Photographic Publications, Eastman Kodak Co., Rochester, N.Y. Author of *How to Make Good Pictures*; etc.
- W. B. Ca.**—W. Bentley Capper. Editor of the *Hotel Review*.
- W. B. Ck.**—William Bell Clark. Vice-President, N. W. Ayer & Son, Advertising, 1939-47. Member, Naval History Foundation. Author of *Lambert Wickes, Sea Raider and Diplomat*; etc.
- W. B. Cn.**—Warren Benjamin Catlin. Fayerweather Professor of Economics and Sociology, and Head of the Department, Bowdoin College, Brunswick, Me. Author of *The Labor Problem in the United States and Great Britain*.
- W. B. Co.**—William B. Cox. Field Secretary and Prison Investigator of the National Society of Penal Information.
- W. B. D.**—William Bell Dinsmoor. Professor of Archaeology and Executive Officer, Department of Fine Arts, Columbia University. Professor of Architecture, American School of Classical Studies at Athens, 1924-28. Associate Editor, *American Journal of Archaeology*. Co-author of *The Architecture of Ancient Greece*.
- W. B. Dn.**—Winton Basil Dean. Author of *Bizet*; *Carmen*; etc.
- W. Be.**—William Beebe. Curator of Ornithology and Director of Department of Scientific Research, New York Zoological Society. Author of *Galapagos*, *World's End*.
- W. B. E.**—Walter Bryan Emery. Edwards Professor of Egyptology, University of London. Author of *Great Tombs of the First Dynasty*; *Hor-Aha*; *Nubian Treasure*; *The Royal Tombs of Ballana and Qustol*; *The Tomb of Hemaka*.
- W. B. Fr.**—William Bayne Fisher. Senior Lecturer in Geography, University of Aberdeen, Aberdeen, Scot. Author of *The Middle East: A Physical, Social and Regional Geography*.
- W. B. G.**—William Benjamin Gregory. Former Professor of Experimental Engineering and Hydraulics, Tulane University, New Orleans, La.
- W. B. H.**—Walter Burton Harris. Former Correspondent of the *Times* (London) in Morocco. Author of *Morocco That Was*.

- W. B. He.**—William B. Hesseltine. Professor of History, University of Wisconsin, Madison, Wis. Author of *The South in American History*; etc.
- W. B. Ho.**—William Bowyer Honey. Keeper, Department of Ceramics, Victoria and Albert Museum, London. Author of *Old English Porcelain*; etc.
- W. B. Ht.**—W. Ben Hunt. Author of *Indian and Camp Handicraft*; *Indiancraft*.
- W. Bi.**—Walter Binni. Professor of Italian Literature, University of Genoa, Genoa, It. Author of *La poetica del decadismo italiano*; etc.
- W. Bl.**—Walter Blair. Professor of English Literature, The University of Chicago.
- W. Bm.**—William Bloom. Professor of Anatomy, The University of Chicago.
- W. Bn.**—Walter J. Brown. Manager, Publicity Department, San Francisco Chamber of Commerce, San Francisco, Calif.
- W. B. P.**—William Belmont Parker. Former Editor of *South Americans of Today*. Author of *Chileans of Today*; *Paraguayans of Today*; etc.
- W. B. Pn.**—Wheeler B. Preston. Former author and publicist.
- W. B. Py.**—Walter Bowers Pillsbury. Emeritus Professor of Psychology, University of Michigan, Ann Arbor, Mich. Author of *History of Psychology*; *Fundamentals of Psychology*.
- W. Br.**—William Brown, M.D. Wilde Reader in Mental Philosophy and Director of the Institute of Experimental Psychology, Oxford University, 1936-45. Director of the Psychological Laboratory at King's College, University of London, 1908-21. Author of *Mind and Personality*.
- W. B. R.**—Wilbur B. Rayton. Former Director, Scientific Bureau, Bausch & Lomb Optical Company, Rochester, N.Y.
- W. B. R. K.**—William Bernard Robinson King. Professor of Geology, Cambridge University, 1943-.
- W. Bro.**—William Brown. Professor of Plant Pathology of the University of London and Head of the Botanical Department at the Imperial College of Science and Technology, University of London.
- W. B. S.**—William Barclay Squire. Former Assistant in charge of Printed Music, British Museum, London, and Honorary Secretary of the Purcell Society.
- W. B. Sh.**—Wilfred Byron Shaw. Director, Bureau of Alumni Relations, University of Michigan, Ann Arbor, Mich. Editor of *Michigan Alumnus: Quarterly Review*. Author of *The University of Michigan*; etc.
- W. B. Sm.**—William Benjamin Smith. Former Professor, Tulane University, New Orleans, La.
- W. Bu.**—William Burrows. Associate Professor of Bacteriology, The University of Chicago. Author of *Textbook of Bacteriology*.
- W. B. W.**—William Basil Worsfold. Editor of the *Johannesburg Star*, 1904-05. Author of *A History of South Africa*; etc.
- W. B. Wo.**—W. Birkbeck Wood. Sometime Classical Scholar of Worcester College, Oxford. Author of *A History of the Civil War in the United States*.
- W. By.**—Hon. Wilfrid Bovey. Member, Legislative Council, Quebec, Canada. Author of *The French Canadians Today*; etc.
- W. C. A.**—W. C. Allee. Head Professor of Biology, University of Florida, Gainesville, Fla. Author of *Animal Aggregations*; *Social Life of Animals*.
- W. C. An.**—William Christopher Atkinson. Stevenson Professor of Spanish, University of Glasgow, Glasgow, Scot. Author of *Spain: A Brief History*.
- W. C. Be.**—William Cabell Bruce. Member of the United States Senate, 1923-29. Author of *John Randolph of Roanoke*; etc.
- W. C. Ben.**—Wendell Clark Bennett. Professor of Anthropology, Yale University, 1945-53. Associate Professor of Anthropology, University of Wisconsin, Madison, Wis., 1938-40.
- W. C. B. T.**—William Cuthbert Brian Tunstall. Lecturer in International Relations, London School of Economics. Lecturer in History and English, Royal Naval College, Greenwich, 1925-37. Member of B.B.C. Research Unit (Overseas), 1941. Naval Correspondent, B.B.C. European Services, 1942-45. Author of *The Realities of Naval History*; etc.
- W. C. Dr.**—Sir William Cecil Dampier. Fellow of Trinity College, Cambridge, 1891. Sometime Chairman of the Home Office Committee on the Lighting of Factories and of the Machinery Committees of the Ministry of Agriculture. Author of *The Theory of Experimental Electricity*; etc.
- W. C. Ha.**—Sir William Clarke Hall. Former Metropolitan Magistrate and Chairman of the Shoreditch Juvenile Court, England. Author of *The Law Relating to Children*; etc.
- W. C. J.**—Warren C. Johnson. Chairman, Department of Chemistry, and Associate Dean, Division of the Physical Sciences, The University of Chicago. Author of *Ionic Equilibrium as Applied to Qualitative Analysis*; *Qualitative Analysis and Chemical Equilibrium*.
- W. Ck.**—Walter Clark. Technical Assistant to Vice-President in Charge of Research and Development, Eastman Kodak Company, Rochester, N.Y. Author of *Photography by Infrared: Its Principles and Practice*.
- W. C. K.**—William Calvert Kneale. Fellow of Exeter College, Oxford. Lecturer in Philosophy, Oxford University. Author of *Probability and Induction*.
- W. C. M.**—Walter Conrad Muenscher. Professor of Botany, Cornell University, Ithaca, N.Y. Author of *Weeds* (of the United States); *Poisonous Plants of the United States*; etc.
- W. C. N.**—Winthrop C. Neilson. President, Republic Mining and Manufacturing Company, Philadelphia, Pa.
- W. C. Ny.**—Wayne C. Neely. Professor of Sociology, Hodge College, Frederick, Md. Author of *The Agricultural Fair*.
- W. C. P.**—W. Conway Pierce. Chairman, Department of Chemistry, Pomona College, Claremont, Calif. Author of *Quantitative Analysis*.
- W. Cr.**—Walter Crane. Art Director of Reading College, England, 1896. Principal of the Royal College of Arts, 1898.
- W. Cro.**—William Crocker. Former Managing Director of the Boyce Thompson Institute for Plant Research, Inc., Yonkers, N.Y.
- W. C. T.**—W. Cave Thomas. Author of *Mural or Monumental Decoration*; *Revised Theory of Light*; etc.
- W. C. Wh.**—William C. White. Electronics Engineer, General Electric Research Laboratory, General Electric Company, Schenectady, N.Y.
- W. C. Wu.**—Wang Chi-Wu. Research Associate, Harvard Forest, Harvard University, Petersham, Mass. Author of *The Vegetation of Eastern Asia*.
- W. Da.**—W. Dalton. Author of *Bridge Abridged, or Practical Bridge*.
- W. D. A.**—Winfield Dockery Armentrout. Vice-President, Colorado State College of Education, Greeley, Colo. Author of *The Conduct of Student Teaching in State Teachers' College*.
- W. D. C.**—William D. Clark. Former Assistant Director, British Information Services, Chicago, Ill.
- W. de B. H.**—William de Bracy Herbert. Former Recorder of Newcastle under Lyne, England.
- W. D. F.**—Walter Deane Fuller. President, Curtis Publishing Company, Philadelphia, Pa.
- W. D. G.**—William D. Grampp. Vice-Consul in the American Foreign Service Auxiliary, the Department of State. Former Professor of Economics, Elmhurst College, Elmhurst, Ill.
- W. Di.**—Wayne Dinsmore. Secretary, Horse Association of America. Co-author of *A History of the Percheron Horse*.
- W. Dk.**—William Dameshek, M.D. Professor of Clinical Medicine, Tufts College Medical School, Medford, Mass. Senior Physician and Haematologist, New England Center Hospital, Boston, Mass.
- W. D. Kr.**—Walter David Keller. Professor of Geology, University of Missouri, Columbia, Mo. Author of *Common Rocks and Minerals of Missouri*.
- W. D. L.**—William Draper Lewis. Director, American Law Institute, Philadelphia, Pa., 1923-47. Professor of Law, University of Pennsylvania, Philadelphia, 1896-1924; Dean of Law Department, 1896-1914. Editor of *Great American Lawyers*; etc.
- W. D. La.**—Walter Davis Lambert. Principal Mathematician and Chief of the Section of Gravity and Astronomy, U.S. Coast and Geodetic Survey. Author of *The Effect of the Change of Spheroid on the Mapping of a Region*; etc.
- W. D. M.**—William Diller Matthew. Former Professor of Palaeontology, and Director, Museum of Palaeontology, University of California; Curator in Chief of The American Museum of Natural History, New York, N.Y.
- W. D. Os.**—William David Ollis. Lecturer in Organic Chemistry, University of Bristol, Eng.
- W. Ds.**—William Davis. Professor of Textile Industries, University College, Nottingham, England.
- W. Du.**—William James Durant. Author of *The Story of Philosophy*; etc.
- W. Dy.**—Walter Duranty. Correspondent of North American Newspaper Alliance in Europe, U.S.S.R., Japan, 1939-41. Correspondent in Moscow for *The New York Times*, 1921-34. Author of *The Kremlin and the People*; etc.

W. E.—William Henry Eccles. President of the Institute of Electrical Engineers, 1926-27. Former Professor of Applied Physics and Electrical Engineering, City and Guilds of London Technical College, Finsbury.

W. E. A.—W. E. Armstrong. Former Lecturer on Social Anthropology, Cambridge.

W. E. A. A.—William Edmund Armitage Axon. Sometime Deputy Chief Librarian of the Manchester Free Libraries, Manchester, England.

W. E. Ai.—Wellington E. Aiken. Emeritus Professor of English, University of Vermont, Burlington, Vt.

W. E. B.—William Edgar Borah. United States Senator from Idaho, 1907-43.

W. E. Ba.—William Emery Barnes, D.D. Former Fellow of Peterhouse, Professor of Divinity and Dean, Cambridge University. Hulsean Professor of Divinity, Cambridge, 1901-34.

W. E. Bn.—Walton E. Bean. Instructor in History, University of California, Berkeley, Calif.

W. E. Bt.—William E. Brandt. Author and radio commentator.

W. E. C.—Walter E. Collinge. Keeper of the Yorkshire Museum, York, England, 1921-41. Former Editor of *The Journal of Zoological Research*, and Lecturer on Economic Zoology, University of Birmingham.

W. E. Cl.—William Elmer Caldwell. Associate Professor of Chemistry, Oregon State College, Corvallis, Ore. Author of *General Chemistry; Semimicro Qualitative Analysis*.

W. E. Co.—Rt. Rev. William Edward Collins, D.D. Former Bishop of Gibraltar. Former Professor of Ecclesiastical History, King's College, University of London, and Lecturer, St. John's and Selwyn Colleges, Cambridge. Author of *The Beginnings of English Christianity*.

W. E. Cu.—William Edward Curtis. Professor of Physics, King's College, Newcastle-on-Tyne, University of Durham, England. Scientific Adviser, Research and Experiments Department, Ministry of Home Security, 1940-43.

W. E. Cx.—Warren Earle Cox. Lecturer on decoration and craftsmanship.

W. E. D.—W. Ernest Dalby. Former Dean and Professor of Engineering at the City and Guild's Engineering College of the Imperial College of Science and Technology, University of London.

W. E. E.—Walter Elmer Ekblaw. Professor of Geography, Clark University, Worcester, Mass., 1926-49. Assistant Editor, *Economic Geography*, 1924-49.

We. G.—Werner Goldschmidt. Profesor contratado de dedicación exclusiva de Derecho Internacional Privado. Director of the corresponding section at the National University of Tucumán, Tucumán, Arg. Author of *Sistema y filosofía del Derecho Internacional Privado, con especial consideración del Derecho Internacional Privado Español*.

W. E. G.—Sir William Edmund Garstin. Inspector General of Irrigation, Egypt, 1892. Built Assuit Barrage and Assuan Reservoir.

W. E. Gr.—Walter Ervin Gloor. Plastics Supervisor, Hercules Powder Company, Parlin, N.J.

W. E. Gs.—Willard E. Givens. Executive Secretary of the National Education Association, 1935-

W. E. H.—William Ernst Hocking, D.D. Chairman of Department of Philosophy, Harvard University, 1937-43. Author of *The Meaning of God in Human Experience; Science and the Idea of God*; etc.

W. E. I.—William Edmund Ironside, 1st Baron Ironside of Archangel and of Ironside. Field Marshal. Commander in Chief, Home Forces, 1940. Commander in Chief, Allied Troops in Russia, 1918-19. Commandant, Staff College, Camberley, 1922-26. Chief of the Imperial General Staff, 1939-40. Author of *Tannenberg: The First Thirty Days in East Prussia*.

W. E. K. M.—William E. Knowles Middleton. Meteorologist, Meteorological Service, Toronto, Ont., Can. Author of *Visibility in Meteorology*; etc.

W. E. L.—William Egbert Leveson. Assistant Secretary, 1896-1906, and Secretary, 1906-18, to the Council for the Foreign Community of Shanghai north of the Yang King Pang.

W. E. M.—W. E. Morton. Professor of Textile Technology in the University of Manchester, England. Author of *An Introduction to the Study of Spinning*; etc.

W. E. Ma.—Wilbur E. Mallalieu. General Manager, National Board of Fire Underwriters, New York, N.Y.

W. E. My.—William Edward May. Commander, Royal Navy. Naval Assistant to Director, Compass Department, Admiralty.

W. En.—William Ebenstein. Associate Professor of Political Science, University of Wisconsin, Madison, Wis. Author of *The Nazi State*; etc.

W. E. S.—Walter Earl Spahr. Professor of Economics, School of Commerce, Accounts and Finance, and Chairman of the Department of Economics, New York University.

W. E. Ss.—Wayne Edson Stevens. Professor of History, Dartmouth College, Hanover, N.H.

W. E. Th.—Wendell E. Thorne. International Section, Division of Research and Statistics, Board of Governors of the Federal Reserve System.

W. E. W.—W. E. Wornum. Technical and Research Chemist, Mander Brothers, Ltd., Wolverhampton, England.

W. E. Wa.—William E. Warne. Assistant Secretary, Department of the Interior, Washington, D.C. Assistant Commissioner, Bureau of Reclamation, Department of the Interior, 1943-47.

W. E. Wh.—Wallace Edward Whitehouse. Acting Head of Department of Geography, University College of Wales, Aberystwyth, 1941-46.

W. F.—William Fairweather, D.D. Minister of Dunniker, United Free Church, Kirkcaldy, N.B. Author of *The Background of the Gospels*; etc.

W. F. A.—William F. Albright. Chairman, Oriental Seminary, The Johns Hopkins University, Baltimore, Md. Author of *The Excavation of Tell Beit Mirsim; From the Stone Age to Christianity*.

W. F. B.—Walter Francis Bogner. Architect. Associate Professor of Architecture, School of Design, Harvard University.

W. F. C.—William Feilden Craies. Former Lecturer on Criminal Law, King's College, University of London. Editor of Archbold's *Criminal Pleading* (23rd edition).

W. Fd.—Walter Armitage Justice Ford. Former Professor of Singing at the Royal College of Music and University of Reading, England.

W. F. D.—Walter Fairleigh Dodd. Professor of Law, 1927-30, and Research Associate Professor, 1930-33, Yale University. Author of *Modern Constitutions*; etc.

W. F. F.—William Frederick Friedman. Principal Cryptanalyst, U.S. War Department, Washington, D.C. Director of Signal Intelligence School, War Department. Chief of Signal Intelligence Service, 1930-40. Author of *Elements of Cryptanalysis*; etc.

W. F. Fr.—Walter Francis Frear. Chief Justice, 1900-07, and Governor, 1907-13, of Hawaii. Former Vice-President, Bishop Trust Company, Honolulu, Hawaii. Author of *Evolution of the Hawaiian Judiciary*; etc.

W. F. I.—William Fergusson Irvine. Local secretary for Cheshire for the Society of Antiquaries, 1909-. Hon. Secretary and General Editor of Record Society of Lancashire and Cheshire, 1895-1909. Author of *Liverpool in the Reign of Charles II*; etc.

W. F. K.—Winifred F. Knox. Author of *The Court of a Saint*.

W. F. L.—Walter Firth Lanterman. Engineer, National Broadcasting Company, Chicago, Ill.

W. F. M.—William Frederick Meggers. Chief, Spectroscopy Section, National Bureau of Standards, Washington, D.C.

W. Fo.—Wolfgang Foerster. Lieutenant Colonel, formerly of the General Staff, German Army. Former Member of the Historical section of the General Staff, Chief of the General Staff of the XI Corps, 1917. Author of *Prinz Friedrich Karl von Preussen; Graf Schlieffen und der Weltkrieg*.

W. F. P.—William F. Parish. Consulting and lubricating engineer, New York. Member, American Society of Mechanical Engineers, etc.

W. F. R.—William Frank Rasche. Director and Principal, Milwaukee Vocational School, Milwaukee, Wis.

W. F. Re.—William Fiddian Reddaway. Former Fellow of King's College, Cambridge, and University Lecturer. Censor of Fitzwilliam House, Cambridge, Eng., 1907-24. Author of "Scandinavia" in the *Cambridge Modern History*.

W. F. S.—William Fleetwood Shepard. Former Fellow of Trinity College, Cambridge. Senior Examiner to the Board of Education.

W. F. Sw.—W. F. Swann. Technical Correspondent, Sales Service Division, Eastman Kodak Company, Rochester, N.Y.

W. Ft.—Wesley Frost. Former U.S. Ambassador to Paraguay. Author of *German Submarine Warfare*.

W. F. W.—Walter Francis Willcox. Emeritus Professor of Economics and Statistics, Cornell University, Ithaca, N.Y. Special Agent of the U.S. Census Bureau, 1902-31. Author of *The Divorce Problem—a Study in Statistics*; etc.

W. G.—William Green. President of the American Federation of Labor, Washington, D.C.

W. Ga.—Walter Garstang. Former Professor of Zoology in the University of Leeds, England. Vice-President, Marine Biological Association, 1940.

W. G. A.—Walter Gordon Armstrong. Assistant to the President, Youngstown Pressed Steel Company, Warren, O.

- W. Gam.**—W. Gamble. Editor, *Penrose's Annual*.
- W. Gar.**—W. Garnett. Educational Advisor to the London County Council, 1904-15.
- W. G. B.**—Walter George Bell. Author of *The Great Fire of London in 1666*; *The Great Plague in London in 1665*; *Unknown London*; etc.
- W. G. C.**—Walter Goodman Cowles. Former Vice-President, Travelers Insurance Company, Hartford, Conn.
- W. G. Co.**—William George Constable. Curator of Paintings, Boston Museum of Fine Arts. Slade Professor of Fine Art, Cambridge University, 1935-37. Former Assistant Director of the National Gallery, London.
- W. G. D.**—William G. Downey, Jr. Major, U.S. Army. Chief, International Law Branch, Office of the Judge Advocate General. Author of *American Maritime Neutrality Policy*; *Revision of the Rules of Warfare*.
- W. Gl.**—Sir Wilfred T. Grenfell, M.D. Author of *An Autobiography of a Labrador Doctor*; etc.
- W. G. M.**—Walter George McMillan. Former Secretary of the Institute of Electrical Engineers and Lecturer on Metallurgy, Mason College, Birmingham. Author of *A Treatise on Electro-Metallurgy*.
- W. G. Ma.**—Sir William Grant MacPherson. Major General, formerly with Army Medical Service. Editor in Chief, *Official Medical History of the War*.
- W. G. P.**—Wibo G. Peekema. Legal Advisor, Standard-Vacuum Petroleum Co.
- W. Gr.**—William Graham. Former M.P. for the Central Division of Edinburgh. Financial Secretary to the Treasury, 1924.
- W. G. R.**—Will G. Robinson. Secretary, South Dakota State Historical Society. Author of *South Dakota in World War II*.
- W. Gs.**—Walter Adolph Gropius. Senior Professor of Architecture and Chairman of School of Architecture, Harvard University.
- W. G. W.**—William Gillies Whittaker. Gardiner Professor of Music, Glasgow University, and Principal, Scottish National Academy of Music, 1930-41.
- W. H.**—Sir (Thomas) Wolsley Haig. Lieutenant Colonel. Former Lecturer in Persian, School of Oriental Studies, University of London. H.B.M.'s Consul-General and Agent to the Government of India, Khurasan, Persia, 1914-16; Isfahan, 1916; Tehran, 1919. Co-editor of the *Cambridge History of India*.
- W. Ham.**—Walter Hampden. Actor manager.
- W. H. B.**—William H. Burnham. Former Professor of Education and School Hygiene, Clark University, Worcester, Mass. Author of *The Normal Mind*; *Great Teachers and Mental Health*.
- W. H. Ba.**—W. H. Balzer. Research Engineer, Staff of Ansonia Clock Company, Brooklyn, N.Y.
- W. H. Bau.**—William H. Baumer. Lieut. Col. Plans and Operations Division, General Staff, Department of the Army, Washington, D.C.
- W. H. Be.**—William Henry Bennett, D.D. Former Professor of Old Testament Exegesis in New and Hackney Colleges, London. Author of *Religion of the Post Exilic Prophets*; etc.
- W. H. Bl.**—Walter Harold Blucher. Executive Director, American Society of Planning Officials. Lecturer in Planning, The University of Chicago, Chicago, Ill.
- W. H. By.**—Wilmot Hyde Bradley. Chief Geologist, U.S. Geological Survey, Washington, D.C.
- W. H. Ca.**—Willis Haviland Carrier. Former President, American Society of Heating and Ventilating Engineers. Co-author and editor, *Fan Engineering*.
- W. H. Ch.**—William Henry Chamberlin. American correspondent for the *Christian Science Monitor* in France, 1939- , in the Soviet Union, 1922-34, the Far East, 1935-39. Author of *Soviet Russia*; *Russia's Iron Age*; *Japan Over Asia*; etc.
- W. H. Cl.**—Sir William Henry Clark. Former Director of Barclay's Bank, etc. Comptroller-General of Department of Overseas Trade, 1917-28. High Commissioner in Union of South Africa for H.M. Government in United Kingdom, 1934-39.
- W. H. Cr.**—Walter Hill Crockett. Former Editor of Publications, University of Vermont, Burlington, Vt.
- W. H. Dr.**—William Hamilton Drummond, D.D. Honorary President Manchester College, Oxford, 1938-42. Secretary of the International Congress of Free Christians and other Religious Liberals, 1920-29.
- W. H. D. R.**—William Henry Denham Rouse. University Teacher of Sanskrit, Cambridge University, 1903-39; Head Master Perse Grammar School, Cambridge 1902-28. Author of *Latin on the Direct Method*.
- W. H. F.**—Rt. Rev. Walter Howard Frere, D.D. Bishop of Truro, 1923-35. Examining Chaplain to the Bishop of Southwark, 1895-1909. Author of *The Marian Reaction*; *Sursum Corda*; etc.
- W. H. H.**—Sir William Henry Hadow. Vice-Chancellor, University of Sheffield, England, 1919-30. Former Member of Council, Royal College of Music. Editor, *Oxford History of Music*. Author of *Studies in Modern Music*; *Sonata Form*; etc.
- W. H. Ha.**—William Henry Hargrove. Emeritus Professor of Rural Education, Colorado State College of Education, Greeley, Colo.
- W. H. Hs.**—William Herman Haas. Emeritus Professor of Geology and Geography, Northwestern University College of Liberal Arts, Evanston, Ill. Author of *The South American Indian*.
- W. H. J.**—Willis Hugh Johnson. Professor of Zoology and Chairman of Department of Zoology, Wabash College, Crawfordsville, Ind.
- W. H. Jn.**—Walter Henry Johnston. Assistant Editor, *Yorkshire Post*, Leeds, Eng.
- W. H. K.**—William H. Kobbé. Director, Kobbé Laboratories, Inc., New York, N.Y.
- W. H. Kn.**—William H. Kern. OIC, Planning and Operations Section, U.S. Army Pigeon Service Agency.
- W. H. La.**—William Henry Lawrence. Emeritus Professor, Architectural Engineering, Massachusetts Institute of Technology, Cambridge, Mass. Curator and member of faculty of Lowell Institute, Boston, Mass. Author of *Principles of Architectural Perspective*.
- W. H. Le.**—W. H. Leffingwell. Author of *Scientific Office Management*; etc.
- W. H. L. W.**—William Henry Lowe Watson. Author of *A Boy's Book of Prose*; *Tales from English History*; etc.
- W. H. M.**—William Henry Maxwell. Borough and Waterworks Engineer, Tunbridge Wells, England. Former President Institute of Sanitary Engineers, London. Author of *Removal and Disposal of Refuse*.
- W. H. Ma.**—William Herrick Macaulay. Former Fellow and Tutor of King's College, Cambridge. Author of *The Law of Thermodynamics*; etc.
- W. H. Mi.**—William Hobson Mills. Emeritus Reader in Stereochemistry and Fellow and President of Jesus College, Cambridge. President Chemical Society, 1941-43.
- W. Hn.**—Wilder Hobson. Author of *American Jazz Music*.
- W. H. N.**—W. H. Nalder. Chief Designing Engineer, U.S. Bureau of Reclamation, Denver, Colo.
- W. Ho.**—William Hodson. Commissioner of Public Welfare, New York City, 1934-43.
- W. H. O.**—Wilfred H. Osgood. Former Curator of Zoology, Chicago Natural History Museum, Chicago, Ill.
- W. H. P.**—Wallace H. Paull. Technical Director of the Dunlop Rubber Co., Ltd., Birmingham, England.
- W. H. P. F.**—William H. P. Fauce, D.D. Former President of Brown University, Providence, R.I. Former President, World Peace Foundation. Author of *The Educational Ideal in the Ministry*; etc.
- W. H. Po.**—Walter Herries Pollock. Editor of *Saturday Review*, 1883-94. Author of *Lectures on French Poets*; etc.
- W. Hr.**—William Holtzheuer. Of the Continental Caoutchouc and Gutta Percha Company, Hanover, Germany.
- W. H. R.**—Worth Huff Rodebush. Professor of Physical Chemistry, University of Illinois, Urbana, Ill. Author of *Physical Chemistry*.
- W. H. S.**—W. Howard Sadgrove. Managing Director of Messrs. Sadgrove & Co., Ltd., Furniture Manufacturers and Upholsters, London.
- W. H. Sa.**—William Henry Salter. Treasurer and Joint Honorary Secretary, Society for Psychical Research, London.
- W. H. Sie.**—William Henry Siebert. Secretary and Director, Hammacher Schlemmer and Company, Inc., New York, N.Y.
- W. H. T.**—William H. Taliaferro. Eliakim Hastings Moore Distinguished Service Professor of Parasitology and Chairman of the Department of Bacteriology and Parasitology, The University of Chicago. Author of *Immunology of Parasitic Infections*; etc.
- W. H. Te.**—William Homan Thorpe. Fellow of Jesus College, Cambridge. Lecturer in Entomology in the University, Cambridge University.
- W. H. Tl.**—William H. Twenhofel. Research Consultant, Magnolia Petroleum Co. Co-author of *Invertebrate Paleontology*; *Principles of Sedimentation*.
- W. H. U.**—William H. Ukers. Editor, *The Tea and Coffee Trade Journal*. Author of *All About Coffee*; *All About Tea*; etc.
- W. H. Wh.**—William Henry Wheeler. Director, Projectile Development, Ministry of Supply, Eng.
- W. H. Wi.**—Sir William Henry Willcox, M.D. Colonel. Medical Adviser to Home Office, 1919-41. Physician, Lecturer on Chemical Pathology and on Forensic Medicine, St. Mary's Hospital, London, 1900-35.

W. H. Wo.—William H. Woodcock. Member of the Society of Public Analysts.

W. H. Wr.—William Hammond Wright. Director (1935-42) and Emeritus Astronomer, Lick Observatory, University of California. In charge of the Lick Observatory's Expedition to the Southern Hemisphere, 1903-06.

W. H. Wt.—Willard Hull Wright. Scientist Director (Colonel), U.S. Public Health Service. Chief, Division of Tropical Diseases, National Institutes of Health, Bethesda, Md.

W. I.—Will Irwin. Author of *Youth Rides West*; *Propaganda and the News*; etc.

Wi. H.—Winfried Heller. Research Associate and Lecturer in Colloid Chemistry, The University of Chicago. Author of *Nouvelles Recherches sur Les Propriétés Magneto-Optiques des Solutions Colloïdales*; etc.

W. I. J.—William Ivor Jennings. Vice-Chancellor, University of Ceylon. Author of *Cabinet Government*; *Parliament*.

W. I. K.—Willford Isbell King. Professor of Economics, New York University School of Commerce. Author of *The Wealth and Income of the People of the United States*; etc.

Wi. Mr.—William Miller. Editor, Alfred A. Knopf, Inc., New York, N.Y. Author of *The Age of Enterprise: a Social History of Industrial America*.

W. J.—W. Jutzi. Dyeworks and Chemical Industries Amalgamation, Ludwigshafen, Germany.

W. J. B.—Sir William John Berry. Director of Naval Construction, Admiralty, 1924-30. Director of Warship Production, 1917-23.

W. J. B.-L.—W. J. Bassett-Lowke. Messrs. Bassett-Lowke, Ltd., Locomotive Engineers, Northampton, England.

W. J. Bp.—William John Bishop. Librarian, Wellcome Historical Medical Library, London. Co-author of *Notable Names in Medicine and Surgery*.

W. J. Br.—Rev. William Jackson Brodribb. Former Fellow of St. John's College, Cambridge.

W. J. Ch.—William Joseph Chipman. Former Football Editor, New York *Daily News*, New York, N.Y.

W. J. D.—William John Dakin. Former Professor of Zoology, University of Sydney, Australia. Former Professor of Biology in the University of Western Australia. Author of *Textbooks on Zoology*; etc.

W. J. Do.—William John Donald. Managing Director, National Electrical Manufacturers Association, New York, N.Y. Author of *Canadian Iron and Steel Industry*; *Trade Associations*; etc. Editor in Chief, *Handbook of Business Administration*.

W. J. Don.—William Joseph Donovan. Major General, U.S.A. Co-ordinator of Information and Director of Strategic Services, Washington, D.C. U.S. Commissioner and Chairman, Colorado River Commission.

W. J. E.—W. J. Everard. Director of F. T. Everard and Sons, Ltd.

W. J. E. B.—William James Eames Binnie. Consulting Engineer, Senior Partner of firm of Binnie, Deacon and Gourley, London. President of Institution of Civil Engineers, 1938-39.

W. J. Et.—Wallace John Eckert. Professor of Celestial Mechanics, Columbia University, New York, N.Y. Author of *Punched Card Methods in Scientific Computation*.

W. J. F.—William J. Filbert. Former Director and Chairman of Finance Committee, United States Steel Corporation, New York, N.Y.

W. J. Gr.—Walter James Greenleaf. Guidance, Higher Education, U.S. Office of Education, Department of the Interior, Washington, D.C. Author of *Land-grant Colleges and Universities*.

W. J. Gru.—William John Gruffydd. Member of Parliament, University of Wales, 1943-. Emeritus Professor of Celtic, University, College of South Wales and Monmouthshire, Cardiff. Author of *History of Welsh Literature (1450-1600)*; etc.

W. J. H.—William James Hughan. Past-Senior Grand Deacon of Freemasons of England, 1874. Honorary Senior Warden of Grand Lodges of Egypt, Quebec and Iona.

W. J. Hs.—William Jackson Humphreys. Retired government scientist. Author of *Physics of the Air*; *Ways of the Weather*; etc.

W. J. J.—William Jackson Jenks. Chairman of the Board, Norfolk & Western Railway Company.

W. J. L.—William John Loeffel. Professor of Animal Husbandry and Chairman, Animal Husbandry Department, Univ. of Nebraska, Lincoln, Neb.

W. J. Lu.—Rev. William J. Lallou, S.T.D. Associate Professor of Sacred Liturgy, Catholic University of America, Washington, D.C.

W. J. M.—William John McCallien. Professor of Geology, University College of the Gold Coast, Achimota, Gold Coast. Author of *Geology of the Glasgow District*; *Scottish Gemstones*.

W. Jn.—William Jackson. Assistant Chief, Animal Husbandry Division, U.S. Department of Agriculture, Washington, D.C.

W. J. Ry.—W. J. Rooney. Physicist, Carnegie Institution of Washington, Department of Terrestrial Magnetism.

W. J. T. H.—W. J. T. Halliwell. Former Principal Pilotage Clerk, Trinity House, London.

W. K.—Wolfgang Köhler. Professor of Psychology, Swarthmore College, Swarthmore, Pa., 1935-. Author of *The Mentality of Apes*; *The Place of Value in a World of Facts*; etc.

W. K. G.—William King Gregory. Emeritus Curator of the Department of Comparative Anatomy and Department of Ichthyology, American Museum of Natural History, New York. Emeritus Professor of Vertebrate Palaeontology, Columbia University. Author of *The Orders of Mammals*; etc.

W. K. L. C.—William Kemp Lowther Clarke, D.D. Canon Residentiary of Chichester Cathedral, 1945-. Editorial Secretary of Society for Promoting Christian Knowledge, 1915-44. Author of *St. Basil the Great*; etc.

W. K. McC.—Sir William Kidston McClure. Former Counsellor, British Embassy, Rome. Former correspondent of *The Times* (London) in Rome. War Correspondent of *The Times* on the Italian Front, 1915-17. Author of *Italy's Part in the War*; etc.

W. Kt.—Waldemar Kaempffert. Science Editor, the *New York Times*. Author of *Explorations in Science*; *History of Astronomy*; *Popular History of American Invention*; *Science Today and Tomorrow*.

W. L.—Walter Landells. London Stock Exchange.

W. La.—William Latey. Of the Middle Temple, and the Probate and Divorce Courts, Barrister-at-Law.

W. L. Ay.—William L. Ayers. Former Director of Public Relations, International Bank for Reconstruction and Development, Washington, D.C.

W. L. B.—William Lewis Blennerhassett. Former Acting British Vice-Consul at Kovno, Lithuania. Member of the London Stock Exchange.

W. L. Bd.—William Leslie Bradford, M.D. Associate Professor of Pediatrics and Assistant Dean, University of Rochester School of Medicine and Dentistry, Rochester, N.Y.

W. L. Bn.—William Laurence Burn. Professor of Modern History, King's College, University of Durham, Newcastle-upon-Tyne, Eng. Author of *The British West Indies*; *Emancipation and Apprenticeship in the British West Indies*.

W. L. D.—Wilfred L. Denno. Warden of Sing Sing Prison, Ossining, N.Y.

W. L. de B.—William Lane de Baufre. Chairman, Department of Engineering Mechanics, University of Nebraska, Lincoln, Neb.

W. L. F.—Walter Lynwood Fleming. Former Dean, College of Arts and Sciences, Vanderbilt University, Nashville, Tenn. Author of *Documentary History of Reconstruction*.

W. L. Fk.—William L. Frederick. Research Associate, Council of State Governments.

W. L. G.—William Lawson Grant. Former Principal of Upper Canada College, Toronto. Beit Lecturer in Colonial History at Oxford University, 1906-10. Professor of Colonial History, Queen's University, Kingston, Canada, 1910-15. Editor of *Acts of the Privy Council*; *Canadian Constitutional Development* (in collaboration).

W. L. Gn.—W. Lashford Griffin. Director of Messrs. William Griffin and Sons, Ltd., Chain Manufacturers, Cradley Heath, Staffs., England.

W. L. H. D.—Wynfrid Laurence Henry Duckworth, M.D. Master of Jesus College, Cambridge, 1940-45; Reader in Human Anatomy, 1920-40.

W. Li.—Walter Lippmann. Special Writer, *New York Herald Tribune*. Former Editor of *New York World*. Author of *Liberty and the News*; etc.

W. L. J.—William L. Jellison. Sanitarian, United States Public Health Service, Rocky Mountain Laboratory, Hamilton, Mont.

W. L. P.—William Lyon Phelps, D.D. Lampson Professor of English Literature, Yale University, 1901-33. Author of *Some Makers of American Literature*; etc.

W. L. R.—William L. Rodgers. Vice-Admiral, U.S.N. Commander in Chief of the United States Asiatic Fleet, 1918-19.

W. L. St.—Waldo L. Schmitt. Head Curator of Zoology, United States National Museum, Washington, D.C. Author of *The Marine Decapod Crustacea of California*; etc.

W. L.-W.—Sir William Lee-Warner. Former Secretary in the Political and Secret Department of the India Office. Author of *Life of the Marquis of Dalhousie*; etc.

W. L. W.—William Lansdell Wardle, D.D. Former Reader in Biblical Criticism and Exegesis of the Old Testament, Manchester University, England. Principal of Hartley Victoria College, Manchester, 1928-1943.

W. L. Wh.—Wilford Lenfestey White. Chief of Management Division, Office of Small Business, 1946-. Chief of the Division of Marketing Research, Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D.C., 1934-39; Chief, Publication Service Division, 1939-41; Chief, Regional Research Unit, 1941-45.

W. M.—William Miller. Author of *The Latins in the Levant; The Ottoman Empire and Its Successors (1801-1930)*; *Greece*; etc.

W. Mar.—Sir William Markby. Former Judge, High Court of Calcutta; Reader in Indian Law, Oxford University. Author, *Lectures on Indian Law*; etc.

W. M. Ca.—William M. Carpenter. Economist, Edison Electric Institute. Author of *The Electric Light and Power Industry, Its Facts and Figures*; etc.

W. McD.—William McDougall. Former Professor of Psychology in Duke University, Durham, N.C.; formerly of Harvard University and Reader in Mental Philosophy in Oxford University.

W. M. Ck.—W (illiam) Mansfield Clark. De Lamar Professor of Physiological Chemistry, The Johns Hopkins School of Medicine, Baltimore, Md. Author of *The Determination of Hydrogen Ions*.

W. M. D.—William Morris Davis. Former Professor of Geology, Harvard University. Author of *Physical Geography*.

W. Me.—Wilfrid Meynell. Editor of the *Collected Works of Francis Thompson* and of *Alice Meynell*.

W. M. F. P.—Sir William M. Flinders Petrie. Emeritus Professor of Egyptology, University College, University of London, 1933-42. Excavator of Giza, etc.

W. M. G.—W. M. Glog, Professor of Law, University of Glasgow, Scotland, 1905-34.

W. M. H.—William M. Hines, Jr. Writer, Associate Editor, *The Manassas Journal*, Manassas, Va.

W. M. H. G.—W. M. H. Greaves. Astronomer Royal for Scotland and Professor of Astronomy, Edinburgh University.

W. M. Je.—William Martin Jeffers. Former Vice-Chairman, Board of Directors, and former General Manager, Union Pacific Railroad, Omaha, Neb.

W. M. L.—William M. Leiserson. Industrial relations consultant and arbitrator. Author of *Adjusting Immigrant and Industry; Right and Wrong in Labor Relations*.

W. M. La.—Wendell Mitchell Latimer. Dean, College of Chemistry, University of California, Berkeley, Calif.

W. M. M.—William Moulton Marston. Consulting Psychologist, Tufts College, Medford, Mass., 1925-47. Author of *Emotions of Normal People; Psychology* (textbook).

W. M. Mn.—William M. Mann. Director, National Zoological Park, Washington, D.C.

W. M. Pn.—William M. Pinkerton. Director, News Office, Harvard University.

W. M. R.—William Michael Rossetti. One of the founders of the Pre-Raphaelite Brotherhood. Former Editor of *The Germ*. Author of *Lives of Famous Poets*; etc.

W. M. Ra.—Sir William Mitchell Ramsay, D.D. Professor of Humanity, Aberdeen University, Scotland, 1886-1911; of Classical Art, Oxford University, 1885.

W. M. S.—William Marshall Smart. Regius Professor of Astronomy, University of Glasgow, Scotland, 1937-. John Couch Adams Astronomer and Lecturer in Mathematics, Cambridge University, 1919-37. Author of *The Sun, the Stars and the Universe*; etc.

W. M. Sl.—William Milligan Sloane. Former Professor of History, Columbia University. Secretary to George Bancroft while Ambassador in Berlin. Author of *Life of Napoleon Bonaparte*.

Wm. Sp.—William Spragen. Director, Welding Research Council, Engineering Foundation. Editor, *Welding Journal*. Editor, *Welding Engineers Handbook*.

W. M. U.—Wilbur Marshall Urban. Emeritus Professor of Philosophy, and Chairman Department of Philosophy and Director of Graduate Studies, Yale University. Author of *Valuation—Its Nature and Laws*; etc.

W. M. W.—Walter Muir Whitehill. Commander, U.S.N.R. (inactive). Director and Librarian, Library of the Boston Athenaeum, Boston, Mass. Editor, *The American Neptune: A Quarterly Journal of Maritime History*; etc.

W. N. D.—William Nelson Davey. Director, Johnson and Higgins, Average Adjusters and Insurance Brokers, New York, N.Y.

W. N. H.—(Walter) Norman Haworth. Former Professor of Chemistry and Director of Department of Chemistry in the University of Birmingham. Vice-Principal, University of Birmingham, England, 1947-50. Nobel Prize for Chemistry, 1937.

W. N. J.—W. Neilson Jones. Hildred Carlile Professor of Botany, University of London. Author of *Plant Chimaeras and Graft Hybrids*; etc.

W. N. K.—William Norton Keeler. General Manager Sun-Maid Raisin Growers' Association, Fresno, Calif. Vice-President and Director of Dried Fruit Association of California.

W. O.—William Onyon. Engineer-Captain, R.N. Consulting engineer. Past President, Institute of Marine Engineers.

W. O. B.—Rt. Rev. Winfrid Oldfield Burrows, D.D. Bishop of Chichester, England, 1919-29. Honorary Canon of Birmingham, 1906-12. Lecturer in Pastoral Theology, Cambridge University, 1910-11. Lord Bishop of Truro, 1912-1919. Author of *The Mystery of the Cross*.

W. O. E. O.—William O. E. Oesterley, D.D. Former Examining Chaplain to the Bishop of London. Former Professor, Hebrew and Old Testament Exegesis, King's College, London University. Author of *The Books of the Apocrypha: their Origin, Contents and Teaching*; etc.

W. O.-J.—W. Oltar-Jevsky. Graduated as architect from Moscow Academy of Fine Arts.

W. O. L. S.—William Owen Lester Smith. Professor of Education, London University Institute of Education. Author of *To Whom Do Schools Belong?*, etc.

W. Or.—Winfred Overholser, M.D. Superintendent of Saint Elizabeths Hospital, Washington, D.C. Professor of Psychiatry, George Washington University School of Medicine, Washington, D.C.

W. O. S.—William Oscar Scroggs. Dean Graduate School, 1941-, and Professor of Economics and Sociology, 1913-19, Louisiana State University, Baton Rouge, La. Editorial staff, *New York World*, 1925-31. Author of *Filibusters and Financiers*; etc.

W. P.—Woodford Patterson. Former Secretary, Cornell University, Ithaca, N.Y.

W. Pa.—Rev. W. Paton. Editor of *The International Review of Missions*, 1927-1943.

W. P. A.—William Patrick Anderson. Colonel. Former Chief Engineer, Department of Marine and Fisheries of Canada, and Member of the Geographic Board of Canada.

W. Pas.—Rev. Wilfrid Parsons, S.J. Professor of Political Science, Catholic University, Washington, D.C. Author of *Which Way Democracy?*; etc.

W. P. C.—William Pitcher Creager. Consulting hydraulic engineer. Author of *Engineering for Masonry Dams*; etc.

W. P. F.—William Preston Few. President of Duke University, Durham, N.C., 1924-40.

W. P. G.—William Percival Grieve. Barrister-at-Law of the Middle Temple, London, and the Midland Circuit.

W. P. J.—William Price James. High Bailiff of County Courts, Cardiff, Wales. Author of *Romantic Professions*; etc.

W. P. Ma.—Walter P. Marshall. President, the Western Union Telegraph Company, New York, N.Y.

W. Po.—(Frederick) Wilson Popenoe. Director, Escuela Agrícola Panamericana, Tegucigalpa, Honduras, C.A. Collaborator, Office of Foreign Agricultural Relations, U.S. Department of Agriculture. Author of *Manual of Tropical and Subtropical Fruits*.

W. P. P.—W. P. Pycraft. Former Assistant Keeper in Charge of Osteological Collections, British Museum (Natural History), London. Author of *A History of Birds*; etc.

W. P. R.—Wilds Preston Richardson. Colonel, U. S. Army. Author of *Reports of Alaska Road Commission*; etc.

W. P. Re.—Hon. William Pember Reeves. Director, London School of Economics, 1908-19. Agent-General and High Commissioner for New Zealand, 1896-1908. Author of *State Experiments in Australia and New Zealand*.

W. P. T.—William Peterfield Trent. Former Professor of English Literature, Columbia University, New York, N.Y. Author of *English Culture in Virginia*; etc.

W. P. W.—W. Porter Ware. Director of Public Relations, University of the South, Sewanee, Tenn.

W. Py.—William Peery. Associate Professor of English, University of Texas, Austin, Tex. Editor of *The Plays of Nathan Field*.

W. R.—William Ripper. Former Professor of Engineering, University of Sheffield, England. Former Chairman, Joint Advisory Council of the Sheffield Trades Technical Societies.

W. Ra.—William Ratner. Of the *Newark Evening News* (N.J.).

W. R. B.—Rt. Rev. William R. Brownlow, D.D. Former Roman Catholic Bishop of Clifton. Provost and Domestic Prelate to Pope Leo XIII. Co-editor of *English Roma Subterranea*.

W. R. Be.—William Rose Benét. Contributing Editor of the *Saturday Review of Literature*, 1929-50. Awarded Pulitzer Prize for Poetry, 1942.

W. R. By.—William R. Barclay, M.D. Instructor, Department of Medicine, The University of Chicago.

W. R. Ce.—Wesley R. Coe. Emeritus Professor of Biology, Yale University.

W. R. D.—Warren Royal Dawson. Honorary Member of the Egypt Exploration Society.

W. R. Fe.—William R. Forsythe. Physical chemist.

W. R. G.—William R. George. Founder and former Director of National Association of Junior Republics. Author of *The Junior Republic*; etc.

W. R. H.—Sir William Reginald Halliday. Principal of King's College, London. Member of the Court of the University of London. Rathbone Professor of Ancient History in the University of Liverpool, 1914-28. Author of *Folklore Studies, Ancient and Modern*; etc.

W. R. H. B.—Walter H. Brill, Jr., M.D. Assistant in Medicine and Physician in the Student Health Service, The University of Chicago.

W. R. Ho.—William R. Hodgkinson. Former Professor of Chemistry and Metallurgy, Artillery College, Woolwich, and Principal Demonstrator in Chemistry at Royal College of Science. Co-author of Valentine-Hodgkinson's *Practical Chemistry*; etc.

W. R. I.—Very Rev. William Ralph Inge, D.D. Dean of St. Paul's 1911-34; Romanes and Hibbert Lecturer, 1920; etc. Lady Margaret Professor of Divinity and Fellow of Jesus College, Cambridge, 1907-11. Gifford Lecturer, St. Andrews, 1917-18. Author of *Lay Thoughts of a Dean*; *The Philosophy of Plotinus*; etc.

W. R. L.—William Raymond Longley. James E. English Professor of Mathematics, Yale University, and Associate Fellow of Trumbull College, Yale.

W. R. Le.—William Richard Lethaby. Former Professor of Design at the Royal College of Art, South Kensington; former Principal of the London County Council Central School of Arts and Crafts. Author of *Mediaeval Art*; etc.

W. R. Li.—W. Robert Liefmann. Former Professor of Economics and Finance, University of Freiburg in Breslau, Germany. Author of *Kartel and Trusts*.

W. R. M.—Very Rev. Walter Robert Matthews, D.D. Dean of St. Paul's, 1934-. Fellow of King's College, London, and Member of Senate, University of London. Dean of King's College, London, 1918-32. Professor of the Philosophy of Religion, King's College, 1918-32. Chaplain to the King, 1923-31. Author of *Studies in Christian Philosophy*; etc.

W. R. M. L.—Sir Walter Rangeley Maitland Lamb. Secretary of the Royal Academy of Arts, 1913-.

W. R. Mo.—William Richard Morfill. Former Professor of Russian and Other Slavonic Languages in Oxford University and Curator of the Taylorian Institution, Oxford. Author of *Russia*; etc.

W. Rn.—Walter Rosenhain. Superintendent, Department of Metallurgy in the National Physical Laboratory, Teddington, England, 1906-31. Author of *Introduction to the Study of Physical Metallurgy*.

W. Ro.—William Rowan. Professor of Zoology, University of Alberta, Edmonton, Can. Author of *Riddle of Migration*.

W. R. O.—William R. O'Connor. Professor of Dogmatic Theology, St. Joseph's Seminary, Dunwoodie, Yonkers, N.Y. Author of *The Layman's Call*; etc.

W. R. R.—William R. Redden, M.D. National Medical Offices, American National Red Cross, Washington, D.C.

W. R. S.—William Robertson Smith. Scottish philologist, physicist, archaeologist, Biblical critic; Editor of the 9th edition of the *Encyclopædia Britannica*.

W. R. Sm.—William Roy Smith. Former Associate Professor of History, Bryn Mawr College, Bryn Mawr, Pa. Author of *Sectionalism in Pennsylvania during the Revolution*.

W. R. So.—William Ritchie Sorley. Knightbridge Professor of Moral Philosophy in Cambridge University, 1900-33. Author of *A History of English Philosophy*; etc.

W. R. V. A.—Wilbur Rice Van Auken. Captain, U.S.N. (retired). Chief of Naval Personnel, Bureau of Ordnance, Navy Department, 1941-45.

W. R. Wi.—William Rulon Williamson. Actuarial Consultant, Washington, D.C.

W. S.—William Sharp. Author of volumes of poetical prose under pen name of "Fiona Macleod." Author of biographies of Dante Gabriel Rossetti; Heine; etc.

W. S. A.—Sir Westcott Stile Abell. Professor of Naval Architecture, Armstrong College, Newcastle-upon-Tyne, 1928-41. Chief Ship Surveyor, Lloyds Register of Shipping, 1914-28.

W. S. As.—Walter S. Adams. Research Associate, Carnegie Institution. Director, Mount Wilson Observatory of the Carnegie Institution of Washington, Pasadena, Calif., 1923-46.

W. Sc.—Rev. P. Wilhelm Schmidt. Professor of Ethnology, Fribourg University, Switzerland, and Director, Anthropological Institute.

W. S. De.—William Smith Denham. Director of Research, British Silk Research Association, 1921-34.

W. S. E.—William Snyder Eichelberger. Professor of Mathematics, United States Navy, 1900-02. Director of the Nautical Almanac, United States Naval Observatory, 1910-29.

W. S. F.—William Scott Farren. Director, Royal Aircraft Establishment, Farnborough, Hants, England, 1941-45. Lecturer in the Engineering Department, Cambridge University, and at the Royal College of Science, London. Director of Technical Development, Ministry of Aircraft Production, 1940-41.

W. S. Fe.—William Scott Ferguson. McLean Professor of Ancient and Modern History, Harvard University, 1929-45; Dean of the Faculty of Arts and Sciences, 1939-42. Former President American Historical Association. Author of *The Athenian Secretaries*; etc.

W. S. G.—Walter Sherman Gifford. Chairman of the Board, American Telephone and Telegraph Company, New York, N.Y., 1948-49. Chairman, Industry Advisory Committee of the Board of War Communications, 1941-47.

W. S. G.-B.—W. S. Graff-Baker. Assistant Mechanical Engineer, London Underground Railway.

W. S. H.—William S. Harley. Harley Davidson Motor Company, Milwaukee, Wis.

W. Sha.—W. Shakespeare. Former Professor of Singing at Royal Academy of Music and Queen's College, London. Author of *Art of Singing*; etc.

W. S. Hd.—Walter Scott Huxford. Professor of Physics, Northwestern University, Evanston, Ill.

W. S. Hi.—Walter Sanders Hiatt. Newspaper and magazine writer. Former correspondent for Associated Press, Europe and Asia, 1915-23; for other journals, 1937-40.

W. S. Hr.—Walter Samuel Hunter. Professor of Psychology, Brown University, Providence, R.I. Author of *General Psychology*; *Human Behavior*.

W. S. J.—William Stanley Jevons. English economist and logician. Author of *Theory of Political Economy*; *The Principles of Science*.

W. S. L.—W. S. Lewis. Professor of Geography, University College, Exeter, Eng.

W. S. L.-B.—Walter Sydney Lazarus-Barlow, M.D. Former Member of Cancer Committee, Ministry of Health; former Professor of Experimental Pathology, Middlesex Hospital Medical School, University of London. Author of *A Manual of General Pathology*; etc.

W. S. M.—Walter S. McCellan, M.D. Medical Director, Saratoga Spa, Saratoga Springs Commission, Saratoga Springs, N.Y. Associate Professor of Medicine, Albany Medical College, Albany, N.Y.

W. Sp.—William Spry. Former Commissioner of the General Land Office, Department of the Interior, Washington, D.C. Former Governor of Utah.

W. S. Ro.—William Spence Robertson. Emeritus Professor and Head of Department of History in the University of Illinois, Urbana, Ill. Author of *Rise of the Spanish-American Republics*; etc.

W. S. S.—William Stanley Sykes, M.D. Anaesthetist for the General Infirmary, Hospital for Women, St. James' Hospital, and Dewsbury Infirmary, Leeds, England.

W. S. Sn.—W. Stuart Symington. Secretary, U.S. Department of the Air Force, Washington, D.C., 1947-50.

W. Sta.—William Staniar. Mechanical Power Engineer and Division Head, Manufacturing Division, Dupont Engineering Company, Wilmington, Del. Author of *Mechanical Power Transmission*.

W. Sto.—W. Stormont. Major. Manager, Compagnia Italiana Turismo (Italian State Railways), Official Agency and Steamship Lines.

W. S. To.—Walter S. Tower. President, American Iron and Steel Institute, New York, N.Y.

W. Sw.—Wolfgang Stechow. Professor of Fine Arts, Oberlin College, Oberlin, O. Author of *Apollo und Daphne*; *Salomon van Ruysdael*.

W. S. W.—William S. Williams. Superintendent of Engineering, J. A. Fay and Egan Company, Cincinnati, O.

W. S. Wa.—William Stewart Wallace. Librarian, University of Toronto, Canada. Honorary Editor, Royal Society of Canada. Author of *A History of the Canadian People*; etc.

W. T. B.—Wladyslaw Theodor Benda. Illustrator and painter.

W. T. C.—William Thomas Calman. Keeper of the Department of Zoology, British Museum, London, 1927-36.

W. Th.—William Thalbitzer. Professor of Eskimo Language and Culture, University of Copenhagen, 1920-45. Author of *Phonetic Study of the Eskimo Language*.

W. Tho.—Wallace Thompson. Former Editor in Chief of *Ingenieria Internacional*, New York, N.Y. Author of *The People of Mexico*; etc.

W. T. A.—William Thornton Innes. Founder and Director, Typothetae Printing Trade School, Philadelphia, Pa. Author of *Contributions on Photo-Engraving*.

W. T. M.—Rt. Rev. William Thomas Manning, D.D. Bishop of New York, 1921-46.

W. T. M. F.—William T. M. Forbes. Assistant Professor of Entomology, New York State College of Agriculture, Cornell University Agricultural Station, Ithaca, N.Y. Author of *The Lepidoptera of New York and Neighboring States*.

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 Bay, Emmet [Blackburn, M.D. Arteries, Diseases of; Heart, Diseases of the
 Bayles, B. B. Cereals (*in part*)
 Baylis, Harry Arnold. Platyhelminthes or Platyodaria (*in part*); Tapeworms (*in part*); Trematodes (*in part*); Turbellaria (*in part*)
 Beach, Frank A. Play in Animals; Sexual Behaviour
 Beal, John Mann. Bolivia (*in part*); Cercidiphyllum; Gas Plant; Heterogamy
 Bealby, John Thomas. Syr-Darya (*in part*)
 Beale, Joseph Henry. International Law, Private (*in part*)
 Bealer, Lewis W. Amazonas; Ancash; Argentina (*in part*); Bolivia (*in part*); Brazil (*in part*); British Honduras (*in part*); Colombia (*in part*); Costa Rica (*in part*); Ecuador (*in part*); Guadeloupe; Guatemala (*in part*); Honduras (*in part*); Loreto; Madre de Dios; Martinique; Nicaragua (*in part*); Panama (country) (*in part*); Paraguay (*in part*); St. Eustatius and Saba; St. Kitts or St. Christopher; St. Lucia; St. Vincent; Salvador, El (*in part*); San Martin; Tobago; Trinidad; Trujillo (*in part*); Tumbes; Turks and Caicos Islands; Uruguay (*in part*); West Indies, The (*in part*); Windward Islands
 Beals, Carleton. Mexico (*in part*)
 Beams, Jesse Wakefield. Velocity of Light (*in part*)
 Bean, Walton E. America (*in part*)
 Bear, Donald. Painting (*in part*)
 Pearce, H. W. Jolly Balance
 Beardsley, A. P. Ultramarine
 Beardsley, Neil Freeborn. Lantern
 Bearn, J. Gould. Distemper (*in part*); Luminous Paint; Paint (*in part*); Painter-Work in the Building Trade; Varnish
 Beaton, A. C. Kassala
 Beattie, James Alexander. Water
 Beatty, Sir E. W. Canadian Pacific Railway Company
 Beaujon, Paul. Books (*in part*)
 Beazley, Sir Charles Raymond. Andrew of Longjumeau; Cam (Cão) Diogo; Chang Chun, Kiu; Columbus, Christopher (*in part*); Cook, James; Dampier, William; Davis or Davys, John; Hayton; Idrisi; Leif Ericsson; Monte Corvino, Giovanni di; Neckam, Alexander (*in part*); Ptolemy (*in part*); Thorfinn Karlsefni; Varthema (Barthema Vertomannus), Ludovico di; Vespucci, Amerigo; Zemarachus
 Beck, A. L. Land Taxes (*in part*)
 Beck, Bertram Maurice. Juvenile Delinquency (*in part*)
 Beck, Frederick George Meeson. Aethelred; Deira; East Anglia; Edwin; Essex, Kingdom of; Goths (*in part*); Hwicce; Kent; Lombards or Langobardi (*in part*); Lothian; Mercia; Northumbria; Saxons; Strathclyde; Sussex, Kingdom of; Vandals (*in part*); Wessex
 Beck, Horace. Beads
 Beck, Norman Wood. New Jersey
 Becke, Archibald Frank. Waterloo Campaign, 1815
 Beebe, William. Galápagos Islands (*in part*)
 Beebe-Center, John G. Feeling, Psychology of
 Beekley, John Sherman. Urea or Carbamide
 Beer, Gavin Rylands de. Caenogenesis
 Behar, M. F. Regulation, Automatic
 Bell, Aubrey Fitzgerald. Camoens (Camões), Luis de; Garrett, João Baptista da Silva Leitão de Almeida (*in part*); Gibraltar (*in part*); Goes, Damião de (*in part*); Herculano de Carvalho e Araújo; Alexandre (*in part*); Lopes, Fernao (*in part*); Manuel de Mello, Dom Francisco (*in part*); Portuguese Literature (*in part*); Vincent, Gil
 Bell, Sir Charles Alfred. Tibet (*in part*)
 Bell, E. T. Abel, Niels Henrik; Bolyai, Johann; Bolyai, Wolfgang; Dedekind, Julius Wilhelm Richard; Equations, Theory of; Fermat, Pierre; Fredholm, Erik Ivar; Frobenius, Ferdinand Georg; Galois, Évariste; Gauss, Karl Friedrich; Hermite, Charles; Hesse, Ludwig Otto; Hilbert, David; Liouville, Joseph; Mathematics, History of; Picard, Charles Émile
 Bell, Elieux Thompson, M.D. Purpura; Ulcer
 Bell, Rev. George K. A., D.D. Davidson of Lambeth, Randall Thomas Davidson
 Bell, Gertrude. Druses (*in part*)
 Bell, Sir Harold Idris. Palaeography (*in part*)
 Bell, Walter George. Barnett (*in part*); Bosworth Field, Battle of; London (*in part*); Tewkesbury (*in part*)
 Bellamy, John Cary. Altimetry
 Bellamy, Paul. Cleveland; Ohio (*in part*)
 Bellot, Hugh Hale Leigh. Aerial Law (*in part*); Age; "Alabama" Arbitration; Alien (*in part*); Allegiance (*in part*); Amnesty; Angary, Right of; Betterment; Blasphemy; Blockade (*in part*); Common Pleas, Court of; Compensation (*in part*); Conquest; Contraband; Declaration of Paris; Drago Doctrine; Embargo; Exterritoriality; Inns of Court and Chancery (*in part*); Justiciarius Capitalis Angliae; King's Bench, Court of; Lord High Chancellor; Master of the Rolls; Mediation (*in part*); Money-Lending (*in part*); Most Favoured Nation Clause; Pacific Blockade (*in part*); Ultimatum; University Courts; Visit and Search (*in part*); Waters, Territorial
 Beloff, Max. Russia (*in part*)
 Bémont, Charles. Baluze, Étienne; Béarn; Chronicle
 Benda, Wladyslaw Theodor. Maski (*in part*)
 Bender, Harold H. Geiger, Wilhelm
 Benedetti-Pichler, Anton Alexander. Chemistry (*in part*)
 Benedict, Agnes E. Day Nurseries (*in part*)
 Benedict, Libby. Rothschild
 Benedikt, Eirikur. Iceland (*in part*)
 Beneš, Eduard. Little Entente (*in part*)
 Benét, William Rose. Dreiser, Theodore; Masters, Edgar Lee (*in part*)
 Bennett, Albert A. Combinatorial Analysis (*in part*)
 Bennett, Alva Herschel. Binocular Instrument (*in part*)
 Bennett, Edward E. Montana (*in part*)
 Bennett, George Allen, M.D. Tongue
 Bennett, R. W. Newark (*in part*)
 Bennett, Wendell Clark. South America (*in part*)
 Bennett, William Henry, D.D. Balaam (*in part*)
 Bennis, Charles. Boot and Shoe Machinery (*in part*)
 Bentley, Wilson Alwyn. Frost
 Benton, W. A. Weighing Machines
 Bentwich, Norman de Mattos, Israel
 Benveniste, Emile. Asiatic Languages; Etruscan Language
 Berg, Carl. Battery (*in part*)
 Berg, Eskil. Mercury-Vapour Boiler
 Bergen, Edgar John. Ventriloquism
 Bergenstal, Delbert M., M.D. Animal Extracts
 Berle, Rudolf P. Conspiracy (*in part*)
 Bernal, John Desmond. X-Rays and Crystal Structure
 Bernard, Augustin. Morocco (*in part*); Senegal (*in part*); Tangier (*in part*); Timbuktu (*in part*); Tlemcen (*in part*)
 Bernowitz, M. W. von. Prospecting
 Bernstein, Eduard. Bebel, August (*in part*); Marx, Karl Heinrich (*in part*)
 Bernus, Pierre. Briand, Aristide; Dreyfus, Alfred; Cachin, Marcel (*in part*); Painlevé, Paul; Poincaré, Raymond; Viviani, René
 Berrill, N. J. Tunicata
 Berry, Arthur. Elliptic Functions (*in part*)
 Berry, Arthur John. Chemistry (*in part*)
 Berry, Sir William John. Armour Plates; Battleship (*in part*); Shipbuilding
 Bertelli, Riccardo. Sculpture Technique (*in part*)
 Best, B. W. Bicycle (*in part*)
 Best, Charles Herbert, M.D. Diabetes Mellitus (*in part*)
 Bethe, Hans Albrecht. Neutron
 Betten, Cornelius. Trichoptera
 Bettesworth, W. A. Stoolball
 Bevan, Edwyn R. Alexander III ("The Great") (*in part*); Lysimachus; Perdiccas; Philip V; Ptolemies; Seleucid Dynasty (*in part*)
 Bewes, Wyndham A. Bailiff and Bailie (*in part*); Inheritance (*in part*); Instalment Purchase (*in part*); International Law, Private (*in part*); Trust and Trustees (*in part*)
 Beyer, Richard L. Hunter, Robert
 Beza, Marcu. Rumanian Language and Literature (*in part*)
 Bezzant, Rev. Canon James Stanley, B.D. England, The Church of (*in part*)
 Bhownaggee, Sir Mancherjee Merwanjee. Patel, Framjee Nasarwanjee (*in part*)
 Bibesco, Prince Antoine. Rumanian Language and Literature (*in part*)
 Bickley, Francis. Diplomatic (*in part*); Record
 Bicknell, Edward John, D.D. Athanasius "The Great"
 Bidou, Henri. Joffre, Joseph Jacques Césaire; Lanrezac, Charles Louis
 Bieber, Ralph Paul. Missouri (*in part*); St. Louis
 Bigg, Rev. Charles, D.D. Philo (*in part*)
 Billings, Marland P. Fault; Folds
 Bills, Arthur Gilbert. Efficiency, Conditions of; Fatigue (*in part*); Psychology, History of (*in part*)
 Bills, Charles E(verett). Cod Liver Oil
 Bingham, Howard. Aerodrome
 Bingham, J. Lyman. Athletic Sports (*in part*)
 Bingham, Millicent Todd. Cuzco (*in part*); Ica (*in part*); Lima (city) (*in part*); Peru (*in part*)
 Binni, Walter. Drama (*in part*)
 Binnie, William James Eames. Catchment Areas; Reservoirs
 Binyon, Laurence. Chinese Painting; Japanese Painting and Prints
 Birch, Francis Lyall. Cabinet (*in part*); Great Britain (*in part*); High Commission, Court of; Prime Minister (*in part*); Privy Council
 Birkenhead, Frederick Edwin Smith, 1st Earl of. Laws Relating to Real Property and Conveyancing (*in part*)
 Birkhoff, Garrett. Lattice Theory; Mathematics, Foundations of; Number

- Birkhoff, George David. Determinant
 Bishop, Carl W. China (*in part*)
 Bishop, Rev. Herbert Louis. Angola (*in part*);
 Portuguese East Africa (*in part*); St. Thomas
 Bishop, Joseph Bucklin. Goethals, George
 Washington
 Bishop, Lottie Genevieve. Yale University
 Bishop, William John. Ranvier, Louis Antoine
 Bissell, Clinton T. Fireproofing (*in part*)
 Bisset, Charles Barron. Tanganyika (territory)
 (*in part*)
 Bisset, John C. Billiards (*in part*)
 Biswell, Charles Bedford. Resorcinol
 Black, John D. Agricultural Wages; Agricul-
 ture, Census of
 Black, John Sutherland. Gibbon, Edward (*in*
part); Mazzini, Giuseppe (*in part*)
 Blackman, Vernon Herbert. Leaf (*in part*);
 Lianas or Lianas; Palm (*in part*); Pollination
 Blackmore, John. Latter-Day Saints, Reorgan-
 ized Church of Jesus Christ of
 Blagden, Charles Otto. Malay Language (*in*
part)
 Blair, Walter. American Literature
 Blake, Roland P. Factory Inspection
 Blakemore, Thomas L. Arbitration (*in part*)
 Blanchard, Arthur A. Carbonyls, Metal
 Blanchard, Major George Samuel. Korean
 War (*in part*)
 Blanksten, George I. Colombia (*in part*);
 Ecuador (*in part*); Honduras (*in part*);
 Nicaragua (*in part*); Salvador (*in part*)
 Blauch, Lloyd E. Universities (*in part*)
 Bleininger, Albert V. China-Clay (*in part*);
 Chinaware (*in part*)
 Blennerhassett, William Lewis. Finland (*in*
part); Lapland (*in part*); Lusatia
 Blewett, John Paul. Amplifiers
 Bliss, Gilbert Ames. Calculus of Variation
 Bloch, Henry Simon. Crédit Foncier de France;
 Leroy-Beaulieu, Pierre Paul
 Bloch, Joshua. Hebrew Literature
 Block, Burton Peter. Tin
 Blondal, Sigfus. Icelandic Literature (*in part*);
 Sigurðsson, Jón (*in part*)
 Bloom, William. Histology; Microtomy
 Bloomfield, Arthur I. Bill of Exchange in Prac-
 tice
 Błowski, A. A. Sugar (*in part*)
 Blucher, Walter H. Town and City Planning
 Blumberg, General Sir Herbert Edward.
 Marines (*in part*)
 Blumenau, Ralph Klaus. Liège
 Blunden, Edmund Charles. English Literature
 (*in part*)
 Blunt, Charles Jaspar. Tirah
 Blunt, Herbert W. Logic, History of (*in part*)
 Blunt, Irene L. Silk and Sericulture (*in part*);
 Silk Manufacture (*in part*); Silk Trade
 Boal, A. M. Admiralty Jurisdiction (*in part*)
 Boas, Frederick S. Drama (*in part*); English
 Literature (*in part*); Medwall, Henry
 Bogner, Walter Francis. Library Architecture
 (*in part*); Museum Architecture (*in part*);
 Religious and Memorial Architecture (*in*
part); School Architecture (*in part*)
 Böhl, F. M. T., D.D. Abraham; Amorites;
 Canaan, Canaanites (*in part*)
 Bohr, Niels Henrik David. Atom (*in part*)
 Bolte, Charles L. Army (*in part*)
 Bond, Horatio. Fire (*in part*); Fire Protection
 Bone, Sir Muirhead. Dry Point (*in part*)
 Boner, Charles Paul. Electronic Musical In-
 struments
 Bonn, Moritz J. Erzberger, Matthias; Ruhr
 Bonneville, Joseph H. Acceptance (*in part*);
 Accrued Dividends; Accrued Interest; Cer-
 tified Cheque; Commercial Paper (*in part*);
 Controlling Interest; Joint Account; Kiting
 Cheques; Margin (*in part*); Money-Lending
 (*in part*); Panic (*in part*); Stock (*in part*);
 Transfer (*in part*)
 Booth, Franklin. Pen Drawing
 Booth, H. C. Vacuum Cleaner (*in part*)
 Bopp, Karl R. Banque de France
 Borah, William Edgar. Idaho (*in part*)
 Borchard, Edwin. Laws of War
 Bordwell, Walter Percy. Laws Relating to Real
 Property and Conveyancing (*in part*)
 Borgese, Giuseppe Antonio. Italian Literature
 (*in part*)
 Boring, Edwin Garrigues. Consciousness; Or-
 ganic Sensations; Psychology (*in part*);
 Psychology, History of (*in part*); Psycho-
 physics; Titchener, Edward Bradford; Sen-
 sation
 Borley, John Oliver. Seining, Netting and
 Trawling; Whale Fisheries
 Born, Lester K. Archives
 Boswell, A. Bruce. Czarniecki, Stefan; Czar-
 toyrski, Adam Jerzy; Czartoryski, Fryderyk
 Michal; Kollontaj, Hugo; Poland (*in part*);
 Poznan or Posen (*in part*)
 Boswell, Percy George H. Clay (*in part*);
 Conglomerate; Flint; Greywacke; Itacol-
 mite; Limestone; Sand (*in part*); Sand-
 stone; Sedimentary Rocks
 Boswell, Victor Rickman. Artichoke; Bean;
 Beet; Broccoli; Cabbage; Celery; Collards;
 Cucumber; Eggplant; Endive; Muskmelon;
 Mustard; Onion; Parsley; Parsnip; Pea;
 Peanut; Pumpkin; Radish; Salsify; Sea-
 Kale; Shallot; Spinach; Squash; Sweet
 Potato; Tomato; Turnip (*in part*); Vegetable;
 Watermelon
 Bouard, A. de. Palaeography (*in part*)
 Boughton, The Rev. Canon Charles Henry
 Knowler, B.D. Bible Societies
 Boulding, Kenneth E. Futures; Market (*in*
part); Wealth and Income, Concepts of
 Bouquet, Alan Coates, D.D. Conversion (*in*
part); Solomon, Odes of
 Bourcier, James David. Athens (*in part*);
 Balkan Peninsula (*in part*); Bulgaria (*in part*);
 Crete (*in part*); Greek Literature (*in part*);
 Ionian Islands (*in part*); Stambulov, Stefan
 (*in part*)
 Bourdoux, Joseph A. Tactics (*in part*)
 Bouscaren, Timothy Lincoln. Index Librorum
 Prohibitum
 Bousset, Wilhelm, D.Th. Antichrist
 Boussières, G. Polonium (*in part*)
 Bouthillet, Lorraine. Affection
 Boutruche, Robert. Albret; Bastide
 Bovey, Hon. Wilfrid. Quebec (*in part*)
 Bowen, E. G. Wales (*in part*)
 Bowen, Frank C. Ship (*in part*); Shipping Lines
 and Groups (*in part*); Shipping Routes
 Bowen, John Poland. Lighthouses (*in part*)
 Bowen, John T. Electrical Power in Agricul-
 ture (*in part*)
 Bower, Edward. Exhibitions and Fairs (*in*
part)
 Bower, Frederick O. Pteridophyta (*in part*)
 Bowley, Arthur Lyon. Index Numbers; Wages;
 Statistics of United Kingdom
 Bowley, Marian Ellen Alberta. Industry and
 Trade, War Control of (*in part*)
 Bowman, LeRoy E. Community Centres (*in*
part)
 Bown, Ralph. Broadcasting (*in part*)
 Box, Rev. George Herbert, Hon. D.D. Gama-
 liel (*in part*); Hezekiah (*in part*); Isaiah; John
 the Baptist; Jubilee; Libertines, Synagogue
 of the; Messiah and Messias; Nahum; Pass-
 over (*in part*); Pentecost; Pharisees; Sad-
 ducees; Shekinah; Tabernacles, Feast of;
 Urim and Thummim
 Boyajian, Aram. Transformer (*in part*)
 Boycott, Arthur Edwin, M.D. Pathology
 Boyer, Carl Benjamin. Archibald, Raymond
 Clare (*in part*); Lebesgue, Henri Léon;
 Lipschitz, Rudolph Otto Sigmund
 Boynton, Percy Holmes. Novel (*in part*)
 Bozorth, Richard Milton. Diamagnetism; Fer-
 romagnetism; Magnetism; Paramagnetism
 Brachet, Jean Louis Auguste, M.D. Embryol-
 ogy, Chemical
 Brackenbury, Sir Henry Britten, M.D. Insect
 Bites and Stings
 Bradbury, Frederick. Sheffield Plate
 Brade-Birks, Rev. S. Graham. Centipede (*in*
part)
 Braden, Charles S. Rosicrucianism
 Bradford, Frederick Charles. Plant Propaga-
 tion
 Bradford, Gamaliel. Webster, Daniel
 Bradford, William Leslie, M.D. Scarlet Fever
 Bradley, Alice. Cookery (*in part*)
 Bradley, Henry. Beowulf (*in part*); English
 Literature (*in part*); Heliand (*in part*); Slang
 (*in part*)
 Bradley, Stanley E., M.D. Kidney, Diseases of
 Bradley, Wilmot Hyde. Coprolites (*in part*)
 Bradshaw, Harold Chalton. Roman Architec-
 ture (*in part*)
 Bradshaw, Mary N. L. Roman Architecture
 (*in part*)
 Bradshaw, Percy V. Poster (*in part*)
 Brady, Alexander. Canada (*in part*); Ontario
 (*in part*)
 Brambell, F. W. Rogers. Balanoglossus; Hemi-
 chordata
 Brand, Donald D. Tarascans
 Brandeis, Elizabeth. Workmen's Compensation
 (*in part*)
 Brandenburg, Erich. Berlin (*in part*); Bülow,
 Bernhard; Germany (*in part*); Prussia (*in*
part); William II
 Brandin, Louis M. Anglo-Norman Literature;
 Catalan; Charlemagne Legends; French
 Language; Provençal Language and Litera-
 ture (*in part*); Rhaeto-Romance Languages;
 Romance Languages; Rumanian Language
 and Literature (*in part*)
 Brandt, Coenraad Dirk Jan. Holland (*in part*);
 Holland, County and Province of (*in part*);
 Netherlands (*in part*)
 Brandt, William E. Baseball (*in part*)
 Branford, Victor. Sociology
 Brangwyn, Sir Frank. Mural Painting
 Branham, Sara Elizabeth, M.D. Meningitis
 Braunholtz, Hermann Justus, Easter Island
 (*in part*); Oceania (*in part*)
 Bray, Huly Edwin. Surplus Property Disposal
 (U.S.) (*in part*)
 Brearley, Harry. Rustless Steel
 Breasted, James H. Ikhnaton; Tutenkhamon
 Brecht, Arnold. Government Departments (*in*
part)
 Breck, Eduard. Kite-Flying (*in part*)
 Breder, C. M., Jr. Aquarium
 Bredin, G. R. F. Gezira
 Bredsdorff, Elias Lunn. Drama (*in part*)
 Brenier, Henri. Indo-China, French (*in part*);
 Morocco (*in part*)
 Brereton, Cloudeley. Academies (*in part*);
 Classical Education (*in part*); Education,
 History of (*in part*); Examinations (*in*
part); Foreign Languages, Teaching of (*in*
part); Oxford University (*in part*); Universi-
 ties (*in part*)
 Bressey, Sir Charles Herbert. Roads and
 Streets (*in part*)
 Bresson, Marcelle M. Madagascar (*in part*)
 Breton, Norton. Silk and Sericulture (*in part*);
 Silk Manufacture (*in part*)
 Brett, Michael. Salvage (*in part*)
 Bretz, J. Harlen. Korea (*in part*); United
 States (of America), The (*in part*)
 Brewer, Nathan, D.V.M. Animal Experimen-
 tation; Foot-and-Mouth Disease
 Brewster, James. Connecticut (*in part*)
 Bridaham, Lester Burbank. Museums and Art
 Galleries (*in part*)
 Bridges, Sir Edward Ettingdene. Bank Holi-
 days; Civil Service (*in part*); Pensions (*in*
part)
 Bridgewater, H. M. Chain Manufacture (*in*
part)
 Bridgman, Edward C. Drawing, Anatomical
 (*in part*)
 Bridgman, George B. Drawing, Anatomical
 (*in part*)
 Bridgman, P. W. Dimensional Analysis
 Briggs, Asa. Corn Laws (*in part*); Disarma-
 ment; English History (*in part*)
 Brill, John L. Cellophane
 Brill, Walter H., Jr., M.D. Streptomycin
 Brinckerhoff, A. F. Landscape Architecture (*in*
part)
 Brinckerhoff, Henry M. Traffic and Traffic
 Regulations (*in part*)
 Brinkley, Captain Frank. Japan (*in part*)

- Briscoe, Herman Thompson. Calcium
 Bristol, Margaret C. Charity (*in part*)
 Brock, Alan St. Hill. Fireworks; Flare
 Brockway, Lawrence Olin. Electron Diffraction
 Brodd, Lawrence S. Curling
 Brode, Robert Bigham. Wilson Cloud Chamber (*in part*)
 Brodie, Bernard. Pacific, Command of the; Sea Power
 Brodie, Lawrence Sabin. Compass (*in part*)
 Brodie, Thomas Gregor, M.D. Muscle, Structure of; Phagocytosis
 Brodribb, Rev. William Jackson. Tacitus, Cornelius (*in part*)
 Brody, Samuel. Growth
 Broek, Jan O. M. Asia (*in part*); Batavia (*in part*); East Indies (*in part*); Jambi (*in part*); Java (*in part*); Lampong (The) (*in part*); Palembang (*in part*); Sumatra (*in part*)
 Bronson, Dorrance Crawford. Pensions (*in part*)
 Broodbank, Sir Joseph Guinness. London (*in part*)
 Brooke, Major General Geoffrey. Horsemanship and Riding (*in part*)
 Brooke, George Doswell. New York, Chicago and St. Louis Railroad
 Brooke, Squadron Leader J. C. Seaplane (*in part*)
 Brooks, C. E. P. Africa (*in part*); Asia (*in part*); Climatic History
 Brooks, R. C. Baker, Newton Diehl; Progressive Party, U.S. (*in part*)
 Brooks, Robert Preston. Georgia
 Brooks, Van Wyck. James, Henry; Twain, Mark
 Broome, Dorothy M. Chamber, The King's; Household, The Royal or Curia Regis; Seals (*in part*)
 Broomhall, G. P. Grain Production and Trade
 Brouwer, Dirk. Celestial Mechanics; Trojan Planets
 Browett, F. T. Boot and Shoe Industry
 Brown, A. Curtis. Royalties
 Brown, Andrew Wilson. Psychology (*in part*)
 Brown, Arthur C. Barrington. Joins
 Brown, Arthur E. Brick (*in part*)
 Brown, Charles A. C. Windmills and Wind Power (*in part*)
 Brown, Charles E. Signal Corps, U.S.; Tanks
 Brown, Charles Reynolds, D.D. Edwards, Jonathan
 Brown, Frank A., Jr. Hormones, Invertebrate
 Brown, Sir Frank Herbert. Halifax, Edward Frederick Lindley Wood, 3rd Viscount (*in part*); Lajpat Rai, Lala; Naidu, Sarojini (*in part*); Nehru, Pandit Motilal; Sankaran Nair, Sir Chettur; Sapru, Sir Tej Bahadur (*in part*); Sastri, V. S. Srinivasa (*in part*)
 Brown, Frederic K. Snow-Shoes (*in part*)
 Brown, Horatio Robert Forbes. Venice (*in part*)
 Brown, Irving. Gypsies (*in part*)
 Brown, Ivor. Drama (*in part*)
 Brown, Lieutenant General Sir John. Territorial Army (*in part*)
 Brown, Peter Gordon. Annuity (*in part*); Expectation of Life; Industrial Insurance (*in part*); Insurance: Post Office Facilities
 Brown, Ray E. Clinic
 Brown, Roland Wilbur. Eocene and Palaeocene
 Brown, Walter J. San Francisco (*in part*)
 Brown, William, M.D. Body and Mind
 Brown, William. Plants and Plant Science (*in part*)
 Brown, William Adams, D.D. Fundamentalism
 Brownback, Henry Lowe. Motor Car (*in part*)
 Browne, Frank A. Road Roller
 Browne, Frederick Lincoln. Casein
 Browne, Harris Warren C. Printing Type (*in part*)
 Brownlee, Emery A. Legal Aid (*in part*)
 Brownlee, John, M.D. Epidemiology (*in part*)
 Brownlee, Oswald H. Income Tax
 Brownlow, Rt. Rev. William R., D.D. Catacombs (*in part*)
 Bruce, Barry Wallace. Boxmaking
 Bruce, Brigadier General Hon. Charles Granville. Everest, Mount (*in part*)
 Bruce, William Cabell. Randolph, John
 Brues, Charles Thomas. Ant
 Brügel, Fritz. Kautsky, Karl
 Bruman, Henry J. Argentina (*in part*); Chile (*in part*); Peru (*in part*); South America (*in part*)
 Brummitt, Wyatt B. Photography (*in part*)
 Brundage Avery. Olympic Games
 Bruno, Frank John. Relief (*in part*)
 Brunson, Mark V. Barracks (*in part*)
 Brunstetter, Max Russell. Motion Pictures (*in part*)
 Brunt, David. Dust; Rainbow
 Bryant, Carroll L. Drowning and Lifesaving
 Bryce, Rt. Hon. James, 1st Viscount Bryce. Justinian I (*in part*)
 Bryson, Gladys. Nation, Carry
 Buchanan, Sir George Seaton, M.D. Public Health (*in part*)
 Buchanán, L. M. Dongola (*in part*)
 Buchanan, Norman Sharpe. Company Promotion
 Buchholz, John T. Gymnosperms (*in part*)
 Buck, Solon Justus. Minnesota (*in part*)
 Buckle, George Earle. Balfour, Arthur James Balfour (*in part*); Grey of Fallodon, Edward Grey (*in part*); Law, Andrew Bonar; McKenna, Reginald
 Buckley, Francis. Glass (*in part*)
 Buckley, J. W. Electric Furnaces
 Buckley, Millard. Rolls-Royce Limited (*in part*)
 Buckman, Harry Oliver. Physical Natural Resources (*in part*)
 Buckmaster, Barbara. Rumania (*in part*)
 Bucy, Paul C., M.D. Apoplexy; Brain (*in part*)
 Budberg, Baroness Maura. Drama (*in part*)
 Budden, Lionel Bailey. Architectural Education (*in part*)
 Buddenbrock-Hettersdorf, Wolfgang Von. Sight, Sense of; Touch, Sense of
 Buddington, Arthur F. Sill
 Buettner-Janusch, John. Central America (*in part*)
 Bull, A. J. Bank-Notes (*in part*)
 Bullene, Major General E. F. Biological Warfare
 Bulliet, Clarence Joseph. Chicago (*in part*)
 Bullock, Alan. Germany (*in part*)
 Bullock, Fred. Veterinary Science (*in part*)
 Bullocke, J. G. Austrian Succession, War of The (*in part*); Collingwood, Cuthbert Collingwood (*in part*); Copenhagen (*in part*); First of June (*in part*); French Revolutionary Wars (*in part*); Lepanto, The Battle of (*in part*); Napoleonic Campaigns (*in part*); Nile, Battle of The (*in part*); Saints, Battle of The (*in part*); Toulon (*in part*); Trafalgar, The Battle of (*in part*)
 Bunbury, Sir Edward Herbert. Pompeii (*in part*); Ptolemy (*in part*)
 Bunche, Ralph J. Beira; Belgian Congo (*in part*); Nairobi; Portuguese East Africa or Mozambique (*in part*)
 Bunn, E. S. Brass Manufactures (*in part*)
 Burch, Dallas S. Sheep (*in part*)
 Burford, Thomas Hannahan, M.D. Heart and Lung, Surgery of
 Burg, Anton B. Borax; Boric Acid; Borides; Boron
 Burgess, Ernest Watson. Park, Robert Ezra
 Burgess, Robert Wilbur. Graphic Methods in Mathematics
 Burke, Agnes. Children's Games (*in part*)
 Burke, Henry Penn. Rowing (*in part*)
 Burkholder, Paul Rufus. Botanical Society of America
 Burkitt, Francis Crawford, D.D. Apocalypse; Bible (*in part*); Edessa (*in part*); Mandaeans; Syriac Language
 Burkitt, Miles Crawford. Archaeology (*in part*); Eoliths; Flints; Typology
 Burkman, Eric C. United States Rubber Company
 Burls, G. A. Internal Combustion Engines
 Burn, William Laurence. British Honduras (*in part*); Guiana (*in part*)
 Burnet, Frank Macfarlane, M.D. Filterable Viruses
 Burnham, William H. School Hygiene and Physical Education
 Burpee, Lawrence Johnston. Canadian Literature (*in part*); Ottawa (*in part*)
 Burrard, Major Sir Gerald. Big Game Hunting; Pig-Sticking or Hog-Hunting (*in part*)
 Burrow, Thomas. India (*in part*)
 Burrows, George Thomas. Bowls (*in part*)
 Burrows, Millar, B.D. Job
 Burrows, William. Cholera
 Burrows, Rt. Rev. Winfrid Oldfield, D.D. Absolution
 Burstein, Sona Rosa. Tabu
 Burtt, Harold Ernest. Psychology (*in part*)
 Bury, John Bagnell. Alexius I; Alexius II (*in part*); Alexius III; Gibbon, Edward (*in part*); Roman Empire, Later
 Bury, John Patrick Tuer. France (*in part*)
 Bush, Vannevar. Harmonic Analysis
 Bushnell, Asa A. Football (*in part*)
 Buss Kenneth Caron. Aleppo (*in part*); Cyprus (*in part*); Egypt (*in part*); Iraq (*in part*); Lebanon (*in part*); Persia (*in part*); Sudan; Sudan, Anglo-Egyptian (*in part*); Syria (*in part*); Turkey (*in part*)
 Butler, Arthur John. Dante (or Durante) Alighieri (*in part*)
 Butler, Rt. Rev. Edward Cuthbert. Benedict of Nursia, Saint; Brigitines; Canon (*in part*); Clara, Saint; Dominic, Saint (*in part*); Franciscans; Francis of Assisi, St. (*in part*); Groat, Gerhard (*in part*); Imitation of Christ, The (*in part*); Mabillon, John; Maurists; Mechitarists; Mendicant Movement and Orders (*in part*); Servites or "Servants of Mary"; Thomas of Celano; Trappists
 Butler, Elmer Grimshaw. American Society of Zoologists; Zoological Societies (*in part*)
 Butler, Francis H. Compass (*in part*); Hunter, John (*in part*)
 Butler, H. J. Carriage
 Butler, Nicholas Murray. Columbia University
 Butler, Richard A. Conservative Party, British
 Butts, A. B. Mississippi (*in part*)
 Butts, Allison. Copper (*in part*)
 Buxton, Claude E. Transfer of Training
 Buxton, L. H. Dudley. Ainu; Asia Minor (*in part*); Basra (*in part*); China (*in part*); Euphrates; Kirghis; Kish; Mesopotamia (*in part*); Mongolia (*in part*); Mosul (*in part*); Nineveh; Nippur; Races of Mankind; Sarts; Seleucia; Shuruppak; Tigris; Turkomans; Turks (*in part*); Ur
 Buxton, Travers. Slavery Convention
 Byers, Horace Robert. Anticyclone; Blizzard; Broken Bow, Spectre of the Broken; Convection; Crepuscular Rays; Cyclone; Dol-drums; Gale; Hurricane; Insolation; Isallo-bars; Isobar; Isopycnic; Isosteres; Storm
 Byrd, Harry Flood. Virginia (*in part*)
 Byrd, Richard Evelyn. Peary, Robert Edwin
 Byrne, Paul Ryan. Notre Dame, University of (*in part*)
 Cabrera, Luis. Carranza, Venustiano
 Cadbury, Henry Joel, D.D. Luke, Gospel of
 Caddow, H. A. Burgundy Wines; Champagne Wines; Claret; Hock; Moselle Wines; Port Wine; Sauternes; Sherry; Wine
 Cadman, John, 1st Baron Cadman. Anglo-Persian (now Anglo-Iranian) Oil Company, Ltd. (*in part*)
 Cady, Gilbert Haven. Coal and Coal Mining (*in part*); Lignite; Neon
 Caesar, George V. Starch (*in part*)
 Cairns, James Ford. Australia (*in part*)
 Cajori, Florian. Binomial Formula; Geometry (*in part*); Logarithms
 Caldwell, William Elmer. Gold (*in part*)
 Calingaert, George. Organometallic Compounds (*in part*)
 Calkins, Mary W. Royce, Josiah (*in part*)
 Callender, Hugh Longbourne. Black Body; Calibration; Heat (*in part*); Thermodynamics (*in part*); Vaporization
 Callender, Sir Geoffrey Arthur Romaine. Ar-

- mada, The (*in part*); Austrian Succession, War of The (*in part*); Chioggia (*in part*); Collingwood, Cuthbert Collingwood (*in part*); Copenhagen (*in part*); Dutch Wars (*in part*); First of June (*in part*); French Revolutionary Wars (*in part*); Grand Alliance, War of The (*in part*); La Hogue, Battle of (*in part*); Lepanto, The Battle of (*in part*); Napoleonic Campaigns (*in part*); Navarino, Battle of (*in part*); Nile, Battle of the (*in part*); Quiberon, Campaign and Battle of (*in part*); Saints, Battle of the (*in part*); Seven Years' War (*in part*); Spanish Succession, War of The (*in part*); Toulon (*in part*); Trafalgar, The Battle of (*in part*).
- Callwell, Major General Sir Charles Edward.** Balkan Wars, 1912-13; Dardanelles Campaign; Mesopotamia, Operations in
- Calman, William Thomas.** Barnacle; Branchiopoda (*in part*); Cirripedia (*in part*); Copepoda (*in part*); Crab (*in part*); Crustacea (*in part*); Malacostraca (*in part*); Ostracoda; Rotifera (*in part*); Tereido (*in part*); Trilobita; Water-Flea; Wood Louse (*in part*)
- Calver, James L.** Everglades
- Cam, Helen M.** Borough (*in part*); Mayor (*in part*)
- Cameron, Norman Alexander, M.D.** Abnormal Psychology; Defense Mechanisms
- Cammaerts, Emile.** Belgium (*in part*); Mercier, Désiré
- Campbell, Rev. Lewis.** Jowett, Benjamin (*in part*)
- Campbell, Mildred.** Absentee Ownership
- Campion, Sir Gilbert Francis Montriou.** Parliament (*in part*)
- Can, Frank Richardson.** Africa (*in part*); Angola (*in part*); Belgian Congo (*in part*); Benin; Camerons (*in part*); Congo; Congo Free State (*in part*); Egypt (*in part*); French Guinea (*in part*); Gold Coast (*in part*); Ibadan; Liberia (*in part*); Madagascar (*in part*); Natal (*in part*); Niger; Nigeria (*in part*); Nile (*in part*); Nyasaland Protectorate (*in part*); Orange Free State (*in part*); Portuguese East Africa or Mozambique (*in part*); Rio de Oro; St. Helena (*in part*); Senegal colony (*in part*); Senussi and Senussites (*in part*); Sierra Leone; Sokoto (*in part*); Stanley, Sir Henry Morton; Sudan, Anglo-Egyptian (*in part*); Timbuktu (*in part*); Tlemcen (*in part*); Togoland (*in part*); Transvaal (*in part*); Tripolitania (*in part*); Uganda (*in part*); Wadai (*in part*); West Africa; Zambezi; Zululand (*in part*)
- Canby, Henry Seidel.** Cather, Willa Sibert; Lewis, Sinclair (*in part*)
- Cannon, Clarence.** Parliamentary Law
- Capers, Gerald M.** New Orleans (*in part*)
- Capper, Arthur.** Kansas (*in part*)
- Capper, W. Bentley.** Hotel (*in part*)
- Carlsen, Emil.** Still-Life Painting
- Carlson, Kenneth S.** Blockade (*in part*); Neutrality (*in part*)
- Carlyle, Margaret Monteith.** Italy (*in part*)
- Carmichael, Robert Daniel.** Barycentric Calculus; Diagram (*in part*); Dimension; Geometries, Finite; Infinity and the Infinite; Limit
- Carmody, John M.** Relief (*in part*)
- Carpender, J. W. J., M.D.** Radiology (*in part*)
- Carpenter, Charles M., M.D.** Leprosy (*in part*)
- Carpenter, F. M.** Neuroptera (*in part*)
- Carpenter, Rhys.** Spain (*in part*)
- Carpenter, Thorne Martin.** Animal Heat
- Carpenter, William M.** Electrical Power: National and Regional Schemes (*in part*); Electricity Supply: Technical Aspects (*in part*)
- Carr, Albert Raymond Maillard.** Bonde, Gustav
- Carr, Sir Cecil.** Provisional Order
- Carrel, Alexis, M.D.** Tissue Culture
- Carrier, Willis H.** Air Conditioning (*in part*)
- Carroll, George.** Winter Sports
- Carroll, Henry King.** Mennonites (*in part*);
- Moravian Brethren** (*in part*)
- Carroll, John Anthony.** Eclipse (*in part*)
- Carr-Saunders, Sir Alexander Morris.** Eugenics; Population
- Carson, George Barr, Jr.** Bolshevism (*in part*)
- Carter, Elliott C.** Music (*in part*)
- Carter, George Stuart.** Animals, Phylogeny of
- Carter, H. B.** Reuters (*in part*)
- Cartier, Jacques.** Jewellery (*in part*)
- Cartwright, Morse Adams.** Adult Education (*in part*)
- Carver, Thomas Gilbert.** Salvage (*in part*)
- Cary, Max.** Actolia; Argos (*in part*); Aristides; Athens (*in part*); Hellenism; Heraculus; Irene (*in part*); Justin II; Macedonian Empire; Manuel I. Comnenus; Pericles; Phrygia; Plataea; Punic Wars; Salamis
- Case, H. C. M.** Agricultural Economics (*in part*); Agricultural Labourer (*in part*); Farm Management (*in part*); Farm Rents (*in part*); Small Holdings (*in part*)
- Casey, Robert Pierce.** Anathema (*in part*); Simon Magus
- Casey, Robert S.** Ink (*in part*)
- Casey, T. W.** War Pensions (*in part*)
- Cassels, Donald E., M.D.** St. Vitus' Dance
- Cassino, Jay Allen.** Government Departments (*in part*)
- Cassirer, Ernst.** Neo-Kantianism; Rationalism; Substance; Transcendentalism; Truth
- Casson, Stanley.** Rumania (*in part*)
- Castle, Egerton.** Book-Plates
- Cater, Harold Dean.** Minnesota (*in part*)
- Cathcart, Edward Provan, M.D.** Nutrition
- Catlin, Warren B.** Hours of Labour (*in part*)
- Caton-Thompson, Gertrude.** Stratigraphy
- Cauthen, Charles Edward.** South Carolina (*in part*)
- Cecil, Lady Gwendolen.** Salisbury, Robert Arthur Talbot Gascoyne-Cecil, 3rd Marquis of
- Cestre, Charles.** Poe, Edgar Allan
- Chadwick, Sir David Thomas.** Imperial Economic Committee (*in part*)
- Chadwick, Hector Munro.** Anglo-Saxons; Britain (*in part*); Goths (*in part*); Jutes; Teutonic Peoples (*in part*); Thor
- Chadwick, James.** Radioactivity, Natural (*in part*)
- Chalkley, Alfred Philip.** Motor-Boat (*in part*)
- Chalmers, Henry.** Tariffs (*in part*)
- Chalmers, Sir Mackenzie Dalzell.** Bill of Exchange (*in part*); Sale of Goods (*in part*)
- Chamberlain, Paul M.** Watches (*in part*)
- Chamberlain, William Henry.** Brunei (*in part*); Fiji; Gilbert and Ellice Islands; Japan (*in part*); Melanesia; Micronesia; New Britain; New Hebrides; Pacific Islands (Oceania); Russia (*in part*); Tonga
- Chambers, Sir Edmund Kerchever.** Shakespeare, William (*in part*)
- Chambers, H.** Seed Trade (*in part*)
- Chambers, Robert.** Micromanipulation or Microscopy (*in part*); Protoplast (*in part*)
- Champion, Pierre.** Joan of Arc (*in part*)
- Chancellor, Edwin Beresford.** Clubs (*in part*)
- Chandrasekhar, Subrahmanyan.** Chromosphere (*in part*); Galaxy
- Chaney, Ralph Works.** Palaeobotany
- Channing, Edward Adams, John; Adams, John Quincy; Adams, Samuel**
- Chapman, Charles Edward.** California (*in part*); Cuba (*in part*)
- Chapman, Sydney.** Atmosphere; Aurora Polar
- Chapple, Bennett.** Tin-Plate and Terne-Plate
- Charles, Cecil Marvin, M.D.** Reproductive System (*in part*)
- Charles, Robert Henry, D.D.** Apocalyptic Literature (*in part*); Apocryphal Literature (*in part*); Baruch (*in part*); Daniel (*in part*); Enoch, Book of (*in part*); Ezra, Fourth Book (or Apoclypse) of (*in part*); Jeremy, Epistle of; Jubilees, Book of (*in part*); Judith, The Book of (*in part*); Manasses, Prayer of (*in part*); Moses, Assumption of; Solomon, Psalms of; Testaments of The Twelve Patriarchs
- Charr, Robert, M.D.** Respiratory System, Diseases of
- Chase, Edna Woolman.** Forms of Address (*in part*)
- Chase, Philip Putnam.** New England
- Chase, Winn W.** Cotton and the Cotton Industry (*in part*); Rain-Proof Fabrics
- Chaumeix, André.** France, Anatole
- Cheatham, Elliott E.** Legal Education (*in part*)
- Cheney, Sheldon.** Theatre (*in part*)
- Chen, Pu-lai.** World War II (*in part*)
- Chesterton, Gilbert Keith.** Dickens, Charles John Huffam
- Cheyne, Rev. Thomas Kelly, D.D.** Esther (*in part*); Jonah
- Child, Charles Manning.** Axial Physiological Gradients
- Childe, V. Gordon.** Europe (*in part*); Scythia (*in part*); Skara Brae
- Childs, Major General Sir Borlase Elward.** Wyndham. Military Law (*in part*)
- Childs, Marquis William.** Adams, Brooks
- Chinnock, A. Vaughan.** Phosgene
- Chipman, William Joseph.** Football (*in part*)
- Chisholm, Cecil.** Instalment Selling (*in part*)
- Chisholm, George Goudie.** Sicily (*in part*)
- Chisholm, Hugh.** Albert, Prince Consort of England; Balfour, Arthur James Balfour, 1st Earl of (*in part*); Canon (*in part*); Edward VII (*in part*); George IV (*in part*); Meredith, George; Parliament (*in part*); Sherbrooke, Robert Lowe; Walter, John (*in part*)
- Chitwood, B. G.** Nematoda
- Chivers, Joseph Hardy, M.D.** Industrial Medicine (*in part*)
- Cholet, Bertram.** Brush (*in part*)
- Chopra, Ram Nath, M.D.** Opium Eating and Opium Smoking
- Chree, Charles.** Inclinator
- Christensen, Aksel E.** Denmark (*in part*)
- Christensen, Georg.** Danish Language and Literature (*in part*)
- Chrystal, George.** Perpetual Motion (*in part*)
- Church, George Earl.** Plata, Rio de la, or River Plate (*in part*)
- Church, P. E.** United States (of America), The (*in part*)
- Church, Randolph W.** Virginia (*in part*)
- Church, The Very Rev. Richard William, D.D.** Lombards or Langobardi (*in part*)
- Cislak, Francis Edward.** Coal Tar; Creosote; Toluene
- Clancy, Frederick M.** ("Fog Horn"). Rodeo
- Claremont, Claude A.** Montessori System
- Clark, Albert Curtis.** Cicero
- Clark, Alfred Joseph, M.D.** Heart, Comparative Physiology of
- Clark, Austin Hobart.** Echinoderma (*in part*); Sea-Urchin (*in part*); Star-Fish
- Clark, Charles Edward.** Appeal (*in part*); Landlord and Tenant (*in part*); Practice and Procedure (*in part*)
- Clark, Charles Manning Hope.** Australian Literature
- Clark, Eugene Francis.** Dartmouth College
- Clark, George Lindenberg.** X-Rays, Nature of (*in part*)
- Clark, George Norman.** Holland (*in part*); Netherlands (*in part*)
- Clark, Harry Hayden.** Freneau, Philip Morin
- Clark, Walter.** Filters, Light; Photography (*in part*)
- Clark, William Bell.** Barry, John; Biddle, James; Conyngham, Gustavus; Dale, Richard; Du Pont, Samuel Francis; Fiske, Bradley Allen; Fleet Auxiliary Vessels; Fleet, Naval (*in part*); Gleaves, Albert; Hopkins, Esk; Jones, Jacob; Jones, John Paul; King, Ernest Joseph (*in part*); Leahy, William Daniel; Marines (*in part*); Mayo, Henry Thomas; Truxton, Thomas
- Clark, William D.** Crown; Custom House; Rupee (*in part*); Sterling
- Clark, Sir William Henry.** Trade Facilities
- Clark, W(illiam) Mansfield.** Hydrogen Ions
- Clarke, Alexander Ross.** Map (*in part*)
- Clarke, E. Gladys.** Cookery (*in part*); Salad; Sauce
- Clarke, George Sydenham, 1st Baron Sydenham of Combe.** Graeco-Turkish War

- Clarke, Rev. William Kemp Lowther, D.D. Apollos; Catechumen; Joseph of Arimathea; Matthias (Disciple); Philip (Evangelist)
- Clay, Charles. Alberta (*in part*); British Columbia (*in part*); Canada (*in part*); Chatham (New Brunswick); Chatham (Ontario); Chicoutimi; Crémazie, Octave; Guelph; Kingston (Ontario); Labrador (*in part*); Manitoba (*in part*); New Brunswick (*in part*); Newfoundland (*in part*); Northwest Territories (*in part*); Nova Scotia (*in part*); Ontario (*in part*); Ottawa (*in part*); Parker, Sir Gilbert; Prince Edward Island (*in part*); Quebec (province); Rouyn; St. Pierre and Miquelon; Saskatchewan (*in part*); Saskatoon; Shawinigan Falls; Three Rivers; Timmins; Toronto (*in part*); Ungava; Vancouver; Victoria; Winnipeg; Yukon Territory
- Clay, R. C. C. Stonehenge
- Clay, Reginald S. Kaleidoscope; Mirror (*in part*); Spectacles
- Clemence, Gerald M. Time Measurement (*in part*)
- Clement, Martin W. Pennsylvania Railroad Company, The
- Clements, F. Bessemer Steel (*in part*); Blast Furnace
- Clerc, Charly. Ramuz, Charles Ferdinand
- Clerke, Agnes Mary. Astronomy (*in part*); Copernicus or Koppernigk, Nicolaus; Galileo Galilei (*in part*); Humbolt, Alexander (*in part*); Mayer, Johann Tobias (*in part*)
- Clery, Arthur Edward. Brehon Laws (*in part*)
- Clifford, Sir Hugh. Borneo (*in part*); Borneo, State of North (*in part*); Johore (*in part*); Malacca; Malay Language (*in part*); Malay Peninsula (*in part*); Malays; Malay States (*in part*); Singapore
- Clifton, Colonel Chester V. Korean War (*in part*)
- Climenhaga, Rev. A. W. Brethren in Christ Clinchy, Everett Ross. Anti-Semitism (*in part*)
- Cline, Howard F. Acapulco; Anahuac; Hidalgo; Manzanillo; Matamoros; Mazatlán; Mexico (*in part*); Mexico; Mexico, Federal District of; Mexico City; Monterrey; Nayarit; Nuevo Leon; Oaxaca; Oaxaca de Juarez; Mérida; Michoacán; Orizaba; Puebla (city); Puebla; Quintana Roo; Queretaro; Salina Cruz; Saltillo; Sinaloa; Sonora; Tlaxcala; Toluca; Valladolid; Veracruz (state); Veracruz (town)
- Clouzot, E. International Bureaus
- Coad, B. R. Ball Weevil, Cotton (*in part*)
- Cobb, George Watson, Jr. Canning, Commercial (*in part*)
- Cobb, James Harrel. Churches of Christ; Jehovah's Witnesses
- Cobb, John W. Gas Manufacture (*in part*)
- Cochaux, Henri. Arbitration (*in part*)
- Cockerell, Douglas B. Bookbinding (*in part*)
- Cockfield, Francis Arthur. Income Tax: In Practice (*in part*)
- Cocks, Dorothy. Hair (*in part*); Manicuring
- Coe, Wesley R. Nemertea; Sex Ratio (*in part*)
- Coetzee, Abel Jacobus. South African Literature (*in part*)
- Coffman, Lotus Delta. Minnesota, University of (*in part*)
- Cogdon, Ronald Stephenson. Jetty (*in part*)
- Coggeshall, Lowell T., M.D. Malaria
- Coghill, Robert de Wolf. Purines
- Cohen, Arthur Le Roy. Mycetoza or Myxomycetes
- Cohen, E. Richard. Fundamental Physical Constants (*in part*)
- Cohen, I. Bernard. Camera Obscura
- Cohen, Julius Henry. Port Authority (*in part*)
- Cohen, Karl. Diffusion
- Coker, Ernest George. Pulley
- Colby, Colonel Elbridge. Militia
- Cole, Alan Summerly. Textile Printing (*in part*)
- Cole, Felix. Algeria (*in part*); Algiers (*in part*)
- Cole, George Douglas Howard. Butler, Samuel; Ca' Canny; Cobbett, William; Co-operation; Fabian Society; Guild Socialism; Industrial Councils; Industrial Court; Industrial Health Board; Marx, Karl Heinrich (*in part*); Labour Party, The; Minimum Wage (*in part*); Socialism; Strikes and Lock-outs (*in part*); Syndicalism; Trade (Labour) Unions (*in part*); Wage-Systems in Industry
- Cole, LaMont C. Physical Natural Resources (*in part*)
- Cole, Leon Jacob. Sex Ratio (*in part*)
- Cole, Sanford D. Affreightment; Bottomry; Code; Fisheries, Law of (*in part*); Navigation Laws
- Cole, Sonia Mary. Kenya (colony) (*in part*)
- Cole, Sydney W. Proteins
- Coleman, Arthur Philemon. Canada (*in part*); Quebec (*in part*)
- Coleman, Christopher Bush. Indiana (*in part*)
- Coleman, G. S. Sanitation of Buildings (*in part*); Sewer Construction
- Coleridge, Ernest Hartley. Byron, George Gordon Byron, 6th Baron (*in part*)
- Colgate, R. T. Bread and Bread Manufacture (*in part*)
- Colles, Henry Cope. Ravel, Maurice
- Collier, Theodore Freylinhuysen. Innocent (*in part*); Sixtus V
- Collinge, Walter E. Ornithology (*in part*)
- Collins, George Rowland. Jobber; Retailing (*in part*)
- Collins, K. Ruth. Drop Forging (*in part*)
- Collins, Rt. Rev. William Edward, D.D. Establishment (*in part*); Testamentum Domini
- Collum, V. C. C. Carnac (*in part*); Stone Monuments, Primitive
- Collyer, Brigadier General John J. East Africa, Operations in; South-West Africa, Campaign in
- Colvin, Charles Herbert. Air Log or Air Distance Recorder
- Colvin, Fred Herbert. Automatic Machines; Machine-Tools (*in part*); Valves (Mechanical)
- Colvin, Sir Sidney. Bellini (*in part*); Dürer, Albrecht (*in part*); Giorgione (*in part*); Giotto (*in part*); Leonardo da Vinci (*in part*); Michelangelo (*in part*)
- Colyer, Douglas. Air Forces (*in part*); Air Raids; Government Departments (*in part*); Great Britain (*in part*)
- Comber, Christine. Bruce of Melbourne, Stanley Melbourne Bruce, 1st Viscount
- Compton, Arthur Holly. Compton Effect
- Comrie, Leslie John. Ephemeris
- Condit, Ira Judson. Fig; Olive
- Condliffe, John B. Free Trade
- Connick, Robert Elwell. Cadmium (*in part*); Francium; Zinc (*in part*)
- Constable, William George. Museums and Art Galleries (*in part*)
- Contenau, G., M.D. Asia Minor (*in part*)
- Contreras, Carlos. Spanish-American Architecture
- Converse, Paul D. Broker
- Conway, Robert Seymour. Iovillae; Praeneste (*in part*)
- Conybeare, Frederick Cornwallis. Ablution; Armenian Literature (*in part*)
- Coode, Arthur T. Dredges and Dredging (*in part*)
- Cook, A. C. Cattle (*in part*)
- Cook, James Wilfred. Carcinogenic Hydrocarbons; Hydrocarbon; Naphthalene
- Cook, Sherwin Lawrence. Boston (*in part*)
- Cook, Stanley Arthur, D.D. Baal (*in part*); Chronicles, Books of (*in part*); Damascus (*in part*); Decalogue (*in part*); Edom (*in part*); Genealogy (*in part*); Genesis; Gideon (*in part*); Haggai (*in part*); Hebrew Religion; Hezekiah (*in part*); Jacob (*in part*); Jesus Christ (*in part*); Jews (*in part*); Joshua, Book of; Judges, The Book of (*in part*); Kings, First and Second Books of; Levites (*in part*); Moab; Moloch (*in part*); Moses (*in part*); Nabataeans (*in part*); Philistines; Ruth, Book of; Sabbath (*in part*); Samuel, Books of; Serpent Cults; Sinai; Talmud (*in part*); Zephaniah
- Cook, Thomas Ira. Authority, Political; Republic
- Cooke, Rev. George Albert, D.D. Ezekiel; Odaenathus; Palmyra; Phoenicia; Zenobia (*in part*)
- Coolidge, Rev. William Augustus Brevoort. Arnaud, Henri; Dauphiné (*in part*); Jenatsch, Georg; Lugano, Lake of; Switzerland (*in part*); Tell, William (*in part*); Zürich (capital) (*in part*)
- Coomaraswamy, Ananda K. Bronze and Brass Ornamental Work (*in part*); Dance (*in part*); Indian and Sinhalese Art and Archaeology; Indian Architecture (*in part*); Indonesian and Further Indian Art; Iron in Art (*in part*); Textiles and Embroideries (*in part*); Yakasas
- Cooper, Delmer Clair. Angiosperms (*in part*)
- Cooper, Frank Irving. School Architecture (*in part*)
- Cooper, G. Arthur. Brachiopoda
- Cooper, John I. Canada (*in part*); Newfoundland (*in part*)
- Cooper, Kent. Associated Press (*in part*)
- Cooper, Robert William. Berlin (*in part*)
- Cope, Vincent Zachary, M.D. Shock and Collapse
- Copping, George. Chinaware (*in part*); Earthenware
- Corbett, Harvey Wiley. Architecture
- Corddry, Graham W. Colour Mill
- Cordonnier, Louis Emilien Victor. Frontier, Battles of the (*in part*)
- Cornell, Constance Margaret. Chamberlain, Arthur Neville; George VI (*in part*)
- Corner, George Washington. Embryology, Human (*in part*)
- Cornish, Vaughan. Waves of the Sea
- Corrigan, Cecil Edwin, M.D. Tumour
- Corthorn, Charles E. L. Ottoman Bank (*in part*)
- Corwin, Alsoph Henry. Pyrrole
- Corwin, Charles Abel. Museums of Science (*in part*)
- Cottingham-Taylor, Mrs. Dorothy Daisy. Carving (*in part*); Menus; Preserving and Bottling (*in part*)
- Cotton, James Sutherland. Hastings, Warren (*in part*); Omichund
- Cottrell, Frederick Gardner. Fume Precipitation, Electrical
- Coulson, Major Thomas. Research, Industrial (*in part*)
- Coulton, George Gordon. Concubinage; Knighthood and Chivalry (*in part*); Reformation
- Countryman, Vern. Bankruptcy (*in part*)
- Coursey, Philip R. Condenser (Electrical)
- Courtney, Giles L. Account; Account Current; Account Rendered; Account Sales; Accounts Payable Ledger; Accounts Receivable (*in part*); Accounts Receivable Ledger; Current Assets
- Courtney, Janet Elizabeth. Alexandra, Queen
- Coward, T. A. Bird Sanctuaries (*in part*)
- Cowl, Richard Pope. Edda (*in part*); Icelandic Literature (*in part*); Saga (*in part*)
- Cowles, Walter Goodman. Engineering Insurance (*in part*)
- Cowley, Sir Arthur Ernest. Samaritans; Seadiah, Ben Joseph
- Cox, Alonzo Bettis. Cotton and the Cotton Industry (*in part*); Cotton Belt
- Cox, H. E. Food Preservation (*in part*); Jams and Jellies (*in part*)
- Cox, Isaac Joslin. Chile (*in part*); Wilkinson, James
- Cox, Major General Sir Percy Zachariah. Fars (*in part*); Firuzabad; Hormuz; Kerman; Khurasan; Khuzistan (*in part*); Kuchan; Kurdistan (*in part*); Laristan; Lingeh; Persia (*in part*); Persian Gulf; Qain (*in part*); Qais; Resht; Seistan (*in part*); Shiraz; Tabriz (*in part*); Tehran Province (*in part*); Yezd (*in part*)
- Cox, Warren Earle. Batik; Cartoon (*in part*); Design (*in part*); Drawing (*in part*); Gothic Art; Lamp (*in part*); Periods of Art (*in part*); Sculpture Technique (*in part*); Ter-

- ra-Cotta (*in part*)
 Cox, William B. Chain Gang
 Coxeter, Harold Scott Macdonald. Surface (*in part*)
 Crackanthorpe, Montague Hughes. Mediation (*in part*)
 Craddock, Sir Reginald Henry. Bilaspur; Central Provinces and Berar (*in part*); Chhattisgarh (*in part*); Chhindwara (*in part*)
 Craft, Herbert. Exports, Invisible (*in part*)
 Craies, William Feilden. Habeas Corpus (*in part*); Quarter Sessions, Court of (*in part*); Trade Marks (*in part*); Treason (*in part*); Warrant (*in part*); Wildlife Conservation and Management (*in part*); Witness (*in part*)
 Craigmyle of Craigmyle, Thomas Shaw, 1st Baron. Vergniaud, Pierre Victorien (*in part*)
 Cranage, Very Rev. David Herbert Somerset, B.D. University Extension (*in part*)
 Crandall, Lee S. Aviary and Aviculture (*in part*)
 Crane, Charles Howard. Theatre (*in part*)
 Crane, J. B. Steam Generation (*in part*)
 Crane, Walter. Arts and Crafts Movement, The (*in part*)
 Crawford, John Grenfell. Australia (*in part*)
 Crawford, Nelson Antrim. Nonpartisan League
 Crawford, Osbert Guy Standhope. Archaeology (*in part*); Barrow; Mouth-Builders
 Creager, William Pitcher. Dams (*in part*)
 Creed, Rev. John Martin, B.D. Baptism (*in part*); Bible (*in part*); Eucharist (*in part*)
 Cret, Paul Philippe. Library Architecture (*in part*); Museum Architecture (*in part*); Renaissance Architecture (*in part*)
 Crew, F. A. E., M.D. Albino; Fertility and Fecundity (*in part*); Genetics; Hermaphrodite (*in part*); Mendelism; Selection (*in part*); Sex (*in part*); Sterility
 Crew, Henry. Langley, Samuel Pierpont; Millikan, Robert Andrews; Physical Units (*in part*); Rutherford, Ernest; Thomson, Sir Joseph John
 Crile, George W., M.D. American College of Surgeons
 Cripps, Rev. Richard Seymour. Amen
 Croce, Benedetto. Aesthetics
 Crocker, William. Boyce Thompson Institute for Plant Research, Inc. (*in part*)
 Crockett, Walter Hill. Vermont (*in part*)
 Crombie, Alistair Cameron. Spallanzani, Lazzaro
 Crommelin, Andrew C. de la C. Comets (*in part*); Eros; Minor Planet (*in part*)
 Cross, Charles Frederick. Fibres
 Cross, Harold L. Press Laws (*in part*)
 Crosswell, V. R. Naval Stores
 Crouzet, François Marie-Joseph. Agenais or Agenois; Bar, Counts and Dukes of; Blois, Countship of; Limousin; Lorraine; Louis X; Nogaret, Guillaume de; Orleansais; Orleans, Louis, Duke of; Poitou; Roussillon
 Crowdy, Dame Rachel. Opium Traffic (*in part*)
 Crowe, Sir Edward Thomas Frederick. Consul (*in part*)
 Crowe, G. E. W. Household Appliances (*in part*)
 Crowe, Brigadier General John Henry Verinder. Plevna; Shipka Pass
 Crowe, Sir Joseph Archer. Cuyp (*in part*); Eyck, Van (*in part*); Holbein, Hans; Neer, Van Der (*in part*); Ostade (*in part*)
 Crowe, Sibyl Eyre. Algeria (*in part*); Morocco (*in part*); Tangier (*in part*); Tunisia (*in part*)
 Crowfoot, John Winter. Palestine (*in part*)
 Crowne, Irving H. Magneto, High-Tension
 Crue, Francis De. Geneva (*in part*)
 Cruikshank, Robert, M.D. Antiseptics (*in part*)
 Crump, Norman E. Bank of England; Commercial Paper (*in part*); Consols; International Payments (*in part*); Kran; Mint Par of Exchange (*in part*); Pools, in Industry (*in part*); Rial; Rupee (*in part*); Shares; Sol (*in part*); Stock (*in part*); Transfer (*in part*)
 Cubberley, Ellwood Patterson. Education, History of (*in part*); School Administration in the United States
 Culbertson, Ely. Auction Bridge (*in part*); Bridge (*in part*); Contract Bridge (*in part*); Whist (*in part*)
 Culin, Stewart. Dolls; Headdress; Masks (*in part*)
 Culley, A. B. Agents in Business
 Cullinan, Frank P. Apricot; Cherry; Nectarine; Peach; Plum; Quince
 Cummins, Colonel Stevenson Lyle, M.D. Tuberculosis (*in part*)
 Cunningham, James V. Anthology
 Cunyngame, Sir H. Hardinge. Clocks (*in part*); Watches (*in part*)
 Curran, C. H. Anopheles; Bee Fly; Black Fly; Bloodworm; Bluebottle; Botfly; Deer Fly; Diptera; Drosophila; Flesh Fly; Fly; Frit Fly; Fruit Fly; Fungus Gnat; Gallfly; Gall Midge; Hessian Fly; Horsefly; Housefly; Hover Fly; Leatherjacket; Mosquito (*in part*); Onion Maggot; Robber Fly; Sand Fly; Tachinid Fly; Screwworm
 Curry, Michael John. Western Pacific Railroad Corporation, The (*in part*)
 Curtis, Edmund. Ireland (*in part*); Robert Guiscard (*in part*); Roger I; Roger II (*in part*)
 Curtis, George M., M.D. Thyroid
 Curtis, Harry Alfred. Fertilizers; Liming; Nitrogen, Fixation of; Phosphorus
 Curtis, Harvey L. Current Balance
 Curtis, William Edward. Band Spectrum
 Curtiss, David Raymond. Bessel Function
 Cushendon, 1st Baron of (Ronald John McNeill). Bunker Hill; Grattan, Henry; Jeffreys, George Jeffreys, 1st Baron
 Cushman, Joan R. South, The (*in part*)
 Cussons, G. W. Mathematical Models
 Cutter, Donald C. California (*in part*); San Diego
 Dack, Gail M., M.D. Food Poisoning, Bacteriological
 Daggett, Stuart. Inland Water Transport (*in part*)
 Dahl, J. O. Cafeteria
 Dakin, William John. Onychophora (*in part*)
 Dakyns, Arthur L. Co-Partnership
 Dalby, W. Ernest. Dynamometer; Power Transmission (*in part*)
 Dale, E. E. Branding (*in part*)
 Dale, Ernest. Keynes, John Maynard
 Dale, Harold Edward. Agricultural Education (*in part*)
 Daigas, Frederick. Pottery and Porcelain (*in part*)
 Dalton, H. E. Studebaker Corporation, The
 Dalton, Nellis Norman. Glycerin (Glycerol)
 Dalton, Ormonde M. Catacombs (*in part*)
 Dalton, W. Bézique; Piquet; Vingt-Et-Un
 Daly, Reginald Aldworth. Isostasy
 Dameshek, William, M.D. Anaemia; Blood (*in part*); Haemophilia
 D'Amico, Silvio. Pirandello, Luigi
 Dampier, Sir William Cecil. Electrical Power in Agriculture (*in part*); Electrolysis (*in part*); Science
 Daniels, A. M. Chimney (*in part*)
 Daniels, Harry J. Burial (*in part*)
 Dannatt, C. W. Assaying
 Danzig, Allison. Rackets or Racquets (*in part*); Squash Rackets (*in part*)
 Darby, Henry Clifford. Fens
 Darlington, William Aubrey. Drama (*in part*)
 Darrow, George McMillan. Bilberry, Blueberry or Whortleberry; Blackberry; Blueberry; Currant; Dewberry or Trailing Blackberry; Gooseberry; Raspberry; Strawberry
 Darrow, Karl Kelchner. Physics
 Darton, F. J. Harvey. Children's Books (*in part*)
 Darwin, Sir Charles Galton. Light (*in part*)
 Das, H. Dutt, Toru; Ghose, Lalmohun
 Davenport, Major Cyril James H. Mezzotint or Mezzo Tinto
 Davey, William Nelson. Marine Insurance (*in part*)
 Davids, Caroline A. F. Rhys. Pali Language and Literature (*in part*)
 Davids, T. W. Rhys. Devadatta; Mahāvamsa (*in part*); Pali Language and Literature (*in part*)
 Davidson, Rev. Samuel, D.D. Canon (*in part*)
 Davies, Alan Fraser. Australia (*in part*)
 Davies, Cuthbert Collin. Akbar, Jalal ud-din Mohammed; Asoka; Aurangzeb, Mohi ud-din Mohammed; Baber, Zahir ud-din Mohammed; Bengal (*in part*); Central Provinces and Berar; Ceylon (*in part*); Child, Sir John; Cholas; Dewan; India (*in part*); India, French; Kashmir (*in part*); Kaw; Mogul; Punjab (*in part*)
 Davies, Rev. James. Hesiod (*in part*)
 Davies, Colonel Percy George. Croquet (*in part*)
 Davies, Ralf D. Bridging, Military (*in part*)
 Davies, Randall (Robert Henry). Caricature (*in part*)
 Davies, Reginald Trevor. Bedmar, Alfonso de la Cueva; Spain (*in part*)
 Davis, Arthur Llewellyn. Negligence
 Davis, Fanny-Fern. Greens
 Davis, Harold Thayer. Mathematical Tables
 Davis, Henry William Carless. Ambrose; Benedictus Abbas; Bohun; Charles, The Great; Geoffrey of Monmouth (*in part*); Gerard (Archbishop); Gilbert Foliot; Henry I; Henry II; Henry III; John (King of England); Lanfranc (*in part*); Langton, Stephen; Mandeville, Geoffrey De; Marsh, Adam; Montfort, Simon De (*in part*); Nennius; Odo of Bayeux; Orderic Vitalis (*in part*); Richard I; Richard (Earl of Cornwall); Stephen (1097-1154); Theobald; Wace, Robert (?); Walter of Coventry; William I; William of Newburgh
 Davis, John M. Delaware, Lackawanna and Western Railroad Company, The
 Davis, J. S. Rural Education (*in part*)
 Davis, Kenneth S. Eisenhower, Dwight D.
 Davis, Malvin E. Industrial Insurance (*in part*)
 Davis, Mary Dabney. Kindergarten (*in part*)
 Davis, Ozora Stearns, D.D. Congregationalism (*in part*)
 Davis, Sir Robert H. Divers and Diving Apparatus
 Davis, S. C. H. Motor Racing (*in part*)
 Davis, William. Lace (*in part*)
 Davis, William Morris. America (*in part*); Coral Reefs; North America (*in part*)
 Davison, Charles. Earthquake (*in part*)
 Davison, Eloise. Housekeeping (*in part*)
 Davison, Geoffrey Spence. Motorcycles (*in part*)
 Dawson, George Walter. Flower Painting
 Dawson, Harry Medforth. Chemical Action
 Dawson, James P. Boxing (*in part*); Sullivan, John Lawrence (*in part*)
 Dawson, Mitchell. Divorce (*in part*); Infant; Libel and Slander (*in part*)
 Dawson, Warren Royal. Imhotep; Mummy
 Daysh, George Henry John. Free Ports (*in part*)
 Dean, John Gilbert. Nickel
 Dean, Leon W. Vermont (*in part*)
 Dean, Ruth. Landscape Architecture (*in part*)
 Dean, Winston Basil. Bizet, Georges
 Debenham, Frank. Antarctic Regions (*in part*)
 D'Eca, Raul. Aracajá; Aracati; Araguaia; Bagé; Brazil (*in part*); Ceará (*in part*); Espírito Santo (*in part*); Fernando Noronha (*in part*); Pará (*in part*); Paraná (state) (*in part*); Pelotas; Pernambuco (*in part*); Piauí (*in part*); Rio de Janeiro (city) (*in part*); Salvador; São Paulo (state); São Paulo (city)
 De Castro, Morris F. St. Thomas
 Decker, Maurice H. Camping (*in part*)
 Dederick, Louis Serle. Ballistics
 Deese, Sara L. Trade: World Statistics (*in part*)
 Defenbacher, Byron. Idaho (*in part*)
 DeGolyer, Everette Lee. Salt Domes
 Deighton, Herbert Stanley. Abbas II; Fuad I; Egypt (*in part*); Gordon, Charles George; Mohammed, Ahmed ibn Seyyid 'Abdullah;

- Shagia; Sudan, Anglo-Egyptian (*in part*)
 Deignan, Herbert Girtton. Asia (*in part*)
 Delahaye, Colonel James Viner. Woolwich (*in part*)
 Delanglez, Rev. Jean, S.J. Marquette, Jacques
 Delehaye, Rev. Hippolyte, S.J. Canonization; Helena, St.; Roch, St.; Vitus, St.
 Deller, Sir Edwin. London University (*in part*)
 Delmelle, Joseph-Edouard-Marie-Ghislain. Belgian Literature (*in part*)
 Delme-Radcliffe, Lieutenant Colonel Emilius C. Falconry (*in part*)
 De Mille, Cecil Blount. Motion Pictures (*in part*)
 Dendy, Fred L. Acting (*in part*); Inlaying; Museums and Art Galleries (*in part*); Schools of Art (*in part*)
 Dengel, Philipp Ignaz. Papacy (*in part*)
 Denham, William Smith. Silk and Sericulture (*in part*); Silk Manufacture (*in part*)
 Denney, Charles Eugene. Northern Pacific Railway
 Dennis, Charles H. Field, Eugene
 Denno, Bryce F. Battalion; Supply and Transport, Military
 Denno, Wilfred L. Electrocutation
 Denny, Edward M. C. Bill of Exchange (*in part*)
 Dent, Harold Collett. Central Schools; Commercial Education (*in part*); Education, History of (*in part*); Elementary Education (*in part*); Polytechnic (*in part*); Secondary Education (*in part*); Teachers, Training of (*in part*); Technical Education (*in part*); Universities (*in part*)
 Denton, George Bion. Dentistry
 Derrick, Calvin. Reformatory School (*in part*)
 Derrick, (John) Michael. Italy (*in part*)
 Desart, Ellen Odette, Countess Dowager of Desart. Forms of Address (*in part*)
 Deschamps, Hubert. Cayenne; Guiana (*in part*); Sudan, French; Tunis (*in part*)
 Desjardins, Arthur Ulderich, M.D. Finsen, Niels Ryberg
 Despois, Jean-Jacques. Algeria (*in part*); Morocco (*in part*); Tunisia (*in part*)
 DeTurk, Ernest E. Soil (*in part*)
 Deutsch, Herman Julius. Washington
 Deutscher, Isaac. Stalin, Joseph Vissarionovich
 Devine, Henry, M.D. Psychosis (*in part*)
 Dew, Colonel Sir Armine Brereton. Baluchistan (*in part*)
 Dewey, Howard S. Submarine
 Diamond, Louis Klein, M.D. Blood Transfusion
 Dicken, Samuel N. Culiacán or Culiacán Rosales; Monterrey; Quintana Roo
 Dickens, Arthur W. M. Gallic Acid
 Dickinson, Hobart Cutler. Calorimetry
 Dicksee, Lawrence Robert. Accountancy and Accountants (*in part*); Bookkeeping; Cost Accounting (*in part*); Goodwill; Liquidation (*in part*); Overhead Charges; Stock-Taking
 Dickson, Henry Newton. Mexico, Gulf of
 Diehl, Harold S. (healy), M.D. Cold, Common
 Dikaips, Porphyrios. Cyprus (*in part*)
 Dilke, Lady. Millet, Jean François (*in part*)
 Dillman, Arthur C. Flax (*in part*)
 Dillon, Emile J. Alphonso XIII (*in part*)
 Dillon, Mary Earhart. Willard, Frances Elizabeth Caroline (*in part*)
 Dingle, Herbert. Sun (*in part*)
 Dinsmoor, William Bell. Greek Architecture
 Dinsmore, Wayne. Horsemanship and Riding (*in part*)
 Disney, A. W. M. Fazughli; Fung; Sennar
 Dixon, George Campbell. Hughes, William Morris (*in part*)
 Dixon, Harold Bailey. Chemistry (*in part*)
 Dixon, Roland Burrage. Calchaquian; Tapuyan
 Dobson, Austin. Hogarth, William (*in part*); Kauffmann (Maria Anna) Angelica; Richardson, Samuel (*in part*)
 Dobzhansky, Theodosius. Hybridism
 Dock, George, Jr. Falconry (*in part*)
 Dodd, Edwin Merrick. Company and Corporation Law (*in part*)
 Dodd, Walter Fairleigh. Amendment; American Law (*in part*); Constitution and Constitutional Law (*in part*); United States (of America), The (*in part*)
 Dodgson, Campbell. Dry Point (*in part*)
 Dods, Marcus, D.D. Pelagius (*in part*)
 Doll, Edgar Arnold. Mental Deficiency
 Dollman, Captain J. G. Deer (*in part*); Game Reserves (*in part*); Insectivora (*in part*)
 Donahey, Victor. Ohio (*in part*)
 Donald, Sir Robert. Newspapers (*in part*)
 Donald, William John. Employees, Training of
 Donaldson, B. R. Ford Motor Company
 Dondore, Dorothy Anne. Biography (*in part*)
 Donnay, Joseph Désiré Hubert. Goniometer (*in part*)
 Donnelly, Philip J., S.J. Grace
 Donovan, Major General William Joseph. Intelligence, Military; Supreme Court of the United States, The
 Dorfman, Albert, M.D. Rheumatic Fever
 Dorizzi, F. P. Pencil
 Doster, James F. Alabama
 Doucet, Roger. France (*in part*)
 Doughty, Sir Arthur G. Frontenac et Palluau, Louis De Buade; Meighen, Arthur (*in part*)
 Douglas, George William. Flag (or "Flagge") (*in part*); Franklin Institute, The; Pennsylvania (*in part*)
 Douglas, Sir Robert Kennaway. Hsüan Tsang (*in part*); Jenghiz Khan; Mongols (*in part*); Parkes, Sir Harry Smith; Tsêng Kuo-Fan
 Douglass, Mabel S. Women, Education of (*in part*)
 Dow, Edward French. Maine (*in part*)
 Dow, George. London and North Eastern Railway Company, The
 Dowie, H. G. Kent's Cavern
 Downey, William G., Jr. Espionage
 Dowson, Robert. Turbine: Steam
 Dragstedt, Carl Albert, M.D. Anaphylaxis
 Dragstedt, Lester R., M.D. Gastric and Duodenal Ulcer; Peritonitis
 Drever, James. Instinct in Man
 Drew, Edward L. Hides (*in part*)
 Drew, Frederic William. Chartreuse (*in part*)
 Drew, H. J. B. New Zealand (*in part*)
 Driberg, Jack Herbert. Africa (*in part*); Age-Grades; Angoni; Ankole; Ganda; Hehe; Langoi; Masai; Nyika; Secret Societies (*in part*)
 Driver, Godfrey Rolles. Assyrian Language; Bible (*in part*); Hebrew Language; Jehovah; Semitic Languages
 Driver, Samuel Rolles, Hon. D.D. Bible: Old Testament (*in part*)
 Drover, Engineer Captain F. J. Marine Engineering; Rotor Ship
 Drower, Margaret Stefana. Egypt (*in part*)
 Drum, Hugh Aloysius. St. Mihel (*in part*)
 Drummond, Jack Cecil. Biochemistry
 Drummond, Rev. William Hamilton, D.D. Reunion, Church
 Drury, F. E. Building (*in part*); Foundations (*in part*); Structural Engineering (*in part*)
 Drysdale, Charles V. Instruments, Electrical
 Duchesne, Louis Marie Olivier. Calixtus or Callistus (*in part*); Gelasius (*in part*); Liberius (*in part*); Lucius (*in part*); Papacy (*in part*); Sixtus
 Duck, Frank J. G. Lithopone; Mercurochrome
 Duckworth, Wynfrid Laurence Henry, M.D. Anthropometry
 Dudeney, Frank M. Exports (*in part*)
 Dudeney, Henry Ernest. Magic Square
 Dudley, A. M. Motor, Electric (*in part*)
 Duff, James H. Pennsylvania (*in part*)
 Duff, Rt. Hon. Sir Mountstuart Elphinstone Grant. Oliphant, Laurence (*in part*)
 Duffy, Francis P. Gibbons, James (Cardinal)
 Duflou, Guillaume. Flemish Language, The
 Dumas, Paul. Motor Racing (*in part*)
 Du Mond, Jesse William Monroe. Fundamental Physical Constants (*in part*); X-Rays, Nature of (*in part*)
 Dunbar, Saidie Orr. Women's Clubs, The General Federation of
 Duncan, Delbert J. Department Store
 Duncan, F. Martin. Hair (*in part*)
 Dunhill, Alfred. Pipe Smoking
 Dunkerley, G. D. Educational Associations (*in part*)
 Dunn, Charles James. Drama (*in part*)
 Dunn, L. C. Bateson, William; Monster
 Dunnage, James A. Importing: In Practice (*in part*)
 Dunstan, Albert E. Kerosene (*in part*); Paraffin
 Du Pont, Lamot. Du Pont de Nemours and Company, E. I.
 Dupuis, Charles Edward. Nile (*in part*)
 Durant, William James. Dewey, John; Santayana, George (*in part*)
 Duranty, Walter. Russia (*in part*)
 Durkee, M. M. Soybean Oil
 Durst, Alan L. Sculpture Technique (*in part*)
 Du Shane, Graham Phillips. Degeneration
 Dushman, Saul. Thermionics
 Du Toit, Alexander L. Gondwanaland (*in part*)
 Dutt, Romesh Chunder. Vidyasagar, Iswar Chandra
 Dyboski, Roman. Mickiewicz, Adam (*in part*); Poland (*in part*); Polish Literature; Poznan or Posen (*in part*)
 Dymond, J. R. Canada (*in part*)
 Dyson, Sir Frank Watson. Parallax
 Earnest, John P. Arson (*in part*); Inebriety, Law of (*in part*)
 Earnshaw, Frank L. Game Reserves (*in part*)
 Eastwood, George Anderson. Armour and Company
 Eaton, Sir F. A. Academy, Royal (*in part*)
 Eaton, Joseph Wechsler. Farm Colony or Group Farm
 Ebenstein, William. Fascism, Economics of
 Ebert, Robert H., M.D. Bronchitis; Pleurisy or Pleuritis; Pneumothorax
 Eccles, William Henry. Wireless Telegraphy (*in part*)
 Eckart, Carl. Ether (*in part*)
 Eckberg, Adrian. Gilding (*in part*)
 Eckenstein, Kenneth Edward. Monaco (*in part*)
 Eckert, Wallace John. Calculating Machines (*in part*)
 Eckhardt, Karl August. Germanic Laws, Early (*in part*); Salic Law (*in part*)
 Eckman, Jeannette. Delaware (*in part*)
 Edgington, Sir Arthur Stanley. Aberration of Light; Algol; Astronomy (*in part*); Centaurus; Cetus; Constellation (*in part*); Micrometer (*in part*); Sirius; Star (*in part*); Telescope (*in part*); Time, Standard
 Eddy, Helen L. Crop-Drying; Cultivation; Reaping; Sowing
 Edgell, Vice-Admiral Sir John Augustine. Chart; Sounding
 Edlin, Bengt. Corona
 Edmonds, Brigadier General Sir James Edward. Loos, The Battle of; Marne, The First Battle of the; Ypres, The Battle of, 1914; Ypres, The Battles of, 1915
 Edmunds, Arnold. Estate Duties; Legacy Duty and Succession Duty
 Edmundson, Rev. George. Brabant; Flanders (*in part*); Gelderland (*in part*); Jacoba or Jacqueline; Oldenbarneveldt, Johan Van (*in part*); Orange, House of; Ostend Company; Pensionary
 Edwards, Alba M. Domestic Service (*in part*)
 Edwards, Arthur Cecil. Turkey (*in part*)
 Edwards, Everett E. Agricultural Organization (*in part*); Agricultural Research; Agricultural Societies and Shows (*in part*); Agriculture, A General Survey (*in part*); American Farm Bureau Federation; Arable; Creameries; Crops; Farmers' Clubs; Farmers' Organizations; Farmers' Union; Grange, The; International Conferences of Agricultural Economists; Thrashing or Threshing
 Edwards, Harry Taylor. Abacá Fibre; Sisal Fibre
 Edwards, Kathleen. Cathedral (*in part*)
 Edwards, Morris O. Court-Martial (*in part*)
 Edwards, Ralph. Interior Decoration (*in part*)
 Edwards, Major T. J. Captain (*in part*); Col-

- ours, Military (*in part*); Honourable Artillery Company; Lance; Numismatics (*in part*); Quartermaster (*in part*); War Office (*in part*)
- Egbert, James Chidester. University Extension (*in part*)
- Egelling, H. Julius. Hinduism (*in part*); Sanskrit Language and Literature (*in part*)
- Eichelberger, William Snyder. Newcomb, Simon
- Einstein, Albert. Space-Time (*in part*)
- Einzig, Paul. Bank for International Settlements (*in part*); Capital Levy (*in part*)
- Eisele, C. Wesley, M.D. Malta Fever or Mediterranean Fever
- Eisenhart, Luther Pfahler. Affine Geometry; Riemannian Geometry
- Eisenmann, Louis. Bohemia (*in part*)
- Eklaw, Walter Elmer. Chichen-Itzá or Chichen; Colossal Cavern; Dismal Swamp; Dunes; Mammoth Cave; Uxmal; Wyandotte Cave; Yellowstone National Park
- Elbe, Guenther von. Combustion
- Elias, Maxim K. Pliocene
- Eliel, Leon Theodore. Photogrammetry
- Eliot, Sir Charles Norton Edgumbe. Asia (*in part*); Huns (*in part*); Japan (*in part*); Khiva (*in part*)
- Eliot, Charles William. Gray, Asa
- Eliot, Martha May, M.D. Maternal and Child Health (*in part*)
- Eliot, Thomas Dawes. Civil Liberties
- Elkin, Adolphus Peter. Australia (*in part*)
- Ellard, Gerald, S. J. Mass (*in part*)
- Elles, G. L. Ordovician System; Palaeozoic Era
- Ellingham, H. J. T. Electrochemistry
- Elliott, George Blow. Atlantic Coast Line Railroad Company
- Elliott, Norman Robson. Free Ports (*in part*)
- Elliott-Binns, Rev. Leonard Elliott, D.D. Baalam (*in part*); Jashar, Book of; Numbers (*in part*)
- Ellis, B. Eldred. Glove Manufacture
- Ellis, Franklin Courtney. Eastman Kodak Company
- Ellis, Sir (Robert) Geoffrey. Peerage
- Ellsworth, Paul Theodore. International Payments (*in part*)
- Elmslie, Rev. William Alexander Leslie, Hon. D.D. Prophet
- Elton, Oliver. English Literature (*in part*)
- Ely, Burl A. International News Service
- Ely, Richard R. Luzon
- Ely, Richard Theodore. Land Tenure: Economic and Agrarian Aspects (*in part*)
- Embree, Edwin Rogers. Negro, The American (*in part*); Philanthropy (*in part*)
- Emerson, Haven, M.D. Public Health (*in part*)
- Emery, Walter Bryan. Egypt (*in part*)
- Emison, John C. American Smelting and Refining Company, The
- Emmons, Gardner. Cloud (*in part*)
- Enfield, Ralph R. Agricultural Credit (*in part*)
- Engel, Edward J. Atchison, Topeka and Santa Fe Railway Company
- Engerand, George C. Mexico (*in part*)
- Engle, Nathanael Howard. United States (of America), The (*in part*)
- English, Earl Franklin. Journalism, Schools of (*in part*)
- Ennis, George Pearse. Water-Colour Painting
- Enslin, Morton Scott. Galatians, Epistle to the
- Epps, Sir George Selby Washington. Superannuation (*in part*)
- Epstean, Edward. Photo-Engraving
- Erdman, Frederick Seward. Food Preservation (*in part*)
- Erickson, Milton Hyland, M.D. Hypnotism
- Esau, Katherine. Plants and Plant Science (*in part*)
- Esdaile, Arundell. Libraries (*in part*)
- Esher, 2nd Viscount, Reginald Baliol Brett. Cabinet, The (*in part*); Edward VII (*in part*)
- Esmein, Jean Paul H. E. A. Appanage; Bailiff and Bailie (*in part*); Basche; Châtelet; Code Napoléon (*in part*); French Law and Institutions (*in part*); Lettres de Cachet; Parlement; Provost; Taille (*in part*)
- Essig, E. O. Entomology (*in part*)
- Estelow, Richard Kempton. Methane
- Esval, Orland E. Earth Inductor Compass
- Eusterman, George B., M.D. Alimentary System, Diseases of the
- Evans, D. M. H. Nubia (*in part*)
- Evans, E. E. Denmark (*in part*)
- Evans, Herbert Walter Lloyd. Mint (*in part*)
- Evans, Joan. Jewellery (*in part*)
- Evans, John W. Devonian System, The
- Evans, Owen David. Schools, Evening (*in part*)
- Evans, Richard Edgar. Spark Photography
- Evans, Richard L. Latter-Day Saints, Church of Jesus Christ of (*in part*)
- Evans, Ulrick Richardson. Corrosion and Oxidation of Metals
- Everard, W. J. Barges and Canal Craft
- Everitt, Charles. Constellation (*in part*)
- Everstine, Carl N. Maryland (*in part*)
- Ewen, David. Ackté, Aino; Alfano, Franco
- Ewing, Sir (James) Alfred. Air-Engine; Siemens, Sir William; Steam; Steam Engine
- Ewing, H. E. Apterygota; Arthropoda; Springtail
- Fage, John Donnelly. Ashanti; Gold Coast (*in part*)
- Fahrnkopf, Harrison. Granaries and Grain Elevators (*in part*)
- Fairbairn, John Shields, M.D. Menopause
- Fairbank, Herbert Sinclair. Roads and Streets (*in part*)
- Fairchild, Charles Owen. Thermometry
- Fairchild, Henry Pratt. Americanization
- Fairchild, Iler J. Standardization
- Fairweather, William, D.D. Maccabees; Maccabees, Books of
- Falkner, Roland Post. Machinery and Production
- Fallow, Thomas Macall. Coronation; Crown and Coronet
- Falls, Laurence E. Insurance: Miscellaneous
- Fanning, Leonard M. Drilling, Petroleum; Gasoline; Gasoline Pressure Appliances; Petroleum
- Farbman, Michael. Russia (*in part*)
- Faris, John Thomson, D.D. Arlington National Cemetery
- Farkas, Adalbert. Hydrogen
- Farley, Joseph F. United States Coast Guard Academy
- Farley, Mary L. Goat (*in part*)
- Farmer, R. C. Filtration
- Farnell, Lewis Richard. Greek Religion (*in part*); Mystery (*in part*)
- Farnum, Royal Bailey. Paul, Bruno
- Farquhar, Francis Peloubet. Sequoia (*in part*); Sierra Nevada, The; Yosemite
- Farquharson, Alexander. Branford, Victor
- Farrell, Edward Paul. Apologetics
- Farrell, James A. Gary, Elbert Henry
- Farren, William Scott. Fuselage
- Faubel, Arthur L. Cork
- Faunce, William H. P., D.D. Brown University
- Faust, Clarence Henry. Puritanism
- Faust, Ernest Carroll. Blackwater Fever; Parasitic Diseases; Psorospermiasis; Sand-Fly Fever; Yaws
- Faust, George Tobias. Becker, George Ferdinand; Erythrite
- Fawcett, Dame Millicent G. Women's Suffrage (*in part*)
- Fawkes, Rev. Alfred. Establishment (*in part*)
- Fay, Bernard. Franklin, Benjamin
- Fay, Sidney Bradshaw. Berlin (*in part*); Hamburg (*in part*); Prussia (*in part*)
- Fayle, Charles Ernest. Shipping, History of (*in part*)
- Feaveyear, Albert Edgar. Pound Sterling (*in part*)
- Fell, Sir Arthur. Channel Tunnel
- Fellows, George Emory. Utah (*in part*)
- Felt, Ephraim Porter. Galls
- Fennell, John Lister Illingworth. Basil
- Fenneman, Nevin M. United States (of America), The (*in part*)
- Fenton, Carroll Lane. Bertrand, Marcel Alexandre (*in part*); Clarke, John Mason (*in part*); Lapworth, Charles (*in part*); Sorby, Henry C. (*in part*)
- Fenton, Mildred Adams. Bertrand, Marcel Alexandre (*in part*); Clarke, John Mason (*in part*); Lapworth, Charles (*in part*); Sorby, Henry C. (*in part*)
- Ferber, Robert. Market Index
- Ference, Michael, Jr. Assmann, Richard; Cloud (*in part*); Föhn
- Ferguson, C. L. Parliamentary Procedure
- Ferguson, Ralph Holmes. Soap
- Ferguson, William Scott. Greek Law
- Ferrier, J. Walter. Heine, Heinrich (*in part*)
- Ferriss, Hugh. Rendering, Architectural
- Fetrow, Ward Willard. Agricultural Co-Operation (*in part*)
- Fetter, Frank Albert. Clark, John Bates
- Fetter, Frank Whitson. Commercial Treaties (*in part*)
- Feuchtwanger, Lion. Novel (*in part*)
- Few, William P. Duke University (*in part*)
- Fioulkes, Charles John. Arms and Armour
- Fioulkes, Constance Jocelyn. Morelli, Giovanni (*in part*)
- Fidler, A. T. Dunlop Rubber Company, Ltd.
- Field, Guy Cromwell. Pacifism
- Filbert, William J. United States Steel Corporation
- Filer, Herbert. Options
- Filman, Jack. Ice Hockey (*in part*)
- Filon, Pierre Marie Auguste. Drama (*in part*)
- Findlay, John Ritchie. De Quincey, Thomas
- Finer, Herman. Electoral Systems; Local Government; Proportional Representation (*in part*)
- Fink, Colin Garfield. Bronze and Brass Ornamental Work (*in part*); Sculpture Technique (*in part*)
- Finkelstein, Herman. Copyright (*in part*)
- Firth, John B. Burnham, Edward Levy Lawson
- Firth, Raymond William. Currency, Primitive; Economics, Primitive; Labour, Primitive; Magic (*in part*); Maori; Property, Primitive; Trade, Primitive; Wealth, Primitive
- Fischer, C. E. C. India (*in part*)
- Fischer, Earl K. Paints, Chemistry of
- Fischer, Eugen. Holstein, Friedrich von
- Fischer, Martin Henry, M.D. Dropsy
- Fish, Carl Russell. Wisconsin (*in part*)
- Fishbein, Morris, M.D. American Medical Association (*in part*); Health Visitor; Medical and Surgical Societies (*in part*); Public Health (*in part*); Quackery (*in part*)
- Fishenden, Margaret White. Smoke and Smoke Prevention (*in part*)
- Fisher, A. Enamel (*in part*)
- Fisher, Allan George Bernard. Imperial Preference; International Monetary Fund
- Fisher, Arthur. Copyright (*in part*)
- Fisher, George J. B. Chemical Warfare (*in part*)
- Fisher, Joel E. Mountaineering
- Fisher, Ronald Aylmer. Biometry
- Fisher, Russell Todd. Sailcloth and Sailmaking (*in part*)
- Fisher, William Bayne. Palestine (*in part*); Tripolitania (*in part*)
- Fiske, John. Grant, Ulysses Simpson (*in part*); Parkman, Francis
- Fitch, James Burgess. Dairy Farming; Dairy Machinery and Equipment
- Fitch, Rachel Louise. Coeducation; Sororities (*in part*)
- Fitzmaurice, Edmund George, 1st Baron Fitzmaurice. Commons (*in part*)
- Fitzmaurice-Kelly, James. Barahona de Soto, Luis; Caballero, Fernán; Calderón de la Barca, Pedro; Campoamor y Campoosorio, Ramon de; Cervantes Saavedra, Miguel de; Lull (or Lully), Raimon (or Raymond); Nuñez de Arce, Gaspar; Palacio Valdés,

- Armando; Pereda, José María de; Picaresque Novel, *The* (*in part*); Quevedo y Villegas, Francisco Gomez de; Ruiz, Juan; Spanish Language and Literature (*in part*); Valera y Alcalá Galiano, Juan; Vega Carpio, Lope Felix de (*in part*)
- Fitzpatrick, Harry Morton. Mushroom
- Flanagan, Urban Gerard. Ireland (*in part*)
- Fleming, Sir Alexander. Penicillin
- Fleming, Sir John Ambrose. Electrical (or Electrostatic) Machine (*in part*); Electricity Supply: Technical Aspects (*in part*)
- Fleming, Philip B. Shipping, History of (*in part*); Shipping: Merchant Ships of the World
- Fleming, R. M. Bessarabia (*in part*); Far Eastern Area (*in part*); Kamchatka; Latvia (*in part*); Ossetian Autonomous Areas; Russia (*in part*); Siberian Area; Tajik Republic; Tatar Republic (*in part*); Ukraine (*in part*)
- Fleming, Richard Howell. Atlantic Ocean (*in part*); Indian Ocean (*in part*); Ocean and Oceanography (*in part*); Pacific Ocean (*in part*)
- Fleming, Walter Lynwood. Lynching (*in part*); Nullification; Secession
- Flère, William A. Inland Water Transport (*in part*)
- Fletcher, Fred. Angling (*in part*)
- Fletcher, Harvey. Noise and Its Control (*in part*)
- Flett, Sir John Smith. Andesite (*in part*); Breccia; Concretion; Diorite; Gabbro (*in part*); Glauconite; Greisen; Laccolith; Lamprophyres; Marble (*in part*); Micropegmatite; Neck; Nepheline-Syenite or Elaeolite-Syenite (*in part*); Nephelinites; Obsidian; Peridotite; Perlite or Pearlstone; Phyllite; Pitchstone; Pneumatolysis; Porphyry; Pumice; Quartzite; Quartz-Porphry; Rhyolite; Scapolite (*in part*); Spherulites; Tonalite; Trachyte
- Fleure, Herbert John. Asia (*in part*); Europe (*in part*); Gibraltar (*in part*); Tibet or Thibet (*in part*); Toulon (*in part*); Transylvania (*in part*)
- Flink, Carl. Radiator (*in part*)
- Flinn, Alfred Douglas. Engineer, Professional
- Flint, Einar P. Firebrick
- Flint, Richard Foster. Glacial Epoch (*in part*)
- Floe, Carl F. Nitrogen Hardening
- Flory, Sir Howard Walter. Lymph, Its Formation and Movement
- Flournoy, Richard W. Nationality
- Flux, Sir Alfred William. Production, Census of (*in part*); Statistics
- Foch, Ferdinand. Army (*in part*)
- Foehringer, Anna. Golitsyn, Boris Borisovich
- Foerster, Lieutenant Colonel Wolfgang. Ludendorff, Erich (*in part*)
- Foley, Raymond Michael. Housing (*in part*)
- Foligno, Cesare. Italian Language, Modern; Italian Literature (*in part*)
- Folks, Homer. County Farm, Poor Farm, County Home, Poor House, or Almshouse; Poor Law (*in part*)
- Foote, Franklin Manley, M.D. Blindness (*in part*)
- Foote, Peter Godfrey. Icelandic Language
- Forbes, Alexander, M.D. All-or-None Law
- Forbes, William T. M. Ailanthus, Cynthia or Eria Silk Moth; European Corn Borer (*in part*); Lepidoptera (*in part*)
- Ford, Henry. Mass Production
- Ford, Lester R. Nomography
- Ford, Walter Armitage. Song (*in part*); Wolf, Hugo
- Forrest, George Topham. School Architecture (*in part*)
- Forsdyke, Sir Edgar John. Africa (*in part*); Bronze and Brass Ornamental Work (*in part*); Crete (*in part*); Pottery and Porcelain (*in part*); Silversmiths' and Goldsmiths' Work (*in part*)
- Forsythe, William R. Nitric Acid and Nitrates (*in part*)
- Forter, Norman L. Bessarabia (*in part*); Dobruja (*in part*)
- Fortescue, Hon. Sir John. Peninsular War
- Fortescue-Brickdale, Sir Charles. Land Titles (*in part*)
- Forward, Alexander. Gas Manufacture (*in part*)
- Fosdick, Raymond Blaine. New York (City) (*in part*); Rockefeller Benefactions (*in part*)
- Foss, Robert. Wisconsin, University of
- Foster, C. C. Singer Manufacturing Company, The
- Foster, John B. Billiards (*in part*)
- Foster, John Watson. Harrison, Benjamin
- Foster, Leon V. Microscope (*in part*)
- Fotheringham, J. K. Eclipse (*in part*)
- Fowler, W. Warde. Fortuna; Mars
- Fox, Aileen. Carleon
- Fox, Lieutenant Colonel Charles James. Salvage Corps (*in part*)
- Fox, Charles J. J. Paper Manufacture (*in part*); Paper Materials
- Fox, Sir Cyril Sankey. Bauxite (*in part*); Laterite
- Fox, Denis L. Colours of Animals (*in part*)
- Fox, Howard, M.D. Lupus
- Fox, Irving. Flea
- Fox, John Jacob. Salt (*in part*)
- Fox, Lionel W. Prison (*in part*)
- Fox, Thomas W. Spinning; Weaving (*in part*)
- Fox, William T. R. Security
- Frame, James E. Colossians, Epistle to the
- Francis, A. G. Salt (*in part*)
- Francis, Howard T. Electroplating
- Francis, Thomas, Jr., M.D. Influenza
- Frank, George Christian. Erie Railroad
- Frank, Helena. Yiddish Language and Literature (*in part*)
- Frank, Lawrence K. Psychiatry (*in part*)
- Frank, Tenney. Italy (*in part*); Rome (*in part*)
- Franklin, Ernest Louis. Arbitrage (*in part*)
- Franklin, Henry James. Cranberry
- Franklin, Sidney. Bullfight
- Franklyn, Charles Aubrey Hamilton, M.D. Robes (*in part*)
- Frantz, Henri. Manet, Édouard; Puvis De Chavannes, Pierre Cécile (*in part*)
- Frary, Francis Cowles. Aluminum or Aluminium
- Fraser, Sir Ian. St. Dunstan's
- Fraser, James Earle. Sculpture (*in part*)
- Fraser, J. S. Deaf-Mutism, Medical Aspects of
- Fraser, John. Scottish Literature (*in part*)
- Fraser, Peter Marshall. Palestine (*in part*)
- Frazier, Sir James George. Praeneste (*in part*)
- Frear, Walter Francis. Hawaii (*in part*); Honolulu (*in part*)
- Frederick, Justus George. Business Codes; Income Tax: In Practice (*in part*); Luxury Taxes (*in part*)
- Frederick, William L. Apportionment Bill
- Free, Edward Elway. Noise and Its Control (*in part*)
- Freeman, Douglas Southall. Davis, Jefferson
- Freeman, Edward Augustus. Goths (*in part*); Normans (*in part*); Sicily (*in part*); Syracuse (*in part*)
- Freeman, Frank Nugent. Visual Education
- Freer, Robert Elliott. Price Maintenance
- Freeze, John Henry. Calpurnius, Titus (*in part*); Hesiod (*in part*); Julian (*in part*); Leo VI
- French, Edward Sanborn. Boston and Maine Railroad, The (*in part*)
- French, Myrtle Meritt. Pottery and Porcelain (*in part*)
- French, Norman. Hardware (*in part*)
- French, Thomas E. Drawing, Engineering
- Frere, Rt. Rev. Walter Howard, D.D. Plain-song, or Plain Chant
- Freud, Sigmund, M.D. Psychoanalysis (*in part*)
- Friedman, William Frederick. Codes and Ciphers
- Friedrich, Carl Joachim. Government; Oligarchy; Representation
- Friesen, Otto v. Runes
- Fritsch, Felix Eugen. Protophyta (*in part*)
- Frondel, Clifford. Argentite; Beryllonite; Cerussite; Chalcocite; Chalcopyrite or Copper-Pyrites (*in part*); Columbite; Emery; Hu-
- mite; Sphalerite; Staurolite (*in part*)
- Frost, Wesley. Arequipa (city); Arequipa (department) (*in part*); Asunción; Bocas del Toro; Colón (*in part*); Concepción; Cuzco (*in part*); Iquitos; Junín; Libertad or La Libertad; Panamá (country) (*in part*); Panamá (city) (*in part*); Paraguari; Paraguay (*in part*); Pasco; Peru (*in part*); Piura; South America (*in part*); Villa del Pilar; Villarrica
- Fry, Roger. Cézanne, Paul
- Fuchs, H. Disconto-Gesellschaft, Berlin
- Fulford, Roger Thomas Baldwin. Elizabeth II; Elizabeth
- Fuller, Edward. Baby-Farming (*in part*); Foundling Hospitals (*in part*)
- Fuller, Major General John Frederick Charles. Aornos, Siege of; Arras, Battle of (*in part*); Conscriptio (*in part*); Cavalry (*in part*); Constantinople, Siege of; Diadochi, Wars of; Dreux (*in part*); Formigny, Battle of (1450); Gaugamela (Arbela), Battle of; Granicus, Battle of The; Hydaspes, Battle of The; Ilberda, Campaign of; Issus, Battle of; Ivry, Battle of (1590); Jemappes; Macedonian Army; Manzikert, Battle of (1071) (*in part*); Munda, Battle of; Mursa, Battle of; Neuve Chapelle, Battle of; Patay, Battle of (1429); Pavia (*in part*); Pharsalus, Battle of; Pydna, Battle of; Religion, Wars of (1562-1609); Strasbourg (*in part*); Taginae, Battle of (A.D. 552); Teutoburger Wald, Battle of; Thapsus, Battle of; Tyre (*in part*)
- Fuller, Walter Deane. Curtis Publishing Company, The
- Fuller-Maitland, John Alexander. Brahms, Johannes
- Fullmer, Irvin H. Precision Gauges and Comparators
- Fulton, Jack. Golf
- Furber, Holden. Cape Province (*in part*); Durban (*in part*); Natal (*in part*); Orange Free State (*in part*)
- Furst, Clyde. Philanthropy (*in part*)
- Fyfe, David Theodore. Egyptian Architecture; Western Asiatic Architecture
- Gabriel, Ralph Henry. Long Island (*in part*)
- Gabrielson, Ira Noel. Fish and Wildlife Service; Wildlife Conservation and Management (*in part*); Wildlife Reserves
- Gadd, Cyril John. Babylonian Law; Sumerian Language; Syria (*in part*)
- Gaffron, Hans. Photosynthesis
- Gager, Charles Stuart. Botanic Garden
- Gahan, Frank. Damages; Wildlife Conservation and Management (*in part*)
- Gairdner, James. Mary I; Talbot (Family) (*in part*)
- Gale, Esson M. Asia (*in part*)
- Gall, Ralf. Early Closing Movement (*in part*)
- Gallaher, Ruth Augusta. Iowa (*in part*)
- Gallotti, Jean. Wood-Carving (*in part*)
- Galloway, George, D.D. Religion (*in part*)
- Galloway, George Barnes. House of Representatives; Senate (*in part*); Speaker (*in part*)
- Galtsoff, Paul S. Sponges
- Gamble, W. Music Printing
- Ganoe, William Addleman. Buena Vista; Cerro Gordo; Chapultepec; Churubusco; Contreras; Palo Alto; Resaca de la Palma
- Gapen, C. E. Agricultural Power and Machinery (*in part*)
- Garber, Daniel. Landscape Painting (*in part*)
- Garcke, E. Electricity Supply; Commercial Aspects (*in part*); Tramway (*in part*)
- Gardiner, Alfred G. Oxford and Asquith, Herbert Henry Asquith, 1st Earl of
- Gardiner, Linda. Birds, Protection of (*in part*)
- Gardiner, Samuel Rawson. George I (*in part*); George II; George IV (*in part*)
- Gardner, E. G. Dante (or Durante) Alighieri (*in part*)
- Gardner, Ernest Arthur. Clazomenae; Inscriptions; Parthenon (*in part*); Propylaea
- Gardner, Percy. Demetrius; Greek Art; Lysippus
- Gardner-Smith, Rev. P., B.D. Peter, St. (*in*

- part*); Peter, First Epistle of; Peter, Second Epistle of
Garland, John H. Corn (Maize) Belt; Great Lakes, The
Garner, James Bert. Natural Gas
Garnett, Richard. Irving, Washington; Müller, Max (*in part*); Panizzi, Sir Anthony (*in part*); Peacock, Thomas Love (*in part*); Sarpi, Paolo; Satire (*in part*); Swift, Jonathan (*in part*)
Garnett, W. Energy (*in part*)
Garrett, Henry Edward. Differential Psychology
Garrod, Heathcote William. Wordsworth, William
Garside, Alston H. Cotton and the Cotton Industry (*in part*)
Garstang, Walter. Amphioxus or Lancelet; Pisciculture (*in part*)
Garstin, Sir William Edmund. Nile (*in part*)
Garten, Hugo R. Drama (*in part*)
Garvie, A. E., D.D. Devil; Eschatology; Immortality; Inspiration; Miracle; Predestination
Garvin, James Louis. English-Speaking World: Origins; Expansion, Relations and Prospect
Gaselee, Sir Stephen. Foreign Office (*in part*); Latin Literature (*in part*)
Gaskin, John George Noel. Rum
Gaster, Moses. Bassarab, or Bassaraba; Gypsies (*in part*); Hasdeu or Hajdeu, Bogdan Pelriceicu; Sturdza; Vacarescu
Gathorne-Hardy, Geoffrey Malcolm. Norway (*in part*)
Gatley, Clement. Guarantee (*in part*); Libel and Slander (*in part*)
Gaus, John Merriman. Public Administration
Gauvreau, Emile Henry. Mitchell, William
Gay, Edwin Francis. Hanseatic League
Geddes, Norman Bel. Theatre (*in part*)
Gedye, Nicholas George. Beacon (*in part*); Breakwater; Caisson; Canals and Canalized Rivers; Coast Protection and Land Reclamation (*in part*); Docks (*in part*); Embankment; Fog Signals; Graving Dock; Groyne; Harbours (*in part*); Inland Water Transport (*in part*); Jetty (*in part*); Lighthouses (*in part*); Lock; Pier (*in part*); River and River Engineering (*in part*); Slipway; Weir; Zuider Zee (*in part*)
Geikie, Sir Archibald. Hutton, James (*in part*); Vesuvius (*in part*)
Geldner, Karl Friedrich. Zend-Avesta (*in part*)
Geiston, Arthur S., Jr. Brazil (*in part*)
George, William R. George Junior Republic, The
Géraud, André. Delcassé, Theophile
Gerhardt, Paul L. Port Operation (*in part*)
Gersh, Isidore. Glands
Geyl, Pieter. Holland (*in part*); Holland. County and Province of (*in part*); William (the Silent)
Ghormley, Ralph Kalb, M.D. Orthopaedic Surgery
Giachardi, Iva Lilian. Austria (*in part*); Germany (*in part*)
Gibb, Hamilton Alexander Rosskeen. Abbasids; Abu Bekr; Almohades (*in part*); Almoravides (*in part*); Alp Arslan, Mohammed ibn Da'ud; Arabic Literature (*in part*); Caliphate; Omar; Persia (*in part*); Seljuks; Spain (*in part*); Syria (*in part*); Timur
Gibb, Thomas R. P., Jr. Hydrides
Gibbons, Cedric. Motion Pictures (*in part*)
Gibson, Arnold Hartley. Electrical Power Generation (*in part*); Hydraulic Machinery; Hydraulic Power Transmission; Hydraulics; Pump; Tidal Power; Turbine; Water
Gide, Charles. Economic Man
Gieseking, John Eldon. Soil (*in part*)
Giffen, Sir Robert. Bagehot, Walter
Gifford, Walter Sherman. American Telephone and Telegraph Company; Telephone (*in part*)
Gilbert, Alfred C. Pole Vaulting
Gilbert, Joseph. Motor Car (*in part*)
Gilbert, Milton. United States (of America), The (*in part*)
Gilbertson, George Waters. Balochi Language
Gilchrist, Raleigh. Ruthenium
Giles, Albert William. Novaculite
Giles, George W. Allotments (*in part*)
Giles, Peter. Indo-Europeans
Gill, Sir David. Telescope (*in part*)
Gill, Eric. Stone Carving
Gill, Richard Cochran. Curare
Gillies, Alexander. German Literature
Gillin, John P. Piarou; Warrau
Gillmor, Reginald E. Gyroscope (*in part*)
Gilmore, Eugene Allen. Iowa, State University of (*in part*)
Ginsberg, Morris. Social Philosophy
Ginsburg, Jekuthiel. Euler Numbers or Eulerian Numbers; Stirling Numbers
Giraud, Jean. Stendhal
Girden, Edward. Conditioning
Gittinger, Roy. Oklahoma
Givens, Willard E. Educational Associations (*in part*)
Gladstone, Reginald John, M.D. Brain (*in part*)
Glaeser, Martin Gustave. Public Utilities
Glaister, John, M.D. Poison (*in part*)
Glanzman, George S., S. J. Apostle
Glasgow, George. Benés, Eduard (*in part*); Locarno, Pact of; Masaryk, Thomas Garrigue
Glazebrook, Sir Richard Tetley. Newton, Sir Isaac (*in part*); Research, Industrial (*in part*)
Gleichen, Major General Lord Edward Gleichen. Abyssinia (*in part*)
Gloag, W. M. Scots Law
Gloor, Walter Ervin. Celluloid
Glover, Arnold. Layard, Sir Austen Henry (*in part*)
Gloyd, Howard K. Chicago Academy of Sciences, The (*in part*)
Goddard, Calvin Hooker, M.D. Ammunition; Armoured Car; Artillery (*in part*); Balloons in War; Canteen; Cantonment; Engines of War; Gun, Machine; Gunpowder (*in part*); Pistol; Small Arms, The Development of
Godfrey, Hugh. Dial and Dialling (*in part*)
Goeje, Michael Jan de. Arabic Literature (*in part*)
Goering, Paul L. Conscientious Objector
Goes, Clifford. Rowing (*in part*)
Goethals, George Washington. Panama Canal (*in part*)
Goetz, Hermann. Mohammedan Architecture; Mohammedan Art
Goitein, Hugh. Jurisprudence; Jurisprudence, Comparative (*in part*); Sale of Goods (*in part*)
Goldenweiser, E. A. Central Bank
Goldie, Sir George Taubman. Brazza, Pierre Paul François Camille Savorgnan de
Golding, C. E. Reinsurance (*in part*)
Goldschmidt, Werner. Arbitration (*in part*)
Goldsmith, Margaret (Mrs. Fritz A. Voigt). Mesmer, Franz Anton
Goldstone, Sir Frank W. Educational Associations (*in part*)
Goldthwait, Charles Francis. Mercerizing
Gollancz, Sir Israel. Pearl, The
Gomme, Lady. Children's Games (*in part*)
Good, Dorothy. Japan (*in part*)
Good, Harry Gehman. Teachers, Training of (*in part*)
Good, William A. Canoe (*in part*)
Goodenough, Florence Laura. Atypical Children; Genius
Goodlad, John Inkster. Elementary Education (*in part*)
Goodrich, Leland M. United Nations
Goodwin, Albert. Barras, Paul François Jean Nicolas
Goodwin, Robert C. Unemployment Insurance (*in part*)
Gordon, Rev. Alexander. Blandrata or Blandrata, Giorgio; Buckholdt, Johann; Bullinger, Heinrich; Knipperdöllinck or Knipperdölling, Bernst; Servetus, Michael; Socinus; Valdes, Juan de
Gordon, Howard Wright, Jr. Battleship (*in part*)
Gordon, Strathearn. Great Britain (*in part*)
Gorell, Lord. Teachers Registration Council
Gossnell, Harold Foote. Voting
Gosse, Sir Edmund. Anagronics; Andersen, Hans Christian; Beaumont, Sir John; Biography (*in part*); Collins, William; Donne, John; Drachmann, Holger Henrik Herboldt; Drayton, Michael; Etherage, Sir George; Fitzgerald, Edward; Gnome and Gnomonic Poetry; Heroic Romances (*in part*); Herrick, Robert; Huygens, Sir Constantijn (*in part*); Kyd, Thomas (*in part*); Lie, Jonas; Norton, Thomas; Novel (*in part*); Ohlenschläger, Adam Gottlob (*in part*); Prologue (*in part*); Prose (*in part*); Rimbaud, Jean Arthur; Rossetti, Christina Georgina; Saga (*in part*); Stevenson, Robert Louis Balfour (*in part*); Style (*in part*); Swinburne, Algernon Charles (*in part*); Tennyson, Alfred Tennyson; Verse (*in part*); Waller, Edmund (*in part*); Watson, Thomas
Gosse, Philip, M.D. Pirates and Piracy (*in part*)
Gothard, William W. Plumbing
Gott, Philip Porter. Confectionery Manufacture
Gough, Alfred Bradley. Swabian League; Westphalia, Treaty of
Gough, Herbert John. Fatigue of Metals; Heliotherapy
Gould, F. A. Barometer
Gould, Gerald. Wells, Herbert George
Gould, Lieutenant Commander Rupert Thomas. Chronometer (*in part*)
Goulinat, Jean Gabriel. Oil Painting, Technique of
Gourley, H. J. F. Water Supply
Graber, Laurence Frederick. Alfalfa, Lucerne or Purple Medick
Grace, Eugene Gifford. Bethlehem Steel Corporation (*in part*)
Grady, Henry Francis. Reciprocity
Graff-Baker, W. S. Escalators
Graham, Bessie. Nobel Prizes
Graham, Frank D. Gold Standard
Graham, John. Tonic Sol-Fa
Graham, William. General Strike (*in part*)
Grampp, William D. Biddle, Nicholas; Carey, Henry Charles; Inter-Allied Debts; Reparations; Savings Banks
Grand, Constantine G. Micromanipulation or Micurgy (*in part*)
Grant, Bruce. Hull, Isaac
Grant, Brigadier General R. C. Toc H
Grant, William Lawson. Brown, George; Galt, Sir Alexander Tilloch; Mackenzie, William Lyon
Grave, Walter Wyatt. Cambridge University
Graves, Lawrence Murray. Aggregates, Theory of; Bliss, Gilbert Ames (*in part*); Complement; Continuity; Function; Maxima and Minima; Number Sequences; Taylor's Theorem
Graves, Philip Perceval. Druses (*in part*); Lebanon (*in part*); Mesopotamia (*in part*); Palestine (*in part*)
Gray, Carl Raymond, Jr. Veterans Administration; War Pensions (*in part*)
Gray, George Buchanan, D.D. Bible (*in part*)
Gray, John Evelyn Bury. Drama (*in part*)
Gray, Sir John Milner. Gambia (*in part*)
Gray, R. B. Agricultural Engineering; Agricultural Power and Machinery (*in part*); Harvesting Machinery; Planting Machinery; Processing Machinery; Spraying and Dusting Machinery; Tillage Machinery; Tractors (*in part*)
Graves, J. L. Cardboard (*in part*)
Graves, W. M. H. Photometry (*in part*)
Green, Lois Angell. Spencer, Anna Garlin
Green, Margaret M. Education, History of (*in part*)
Green, Marjorie E. Family (*in part*)
Green, Nathan. Injunction (*in part*)
Green, William. American Federation of Labor
Greene, David (William). Irish Language; Irish Literature (*in part*)

- Greenish, Henry George. Pharmacy (*in part*)
 Greenleaf, Walter James. Land-Grant Colleges and Universities
 Greenwood, Rt. Hon. Arthur. Trades Union Congress, The (*in part*)
 Greenwood, Major. Epidemiology (*in part*)
 Gregg, Allan, M.D. Medical Education
 Gregg, Isaac. Government Departments (*in part*); Post and Postal Services (*in part*)
 Gregory, John Walter. Africa (*in part*)
 Gregory, Sir Theodor E. G. Fiduciary Issue; Panic (*in part*); Quantity; Theory of Money
 Gregory, Theophilus Stephen. Roman Catholic Church (*in part*)
 Gregory, William Benjamin. New Orleans (*in part*)
 Gregory, William King. Mammalia; Marsupialia (*in part*); Monotremata; Perissodactyla; Primates (*in part*); Ungulata
 Grenfell, Sir Wilfred T., M.D. Labrador (*in part*)
 Gretton, R. H. English History (*in part*)
 Greville, Thomas Nal Eden. Life Tables
 Grey, Egerton C. Fermentation
 Grey, Francis Temple. Capital Punishment (*in part*); Coroner; Extradition (*in part*); Insanity in Law (*in part*); Medical Jurisprudence (*in part*)
 Grey, Ian. Russia (*in part*)
 Grieve, Rev. Alexander James, D.D. Catechism (*in part*); Logos (*in part*); Preaching; Primitive Methodists (*in part*); Septuagint, The; Smyth (or Smith), John (*in part*); Swedenborg or Swedberg, Emanuel (*in part*); Ursula, St. (*in part*)
 Grieve, William Percival. Chancery (*in part*)
 Griffin, H. W. Shipping: War Losses of (World Wars I and II) (*in part*)
 Griffin, W. Lashford. Chain Manufacture (*in part*)
 Griffiths, Bartow. Instalment Selling (*in part*)
 Griffith, Francis Llewellyn. Busiris; Coptic Language; Demotic Language and Writing; Egypt (*in part*); Egyptian Language; Hieroglyphs; Meroc; Merotic Language and Writing; Moeris, Lake of; Nubian Language and Writing; Obelisk; Pharaoh; Psammethichus; Scarab (*in part*); Sphinx (*in part*); Thebes (*in part*)
 Griggs, Laura T. Valley of Ten Thousand Smokes
 Grim, Ralph Early. Argillite; Shale
 Grimshaw, Harold Atheling. Hours of Labour (*in part*)
 Grimwood, Herbert H. Wood-Carving (*in part*)
 Grinker, Roy R., M.D. Psychiatry (*in part*)
 Grinter, Linton E. Sand-Blasting and Shot Peening
 Grogan, Elinor F. B. (Lady Grogan). Bulgaria (*in part*)
 Groom, Percy. Dry Rot; Timber; Wood
 Gropius, Walter Adolph. Architectural Education (*in part*)
 Gross, Charles. Guilds
 Gross, Leo. Fried, Alfred Hermann (*in part*)
 Grossman, Morton I., M.D. Medical Research
 Grosvenor, Gilbert Hovey. National Geographic Society (*in part*)
 Grout, Frank F. Barrell, Joseph (*in part*)
 Grove, Vernon Guy. Differential Geometry
 Gruening, Ernest, M.D. Alaska (*in part*)
 Gruenthaner, Michael Joseph, S.J. Angel
 Gruffydd, William John. Welsh Language and Literature
 Grundy, George Beardo. Graeco-Persian Wars; Greece (*in part*)
 Gruner, John W. Taconite
 Gruson, M. Est de France, Compagnie des Chemins de Fer de L'
 Guérin, Basil Campbell de. Guernsey
 Guice, C. Norman. Honduras (*in part*)
 Guild, David Alexander. Arbitration (*in part*)
 Guilday, Right Reverend Monsignor Peter. Roman Catholic Church (*in part*)
 Guillaume, M. Lyautey, Louis Hubert Gonzalez; Nivelles, Robert George
 Guillebaud, Claude William. Luxury (*in part*); Luxury Taxes (*in part*); Malthus, Thomas Robert (*in part*); Marshall, Alfred (*in part*)
 Gulick, Luther Halsey. Brooklyn (*in part*); Long Island (*in part*); Mayor (*in part*); New York (City) (*in part*); Staten Island
 Gulliksen, Harold. Learning; Memory
 Gummer, C. F. Triangle
 Gunther, Robert Theodore. Armilla or Armillary Sphere; Astrolabe; Dial and Dialling (*in part*)
 Guthmann, Harry G. Financial Statements
 Guttridge, George H. Whig and Tory
 Guyer, Michael Frederic. Birth Control; Reproduction (*in part*)
 Gwynn, Denis Rolleston. Ireland (*in part*); Ireland, Republic of (*in part*)
 Gwynn, Stephen Lucius. Collins, Michael; Cosgrave, William Thomas (*in part*); Griffith, Arthur; Healy, Timothy Michael
 Gwynne, Major F. W. W. Lena Goldfields Limited (*in part*)
 Haas, Fritz. Pearl (*in part*)
 Haas, William Herman. Chile (*in part*)
 Haberler, Gottfried. Quota
 Hackett, Charles Wilson. Mexico (*in part*)
 Hackin, Joseph. Tibetan Art
 Hackworth, Green H. International Court of Justice
 Haddon, Alfred Cort. New Guinea (*in part*)
 Hadfield, Sir Robert A. Engineering Education (*in part*)
 Hadow, Sir William Henry. Bach, Karl Philipp Emanuel; Haydn, Franz Joseph; Schubert, Franz Peter
 Hagedorn, Hermann. Roosevelt, Theodore
 Hahn, Mannel. Philately
 Hahn, Richard David, M.D. Venereal Diseases (*in part*)
 Hahne, Ernest Herman. War Finance: Cost of World Wars I and II
 Haig, Lieutenant Colonel Sir Thomas Wolseley. Afghanistan (*in part*)
 Haldane, Elizabeth Sanderson. Nursing (*in part*)
 Haldane, John Burdon Sanderson. Heredity (*in part*)
 Hale, Edward Everett. Clarke, James Freeman; Everett, Edward
 Hale, George Ellery. Spectroheliograph
 Hale, Robert Lee. Compensation (*in part*)
 Halecki, Oskar. Poland (*in part*)
 Halford, Jeannette. Baby-Farming (*in part*); Foundling Hospitals (*in part*)
 Hall, Sir Alfred Daniel. Agricultural Organization (*in part*); Agriculture: A General Survey (*in part*)
 Hall, Charles Henry. Motor-Boat (*in part*)
 Hall, Harry Reginald Holland. Archaeology (*in part*); Chronology (*in part*); Dress (*in part*); Egypt (*in part*); Scarab (*in part*); Sphinx (*in part*)
 Hall, Jerome. Criminal Law (*in part*)
 Hall, R. Dawson. Anthracite (*in part*)
 Hall, Richard B. Title Insurance or Guarantee of Title
 Hall, Colonel Robert Burnett. Haiti; Santo Domingo (*in part*)
 Hall, Sir William Clarke. Borstal System; Children's Courts or Juvenile Courts (*in part*); Probation
 Hallett, R. L. Lead
 Halliday, Frank W. Martial Law (*in part*)
 Halliday, Sir William Reginald. Folklore
 Halliwell, W. J. T. Pilotage Laws (*in part*)
 Halm, George N. Exchange, Foreign
 Halphen, Louis. Anjou (*in part*); Fulk Nerra
 Halstead, Paul B. Cotton and the Cotton Industry (*in part*)
 Hamburger, Viktor. Experimental Embryology; Regeneration
 Hamer, Sam Field. Monuments, Preservation of (*in part*)
 Hamilton, A. R. Cane Fencing; Quarter-Staff; Single-Stick
 Hamilton, Mary Agnes. MacDonald, James Ramsay
 Hamlin, Talbot Faulkner. Amphitheatre; Apse; Arcade; Arch; Atrium; Baldachino; Basilica; Baths; Battlement; Buttress; Byzantine and Romanesque Architecture; Campanile; Capital; Ceiling; Château; Chimney (*in part*); Column; Crypt; Decorated Period; Diaconicon; Dome; Door; Doorway; Early English Period; Erechtheum; Flamboyant Style; Flute (*in part*); Fountain; Fret; Gothic Architecture; Governmental Architecture; Half-Timber Work; Hall; House; Hypæthruss; Lotus (*in part*); Louis Styles; Manor House; Minaret; Mosaic; Mosque; Moulding; Order; Panel; Perpendicular Period; Persian Art, Painting and Calligraphy (*in part*); Plateresque; Porch; Renaissance Art; Romanesque Art; Rosette; Rose Window or Wheel Window; Screen (*in part*); Shaft; Spire; Stair; Staircase; Strap Work; Swastika; Temple; Tile; Tomb; Tower; Tracery; Tritorium; Triumphal Arch; Tudor Period; Vault; Window
 Hammer, S. C. Drama (*in part*); Norwegian Language and Literature (*in part*)
 Hammick, Dalziel Llewellyn. Benzidine (*in part*)
 Hammond, Bray. Banking (*in part*)
 Hammond, John Lawrence Le Breton. Industrial Revolution, The
 Hamor, William Allen. Motor Car Engines: Their Operation and Care (*in part*); Research, Industrial (*in part*)
 Hampden, Walter. Booth, Edwin Thomas
 Hand, Irving F. Sunshine
 Handley, Louis de Breda. Swimming (*in part*)
 Haney, Thomas V. Ski; Walking Races
 Hannay, David. Abbades; Alphonso I; Bainbridge, William; Byng, John; Dahlgren, John Adolf; Fisher, John Arbutnot Fisher, 1st Baron (*in part*); Fox, Charles James (*in part*); Impressment; Junius (*in part*); Lissa; Nelson, Horatio Nelson, Viscount (*in part*); Pepys, Samuel (*in part*); St. Vincent, John Jervis; St. Vincent, Battle of; Sluys (Slois), Battle of; Spinola, Ambrose
 Hansen, Harry. Lawson, Victor Fremont
 Hansen, Robert W. Friendly Societies (*in part*)
 Hanton, W. A. Weaving (*in part*)
 Harada, Jiro. Bon-Seki; Dance (*in part*); Interior Decoration (*in part*); Ivory Carving (*in part*); Japanese Architecture; Japanese Gardens; Japanese Music; Japanese Sculpture; Museums and Art Galleries (*in part*); Nō Drama (*in part*); Societies of Art (*in part*); Tea Ceremony; Wood-Carving (*in part*)
 Harap, Henry. School and Curriculum (*in part*)
 Hardenbergh, J. G., V.M.D. Pleuropneumonia
 Hardenbergh, William Andrew. Refuse Disposal; Sewage Disposal
 Hardin, Charles Meyer. Government Departments (*in part*)
 Harding, Lowry W. Illiteracy
 Hardman, Oscar, D.D. Fasting
 Hardy, Arthur C. Colour
 Hargrove, William Henry. Consolidated School (*in part*)
 Harley, William S. Motorcycles (*in part*)
 Harmer, Sir Sidney Frederic. Cetacea (*in part*); Polyzoa (*in part*); Pterobranchia (*in part*)
 Harnack, Adolf von. Millennium; Neoplatonism (*in part*); Origen; Sabellius; Theodore of Mopsuestia (*in part*); Theodoret (*in part*)
 Harned, Herbert Spencer. Solutions
 Harper, Francis. Wildlife Conservation and Management (*in part*)
 Harper, Ida Husted. Women's Suffrage (*in part*)
 Harper, John Ernest Troyte. Falkland Islands, Battle of; "Goeben" and "Breslau"; Navigation
 Harper, Robert Brinton. Gas Manufacture (*in part*)
 Harrar, Ellwood Scott. Acacia; Ailanthus; Alder; Arborvitae; Arbutus; Ash; Aspen; Athel; Basswood; Beech; Birch; Blackhaw;

- Cedar; Chinquapin; Cypress; Dogwood; Douglas-Fir; Fir; Hackberry; Hawthorn; Hornbeams; Horchestnut (*in part*); Juniper; Larch; Lime or Linden; Maple; Mesquite; Mountain Ash; Palo Verde; Persimmon (*in part*); Pine (*in part*); Sycamore; Tree (*in part*); Tuliptree
- Harris, Abram Lincoln. Sombart, Werner Harris, Frederic Robert. Harbours (*in part*) Harris, George Christie. Abietic Acid Harris, Walter Burton. Abdel Krim Harrison, Austin. Harrison, Frederic Harrison, Earl Grant. Naturalization Laws Harrison, Frederic. Ruskin, John Harrison, George Leslie. Federal Reserve System, The (*in part*)
- Harrison, H. Ainsworth. Fluorene Harrison, H. S. Material Culture Harrison, Colonel Lawrence Whitaker. Salvarsan or "606" (*in part*); Wassermann Reaction Harrison, Robert William F. Royal Society, The (*in part*); Violin (*in part*)
- Harrod, R. F. Malthus, Thomas Robert (*in part*)
- Hart, Albert Bushnell. United States (of America), The (*in part*)
- Hart, Albert Gailord. Depreciation (*in part*); National Savings (*in part*)
- Hart, James. Administrative Law; Authority, Administrative
- Hart, John Henry Arthur. Asmoneus or Asamoneaus; Josephus, Flavius (*in part*); Sibylline Oracles (*in part*)
- Hartman, Olga. Annelida (*in part*)
- Hartney, Harold Evans. Observer Corps in Air Defense (*in part*); Parachute
- Hartung, Maurice Leslie. Secondary Education (*in part*)
- Harvey, E. Newton. Bioluminescence Harvey, Ethel Browne. Fertilization Harvey, F. T. Veterinary Science (*in part*)
- Harvey, Godfrey Eric. Burma (*in part*); Burmese Wars
- Harvey, Samuel C., M.D. Surgery Harvey, Thomas Edmund. Fox, George Haseloff, Arthur. Illuminated Manuscripts Hass, Henry Bohn. Charcoal Hasselkus, J. Binocular Instrument (*in part*)
- Hastings, Somerville. Sinus (*in part*)
- Hatch, Frederick Henry. China-Clay (*in part*); Ilmenite; Kaolinite; Ore Deposits
- Hathway, Marion. Social Service Hatschek, Emil. Viscosity
- Hauck, Albert, D.Th. Church History (*in part*)
- Houghton, John L. Metals
- Haurwitz, Bernhard. Winds, General Circulation of
- Hauser, Philip M. Production, Census of (*in part*)
- Haust, Jean. Walloon Literature
- Haven, Charles T. Colt, Samuel
- Haverfield, Francis John. Boadicea; Britain (*in part*); Caledonia (*in part*); Ermine Street; Gaul (*in part*); Numantia; Roman Army; Trinovantes
- Haward, Edwin. India (*in part*); Punjab (*in part*); Sind (*in part*); United Provinces (*in part*)
- Hawk, W. W. Diamond Match Company, The Hawkes, Frederic Clare. Estate and House Agents
- Haworth, Walter Norman. Carbohydrates (*in part*)
- Hawtrex, Ralph George. Civil List (*in part*); Exchequer (*in part*); Finance
- Hayakawa, S. I. Semantics
- Hayes, Carlton Joseph Huntley. Gelasius (*in part*); Guibert or Wibert; Lucius (*in part*); Matilda, countess of Tuscany; Paschal II; Sixtus IV (*in part*); Truce of God; Victor (*in part*)
- Hays, Arthur Garfield. Theatres, Laws Relating to (*in part*)
- Hayward, Herman Eliot. Fruit; Leaf (*in part*); Root; Seed; Stem
- Haywood, Harold Le Roy. Freemasonry (*in part*); Russia (*in part*); Yugoslavia (*in part*)
- Hermannsson, Halldor. America (*in part*); Vinland or Wineland
- Herndon, Arthur H. Sugar (*in part*)
- Herold, Edward William. Electron Tube
- Heron, Harold. Starch (*in part*)
- Herr, Major General John Knowles. Cavalry (*in part*)
- Herr, Major Milton B. Artillery (*in part*); Coast Defense; Field Artillery; Gas Mask; Guerrilla Warfare (*in part*); Smoke; In Warfare; United States (of America), The (*in part*)
- Herick, C. Judson. Evolution, Organic (*in part*)
- Herrick, Horace Terhune. Chemurgy
- Herriot, Edouard. Danton, Georges Jacques; Jaures, Auguste Marie Joseph Jean
- Hersberg, Emanuel Benjamin. Chemical Apparatus
- Hervey, John L. Horse; Horse Racing and Breeding
- Herzberg, Max John. Crane, Stephen
- Herzfeld, Ernest Emil. Persepolis (*in part*)
- Hespelt, E. Herman. Spanish-American Literature
- Hess, Julius Hays, M.D. Antenatal Clinics
- Hesse, Richard. Distribution of Animals (*in part*)
- Hessels, John Henry. Gloss and Glossary (*in part*); Gutenberg, Johann (*in part*)
- Hesseltine, William B. Wisconsin (*in part*)
- Heuser, Chester Henry. Embryology, Human (*in part*)
- Hevesy, George Charles de. Hafnium
- Hewins, William Albert Samuel. Protection (*in part*)
- Hewson, Edgar Wendell. Baroclinic; Barotropic; Coriolis, Gaspard Gustave de; Ekman Spiral; Fronts; Geostrophic Wind; Humidity, Atmospheric; Inertia Motion; Motion, Laws of (*in part*)
- Heyneman, Julie Helen. Sargent, John Singer
- Heywood, Lieutenant Colonel T. G. G. Serbian Campaigns
- Hiatt, Walter Sanders. Circulars and Circularizing; Clubs (*in part*)
- Hibbert, Eva. Bleaching; Calico Printing; Dyeing; Textile Printing (*in part*)
- Hickman, Clarence N. Rockets (*in part*)
- Hickman, Kenneth Claude Devereux. Distillation (*in part*)
- Hicks, Agnes H. Sweden (*in part*)
- Hicks, George Dawes. Knowledge, Theory of Hicks, Granville. Steffens, Lincoln
- Hicks, John Donald. Wisconsin (*in part*)
- Hicks, Robert Drew. Stoics
- Higginson, J. Vincent. Mass (*in part*)
- Higgs, Henry. Budget (*in part*)
- Hightower, John. Camping (*in part*); Greyhound Racing (*in part*)
- Hildebrand, Joel Henry. Chemical Equilibrium
- Hildebrand, Karl. Sweden (*in part*)
- Hildebrand, Samuel Frederick. Salmonidae
- Hilfer, Harry. Cosmetics (*in part*)
- Hill, Archibald Vivian. Muscle and Muscular Exercise
- Hill, Sir George Francis. Numismatics (*in part*)
- Hill, James Brents. Louisville and Nashville Railroad Company
- Hill, John Eric. Alpaca (*in part*); Antelope; Artiodactyla; Bat; Beaver; Bobcat; Bovidae; Caenolestid; Carnivora (*in part*); Cat; Chimpanzee; Chipmunk; Chiroptera; Clouded Leopard; Coyote; Diana Monkey; Dingo or Warrigal (*in part*); Dormouse; Drill; Dromedary; Ermine; Eyra; Flying Squirrel; Fossa; Fox (*in part*); Genet; Goral; Grison; Grivet; Grizzly Bear; Ground Squirrel; Guenon; Guinea Pig; Ichneumon; Indri; Insectivora (*in part*); Jaguarundi; Jumping Hare; Jumping Mouse; Kangaroo Rat; Kra; Linsang; Marten; Monkey; Mouflon or Mufon; Musk Ox; Muskrat; Ocelot; Patas or Hussar Monkey; Palm Civet; Panda; Pecary; Pika; Pocket Mouse; Prairie Dog; Primates (*in part*); Ratel; Rodent; Rodentia;
- Hazard, John Newbold. Communist Party
- Hazeltine, Mary Emogene. Christmas (*in part*)
- Headlam, Rt. Rev. Arthur Cayley, D.D. Prayer, Book of Common (*in part*)
- Headlam-Morley, Agnes. Stresemann, Gustav
- Headlam-Morley, James Wycliffe. Benedetti, Vincent; Caprivi de Caprera de Montecucoli, Georg Leo Von
- Healy, John J., S.J. Episcopacy
- Heath, Dudley. Art Teaching (*in part*)
- Heath, Sir Thomas Little. Apollonius of Perga; Archimedes; Diophantus; Euclid; Heraclides; Ponticus; Heron of Alexandria; Nicomachus; Pappus of Alexandria; Porism; Ptolemy (*in part*); Pythagoras; Serenus; Theodosius
- Heaton, Herbert. Factory Production, History of; Market (*in part*)
- Heawood, Edward. Elgon
- Heckel, George Baugh. Interior Decoration (*in part*)
- Heckstall-Smith, Major Brooke. Yachting (*in part*)
- Hedgpath, Joel Walker. Pycnogonida
- Hedin, Göran. Sweden (*in part*)
- Hedley, Frank. Interborough Rapid Transit Company
- Hedley, Rt. Rev. John Cuthbert, O.S.B., D.D. Transubstantiation (*in part*)
- Heffernan, Rear Admiral John B. Constitution; United States (of America), The (*in part*)
- Heidbreder, Edna. Thinking, Psychology of
- Heighway, Arthur J. Advertising (*in part*)
- Helland, Carl August. Geophysical Prospecting (Geophysical Exploration, Applied Geophysics); Geophysics
- Heilbrunn, Lewis Victor. Acclimatization
- Hein, M. A. Ensilage
- Heine-Geldern, Robert von. Indonesia: Archaeology (*in part*)
- Heinemann, Martin, M.D. Tongue, Diseases of
- Heinicke, A. J. Fruit Farming (*in part*)
- Heise, George William. Battery (*in part*)
- Heldt, Peter Martin. Speedometers; Tractors (*in part*)
- Hele-Shaw, Henry Selby. Power Transmission (*in part*)
- Heller, Walter W. Taxation
- Heller, Wilfried. Emulsions; Gel
- Helms, Hermann. Chess (*in part*)
- Hempelmann, Friedrich. Psychology, Comparative
- Henderson, A. F. Fireproofing (*in part*)
- Henderson, Archibald. Shaw, George Bernard
- Henderson, Bernard William. Peloponnesian War, The
- Henderson, George Gerald. Terpenes
- Henderson, K., D.D. Beja (*in part*)
- Henderson, Leon. War Organizations, U.S. (World War II) (*in part*)
- Hendrick, Burton Jesse. Page, Walter Hines
- Hendrick, Ives, M.D. Psychiatry (*in part*)
- Henne, Albert Leon. Freon
- Hennessy, Harriet L., M.D. Intestinal Obstruction; Plague (*in part*)
- Henningsen, Sven. Denmark (*in part*)
- Henry, Robert Mitchell. Drama (*in part*)
- Henry, Robert S. Railways (*in part*)
- Henry, Thomas Anderson. Alkaloids; Cinchona Bark; Alkaloids (*in part*); Glucosides, Natural
- Henson, The Rt. Rev. Herbert Hensley, Hon. D.D. Bible, English (*in part*); Church and State
- Hepburn, Patrick Bruce. Bookselling (*in part*)
- Herbert, Sydney. Syndicalism (*in part*)
- Herbert, William de Bracy. Arrest (*in part*); Bail (*in part*); Bigamy; Blackmail (*in part*); Bribery (*in part*); Habitual Offenders (*in part*); Incest; Infanticide (*in part*); Intent; Larceny (*in part*); Obscenity (*in part*); Quarter Sessions, Court of (*in part*); Riot (*in part*); Treason (*in part*)
- Herdman, Thomas. Arabia (*in part*); Black Sea (*in part*); Czechoslovakia (*in part*); Elbe; Guiana (*in part*); Ireland (*in part*); Mediterranean Sea (*in part*); Persia (*in*

- Sea Cow; Sea Elephant; Sea Lion; Shrew; Tarsier; Thylacine or Marsupial Wolf; Tiger Cat; Tree Shrew; Viscacha; Water Deer; Wapiti; Zebra; Zorilla
- Hill, Sir Leonard Erskine. Aerotherapeutics; Kata Thermometer; Light and Radiation in Relation to Health
- Hill, Norman Llewellyn. Annexation; Boundaries; Hinterland
- Hillier, James. Electron Microscope; Electron Microscopy
- Hills, Edwin Sherbon. Australia (*in part*)
- Hills, John Moore. Salt (*in part*)
- Hills, Nina L. (Hon. Mrs. Eustace Hills). Day Nurseries (*in part*)
- Hilton, John. Amalgamation (*in part*); Combination in Industry; Competition in Industry (*in part*); Gentlemen's Agreements; Monopoly; Pools in Industry (*in part*); Profit-Sharing (*in part*); Rebates, Deferred; Trusts (*in part*)
- Hind, Arthur M. Engraving
- Hines, William M., Jr. War Graves (*in part*)
- Hinkle, Charles W. Camouflage; Cavalry; Chasseurs; Engineers, Military (*in part*); Flame Thrower; Grenades; Mountain Warfare; Training Camps, U.S. Military
- Hinnebusch, William Aquinas. Tetzels, Johann; Torquemada, Thomas
- Hiptkins, Alfred J. Pitch, Musical (*in part*)
- Hippisley, Colonel Richard Lionel. Linkages
- Hirn, Yrjo. Finnish Literature (*in part*)
- Hirose, Arthur Pierson. Washing Machines (*in part*)
- Hirsch, Emanuel, D.Th. Creeds (*in part*)
- Hirsch, Helmut. Campo Formio, Peace of; Gastein, Convention of; Mercenary; Piramens; Saarland
- Hitchcock, Eldred Frederick. Wool, War Control of
- Hitti, Philip Khuri. Arabia (*in part*); Hadhranaut (*in part*); Haza (*in part*); Jidda (*in part*); Kuwait (*in part*); Maronites; Mecca (*in part*); Yemen (*in part*)
- Hoagland, Henry E. Building Societies (*in part*)
- Hobday, Sir F. T. G. Canine Distemper
- Hobhouse, Leonard T. Comparative Ethics
- Hobson, Charles Kenneth. Profiteering (*in part*)
- Hobson, Oscar Rudolf. Money Market (*in part*); Wealth
- Hobson, Robert Lockhart. Pottery and Porcelain (*in part*)
- Hobson, Wilder. Jazz
- Hocking, William Ernst, D.D. Royce, Josiah (*in part*)
- Hodge, Edward Butler. Nitro Compounds
- Hodge, Frederick Webb. Cliff-Dwellings; Scalping
- Hodges, Paul C., M.D. Radiology (*in part*)
- Hodgkin, Major Adrian Elliot. Alkali Manufacture (*in part*); Chlorine; Soda
- Hodgkin, Thomas. Alaric (*in part*); Ravenna (*in part*); Vandals
- Hodgkinson, William R. Picric Acid or Lyddite
- Hodous, Lewis, D.D., B.D. Confucianism; Taoism
- Hodson, William. Children—Protective Laws (*in part*); Legitimacy and Legitimation (*in part*)
- Hoebel, E. Adamson. Blood Feud
- Hoffman, Frederick J. Psychoanalysis (*in part*)
- Hoffmann, Josef. Art Teaching (*in part*); Interior Decoration (*in part*); Tool
- Hogan, James. Ireland (*in part*)
- Hogarth, David George. Aegean Civilization (*in part*); Asia Minor (*in part*); Comana; Druses (*in part*); Ephesus; Lawrence, Thomas Edward (*in part*); Schliemann, Heinrich; Sis or Kozan; Smyrna (*in part*); Xanthus
- Hogben, Lancelot T. Cell; Chromosome; Comparative Physiology; Endocrinology (*in part*); Homology
- Hogg, Hope W. Mesopotamia (*in part*)
- Holden, Arthur C. House Planning (*in part*)
- Holdich, Sir Thomas Hungerford. Chitral (*in part*); Kabul (*in part*); Kalat; North-West Frontier Province (*in part*); Quetta
- Holinger, Paul H., M.D. Laryngitis
- Holland, Sir Eardley Lancelot, M.D. Gynaecology (*in part*)
- Holland, Raymond Prunty. Shooting (*in part*)
- Holley, Horace. Babism; Baha'i Faith
- Hollingworth, Leta S. Family (*in part*)
- Hollis, Henry Park. Observatory (Astronomical) (*in part*); Photography, Celestial (*in part*)
- Holloway, Emory. Whitman, Walt
- Holloway, J. W., Jr. Medical Legislation (*in part*)
- Hollowell, E. A. Clover; Sweetclover
- Hollweg, Admiral Carl. Tirpitz, Alfred von (*in part*)
- Holmes, Sir Charles John. Constable, John
- Holmes, Edward Morell. Opium (*in part*); Pharmacopoeia
- Holmes, O. W. Carver, Jonathan (*in part*)
- Holroyd, Sir Charles. Legros, Alphonse (*in part*)
- Holsapple, Lloyd B. Donation of Constantine
- Holscher, H. H. Bottle Manufacture
- Holstein, Otto. Chan Chan; Trujillo (*in part*)
- Holtom, Daniel Clarence, D.D. Japan (*in part*); Shintoism
- Holtzheuer, William. Continental Caoutchouc and Gutta Percha Company
- Holzman, Benjamin Grad. Hygrometer
- Honey, William Bowyer. Pottery and Porcelain (*in part*)
- Hood, Joseph Douglas. Thysanoptera
- Hook, Sidney. Proletariat
- Hooker, Davenport. Embryos, Behaviour of (Vertebrate)
- Hooper, Franklin Henry. Hancock, Winfield Scott; Harvard University (*in part*); Liberty Loans
- Hoover, Hubert D. Military Law (*in part*)
- Hoover, John Edgar. Fingerprints
- Hopkins, Sir Frederick Gowland, Hon., M.D. Cystine; Glutathione
- Hopkinson, Sir Alfred. Adoption; Legitimacy and Legitimation (*in part*)
- Hopkirk, Howard W. Children: Protective Laws (*in part*)
- Hopper, Turner Harcourt. Cottonseed (*in part*)
- Hopwood, Frank Lloyd. Physics in Medicine
- Horne, Rev. Dom. E. Glastonbury
- Horner, Fred. Annealing; Axle; Brake; Brazing and Soldering; Buffer (*in part*); Bunsen Burner; Clutch; Condenser; Cylinder; Fan; Forging Press; Gas Meter (*in part*); Governor (*in part*); Grinding-Machines; Hydrant; Jig; Lathe; Machine-Tools (*in part*); Milling Machines; Punching and Shearing Machines; Sawing Machines; Shaft, Driving; Steam-Hammer; Steam Shovel or Navy; Torque; Wood-Working Machinery
- Horner, J. G. Screw; Tool
- Horton, Mildred McAfee. Wellesley College
- Hose, Charles. Banjermasin or Bandjarasin (*in part*); Beri-Beri; Blowgun; Borneo (*in part*); Borneo, State of North (*in part*); Brunei (*in part*); Java (*in part*); Kayans; Kenyahs; Klemantans; Labuan (*in part*); Malay Archipelago (*in part*); Sumatra (*in part*)
- Hoselitz, Bert Frank. Export Credits (*in part*); Finance, Articles on; Franc; Trust Company (*in part*)
- Hoster, Mrs. Constance. Forms of Address (*in part*)
- Hough, Henry Beetle. Martha's Vineyard; Nantucket (*in part*)
- Hough, Jack L. Michigan, Lake
- Houghton, A. E. Serrano, Francisco
- Houghton, Henry Garrett. Adiabatic Processes in Atmosphere; Condensation Trails; Geopotential; Hail
- House, Colonel Edward Mandell. Paris, Conference of (*in part*)
- House, M. M., D.D.S. Teeth, Artificial
- Houseman, C. R. Oxygen
- Houston, Sir Alexander C. Water Purification
- Houston, William Vermillion. Electron, The
- Hovey, Rev. Horace Carter, D.D. Luray Cavern
- Howard, Alexander L. Teak (*in part*)
- Howard, Harry Nicholas. Balkan Entente, The; Little Entente (*in part*)
- Howard, Leland Ossian. Alfalfa Weevil; Chinch Bug (*in part*); Colorado Potato Beetle; European Corn Borer (*in part*); Gypsy Moth; Harlequin Bug; Japanese Beetle; Peach Tree Borer; Plum Curculio; Woolly Apple Aphid
- Howarth, F. Bryophyta (*in part*)
- Howarth, Osbert John Radclyffe. London (*in part*); Norway (*in part*); Scotland (*in part*)
- Howe, John Allen. Fuller's Earth (*in part*)
- Howell, Alfred Brazier. Locomotion of Animals (*in part*)
- Howell, Benjamin Franklin. Cambrian System
- Howell, John Thomas. Eastwood, Alice
- Hoye, John. Cotton and Cotton Industry (*in part*)
- Hrozny, Friedrich. Hittites, The
- Hubbard, Eric Hesketh. Dobson, Frank
- Hubbard, Howard Archibald. Arizona
- Hubbard, Prevost. Asphalt
- Hubbard, Theodora Kimball. Landscape Architecture (*in part*)
- Hubbell, Theodore H. Cockroach; Cricket; Earwig; Grasshopper; Grouse Locust; Katydid; Leaf Insect; Locust; Orthoptera; Stick-Insect
- Hubbs, Carl L. Cyclostomata or Marsipobranchii; Fishes (*in part*); Hagfish; Lamprey
- Huber, Max. Red Cross (*in part*)
- Huddleson, I. Forest. Brucellosis
- Hudleston, F. J. Balaclava; Crimean War (*in part*)
- Hudnut, Joseph. Renaissance Architecture (*in part*); Sculpture (*in part*)
- Hudson, Alfred E. Asia (*in part*)
- Hudson, E. B. Sheets, Iron and Steel
- Hudson, Hilda Phoebe. Analytic Geometry; Curve; Surface (*in part*)
- Hudson-Williams, Thomas. Theognis of Megara
- Hueffer, Francis. Handel, George Frederick (*in part*)
- Huff, Clay G. Entomology (*in part*)
- Hügel, Baron F. von. John (The Apostle); John, Gospel of St.
- Huggins, Maurice Loyal. Association
- Hughan, William James. Freemasonry (*in part*)
- Hughes, Charles Evans. Monroe Doctrine, The
- Hughes, E. E. Wales (*in part*)
- Hughes, Rupert. Borglum, Gutzon
- Hulburt, Ray Garland. Osteopathy
- Hull, A. Eaglefield. Musical Notation
- Hume, Brigadier General Edgar Erskine, M.D. Society of the Cincinnati
- Humphrey, George. Association, Mental
- Humphreys, William Jackson. Mirage
- Humphries, Sir Albert Edward. Middlings; Semolina
- Hungerford, Herbert B. Bedbug; Hemiptera (*in part*); Water Boatman
- Hungerford, S. J. Canadian National Railways
- Hunsaker, Jerome Clarke. Farman, Henri
- Hunt, Arthur Surridge. Papyrology
- Hunt, Kenneth Edward. Milk (*in part*)
- Hunt, Rockwell Dennis. Los Angeles (*in part*)
- Hunt, Stanley B. Synthetic Fibres (*in part*)
- Hunt, W. Ben. Woodcraft
- Hunter, Arthur. Annuity (*in part*)
- Hunter, Dard. Watermarks
- Hunter, Sir Robert. Commons (*in part*)
- Hunter, Walter Samuel. Behaviourism
- Huntington, Ellsworth. Fire (*in part*)
- Hurd, Charles DeWitt. Thiophene
- Hurlbut, Cornelius Searle, Jr. Asbestos; Beryl; Mineralogy (*in part*)
- Hurlstone-Jones, F. R. Training Corps, Officers' (*in part*)
- Hurren, S. A. Pianoforte (*in part*); Pianoforte Manufacture (*in part*); Player-Piano
- Hurst, Edward Weston, M.D. Encephalitis
- Husik, Isaac. Jewish Philosophy
- Husserl, Edmund. Phenomenology
- Hussey, Joan Mervyn. Basil I; Basil II, Bul-

- garoctonus
 Hussey, Rowland M. Nail Manufacture
 Hutchens, Arthur R. Football (*in part*)
 Hutchins, Ethel L. Cincinnati
 Hutchins, Leroy W. Canoe (*in part*)
 Hutchinson, George Evelyn. Biology (*in part*); Palolo Worm
 Hutchinson, John. Africa (*in part*)
 Hutchison, A. F. Wallace, Sir William (*in part*)
 Hutton, Rev. Arthur Wollaston. Leo XIII (*in part*); Manning, Henry Edward (*in part*); Newman, John Henry (*in part*); Wiseman, Nicholas Patrick Stephen (*in part*)
 Hutton, Edward. Boccaccio, Giovanni
 Hutton, Eric. Lewis, John Llewellyn (*in part*)
 Hutton, John Henry. Acta; Batak; Bugis; Cynotherapy; Head-Hunting; Khasi and Jaintia Hills (*in part*); Kling or Tling; Kuki; Lisu; Lolo; Lycanthropy; Meithei; Metempsychosis (*in part*); Moro; Naga Hills (*in part*); Rejang; Sakai; Semang; Shan; Talaing
 Huxford, Walter Scott. Stroboscope
 Huxley, Julian Sorell. Courtship of Animals; Dedifferentiation; Individuality; Metamorphosis (*in part*); Selection (*in part*)
 Hyatt, James Philip. Jeremiah (*in part*)
 Hyman, Libbie Henrietta. Morphology; Rotifera (*in part*); Tapeworms (*in part*); Turbellaria (*in part*); Vertebrata; Worm; Zoology
 Hymans, Henri Simon. Rubens, Peter Paul (*in part*); Van Dyck, Sir Anthony (*in part*)
 Iibert, Sir Courtenay. Evidence (*in part*)
 Imison, C. S. Sulphuric Acid
 Imms, A. D. Aphides (*in part*); Coleoptera (*in part*); Diptera (*in part*); Entomology (*in part*); Hemiptera (*in part*); Hymenoptera; Lepidoptera (*in part*); May Fly (*in part*); Mosquito (*in part*); Neuroptera (*in part*); Phylloxera; Saw-Fly; Social Insects; Tsetse Fly; Wasp; Weevil (*in part*)
 Ingalls, A. G. Mirror (*in part*)
 Inge, Very Rev. William Ralph, D.D. Plotinus
 Ingham, Kenneth. Kenya (colony) (*in part*)
 Ingham, P. B. Eurythmics
 Ingles, Harry Clyde. Signal Communication
 Ingpen, Roger. Shelley, Percy Bysshe (*in part*)
 Ingram, Beresford. Continuation Schools (*in part*)
 Ingram, John Kells. Senior, Nassau William (*in part*); Slavery (*in part*)
 Ingram, Thomas Allan. Bill of Sale (*in part*); Holiday
 Innes, Alexander. Knox, John
 Innes, William Thornton. Ives, Frederic Eugene
 Innes of Learney, Sir Thomas. Eglinton; Earls of
 Innis, Harold Adams. Canada (*in part*)
 Inwards, H. Straw and Straw Manufactures (*in part*)
 Ireland, Philip Willard. Addis Ababa; Algeria (*in part*); Algiers (*in part*); Angola (*in part*); Asmara; Benghazi (*in part*); Congo Free State (*in part*); Eritrea (*in part*); Fez; Fezzan; Iraq (*in part*); Jibuti; Kantanga; Masawa; Mesopotamia (*in part*); Misurata; Oran; Qairwān; Rhodesia (*in part*); Ruanda-Urundi (*in part*); Somaliland; South-West Africa (*in part*); Tanga; Tobruk; Transvaal (*in part*); Tunis (*in part*); Tunisia (*in part*); Wazzān; Zululand (*in part*)
 Ironside, Field Marshal Sir William Edmund. Masurian Lakes, Battles of The (*in part*); Russia, Campaign in North (*in part*); Russo-Polish Campaign; Tannenberg, Battle of
 Irvine, William Fergusson. Liverpool (*in part*)
 Irwin, Robert Benjamin. Blindness (*in part*)
 Irwin, Will. Baseball (*in part*)
 Irwin, William A. Wisdom Literature
 Isaac, Jules. Anne (of France); Francis I (*in part*)
 Isaacs, Asher. Exports (*in part*)
 Isaacs, Jacob. Dramatic Criticism
 Isaacs, S. C. Theatres, Law Relating to (*in part*)
 Izard, Thomas C. Whetstone, George
 Jack, George. Sculpture Technique (*in part*)
 Jackson, Dunham. Polynomial (*in part*)
 Jackson, Henry. Parmenides of Elea; Sophists; Thales of Miletus (*in part*); Xenocrates of Chalcodon (*in part*)
 Jackson, Sir Herbert. Microscopy (*in part*)
 Jackson, John. Moon; Planetarium
 Jackson, John Hampden. Finland (*in part*)
 Jackson, Major General Sir Louis (Charles). South African War, 1899-1902 (*in part*)
 Jackson, Stanley Percival. South Africa, Union of (*in part*)
 Jackson, William. Sheep (*in part*)
 Jacob, George James Morley. Juvenile Delinquency (*in part*)
 Jacobs, Rev. Charles Michael, D.D. Lutherans (*in part*)
 Jacobs, Joseph. Jew, The Wandering (*in part*); Passover (*in part*)
 Jacobson, Nathan. Polynomial (*in part*); Ring (*in part*)
 Jadwin, Edgar. Champlain, Lake; Colorado River; Erie, Lake (*in part*); George, Lake; Hudson River; Missouri River; Niagara River; Ontario, Lake (*in part*); Saint Clair River (*in part*)
 Jaffe, Lee K. Port Authority (*in part*)
 Jakl, Vincent E. Kite-Flying (*in part*)
 James, Charles. Europium; Holmium; Neodymium; Samarium; Terbium; Thulium; Ytterbium; Yttrium
 James, E. Ibbetson. Aytoun, William Edmonstone; Chesterton, Gilbert Keith; Chevalier, Albert; Lloyd, Marie
 James, F. E. Skone. Copyright (*in part*)
 James, Harlean. Washington
 James, Milton Carl. Pisciculture (*in part*)
 James, Montague R. Eton
 James, William P. Kipling, Rudyard (*in part*)
 Jamot, Paul. Painting (*in part*)
 Janson, Roland Godfrey. Skating
 Jayne, Kingsley Garland. Malay Archipelago (*in part*)
 Jeans, Sir James Hopwood. Cosmogony; Kinetic Theory of Matter (*in part*); Relativity (*in part*)
 Jebb, Sir Richard Claverhouse. Aristophanes (*in part*); Demosthenes; Greek Literature (*in part*); Isocrates (*in part*); Lysias (*in part*); Pindar (*in part*); Rhetoric (*in part*); Thucydides (*in part*)
 Jeffers, William Martin. Union Pacific Railroad (*in part*)
 Jefferson, Geoffrey. Spinal Column, Surgery of
 Jefferson, Mark. Argentina (*in part*)
 Jeffery, H. E. Goat (*in part*)
 Jeffreys, Harold. Earth
 Jeffries, Zay. Alloys
 Jeilinson, William L. Bird Louse; Louse
 Jenkins, Evan David Thomas. Constitution of Athens
 Jenkins, Francis Arthur. Light (*in part*)
 Jenkins, Hilger Perry, M.D. Appendicitis
 Jenkinson, Sir Hilary. Exchequer (*in part*); Tally
 Jenks, William Jackson. Norfolk & Western Railway Company, The
 Jenne, Eldon I. Physical Education
 Jenness, Diamond. Ivory Carving (*in part*)
 Jennings, Walter W. Kentucky (*in part*)
 Jennings, William Ivor. Ministry; Speaker (*in part*)
 Jespersen, Otto. Grammar; Language; Philology
 Jessup, Walter Albert. Iowa (*in part*)
 Jeyons, William Stanley. Boole, George
 Jóhannesson, Thorkell. Iceland (*in part*)
 Johannsen, Albert. Diabase; Dolerite
 Johns, Iral Brown. Calomel; Corrosive Sublimite; Mercury
 Johnson, A. Le Roy. Orthodontia
 Johnson, Earl Shepard. Civics
 Johnson, Edward C. Embalming
 Johnson, Emory Richard. Inter-State Commerce; Transport (*in part*)
 Johnson, Frank William. Oak (*in part*); Oil-Palm (*in part*)
 Johnson, James Weldon. Negro, The Ameri-
- can (*in part*)
 Johnson, Martin Wiggo. Marine Biology; Ocean and Oceanography (*in part*); Zoological Collecting (*in part*)
 Johnson, O. M. Farm Rents (*in part*)
 Johnson, Raymond. Softball
 Johnson, Thomas Hope. Chronographs (*in part*); Electricity; Atmospheric
 Johnson, Warren C. Urey, Harold Clayton
 Johnson, Willis Hugh. Amoeba; Euglena; Paramedium; Volvox; Vorticella
 Johnston, Alexander. United States (of America), The (*in part*)
 Johnston, Charles. Song Birds (*in part*)
 Johnston, Charles Haven Ladd. McClellan, George Brinton
 Johnston, Sir Harry Hamilton. Africa (*in part*); Liberia (*in part*); Uganda (*in part*)
 Johnston, Henry Phelps. American Revolution, The (*in part*)
 Johnston, Paul E. Farm Management (*in part*)
 Johnston, Walter Henry. Great Britain (*in part*)
 Jolas, Maria. Drama (*in part*)
 Joliot-Curie, Irène. Polonium (*in part*)
 Joll, James Byssie. Germany (*in part*)
 Jolliffe, Arthur Ernest. Series (*in part*)
 Jolowicz, Herbert Felix. Roman Law
 Joly, Charles Jasper. Camera Lucida
 Jones, Sir Bennett Melville. Aerodynamics
 Jones, E. Alfred. Golden Rose (*in part*); Mace (*in part*); Silversmiths' and Goldsmiths' Work (*in part*)
 Jones, Ernest, M.D. Freud, Sigmund (*in part*)
 Jones, E. Taylor. Electromagnet (*in part*); Induction Coil
 Jones, Frederic Wood. Australia (*in part*)
 Jones, Gilbert Starling. Valley Forge
 Jones, Gwilym Peredur. Freemasonry (*in part*)
 Jones, Sir Harold Spencer. Astronomy (*in part*); Astrophysics; Telescope (*in part*); Star (*in part*)
 Jones, Henry Albert. Potato (*in part*)
 Jones, J. C. Griffith. Eisteddfod
 Jones, Jenkin William. Rice (*in part*)
 Jones, Percy Herbert. Cremation (*in part*)
 Jones, Philip James. Farnese
 Jones, Robert Edmond. Theatre (*in part*)
 Jones, S. Voice (*in part*)
 Jones, Vernon S. Laws Relating to Seamen (*in part*)
 Jones, W. Neilson. Chimaera
 Jopson, Norman Brooke. Old Slavonic; Polish Language; Russian Language and Literature (*in part*); Serbo-Croat Language and Literature (*in part*); Slavonic Language; Slavs (*in part*)
 Jordan, David Starr, M.D. Agassiz, Jean Louis Rodolphe
 Joseph, Helen Haiman. Marionettes and Puppets
 Joseph, Horace W. B. Species (*in part*)
 Josselyn, Lloyd W. Canoe (*in part*)
 Jourdain, Rev. Francis C. R. Cuckoo
 Joyce, Adrian D. Turpentine
 Joyce, Cyril Alfred. Juvenile Delinquency (*in part*)
 Joyce, Thomas Athol. Colombia (*in part*); Dress (*in part*); Inca; South America (*in part*); West Indies, The (*in part*)
 Judson, Lewis Van Hagen. Measures and Weights
 Jull, Morley Allan. Egg (*in part*); Poultry and Poultry Farming; Turkey
 Jung, Frederic Theodore, M.D. Beauty Culture
 Jutzi, W. Dyeworks and Chemical Industries, Amalgamation of (*in part*)
 Kaempffert, Waldemar. Inventions and Discoveries
 Kahn, Ely Jacques. Colour in Architecture; Shop Front Design (*in part*)
 Kahn, Richard Arthur. Physical Natural Resources (*in part*)
 Kallen, Horace Meyer. James, William
 Kamp, Ewald A. Bolt

- Kandel, Isaac Leon. Classical Education (*in part*); Degree (*in part*); Education, History of (*in part*)
- Kang, Younghill. Bed (*in part*); Dance (*in part*); Dress (*in part*); Li Po or Li Tai Po; Societies of Art (*in part*); Tonghak or Chuntokyo; Tu Fu
- Karpen, Leo. Furniture Manufacture (*in part*)
- Karve, Dattatreya Gopal. Bombay (*in part*); Bombay State (*in part*)
- Kasner, Edward. Levi-Civita, Tullio
- Kassel, Louis S. Catalysis (*in part*)
- Katz, Daniel. Aesthetics, Experimental (*in part*)
- Kawin, Ethel. Parent Education (*in part*)
- Keefer, Chester Scott, M.D. Sulfonamides, The
- Keeler, William Norton. Raisin
- Keeling, S. V. Cartesians
- Keeton, George Williams. Torture (*in part*)
- Keiper, Frank. Voting Machines
- Keith, Sir Arthur, M.D. Man, Evolution of
- Keith, E. Gordon. Corporation Tax
- Keller, Arthur Charles. Gramophone (*in part*)
- Keller, Kaufman Thuma. Chrysler Corporation
- Keller, Walter David. Tripoli
- Kellett, E. E. Jew, The Wandering (*in part*); Paston Letters (*in part*); Prologue (*in part*); Prose (*in part*); Rhythm (*in part*); Round Table; Sonnet; Webster, John
- Kelley, Charles Fabens. Bronze and Brass Ornamental Work (*in part*)
- Kelley, Florence. Sweating System (*in part*)
- Kelley, Robert F. Polo (*in part*)
- Kelliher, Harry P. Trans-Oceanic and Trans-Continental Flights (*in part*)
- Kellogg, Charles E. Glinka, Konstantin Dimitrievich
- Kellogg, Vernon. Burbank, Luther; Hoover, Herbert Clark (*in part*)
- Kelly, George Arthur. Pullman Incorporated (Delaware)
- Kelly, Raymond John. American Legion
- Kelsen, Hans. Absolutism, Political
- Kelsey, Clarence Hill. Title Guarantee Companies
- Kelsey, Frances Oldham, M.D. Atropine
- Keltie, Sir John Scott. Africa (*in part*); Livingstone, David
- Kempff, Clarence Selby. Ship-Lanes of the North Atlantic
- Kendall, E. C. Addison's Disease; Adrenal Glands
- Kendall, Henry M. Air; Belle-Ile-En-Mer; Corsica (*in part*); Tahiti; Tripoli (*in part*)
- Kendrick, Albert Frank. Dress (*in part*); Interior Decoration (*in part*); Textiles and Embroideries (*in part*)
- Kendrick, Benjamin B. Calhoun, John Caldwell; Hayes, Rutherford Birchard (*in part*); Johnson, Andrew; Quincy, Josiah
- Kendrick, Thomas Downing. Balearic Islands (*in part*); Corsica (*in part*); Druidism; Malta (*in part*); Sardinia (*in part*)
- Kennard, Earle Hesse. Kinetic Theory of Matter (*in part*); Radiometer
- Kennedy, Albert J. Social Settlements (*in part*)
- Kennedy, Rev. Archibald Robert Stirling, D.D. Tabernacle
- Kennedy, Sir Charles Malcolm. Commercial Treaties (*in part*)
- Kennedy, Clarence Hamilton. Dragonfly; Insect (*in part*)
- Kennedy, Edward T. Water Polo
- Kennedy, John Joseph. Sodium (*in part*)
- Kennedy, John Lyon. Parapsychology; Psychological Research (*in part*)
- Kennedy, Major General John Noble. Artillery (*in part*)
- Kennedy, Captain M. D. Japan (*in part*)
- Kennedy, Vincent Lorne. Assumption, Feast of; Exorcism
- Kenny, Meave, M.D. Puerperal Fever
- Kent, Francis Lawrence. Libraries (*in part*); Periodical (*in part*)
- Kenyon, Dorothy. Husband and Wife (*in part*)
- Kenyon, Sir Frederic George. Museums and Art Galleries (*in part*)
- Kerby, C. Edith. Blindness (*in part*)
- Kern, William H. Pigeon-Flying
- Kerr, Charles, Jr. Locomotive (*in part*)
- Kerr, Clark. Industrial Relations (*in part*)
- Kerr, Duncan J. Lehigh Valley Railroad, The
- Kerr, Sir John Graham. Vertebrate Embryology (*in part*)
- Kerr, Philip Henry, Marquess of Lothian. Rhodes Scholarships
- Kerwin, Jerome Gregory. Alderman; Autocracy; Democratic Party (*in part*); Filibuster
- Kester, Roy Bernard. Cost Accounting (*in part*)
- Ketch, James Moss. Reflectors
- Ketchum, Marshall D. Investments: In Business; Investment Trusts; Listed Securities
- Kettering, Charles Franklin. Motor Car (*in part*)
- Keutgen, Friedrich Wilhelm Eduard. Commune (*in part*)
- Key, V. O., Jr. National Convention, The (*in part*); Party, Political; Referendum and Initiative; Spoils System
- Keyes, Henry Wilder. New Hampshire (*in part*)
- Keynes, Geoffrey Langdon, M.D. Blake, William
- Kiernan, Loyd J. Railways (*in part*)
- Kilborn, Holloway. Drop Forging (*in part*); Forging
- Kimball, Dexter Simpson. Technical Education (*in part*)
- Kimball, Fiske. Interior Decoration (*in part*); Modern Architecture, 18th and 19th Centuries (*in part*)
- King, Frank L. Fountain Pen
- King, James F. Colombia (*in part*)
- King, John. Light (Thin) Castings Industry
- King, Willford Isbell. Competition in Industry (*in part*); Demand; Diminishing Returns; Instalment Selling (*in part*); Panic (*in part*); Single Tax; Trade Forecasts; Trusts (*in part*)
- King, William Bernard Robinson. Coprolites (*in part*); England (*in part*); Springs
- King-Page, Douglas. Marine Insurance (*in part*)
- Kingsbury, Forrest Alva. Abilities, General and Special; Psychological Tests
- Kingsford, Charles Lethbridge. Buckingham, Henry Stafford, 2nd Duke of; Edward IV; Henry IV; Henry VI; Richard II; Richard III; Salisbury, Thomas de Montacute; Somerset, Edmund Beaufort, Duke of; Whittington, Richard
- Kingsford, H. S. Seals (*in part*)
- Kingslake, Rudolf. Photography (*in part*)
- Kinkeldey, Otto. Chinese Music
- Kinley, David. Illinois (*in part*); Illinois, The University of (*in part*)
- Kiphuth, Robert John Herman. Swimming (*in part*)
- Kirby, Rollin. Cartoon (*in part*)
- Kircher, Paul. Accrued Expenses; Accrued Income
- Kirchwey, George W. Convict; Criminology; Habitual Offenders (*in part*); House of Correction or Bridewell; Imprisonment; Penology
- Kirk, George Eden. Aden; Arabia (*in part*); Arab League; Cyrenaica (*in part*); Ibn Sa'ud 'Abd ul-'Aziz ibn 'Abd ur-Rahman ibn Faisal; Kuwait (*in part*); Lebanon (*in part*); Mediterranean Sea (*in part*); Palestine (*in part*); Syria (*in part*); Transjordan (*in part*); Tripolitania (*in part*)
- Kirk, Paul L. Ultramicrochemistry
- Kirkup, Thomas. Julian (*in part*); Lassalle, Ferdinand
- Kirkwood, John Gamble. Liquid State, The
- Kirsner, Joseph B., M.D. Liver and Gall-Bladder, Diseases of
- Kistiakowsky, George B. Cyclonite; Detonator; Explosives; Lead Azide; Mercuric Fulminate; Nitrocellulose; Nitroglycerin; Propellants; T.N.T.
- Kitson, Harry Dexter. Job Analysis
- Klauder, Charles Z. University Architecture (*in part*)
- Klein, Major Adrian B. Colour-Music
- Klein, David Ballin. Dreams
- Klemin, Alexander. Gliding (*in part*)
- Kline, Hibberd Van Buren, Jr. Gold Coast (*in part*); Kontagora; Tripoli (*in part*)
- Kloeke, G. G. Dutch Language and Literature (*in part*)
- Klopsteg, Paul Ernest. Archery; Vacuum (*in part*)
- Klüver, Heinrich. Eidetic Images
- Knapp, A. W. Chocolate (*in part*)
- Knappett, Charles Richard, M.D. Antiseptics (*in part*)
- Kneale, William Calvert. Frege, Gottlob
- Knight, Frank Hyneman. Capital and Interest; Economics; Individualism
- Knight, Henry Granger. Coco-Nut Oil and Cake; Maple Sugar; Margarine
- Knopf, Adolph. Becke, Friedrich
- Knott, Henry William Howard. Hughes, Charles Evans (*in part*)
- Knott, James Edward. Lettuce
- Knowles, C. M. Workmen's Compensation (*in part*)
- Knowles, Hugh S. Loud-Speaker
- Knox, Major General Sir Alfred William Fortescue. Nicholas (Grand Duke)
- Knox, Dudley Wright. American Revolution (*in part*); War of 1812, The
- Knox, Edmund George Valpy. Horace; Limericks; Parody
- Knox, Rev. G. W., D.D. Christianity (*in part*)
- Knox, Winifred F. Saladin (*in part*)
- Knox-Shaw, Harold. Nebula
- Knudsen, Ole Ferdinand. Norway (*in part*)
- Kobbé, William H. Sulphur, Special Applications of
- Koch, Helen Lois. Child Psychology and Development; Handedness
- Koeber, R. B. San Francisco (*in part*)
- Kohler, Wolfgang. Psychology, History of (*in part*)
- Kohman, Truman Paul. Radium; Radon
- Kohn, Hans. Abyssinia (*in part*); Colour and Race (*in part*); Communism; Damascus (*in part*); Democracy (*in part*); Dobruja (*in part*); Fascism; Greece (*in part*); Haifa; Imperialism; Jerusalem (*in part*); Minorities; Mustafa Kemal Atatürk (*in part*); Nationalism (*in part*); National Socialism; Nehru, Jawaharlal (*in part*); Palestine (*in part*); Pan-Slavism; Ruthenia or Carpathian Ruthenia; Schuschnigg, Kurt von (*in part*); Silesia; Slovakia; Tel Aviv; Zionism (*in part*)
- Kolb, Avery E. Motor Transport, Military
- Kolb, Lawrence, M.D. Drug Addiction (*in part*)
- Kolsrud, Sigurd. Norwegian Language and Literature (*in part*)
- Komisarjevsky, Theodore. Acting (*in part*)
- Konody, Paul G. Art (*in part*); Impressionism; Post-Impressionism; Potter, Paul
- Kook, Edward. Stage Design (*in part*)
- Kornerup, Bjørn. Andersen, Hans Niels
- Kossoris, Max Davis. Industrial Accidents
- Kracek, Frank Charles. Polymorphism
- Kraehenbuehl, John Otto. Lighting and Artificial Illumination (*in part*)
- Kramer, Victor. Dry Cleaning; Laundry Industry
- Krapp, George Philip. Slang (*in part*)
- Kravis, Irving B. Prices, Statistics of (*in part*)
- Krebs, Hans Adolf. Citric Acid
- Kreps, Theodore J. Trade Organization
- Kreutzberg, Harald. Pantomime
- Krock, Arthur. Baruch, Bernard Mannes
- Kroeber, Alfred L. Algonkin; Athabaskan; Aztec; Chinook; Cree; Creek; Dakota; Flathead; Hoka; Hopi; Iroquois; Kiowa; Kootenay; Kwakiutl; Mandan; Mimac; Muskhog Indians; North America (*in part*); North Pacific Coast Indians; Ojibwa; Pima; Plains Indians; Powhatan; Pueblo; Siouan

- Indians (*in part*); Tlingit; Uto-Aztecan Family
- Krom, Nicolaas Johannes. Cambodia (*in part*); Java (*in part*)
- Kronfeld, Peter C., M.D. Colour Blindness
- Kropa, Edward L. Fumaric and Maleic Acids; Plastics; Resins
- Kropotkin, Prince Peter Alexeivitch. Anarchism (*in part*); Bulgaria, Eastern; Syr-Darya (*in part*)
- Krug, Julius A. Government Departments (*in part*)
- Krumbacher, K. Greek Literature (*in part*)
- Krusen, Frank Hammond, M.D. Electrotherapy and Electrodiagnosis; Ultrasonics in Medicine
- Krutch, Joseph W. Cabell, (James) Branch
- Kubie, Lawrence Schlesinger, M.D. Psychiatry (*in part*); Psychoanalysis (*in part*)
- Kühnel, Ernst. Persian Art, Painting and Calligraphy (*in part*)
- Kulischer, Eugene. Migration
- Kumler, Katherine W. Home Sewing
- Kunz, George Frederick. Jade and Other Hard Stone Carvings; Lapidary and Gem Cutting
- Kurn, James M. St. Louis-San Francisco Railway Company (*in part*)
- Kurtz, Rev. Daniel Webster, D.D. German Baptist Brethren
- Kuznets, Simon. National Income; Wealth, National; Wealth and Income, Statistics of
- Laaman, Eduard. Estonia (*in part*)
- Labadie-Eurite, Juan. Aguadilla (*in part*); Caguas; Fajardo; Humacao (*in part*); Ponce (*in part*); Porto Rico (*in part*); San German; San Juan (*in part*)
- Labouret, Henri. Africa (*in part*); Hausa (*in part*)
- Labovitz, I. M. Land Taxes (*in part*)
- Lacey, Thomas Alexander, D.D. Augustine, Saint (Aurelius Augustinus); Church (*in part*)
- LaFarge, The Reverend John, S.J. Roman Catholic Church (*in part*)
- Laidlay, E. C. Fur
- Lake, Kirsopp. Soden, Hermann von
- Lake, Philip. Asia (*in part*); Continents, Origin of; Europe (*in part*); Germany (*in part*); India (*in part*)
- Lallou, William J., S.T.D. Consecration
- Lamar, John Everts. Cement Rock
- Lamb, M. C. Leather
- Lamb, Walter Rangeley Maitland. Academy, Royal (*in part*)
- Lambert, James Douglas. Belgium (*in part*); France (*in part*); Holland (*in part*); Luxembourg; Paris (*in part*); Spain (*in part*)
- Lambert, Walter Davis. Geodesy
- LaMont, Stewart M. Accident Insurance, Personal (*in part*)
- Lamoureux, Andrew Jackson. Atacama, Desert of; Belém (*in part*); Bogotá (*in part*); Venezuela (*in part*)
- Lancour, Harold. Auctions and Auctioneers (*in part*)
- Landauer, H. Edgar. Dyeworks and Chemical Industries; Amalgamation of (*in part*); Siemens (*in part*); Vereinigte Industrie-Unternehmungen Aktiengesellschaft
- Landells, Walter. Jobber (Stock Exchange); Stockbroker (*in part*)
- Lander, Cecil Howard. Fuel: A General Survey
- Landis, Benson Y. Anti-Semitism (*in part*)
- Landis, Carney. Emotion; Psychogalvanic Reflex (*in part*)
- Landis, James McCauley. Alien (*in part*); Ejectment (*in part*); Executors and Administrators (*in part*); Extradition (*in part*); Habeas Corpus (*in part*); Injunction (*in part*); Intestacy (*in part*); Land Titles (*in part*); Maintenance and Champerty (*in part*); Nullity of Marriage (*in part*); Partnership (*in part*); Petition of Right (*in part*); Police Power; Statute (*in part*); Summary Jurisdiction (*in part*); Sunday (*in part*); Treason (*in part*); Trust and Trustees (*in part*); Usury; Warrant (*in part*); Will or Testament (*in part*); Writ (*in part*)
- Landon, Grace J. Lumbering (*in part*)
- Lane, Ernest Preston. Involute
- Lane, James W. Fraser, James Earle
- Lane-Poole, Stanley. Burton, Sir Richard Francis
- Lang, Andrew. Apparitions; La Cloche, James de (*in part*); Prometheus (*in part*); Second Sight; Tale (*in part*)
- Langdon, Stephen Herbert. Assur, Ashur, Asur; Babylonian and Assyrian Religion; Creation, Epic of; Hammurabi; Marduk; Mesopotamia (*in part*); Nebo or Nabu; Oannes; Sin; Tammuz
- Langer, Rudolph Ernest. Birkhoff, George David; Calculus of Differences; Differential Equations; Mensuration
- Langfeld, Herbert Sidney. Aesthetics, Experimental (*in part*); Stumpf, Carl
- Langworthy, R. A. Steam Accumulators
- Lansbury, John, M.D. Gout
- Lanternman, Walter Firth. Broadcasting (*in part*)
- Lanza, Anthony J., M.D. Pneumoconiosis
- Lapworth, Herbert. Well
- Lardner, George E. Crossword
- Larking, Captain Albert. Early Closing Movement (*in part*)
- Larmor, Sir Joseph. Energy (*in part*)
- Larsen, Arthur J. Minnesota (*in part*)
- Larsen, Helge. Denmark (*in part*); Greenland
- Larson, Taft Alfred. Wyoming
- Lashley, Karl S. Psychology (*in part*)
- Laski, Harold J. Anarchism (*in part*); Bolshevism (*in part*); Laissez-Faire
- Lasky, Jesse L. Motion Pictures (*in part*)
- Lasswell, Harold D. Propaganda
- Latey, William. Nullity of Marriage (*in part*); Press Laws (*in part*); Sunday (*in part*)
- Lathrop, John Howland, D.D. Unitarianism (*in part*)
- Latimer, Wendell Mitchell. Chromium (*in part*); Lewis, Gilbert Newton; Manganese; Oxidation and Reduction
- Latourette, Kenneth Scott, D.D. China (*in part*); Chinese Literature; Chinese Eastern Railway; Formosa (*in part*); Manchuria (Manchoukuo) (*in part*); Missions (*in part*); Mongolia (*in part*)
- Laughton, L. G. Carr. Ships' Figureheads
- Laurie, Arthur Pillans. Fresco Painting
- Lautezhiser, Fred B. Motor Vehicles, Commercial
- Law, Edward F. Anti-Friction Metals
- Law, K. C. Fire Insurance
- LaWall, Charles H. Pharmacy (*in part*)
- Lawrence, Colonel Thomas Edward. Guerrilla Warfare (*in part*)
- Lawrence, William Henry. Perspective
- Lawson, Major General Edward Frederick, 4th Baron Burnham. Yeomanry (*in part*)
- Layard, George Somes. Keene, Charles Samuel (*in part*); Linton, William James
- Lazarus-Barlow, Percy, M.D. Calculi or Stones (*in part*)
- Lazarus-Barlow, Walter Sydney, M.D. Auscultation; Inflammation and Its Sequels; Mammary Gland, Diseases of; Mirror-Writing; Mouth and Salivary Glands (*in part*); Myelitis; Pericardium, Diseases of the; Quackery (*in part*); Sunlight Treatment (*in part*); Thrombosis and Embolism
- Lea, C. A. E. Gallabat
- Leacock, Stephen Butler. Alberta (*in part*); British Columbia (*in part*); Canada (*in part*); Humour; Manitoba (*in part*); Montreal (*in part*); New Brunswick (*in part*); Northwest Territories (*in part*); Nova Scotia (*in part*); Saskatchewan (*in part*)
- Leake, James Miller. Florida
- Leake, James P., M.D. Smallpox; Vaccination
- Leathes, Sir Stanley Mordaunt. Cromwell, Oliver
- Leavens, Dickson H. Bimetallism (*in part*); Tael (*in part*)
- Lebesgue, Philéas. Greek Literature (*in part*)
- Leckie, John. Pencil Drawing (*in part*)
- Lederer, Emil. International, The (*in part*)
- Lee, Major General Alec Wilfred. World War II (*in part*)
- Lee, Robert Warden. Roman-Dutch Law
- Leech, Lewis Harper. Chicago (*in part*)
- Lee of Fareham, Arthur Hamilton Lee. Sulgrave Manor
- Lee-Warner, Sir William. Dalhousie, James Andrew Brown Ramsay, 1st Marquess and 10th Earl of (*in part*)
- Leffingwell, W. H. Office Appliances; Office Management
- Legge, James. Confucius (*in part*); Lao-Tse (*in part*)
- Legge, Robin Humphrey. Debussy, Claude A. (*in part*)
- Lehman, Eugene Heitler. Camping (*in part*)
- Lehman, Herbert H. War Relief Work
- Lehmann-Haupt, Carl F. Urartu
- Lehmann-Haupt, Hellmut. Bookselling (*in part*)
- Lehmer, Derrick Henry. Bernoulli Numbers or Bernoullian Numbers
- Leigh, Richard Henry. Uniforms (*in part*)
- Leighly, John. Running Water; Seasons
- Leighton, Morris M. Glacial Epoch (*in part*)
- Leiserson, William M. Industrial Relations (*in part*)
- Leland, Simeon Elbridge. National Debt
- Lemon, Harvey Brace. Bohr, Niels; Capacitance; Capillary Tube
- Lenroot, Katharine Fredrica. Child Welfare and Child Labour (*in part*); Maternal and Child Health (*in part*)
- Lentelli, Leo. Sculpture Technique (*in part*)
- Lenti, Libero. Italy (*in part*)
- Leopold, Aldo. Game Management
- Lerner, Abba P. Investments, Economic Aspects of; Money
- Lescohier, Don Divance. Casual Labour (*in part*); Profit-Sharing (*in part*); Unemployment Insurance (*in part*); Wages; Wage Statistics; International Comparisons; Wages: Statistics of United States
- Lester, Robert MacDonald. Carnegie Trusts (*in part*)
- Lethaby, William Richard. Design (*in part*)
- Lethbridge, Thomas Charles. Scandinavian Civilization (*in part*)
- Letiche, John M. Balance of Payments
- Leveson, William Egbert. Chang Tso-lin; Chiang Kai-shek (*in part*)
- Levett, Ada E. Manor (*in part*)
- Levi, Nathan. Smuts, Jan Christiaan (*in part*)
- Levin, Isaac H. Gems, Synthetic (*in part*)
- Levine, Philip. Blood (*in part*)
- Levinson, André. Bakst, Léon
- Levinson, Nathan. Motion Pictures (*in part*)
- Levinson, Sidney O., M.D. Serum Therapy
- Levy, Oscar, M.D. Nietzsche, Friedrich Wilhelm
- Levy, Reuben. Ecbatana; Susa
- Lewin, Bertram David, M.D. Psychoanalysis (*in part*)
- Lewis, Bernard. Assassin
- Lewis, Bernard. Flame
- Lewis, B. R. Guerrilla Warfare (*in part*)
- Lewis, Cal. Clothing Manufacture (*in part*)
- Lewis, Charles F. Pittsburgh
- Lewis, Geoffrey Lewis. Mahmud I; Mohammed I, II, III, IV; Murad I, II, III, IV; Selim I; Selim II; Selim III; Soliman I, II; Turkey (*in part*)
- Lewis, Henry. Breton Literature; Cornish Language
- Lewis, Peter Edwin. Court (*in part*); Statute (*in part*)
- Lewis, Robert Strong. Mining, Metalliferous (*in part*)
- Lewis, Samuel Richard. Heating and Ventilation (*in part*); Ventilation
- Lewis, Stuart. Assessor (*in part*); Associate Justice; Budget (*in part*); Corrupt Practices (*in part*); Initiative; Mason and Dixon Line; National Convention, The (*in part*) Township
- Lewis, William Draper. Judicial Reform (*in part*); Marshall, John

- Lewis, W. S. Austria (*in part*); Austria, Lower; Budapest (*in part*); Burgenland; Carinthia; Carlsbad (Bohemia) (*in part*); Carpathian Mountains; Prague; Styria; Tatra Mountains; Tirol (*in part*); Vienna (*in part*)
- Lewkowitsch, P. R. Elsa. Almond Oil (*in part*); Beeswax (*in part*); Bone, Industrial Uses of (*in part*); Candle (*in part*); Essential Oils (*in part*); Oils, Fats and Waxes (*in part*); Olive Oil (*in part*); Palm Oil (*in part*); Tung Oil (*in part*); Whale Oil (*in part*)
- Leyser, Karl Joseph. Germany (*in part*)
- Lichtenstein, Walter. Bank for International Settlements (*in part*)
- Liddell, Lionel Charles. War Trade Advisory Committee
- Liddell Hart, Captain B. H. Allenby, Edmund Henry Hynman, 1st Viscount; Aspern-Essling, Battle of; Breitenfeld; Cambrai, Battle of; Chemin-Des-Dames; Hamilton, Sir Ian Standish Monteith; Ilipa, Battle of; Mantinea; Marne, Second Battle of The; Mongol Campaigns; Pershing, John Joseph (*in part*); Quebec (*in part*); St. Quentin, Battle of, 1918; Salonika Campaigns, 1915-18; Somme, Battles of The, 1916; World War I (*in part*); World War II (*in part*); Ypres, Battles of, 1917
- Liebman, A. J. Whisky or Whiskey (*in part*)
- Liefmann, W. Robert. Cartel or Kartel
- Liegler, L. Vienna (*in part*)
- Lietzmann, Hans, D.Th. Baptism (*in part*); Creeds (*in part*)
- Lillie, Frank R. Feather (*in part*)
- Lillie, Ralph D., M.D. Psittacosis
- Lincoln, Frederick C. Bird Banding
- Lindsay, Alexander Dunlop, 1st Baron Lindsay of Birker. Adult Education (*in part*)
- Lindsay, Samuel McCune. International Labour Organization, The; Liquor Laws and Liquor Control; Prohibition
- Lindsay, Rev. Thomas Martin, D.D. Lollards (*in part*); Lutherans (*in part*); Thomas A Kempis
- Lindstrom, Ernest Walter. Plant Breeding
- Ling, Arthur Robert. Malt (*in part*)
- Lingane, James J. Polarography
- Linton, Morris Albert. Actuary
- Linton, Robert R., M.D. Varicose Veins
- Lipman, Jacob Goodale. Agricultural Education (*in part*)
- Lippmann, Walter. Pulitzer, Joseph (*in part*)
- Lipsett, Caldwell H. Afridi (*in part*)
- Lipson, Leslie. Governor (*in part*)
- Lissens, René Felix. Belgian Literature (*in part*)
- Little, Clarence Cook. Cancer Research
- Little, Frances. Textiles and Embroideries (*in part*)
- Little, Sir Rudolf Alexander. Post and Postal Services (*in part*)
- Little, Stuart. Match
- Littlefield, Catherine. Ballet
- Livermore, Harold Victor. Portugal
- Livingstone, C. J. Motor Car Engines: Their Operation and Care (*in part*)
- Llewellyn, Karl Nickerson. Bill of Exchange (*in part*); Chattel Mortgage; Contract (*in part*); Factor (*in part*); Foreclosure (*in part*); Guarantee (*in part*); Instalment Purchase (*in part*); Sale of Goods (*in part*); Valuation and Values (*in part*)
- Lloyd, Charles Mostyn. Pauper; Poor Law (*in part*); Workhouse
- Lloyd, E. M. H. Rationing (*in part*); War Control of Food (*in part*)
- Lloyd, Francis Ernest. Byblis; Carnivorous Plants; Darterlingtonia; Drosophyllum; Pinguicula; Pitcher Plants; Roridula; Sundew; Utricularia; Venus's Fly-Trap
- Lloyd, Sir John Edward. Wales (*in part*)
- Lloyd, Nathaniel. Brickwork
- Lloyd-James, Arthur. Pronunciation
- Lobel, Edgar. Sappho
- Lobingier, Charles Sumner. Aliaga; Antipolo; Aparri; Argao; Bacolod; Baguio; Balayan; Baliuag; Barotac Nuevo; Barugo; Batac; Batangas; Bauan; Baybay; Binan; Binmaley; Bogó; Bulacan; Burauen; Cabatuan; Cadiz; Calamba or Klamba; Calasiao; Candon; Carcar; Carigara; Hagonoy; Ilagan; Iloilo; Iriga; Manila; Philippine Islands (*in part*); San Carlos; San Fernando (de la Union); San Pablo; Santa Cruz; Surigao (*in part*); Taal; Tabaco; Tarlac; Tayabas; Tuguegarao; Zamboanga
- Locke, Alain LeRoy. Negro, The American (*in part*)
- Locke, Charles E. Ore Dressing
- Locket, Margery. Motion Pictures (*in part*)
- Lockhart, Laurence. 'Abbas I; Merv; Persia (*in part*); Riza Shah Pahlavi
- Lodge, Gonzalez. Classical Education (*in part*)
- Lodge, Sir Oliver Joseph. Spiritualism
- Loeb, Leonard Benedict. Corkscrew; Electricity, Conduction of (*in part*)
- Loeffel, William John. Bacon; Beef (*in part*); Meat; Mutton; Pork
- Loewe, Herbert Martin James. Calendar (*in part*); Chronology (*in part*); Essenes; Jerusalem (*in part*); Jews (*in part*); Judaism
- Loewenson, Erwin Hugo. Arbitration (*in part*)
- Loewenstein, Leo. Osterman, Andrei Ivanovich
- Loewenstein, Karl. German Law (*in part*)
- Loewy, Raymond Fernand. Motor Car (*in part*)
- Lohr, Lenox Riley. Exhibitions and Fairs (*in part*)
- Lokey, Eugene. Stock Exchange or Bourse (*in part*)
- Lomax, John Avery. Folk-Song (*in part*)
- Lomax, Paul S. Commercial Education (*in part*)
- Lombardini, M. S. Pirelli, Ltd. (*in part*)
- Lones, Thomas East. Meters, Electric
- Long, Edward Ernest. 'Amboina (*in part*); Bachian (*in part*); Bali (*in part*); Bandung (*in part*); Banka (*in part*); Bantam; Batavia (*in part*); Celebes; Ceram (*in part*); East Indies (*in part*); Flores (*in part*); Garut (*in part*); Jambi (*in part*); Jokjakarta or Jokyakarta; Kei Islands; Lampongs (The) (*in part*); Lamboke; Macassar (*in part*); Madura; Malay Archipelago (*in part*); Mentawai; New Guinea (*in part*); Nias; Palembang (*in part*); Sangihe (Sangir) and Talaut Islands (*in part*); Semarang (Residency) (*in part*); Semarang (Town) (*in part*); Solor and Alor Islands (*in part*); Sula Islands (*in part*); Sumatra (*in part*); Sumba (*in part*); Sumbawa (*in part*); Surabaya (Port) (*in part*); Surakarta (*in part*); Ternate (*in part*); Tidore or Tidor (*in part*); Timor; Timor Laut, Tenimbar or Tenimber (*in part*)
- Long, Esmond Ray, M.D. Tuberculosis
- Long, H. C. Great Britain (*in part*)
- Long, Richard C. E. Calendar (*in part*); Chronology (*in part*)
- Long, Robert A. Lumbering (*in part*)
- Longford, Edward Arthur Henry Pakenham, Earl of. Irish Literature (*in part*)
- Longhurst, Margaret Helen. Effigies, Monumental; Ivory Carving (*in part*)
- Longhurst, Percy. Wrestling (*in part*)
- Longley, William Raymond. Descriptive Geometry
- Longmuir, Percy. Founding; Needle
- Longnon, Auguste. Champagne (*in part*)
- Loomis, C. Frances. Girls, Camp Fire
- Loosanoff, Victor L. Oyster
- Lord, Isabel Ely. Budget, Family; Home Economics; Oriental Cookery; Preserving and Bottling (*in part*)
- Lorimer, Lieutenant Colonel David Lockhart Robertson. Burushaski Language
- Lorwin, Lewis L. Direct Action
- Lothrop, Samuel Kirkland. Alacaluf; Ona; Pipil; Pokomam; Quiché; Yahgan
- Lotka, Alfred J. Birth-Rate (*in part*); Death-Rate (*in part*); Longevity (*in part*); Marriage-Rate; Sex Ratio (*in part*); Suicide
- Lott, Arnold S. Aircraft Carrier; Destroyer; Mines (Naval); Monitor, Naval; Submarine Campaigns (World Wars I and II) (*in part*); Torpedoes; Torpedoplanel
- Loughran, Charles Patrick, S.J. Montanism
- Louis, Henry. Blowing Engines
- Lovejoy, Ellis. Brick (*in part*)
- Loveland, Edward Rutherford. American College of Physicians
- Lowell, A. Lawrence. Lowell Institute
- Lowes, John Livingston. Lowell, Amy
- Lowie, Robert Harry. Relationship Terms
- Lubker, Robert A. Invar
- Lucas, Anthony Thomas. Ireland (*in part*)
- Lucas, Cyril Edward. Plankton
- Lucas, Edward Verrall. Austen, Jane; Lamb, Charles (*in part*)
- Lucas, Frederic Augustus. Museums of Science (*in part*)
- Luce, J. W. Gin (*in part*)
- Luchaire, Achille. Papacy (*in part*)
- Luchaire, Julien. Intellectual Co-operation, International Institute of
- Luckhardt, Arno B. Bayliss, Sir William Maddock; Bell, Sir Charles; Cannon, Walter Bradford; Ethyl Chloride (*in part*); Ethylene (*in part*)
- Luckock, Major General Russell Mortimer. Amiens, Battle of (1918)
- Ludwig, Emil. Hohenzollern Dynasty
- Lugard, Frederick Dealtry Lugard, 1st Baron. Mandate (*in part*); Slavery (*in part*)
- Lugard, Lady (Flora). Nigeria (*in part*); Rhodes, Cecil John (*in part*); Sokoto (*in part*)
- Lumsden, E. S. Etching (*in part*)
- Lundell, R. A. Pneumatic Tools
- Lundy, John Silas, M.D. Anaesthesia and Anaesthetics
- Lush, Jay Laurence. Animal Breeding; Animals, Domestication of; Breeds and Breeding; Inbreeding
- Lutz, Friedrich A. Monetary Agreement
- Lützwow, Count. Hussites
- Lyall, Sir Charles James. Arabic Literature (*in part*); Hamasa (*in part*); Hindostani Literature; Mofaddaliyat; Tulsī Dās (*in part*)
- Lybyer, Albert Howe. Turkey (*in part*)
- Lydekker, Richard. Sheep (*in part*)
- Lyell, Colonel David. Light Railways, Military (*in part*)
- Lynch, Daniel F. J. Cottonseed (*in part*)
- Lynch, Patrick K. Ireland, Republic of (*in part*)
- Lynd, Robert. Bennett, Enoch Arnold
- Lyrip, B. F., Jr. Sugar (*in part*)
- Lyon, Harold Lloyd. Sugar (*in part*)
- Mabbott, John David. Free Will
- Macalister, Alexander, M.D. Palmistry
- Macalister, Robert Alexander Stewart. Cú Chulainn; Deirdre; Diptych; Edom (*in part*); Finn Mac Cumhail; Ireland (*in part*); Oisín; Palestine (*in part*)
- McAllister, Elizabeth Glen. Housing (*in part*)
- McAllister, Gilbert. Housing (*in part*)
- Macartney, Carlile Aylmer. Alexandrov, Todor; Aquileia; Asen or Assen; Austria, Empire of (*in part*); Avars; Bulgaria (*in part*); Conrad von Hötzingdorf, Franz; Cumans or Comans; Czech; Francis Joseph I; Galicia (*in part*); Goebbels, Josef; Goluchowski; Göring, Hermann; Habsburg or Hapsburg; Horea, Nicolas Ursu (*in part*); Hungary (*in part*); Kun, Bela (*in part*); Ludendorff, Erich (*in part*); Military Frontier; Petche-negs or Patzinaks; Rudolph of Habsburg; Ruthenians; Schnitzler, Arthur; Successor State; Transylvania (*in part*); Trnovo
- Macartney, Sir Mervyn E. London (*in part*)
- Macaulay, George Campbell. Gower, John
- Macaulay, Thomas Babington, 1st Baron Macaulay of Rothley. Bunyan, John; Goldsmith, Oliver; Johnson, Samuel (*in part*)
- Macaulay, William Herrick. Motion, Laws of (*in part*)
- McBane, Major Robert B. National Guard
- MacBride, Ernest William. Metamorphosis (*in part*); Phoronidea (*in part*)
- McBride, George McCutchen. Bolivia (*in part*); Cuba (*in part*); Florianopolis (*in part*); La Paz (*in part*); Oruro; Venezuela (*in part*); West Indies, The (*in part*)
- McBryde, F. Webster. Central America (*in part*)

- (*part*)
McCall, John Oppie, D.D.S. Pyorrhoea (*in part*)
McCallien, William John. Gold Coast (*in part*)
McCallum, Ronald Buchanan. Paris, Conference of (*in part*)
McCartan, Edward. Sculpture (*in part*)
McCartney, James Elvins, M.D. Carriers
McCellan, Walter S., M.D. Mineral Waters
McClelland, Nancy Vincent. Interior Decoration (*in part*)
McCloy, John Jay. World War II (*in part*)
McClure, Sir William Kidston. Asiago, Battle of, 1916; Cadorna, Luigi; Caporetto, Battle of; Italo-Turkish War; Vittorio Veneto, Battle of
McCollum, Elmer Verner. Cereals (*in part*)
McConnell, Beatrice. Child Welfare and Child Labour (*in part*)
McConnell, F. B. Sears, Roebuck and Co.
McConnell, Francis John, D.D. Asbury, Francis
McCormac, Henry, M.D. Urticaria
McCown, Donald E. Persia (*in part*)
McCoy, Byron Omar. Dams (*in part*)
McCuifough, Norman B., M.D. Typhoid and Paratyphoid Fevers
McCune, Shannon. Korea (*in part*)
McCutcheon, Thomas Potter. Cobalt
McDaniel, J. S. Rope and Ropemaking (*in part*)
McDonald, Angus D. Southern Pacific Company
McDonald, Charles B. Company
McDonald, Duncan Black, D.D. Imām; Islamic Institutions; Shaf'i; Thousand and One Nights
McDonald, Sir George. Britain (*in part*); Caledonia (*in part*); Gaul (*in part*)
McDonald, James Grover. Refugees and the Exchange of Populations (*in part*)
McDonald, Rt. Hon. James Ramsay. London Naval Conference, 1930, The (*in part*)
McDonald, J. H. Budget, Business
McDonald, Sir Murdoch. Irrigation (*in part*)
MacDonald, Robert, Jr. Corundum, Artificial
MacDonald, Thomas Harris. Highways, U.S.; Roads and Streets (*in part*)
MacDonell, Arthur Anthony. Kālidāsa
Macdonell, Sir John. Protectorate; Sovereignty (*in part*)
Macdonogh, Michael. Reporting (*in part*)
MacDougald, Duncan, Jr. Baker Street Irregulars
MacDougall, Samuel Michael. Lotto (*in part*)
MacDougall, William. Hallucination; Suggestion; Trance
McDowell, D. Clay. Surge
MacDuffee, C. C. Arithmetic; Coefficient; Complex Numbers; Matrices; Root
McEachron, Karl Boyer. Lightning and Lightning Protection (*in part*)
McFadyean, Sir Andrew. Inter-Ally Council of War Purchases and Finance (*in part*); Liberal Party (*in part*)
Macfadyen, Rev. Dugald. Concordance (*in part*); Excommunication (*in part*); Glasites
McGiffert, Arthur Cushman, D.D. Church History (*in part*)
McGilvray, Charles Duncan, M.D.V., D.V.Sc. Glanders
McGovern, John T. Track and Field Sports
Macgowan, Kenneth. Theatre (*in part*)
McGregor, J. E. M. Pneumatic Dispatch
McGregor, James Howard. Gorilla (*in part*); Primates (*in part*)
McGregor, Stuart. Texas
McGuire, Constantine Edward. Antofagasta; Anzōtegui; Apure (state); Aragua; Araucania; Avellaneda; Bahía Blanca; Barcelona; Barquisimeto; Bío Bío (province); Bolívar; Catamarca (province) (*in part*); Catamarca (city); Chaco; Chubut; Ciudad Bolívar; Colón; Colorado River; Córdoba; Coro; Cuba (*in part*); Cumaná; Entre Ríos (*in part*); Falcón; Formosa (*in part*); Gibara; Gualeguaychú; Guanabacoa; Guanajay; Guantánamo; Guárico; Havana (*in part*); Holguín; Jujuy (*in part*); La Guaira; La Plata; Lara; Maracaibo; Matanzas; Pampa, La; Paraguaná; Patagonia (*in part*); Port au Prince; Puerto Cabello; Puerto la Cruz; Sancti Spiritus; Santo Domingo (*in part*); Venezuela (*in part*)
McGuire, Martin Rawson Patrick. Clementine Literature
McHardy, Commander J. G. M. Ordnance (*in part*)
McIlwaine, Henry Read. Smith, John
McIlwraith, Thomas Forsyth. Canada (*in part*)
Macintire, Horace James. Refrigeration and its Application (*in part*)
Macintosh, E. H. Omdurman
MacKaye, Benton. Regional Planning (*in part*)
McKellar, Andrew. Comets (*in part*)
McKenzie, Robert Tait, M.D. Gymnastics and Gymnasium (*in part*)
MacKenzie, Roderick. Greek Language (*in part*); Lettish Language; Lithuanian Language
McKerrow, Ronald Brunlees. Parnassus Plays
McKhan, Charles F., M.D. Measles and German Measles
Mackinder, Rt. Hon. Sir Halford John. Trade Routes (*in part*)
McKinley, Samuel Justus. Boston (Mass.) (*in part*)
MacKinnon, James, D.D. Covenanters; Luther, Martin
MacKinnon, Kenneth Wulsten. Company and Corporation Law (*in part*)
MacKintosh, Rev. Robert, D.D. Dogma, Dogmatic Theory
MacLagan, Sir Edward Douglas. Punjab (*in part*)
McLaughlin, Dean Benjamin. Nova and Supernova
Maclean, Fitzroy. Guerrilla Warfare (*in part*)
McLean, Neil Hartley. Broken Hill Proprietary Company Limited
McLean, Norman. Syriac Literature
McLeod, James Walter. Diphtheria
McLeod, John J. R. Insulin
McMahon, Francis Elmer. De Valera, Eamon (*in part*)
MacMillan, David. Corrugated Iron
McMillan, Walter George. Graphite (*in part*)
MacMunn, Lieutenant General Sir George Fletcher. Baluchistan (*in part*); Bamian; India (*in part*); Indian Mutiny, The
McMurtrey, James Edward, Jr. Tobacco
McMurtree, Douglas C. Books (*in part*); Collo-type; De Vinne, Theodore Low
MacNair, Harley F. Chinese Immigration; Far Eastern Problem, The
McNamara, Edward Joseph. Shorthand
McNamee, Colonel Frank A., Jr. Observer Corps in Air Defense (*in part*)
MacNeill, John Eoin. Ireland (*in part*)
McNickle, D'Arcy. Indian, North American
McNish, A. G. Magnetometer; Terrestrial Magnetism
MacPherson, John, M.D. Paranoia
MacPherson, Sir William Grant. Medical Service, Army
McQuarrie, Irvine, M.D. Children, Diseases of; Epilepsy and Epileptic Fit
Macurdy, L. B. Balance
McWhirter, Norris Dewar. Athletic Sports (*in part*)
Madariaga, Don Salvador de. Spanish Language and Literature (*in part*)
Madden, J. F. Darfur (*in part*)
Madden, John Thomas. Accountancy and Accountants (*in part*); Fiduciary Accounting
Madelin, Emile Marie Louis. Foch, Ferdinand
Magath, Thomas Byrd, M.D. Albuminuria
Magness, John Robert. Crab-Apple; Pear
Magoun, Horace Winchell. Brain (*in part*)
Maguire, John MacArthur. Evidence (*in part*)
Maguire, Mary Hume. Leach, Abby
Mair, Alexander W. Classics; Epicurus; Livy; Lucan (Marcus Annaeus Lucanus); Lucian; Lucretius; Martial (Marcus Valerius Mar-tialis); Menander; Petronius; Pliny The Elder; Pliny The Younger; Polybius; Seneca, Annaeus (*in part*); Seneca, Lucius Annaeus; Terence; Varro, Marcus Terentius
Maitland, Frederic William. Bracton, Henry De; English Law
Major, Rev. Henry Dewsbury Alves, D.D. Modernism
Malcolm, Major General Sir Neill. Wilson, Sir Henry Hughes
Malcolm-Smith, Elizabeth F. Canning, Charles John; Canning, George; Dilke, Sir Charles Wentworth
Malinowski, Bronislaw. Kinship; Marriage; Social Anthropology
Mallalieu, Wilbur E. Salvage Corps (*in part*)
Mallet, Sir Charles Edward. Gladstone, William Ewart
Mallon, James Joseph. Social Settlements (*in part*); Sweating System (*in part*); Toynbee Hall
Man, David Morrice. Governor (*in part*)
Mangels, Max Cornils. Kiel Canal (*in part*)
Mangelsdorf, Paul Christoph. Maize (*in part*)
Mangin, Charles Marie Emmanuel. Champagne, Battles in (*in part*)
Manley, John H. Atomic Energy
Manly, John Matthews. English Literature (*in part*)
Mann, Frank Charles, M.D. Gall-Bladder
Mann, Frederick Justin. Consul (*in part*)
Mann, William M. Zoological Gardens
Manning, S. C., Jr. Shipping: War Losses of (World Wars I and II) (*in part*); Shipping: Wreck Statistics; Shipping Lines and Groups (*in part*)
Manning, Rt. Rev. William Thomas, D.D. Protestant Episcopal Church (*in part*)
Manross, William W. Protestant Episcopal Church (*in part*)
Manship, Paul. Sculpture (*in part*)
Manson, James Alexander. Bowls (*in part*)
Manson, J. Leask. Building (*in part*); Foundations (*in part*); Structural Engineering (*in part*)
Manson-Bahr, Sir Philip Henry, M.D. Dysentery
Marcel, Gabriel. Bernard, Jean-Jacques; Romain, Jules (*in part*)
March, Benjamin. Iron in Art (*in part*)
Marcus, Jacob Rader. Jews (*in part*)
Marcus, Ralph. Scribes
Marett, Robert Ranulph. Animatism; Animism; Anthropology; Dynamism; Law (Primitive); Mana; Prayer; Religion (*in part*); Spell; Supernaturalism
Margenau, Henry. Energy (*in part*)
Margetts, Arthur Richard. Fisheries (*in part*)
Margoliouth, David Samuel. Egypt (*in part*); Ethiopic Literature (*in part*); Fatimides, (Fatimides) (*in part*); Mohammed (*in part*)
Markby, Sir William. Indian Law (*in part*)
Markland, Ben. Dog (*in part*)
Marks, Lionel Simeon. Mechanical Engineer; Power (*in part*)
Marlow, Joseph W. Antioquia; Baker Island; Barranquilla; Bluefields; Bogotá (*in part*); Bolívar; Bolivia (*in part*); Canton Island; Cochabamba (department); Cochabamba (city); Colombia (*in part*); Córdoba (department); Costa Rica (*in part*); Formosa (*in part*); Galápagos Islands (*in part*); Guatemala (*in part*); Guatemala (Nueva Guatemala) (*in part*); Guayaquil; Howland Island; Ibarra; Jarvis Island; Juticalpa; Midway Islands; Sucre; Tampico; Tarija; Wake Island
Marquis, J. Clyde. International Institute of Agriculture
Marr, Louis F. Detroit
Marrack, John Richardson, M.D. Immunity (*in part*)
Marriage, E. Charles D. Nevada (*in part*)
Marriott, Charles. Religious and Memorial Architecture (*in part*)
Marriott, Sir John Arthur Ransome. Baldwin, Stanley Baldwin (*in part*)
Marsh, Dorothy B. Cakes and Cake-Making

- Marsh, Sir Edward Howard. Brooke, Rupert
Marsh, Rev. Fred Shipley. Elijah; Elisha
Marshall, Francis Hugh Adam. Reproduction
(*in part*)
Marshall, Frederick Henry. Greek Language
(*in part*); Greek Literature (*in part*)
Marshall, General of the Army George Cat-
lett. World War II (*in part*)
Marshall, Walter P. Telegraph
Marston, Philip M. New Hampshire (*in part*)
Marston, William Moulton. Anger; Antipathy;
Synapse
Martet, Jean. Clemenceau, Georges
Marti, L. R. North Dakota
Martin, Anne Henrietta. Butler, Josephine
Elizabeth; White-Slave Traffic
Martin, Ethel Austin. Ice Cream (*in part*)
Martin, G. Rubber: Botany, Cultivation and
Chemistry
Martin, John Holmes. Buckwheat; Millet;
Sorghum; Wheat (*in part*)
Martin, Percy A. Brazil (*in part*)
Martin, Robert E. Negro, The American (*in
part*)
Martin, Thomas Powderly. Austin, Stephen
Fuller; Dallas, George Miffin; Green, Duff;
McDuffie, George
Marvin, Edwin Lakanen. Division (*in part*)
Marwick, Brian Allan. Swazi; Swaziland
Marx, Fritz Morstein. Budget (*in part*)
Marzials, Sir Frank Thomas. Dumas, Al-
exandre; Zola, Emile Edouard Charles
Antoine
Masaryk, Tomas Garrigue. Czechoslovakia (*in
part*)
Massey, Charles Dudley. Book Collecting (*in
part*); Bookselling (*in part*)
Massey, George Bragg. Excavation
Massey, Louis Melville. Smut and Bunt
Massey, Raymond. Acting (*in part*); Motion
Pictures (*in part*)
Masson, Charles. Portrait Painting (*in part*)
Masson, David. Milton, John (*in part*)
Masterman, E. W. G. Sepulchre, The Holy
Mathews, Oscar Roland. Dry Farming
Matthew, William Diller. Carnivora (*in part*);
Creodonta (*in part*); Equidae; Glyptodon;
Machairodus (*in part*); Megatherium;
Mylodon (*in part*); Palaeotherium (*in part*);
Phenacodus; Tylopoda (*in part*)
Matthews, Allan F. Physical Natural Resources
(*in part*)
Matthews, D. J. English Channel
Matthews, F. E. Gold (*in part*); Iridium; Os-
mium; Palladium; Platinum; Platinum
Metals; Rhodium; Silver
Matthews, R. Borlase. Electrical Power in
Agriculture (*in part*)
Matthews, Very Rev. Walter Robert, D.D.
Theism
Maude, Colonel Frederic Natusch. Franco-
German War (*in part*); Napoleonic Cam-
paigns (*in part*); Sedan (*in part*); Seven
Years' War (*in part*); Wörth
Maunsell, Lieutenant Colonel Francis Richard.
Diarbekr (*in part*)
Maurer, Robert J. Photoelectricity
Maurice, Arthur Bartlett. Caricature (*in part*)
Maurice, Major General Sir Frederick Barton.
Haig, Douglas Haig; Jackson, Thomas Jona-
than; Lee, Robert Edward
Maurice, Henry Gascoyen. Fisheries (*in part*)
Mavris, N. G. Dodecanese
Mawer, Sir Allen. Aethelflaed or Ethelfleda;
Aethelstan; Danelagh (*in part*); Eddred;
Edward, "The Elder"; Place-Names (*in
part*)
Mawson, Thomas H. Landscape Architecture
(*in part*)
Maxcy, Kenneth Fuller, M.D. Rocky Moun-
tain Spotted Fever and Other Spotted
Fever; Typhus Fever
Maxton, John P. Agricultural Labourer (*in
part*)
Maxwell, James Clerk. Faraday, Michael (*in
part*)
Maxwell, William Henry. Destructors
May, William Edward. Compass (*in part*)
Mayall, Nicholas Ulrich. Nebula; Photography,
Celestial (*in part*)
Mayo, Frank Rea. Polymerization
Mayor, Alpheus Hyatt. Bibiena (Bibbiena),
Galli da (*in part*)
Meakin, Budgett. Almohades (*in part*); Almor-
avides (*in part*); Morocco (*in part*)
Meakins, Jonathan Campbell, M.D. Medicine
Mechlin, Leila. Societies of Art (*in part*)
Means, Lynn Lester. Thunderstorms (*in
part*)
Meeks, Carroll Louis Vanderslice. Industrial
Architecture; Stadium
Mees, Charles Edward Kenneth. Motion Pic-
tures (*in part*); Photography (*in part*)
Meggers, William Frederick. Spectroscopy;
Stark Effect; Zeeman Effect
Mehigan, Patrick Denis. Hurling
Meiklejohn, Andrew, M.D. Industrial Medi-
cine (*in part*)
Meillet, Antoine. Albanian Language; Arme-
nian Language
Meinzer, Oscar Edward. Ground Water; Hy-
drology
Mellone, Sydney Herbert. Anthropomorphism;
Basilides; Bible, English (*in part*);
Christianity (*in part*); Gnosticism; Heresy;
Ophites; Pelagius (*in part*); Tithes; Uni-
tarianism (*in part*)
Mellor, Arthur. Silk Manufacture (*in part*)
Meloche, Villiers Willson. Selenium
Melrose, Paul C. Hainan; Hakkas
Mencken, Henry Louis. Americanism; Slang
(*in part*)
Mendershausen, Horst. Industry and Trade,
War Control of (*in part*)
Menke, Frank Grant. Cock-Fighting or Cock-
ing
Menzel, D. H. Eclipse (*in part*)
Menzies, Rev. Allan, D.D. Scotland, Church
of (*in part*)
Merkel, Herman. Containers, Metallic
Merkle, F. G. Physical Natural Resources (*in
part*)
Merrick, Frank Anderson. Westinghouse Elec-
tric and Manufacturing Company (*in part*)
Merrill, Elmer Drew. Aceraceae; Bignoniaceae;
Combrataceae; Cornaceae; Dipterocarpa-
ceae; Erythroxylaceae; Gesneriaceae; Loga-
niaceae; Meliaceae; Philadelphus; Pipera-
ceae; Rhamnaceae; Salicaceae; Taxaceae;
Thymelaeaceae; Zygophyllaceae
Merrill, Hon. Frederick James Hamilton.
Quarrying
Merrill, Harrison J. Range Finders (*in part*)
Meston, James Scorgie Meston, 1st Baron.
Egypt (*in part*); India (*in part*); Untouch-
ables (*in part*)
Metcalf, Zeno P. Cicada; Cuckoo-Spit; Lan-
tern Fly
Metz, C. W. Cytology; Nucleus
Meyendorff, Baron Alexander. Siberia (*in part*)
Meyer, Adolf. Insanity (*in part*)
Meyer, Bernard Sandler. Plants and Plant
Science (*in part*)
Meyer, Eduard. Ardashir; Artabanus; Arta-
xerxes; Astyages; Bactria; Darius; Deme-
trius (King of Bactria); Diodotus; Eucra-
tides; Euthydemus; Hormizd or Hormizdas;
Kavadh; Media; Mithradates (*in part*);
Osroene or Osroene; Pacorus; Parthia;
Perôz; Persia (*in part*); Persis (*in part*);
Pharnabazus; Phraates; Phraortes; Satrap;
Shapur; Smerdis; Tiridates; Tissaphernes;
Vologaeses; Vonones; Xerxes; Yazdegerd
Meyer, Jacob Conrad. Alsace-Lorraine (*in
part*)
Meyerson, Emile. Explanation
Meynell, Alice. Browning, Elizabeth Barrett
Meynell, Sir Francis. Books (*in part*)
Meynell, Wilfrid. Meynell, Alice
Mezger, Ernest. Arbitration (*in part*)
Michael, Max A. Cruiser
Michaelis, Leonor. Free Radicals (*in part*)
Michal, Aristotle Demetrius. Differential
Forms (*in part*); Tensor Analysis (*in part*)
Michelson, A. A. Interferometer (*in part*);
Velocity of Light (*in part*)
Middleton, John Henry. Monreale (*in part*);
Raphael Sanzio (*in part*); Ring (*in part*);
Verona (*in part*); Wren, Sir Christopher
Middleton, William E. Knowles. Anemometry
(*in part*); Beaufort Scale; Cloud (*in part*);
Radiosonde; Upper Air Soundings; Visibility
Miers, Sir Henry Alexander. Diamond
Migrdichian, Vartkes. Cyanamide; Prussic Acid
Mijatovich, Chedomille. Karajich, Vuk Set-
fanovich (*in part*)
Milbourne, R. J. Gasholders
Miles, J. Hamish. Beerbohm, Sir Max;
Doughty, Charles Montagu
Mill, Courtenay J. Stock Exchange or Bourse
(*in part*)
Mill, Hugh Robert. Geography
Miller, Albert R., D.V.M. Slaughterhouse
Miller, Lieutenant Colonel Edward Darley.
Polo (*in part*)
Miller, Fred J. Scientific Management (*in
part*)
Miller, George Charles. Lithography (*in part*)
Miller, James Grier, M.D. Unconscious
Miller, John Anderson. Electric Traction (*in
part*); Tramway (*in part*)
Miller, Max C. Hosier; Knitting
Miller, Philip L. Gramophone (*in part*)
Miller, Raymond Joseph. Liguori, Alfonso
Maria dei
Miller, S. N. Eburacum
Miller, William. Adriatic Sea (*in part*); Crete
(*in part*); Fiume (*in part*); Greece (*in part*);
Ionian Islands (*in part*); Skanderbeg or
George Castrioti; Thrace; Zaimis, Alexander
Miller, William. Publishing (*in part*)
Milligan, Rev. George, D.D. James (*in part*)
Millingen, Alexander Van, D.D. Constanti-
nople (*in part*)
Mills, James Philip. Assam; Chakma; Magh
Mikir
Mills, Mabel H. Exchequer (*in part*)
Mills, William H. Stereochemistry (*in part*)
Milne, Edward A. Chromosphere (*in part*)
Milne, James Malcolm. Legal Education (*in
part*)
Milyukov, Paul. Duma; Russia (*in part*)
Miner, Roy Waldo. Museums of Science (*in
part*)
Minns, Sir Ellis Hovell. Europe (*in part*);
Tauri
Minorsky, Vladimir F. Iranian Languages and
Persian; Persian Literature
Minser, Edward John. Contact Weather; Ice
on Aircraft; Instrument Weather; St. El-
mo's Fire
Mints, Lloyd W. Currency
Mirt, Carl Theodor, D.Th. Pius IX (*in part*);
Trent, Council of (*in part*); Ultramon-
tanism (*in part*); Vatican Council, The (*in
part*)
Mirsky, Prince Dimitri. Chekhov, Anton
Pavlovich; Dostoievski, Theodore (Fyodor)
Mikhaïlovich; Gorky, Maxim; Russian Lan-
guage and Literature (*in part*); Tolstoy, Leo
(Leyv) Nikolayevich, Count; Turgenev, Ivan
Sergeyevich; Ukrainian Literature
Mises, Ludwig von. Boehm Von Bawerk, Eu-
gen; Wieser, Friedrich von
Mitchell, A. D. Hydrogen; Indicators; Oxide
(*in part*); Sulphur; Zinc (*in part*)
Mitchell, Broadus. South, The (*in part*)
Mitchell, J. G. Perylene
Mitchell, John F. Boston (*in part*)
Mitchell, John Malcolm. Bacon, Francis (*in
part*); Carnegie Trusts (*in part*); Harem
(*in part*); Mnemonics; Neoplatonism (*in
part*); Solon (*in part*); Sphinx (*in part*)
Mitchell, Matthew Cargill. Rhode Island
Mitchell, Sir Peter Chalmers. Alimentary
Canal (*in part*); Biogenesis
Mitchell, Brigadier General W. A. Bridging,
Military (*in part*)
Mitra, Sir Dhiren. Arbitration (*in part*)
Mitrany, D. Peasant Movement
Moeblman, Conrad Henry. Baptists
Moelwyn-Hughes, Emyr Alun. Chemistry (*in
part*)
Moffatt, Rev. James, D.D. John, The Epistles

- of; Pastoral Epistles, The; Philemon, Epistle to; Philippians, Epistle to the; Romans, Epistle to the; Timothy or Timotheus; Titus Moffatt, L. E. Household Appliances (*in part*)
Moffett, John Perry. Tanganyika (territory) (*in part*); Tanganyika, Lake
Mollat, Michel. Normandy; St. Pol, Counts of Momigliano, Arnaldo Dante. Hypereides Montchloff, Nicholas Ivan. Boris III; Bulgaria (*in part*); Stambulov, Stefan
Moncur, Alexander. Hong Kong and Shanghai Banking Corporation
Money, Sir Leo Chiozza. Armstrong (Sir W. C.), Whitworth and Co., Ltd. (*in part*); Boicow, Vaughan & Co. Ltd.; Consolidated Gold Fields of South Africa, Ltd. (*in part*); Electrical Power: National and Regional Schemes (*in part*); Exports (*in part*); Fine Cotton Spinners' and Doublers' Association, Ltd.; Furness, Withy and Company Limited; Gas Light and Coke Company (*in part*); Imperial Tobacco Company, Limited; Lever Brothers & Unilever Limited (*in part*); Lloyds Bank Limited (*in part*); Marconi's Wireless Telegraph Co., Ltd.; Midland Bank Limited (*in part*); Pearl (*in part*); Plaster-Work (*in part*); South Metropolitan Gas Company; Swan, Hunter, and Wigham Richardson, Ltd. (*in part*); Vickers Limited (*in part*); Wall Paper Manufacturers Ltd.; White Star Line (*in part*); Yorkshire Electric Power Company (*in part*)
Monkhouse, William Cosmo. Hunt, William Holman (*in part*); Leighton, Frederick Leighton, Baron; Millias, Sir John Everett (*in part*)
Montague, Laurence. Football (*in part*)
Montagu of Beaulieu, 2nd Baron, John Walter Edward Douglas Scott-Montagu. Motoring (*in part*)
Montgomery, Raymond Brains. Ekman, Vagn Walfrid; Turbulence, Atmospheric
Moon, Parry. Candlepower; Photometry (*in part*)
Moore, Carl Richard. Reproduction (*in part*)
Moore, Coyle E. Charity (*in part*)
Moore, Harold. Microscopy (*in part*)
Moore, John Percy. Annelida (*in part*); Leech
Moore, Joseph Earle, M.D. Venereal Diseases (*in part*)
Moore, Robert Foster. Ophthalmology
Moorhead, Max L. Guatemala (*in part*)
Mora, A. Plywood; Veneer
Mordell, Albert. Hearn, Lafcadio (*in part*); Whittier, John Greenleaf
Morehead, Albert H. Auction Bridge (*in part*); Baccarat; Boston (*in part*); Bridge (*in part*); Cards, Playing; Chouette; Contract Bridge (*in part*); Faro; Gaming and Wagering; Lotto (*in part*); Poker; Roulette; Rummy; Whist (*in part*)
Morel-Fatio, Alfred. Spanish Language and Literature (*in part*)
Morfill, William Richard. Nestor
Morgan, Arthur E. Antioch College
Morgan, Conwy Lloyd. Emergence
Morgan, Edward Victor. Banking (*in part*); Great Britain (*in part*)
Morgan, Frank. Motion Pictures (*in part*)
Morgan, Sir Gilbert Thomas. Acenaphthene; Aldehydes (*in part*); Amines (*in part*); Antipyrine (*in part*); Atomic Number; Britannia Metal; Diazo-Compounds; Calcium; Germanium; Hydrate (*in part*); Ketenes (*in part*); Ketones (*in part*); Lactic Acid; Lithium; Organometallic Compounds (*in part*); Ozone; Pyrazoles (*in part*); Pyrogallol; Salicylic Acid; Scandium; Stilbene; Succinic Acid; Sulphonic Acids; Tartar; Tartaric Acid; Tellurium; Thiazoles; Thorium; Triphenylmethane; Type Metal; Vanadium; Zirconium
Morgan, Brigadier General John Hartman. Attorney-General (*in part*); By-Law or Bye-Law (*in part*); Common Law; Constitution and Constitutional Law (*in part*); Martial Law (*in part*); Official Secrets; Petition of Right (*in part*); Prerogative; Public Authorities Protection Act; State, Act of
Morgan, Thomas Hunt. Lamarckism
Morgan, William Wilson. Campbell, William Wallace; Kapteyn, Jacobus Cornelius; Rigol; Saturn (*in part*); Struve, Friedrich Georg Wilhelm
Morgenstern, William W. Chicago, The University of
Morgenthau, Hans J. Authoritarianism; Peace, International; Spheres of Influence
Morison, Robert Swain, M.D. Hypothalamus and Thalamus
Morison, Stanley. Calligraphy; Printing Type (*in part*); Typography
Morley, Christopher. Henry, O.
Morley of Blackburn, John Morley, 1st Viscount. Burke, Edmund; Comte, Auguste (Isidore Auguste Marie François Xavier) (*in part*); Diderot, Denis (*in part*)
Mormino, Ignazio. Sicily, Bank of (*in part*)
Morrill, R. S. Carmine (*in part*); Vanishes, Chemistry of (*in part*)
Morrill, Elliott. Incendiary Mixtures
Morris, Frances. Lace (*in part*)
Morris, Geoffrey Christopher. Prime Minister, British (*in part*)
Morrison, Frank Barron. Feeding Stuffs and Livestock Feeding
Morrow, H. L. Street Cries
Morrow, Ian F. D. Baden (land) (*in part*); Beust, Friedrich Ferdinand von; Black Sea (*in part*); Cambon, Pierre Paul; Capitulations; Clarendon, George William Frederick Villiers, 4th Earl of; Dardanelles; Eulenburg-Hertefeld, Philip zu, Prince and Count (*in part*); Straits Question, The; Tirol (*in part*)
Morse, John Torrey, Jr. Holmes, Oliver Wendell
Morse, Richard Stetson. Vacuum (*in part*)
Mortensen, Brita Maud Ellen. Swedish Language and Literature
Mortimer, Herbert Clifford. Divorce (*in part*)
Morton, George Ashmun. Television (*in part*)
Morton, Hudson T. Bearings
Morton, J. V. Chartreuse (*in part*); Creme De Menthe; Curacao
Morton, W. E. Cotton and the Cotton Industry (*in part*)
Mosca, Gaetano. Sicily (*in part*)
Moss, John. Social Security (*in part*)
Mott, Frank Luther. Journalism; Newspapers (*in part*); Periodical (*in part*); Syndicate, Press
Mott, Sir Frederick Walker, M.D. Neuropathology
Mott, Nevill Francis. Electricity, Conduction of (*in part*)
Mottern, Hugh H. Vinegar
Mott-Smith, Geoffrey. Backgammon; Chess (*in part*); Cribbage; Nine Men's Morris
Mountevans, Admiral Edward Ratcliffe Garth Russell Evans, 1st Baron. Observer Corps in Air Defense (*in part*)
Mousnier, Roland Émile. France (*in part*)
Moyer, John William. Taxidermy (*in part*)
Moyes, Rt. Rev. Monsignor J., D.D. Pius XI (*in part*)
Mudge, George Percival. Incubators (*in part*)
Muenscher, Walter Conrad. Convolvulus; Dandelion (*in part*); Poison Ivy; Poisonous Plants; Thistle; Water-Hemlock; Weeds (*in part*)
Muhfeld, John E. Locomotive (*in part*); Locomotive Coaling (*in part*)
Muir, Ramsay. Liberal Party (*in part*)
Muirhead, James Fullarton. Huggenberger, Alfred (*in part*); Spitteler, Carl; Swiss Literature (*in part*)
Muirhead, John Henry. Idealism
Mulford, Herbert B. Cornerstone
Mulholland, John. Conjuring
Muller, Hermann Joseph. Gene; Variation (*in part*)
Mullinger, James B. Universities (*in part*)
Mumford, Lewis. Regional Planning (*in part*)
Munro, Dana C. Rome (*in part*)
Munro, Neil. Conrad, Joseph
Murdock, Kenneth Ballard. Longfellow, Henry
- Wadsworth; Mather, Cotton; Mather, Increase; Mather, Richard
Murphy, Edward L., S.J. Asceticism
Murphy, Edwin S. Salvage (*in part*)
Murphy, Frank. Government Departments (*in part*)
Murphy, Howard A. Music, Teaching of (*in part*)
Murray, Alexander Stuart. Lamp (*in part*)
Murray, Arthur. Dance (*in part*)
Murray, David Leslie. Beaconsfield, Benjamin Disraeli, Earl of
Murray, George Gilbert Aimé. Drama (*in part*); Euripides; Homer; Homeric Poems
Murray, John Courtney, S.J. Extreme Unction; Holy Spirit, The (*in part*)
Murray, Margaret Alice. Witchcraft
Muskat, Irving E. Alkali Manufacture (*in part*)
Mussey, Henry R. Protection (*in part*)
Muzzev, David Saville. United States (of America), The (*in part*)
Myers, Earl Hamlet. Foraminifera
Myres, Sir John Linton. Argos (*in part*); Corfu (*in part*); Crete (*in part*); Euboea or Negroponte; Gortyna; Oxford; Paphos; Salamis; Thessaly; Troy and Troad (*in part*)
Nabholz, Hans. Switzerland (*in part*)
Naismith, James, M.D. Basketball (*in part*)
Nalder, W. H. Irrigation (*in part*)
Namias, Jerome. Isentropic Charts; Weather Forecasting
Nansen, Fridtjof. Refugees and the Exchange of Populations (*in part*)
Nasmith, Frank. Cotton and the Cotton Industry (*in part*)
Nathan, George Jean. Drama (*in part*)
Navarro, J. M. de. Hallstatt; La Tène; Teutonic Peoples (*in part*)
Naylor, Henry Darnley. New South Wales (*in part*); Queensland (*in part*)
Nearing, G. G. Lichens (*in part*)
Needham, Joseph. Hopkins, Sir Frederick Gowland (*in part*)
Neely, Wayne C. Fair (*in part*)
Neergaard, Charles F. Hospital Planning
Negus, Victor Ewings. Voice (*in part*)
Nehmer, Stanley. Agana; Guam (*in part*); Korea (*in part*); Samoa
Neiburger, Morris. Inversion of Temperature
Neilson, William Allan. Smith College
Neilson, Winthrop C. Bauxite (*in part*)
Nerlove, S. H. Dividends
Nevins, Allan. Ford, Henry; Hearst, William Randolph; Pulitzer, Joseph (*in part*); Roosevelt, Franklin Delano (*in part*); Washington, George
Newbigin, Marion I. Albania (*in part*); Balkan Peninsula (*in part*); Bulgaria (*in part*); Greece (*in part*); Yugoslavia (*in part*)
Newcomb, John Lloyd. Virginia, University of
Newcomb, Simon. Neptune (*in part*); Velocity of Light (*in part*)
Newcomer, Mabel. Taxation, Local
Newhall, Beaumont. Photography (*in part*)
Newman, Horatio H. Twins and Twinning
Newman, Melvin Spencer. Anthraquinone (*in part*); Phenanthrene; Quinones
Newsome, Albert R. North Carolina (*in part*)
Neyman, R. L. Gunnery, Naval (*in part*)
Nichol, F. D. Miller, William; Seventh-day Adventists
Nichol, John. Burns, Robert
Nicholas, Herbert George. Baldwin, Stanley Baldwin, 1st Earl, of Bewdley (*in part*); Churchill, Sir Winston Leonard Spencer; English History (*in part*); Government Departments (*in part*); Prime Minister, British (*in part*); Secretary of State
Nichols, John T. Barracuda; Fishes (*in part*); Grunt; Lancet Fish; Lion Fish; Mamamu; Moorish Idol; Poison Fish; Scorpion Fishes; Squirrel Fishes
Nichols, Joseph C. Ice Hockey (*in part*)
Nichols, Roy Franklin. Taylor, Zachary
Nicholson, Edward Max. Birds (*in part*)
Nicholson, Edward Williams Byron. Mande-

- ville, Jehan De (*in part*)
 Nicholson, James T. Red Cross (*in part*)
 Nicholson, Seth Barnes. Neptune (*in part*); Pluto
 Nickerson, Hoffman. War (*in part*)
 Nicoll, John Ramsey Allardyce. Drama (*in part*)
 Nicolle, John Macarthur. Buoy (*in part*)
 Nicolson, Hon. Harold. Hugo, Victor
 Nightingale, Gordon Thayer. Pineapple
 Nilsson, Martin P. Calendar (*in part*)
 Nimitz, Fleet Admiral Chester William. United States Naval Academy
 Nimkoff, Meyer F. Illegitimacy
 Nisbet, H. Angola; Brocade of Cotton; Calico; Cashmere; Charmeuse; Cheviot Cloth; Delaine; Flannelette (*in part*); Fustian; Gabardine; Georgette; Harris Tweed; Marocain; Moiré; Prunella; Satin; Schappe; Serge; Shantung; Silk Fabrics, Artificial; Tweed; Velvet; Velveteen; Vicuña
 Nitch, Cyril Alfred Rankin. Urology
 Nixon, Herman Clarence. South, The (*in part*)
 Nixon, Roy Wesley. Date Palm
 Noach, Arnoldus. Keyser, Hendrik de; Post, Pieter
 Noble, G. Kingsley. Amphibia (*in part*); Caecilian (*in part*)
 Noble, G. L. Four-H Clubs
 Noel, Evan Baillie. Fives; Rackets or Racquets (*in part*); Squash Rackets (*in part*)
 Noel-Baker, Philip J. Sanctions and Guarantees (*in part*)
 Noffsinger, John Samuel. Correspondence Schools
 Nohara, Daisuke. Yokohama Specie Bank, Ltd., The
 Nöldeke, Theodor. Arabic Literature (*in part*); Mo' Allaqāt or Mu' Allaqāt (*in part*); Pah-lavi or Pehlevi (*in part*); Persepolis (*in part*)
 Nollau, Edgar Hugo. Leather, Artificial
 Noller, Carl Robert. Benzoic Acid; Saponins and Sapogenins
 Nordberg, Bruno Victor. Diesel Engine
 Norgate, G. Le G. Chelmsford, Frederick John Napier Thesiger, 1st Viscount
 Norman, Arthur Geoffrey. Rothamsted Experimental Station
 Norris, Francis Benedict Vincent. Droit Administratif
 North, Frederick J. Slate
 North, Brigadier General Thomas. World War II (*in part*)
 Northedge, Frederick Samuel. International Trade Associations and Congresses
 Norton, Charles Eliot. Curtis, George William
 Norton, L. J. Federal Farm Board
 Norwood, Edwin P. Circus (*in part*)
 Novák, Arne. Czech Language and Literature (*in part*)
 Noyes, Pierrepont Burt. Oneida Community
 Nuelle, Joseph Henry. Delaware and Hudson Company, The
 Nuffield of Nuffield, William Richard Morris, 1st Viscount. Morris Motors Limited
 Nunes, Leo George. Épée Fencing; Fencing; Foil Fencing; Sabre Fencing (*in part*)
 Nunn, Sir T. Percy. Vocational Training (*in part*)
 Nurkse, Ragnar. Reichsbank (*in part*)
 Nutting, Charles B. Statute (*in part*)
 Oakeley, Hilda Diana. Personality
 O'Brien, George. Shannon
 O'Brien, Morrrough P. Coast Protection and Land Reclamation (*in part*)
 O'Connell, Rev. Daniel, S.J. Newman, John Henry (*in part*)
 O'Connor, William R. Confirmation
 Odishaw, Hugh. Standards, National Bureau of
 O'Donnell, Thomas C. Friendly Societies (*in part*)
 Oehser, Paul H. North America (*in part*); United States (of America), The (*in part*)
 Oelsner, Hermann. Italian Literature (*in part*); Provençal Language and Literature (*in part*)
 Oertzen, Karl Ludwig von. Schlieffen, Alfred
 Oesper, Ralph Edward. Armstrong, Henry Edward; Arrhenius, Svante August (*in part*); Berthelot, Marcelin Pierre Eugene (*in part*); Berthollet, Claude Louis (*in part*); Berzelius, Jons Jakob (*in part*); Crookes, Sir William (*in part*); Dumas, Jean Baptiste André; Fresenius Karl Remigius; Glauber, Johann Rudolf; Graham, Thomas; Haber, Fritz; Henry, William; Hofmann, August Wilhelm von; Kolbe, Hermann; Le Bel, Joseph Achille; Mitscherlich, Eilhardt; Nernst, Walter; Nobel, Alfred; Ostwald, Wilhelm; Perkin, William Henry, Jr.; Priestley, Joseph (*in part*); Raoult, François Marie; Richards, Theodore William; Stahl, Georg Ernst; Werner, Alfred; Wislicenus, Johannes; Wohler, Friedrich; Wollaston, William Hyde
 Oesterley, William W. O. E., D.D. Apocalyptic Literature (*in part*); Apocryphal Literature (*in part*); Baruch (*in part*); Enoch, Book of (*in part*); Ezra, Fourth Book (or Apocalypse) of (*in part*); Isaiah, Ascension of; Jubilees, Book of (*in part*); Judith, The Book of (*in part*); Manasses, Prayer of (*in part*); Sibylline Oracles (*in part*)
 Offner, W. W. Magnetic Inspection
 Ogden, Charles Kay. Basic English
 O'Hara, Captain Charles E. Investigation, Criminal (*in part*)
 Ohly, John Hallowell. Government. Departments (*in part*)
 O'Huadhaigh, Seán. Arbitration (*in part*)
 Okey, Thomas. Basket (*in part*); Osier (*in part*)
 Olcott, Frances J. Children's Books (*in part*)
 Oldfield, Lieutenant Colonel Josiah, M.D. Vegetarianism
 Olds, George D. Amherst College
 Oliver, Francis Wall. Spartina
 Oliver, Sir Thomas, M.D. Dangerous Trades
 Olivier, Charles P. Meteor (*in part*)
 Olis, William David. Pyrones
 Olson, Elder J. Criticism
 Olson, James C. Nebraska
 Oltar-Jevsky, V. Russian Architecture (*in part*)
 O'Malley, L. S. Khasi and Jaintia Hills (*in part*)
 Oman, Sir Charles (William Chadwick). Hundred Years' War, The; Mohammedan Campaigns
 O'Neill, John Johnston. Adams, Frank Dawson
 Onions, Charles Talbut. Gloss and Glossary (*in part*)
 Onyon, Engineer-Captain William. Boilers (*in part*)
 O'Reilly, M. Scandinavian Civilization (*in part*)
 Orlemann, Edwin F. Iron
 Ormerod, Robert M. Belting for Power Transmission (*in part*)
 Ormsby, Mrs. Hilda. London (*in part*)
 Orthmann, August Caesar. Leather, Care of
 Osborn, E. B. Boxing (*in part*); Short Story (*in part*)
 Osborne, J. H. Fire Engines (*in part*); Fire Escapes (*in part*)
 Osburn, Raymond C. Kamptozoa; Polyzoa (*in part*)
 Osgood, Herbert Levi. United States (of America), The (*in part*)
 Osgood, Wilfred Hudson. Zoological Nomenclature
 Oswald, John Clyde. Printing (*in part*)
 Ott, Emil. Cellulose
 Overacker, Louise. Primaries
 Overholser, Winfred, M.D. Psychiatry (*in part*)
 Overstraeten, Major R. van. Antwerp, Siege of; Belgium, Invasion of (1914); Yser, Battle of the (*in part*)
 Overton, Sir Arnold. Trade: World Statistics (*in part*)
 Owen, Captain B. J. Sheep Shearing Machines (*in part*)
 Owen, Benjamin Evan. Hopkins, Gerard Manley
 Owen, Sidney George. Ovid (*in part*)
 Owens, Hamilton. Baltimore
 Ower, Ernest. Anemometry (*in part*)
 Pacaut, Marcel Pierre. Bouvines; Champagne (*in part*); Dauphin (*in part*); Louis IX (*in part*); Nivernais; Paris (*in part*); Paris University; Provence (*in part*)
 Pack, George T., M.D. Cancer
 Page, Sir Charles Max. Fractures
 Page, Theodore Stephen. Censorship (*in part*)
 Paget, Sir Richard Arthur Surtees. Voice Sounds
 Paige, John H. Lacrosse
 Paine, S. G. Bacteriology
 Palache, Charles. Goldschmidt, Victor
 Palat, Barthélemy Edmond. Champagne, Battles in (*in part*); Frontier, Battles of The (*in part*)
 Paléologue, Maurice. Romanoff Dynasty
 Pall, Gordon. Numbers, Theory of
 Palmer, B. C. Taximeter
 Palmer, Elbridge Woodman. Bookbinding (*in part*)
 Palmer, Howard. Rocky Mountains, The
 Palmer, John Leslie. Lenormand, Henri-René (*in part*); Molière
 Palmer, Paul F., S.J. Confession; Indulgence
 Paneth, Frederick Adolphus. Meteorites
 Pantin, John. Ink (*in part*)
 Paoli, Cesare. Siena (*in part*)
 Pardee, Joseph Thomas. Phosphate Rock
 Parente, Pascal P. Stigmatization
 Parish, William F. Friction; Lubricants; Lubrication
 Park, Marion Edwards. Bryn Mawr College (*in part*)
 Park, Orlando. Ecology, Animal
 Park, Thomas. Fertility and Fecundity (*in part*); Population Ecology
 Parker, Rt. Hon. Charles Stuart. Peel, Sir Robert
 Parker, Eric. Shooting (*in part*)
 Parker, George Howard. Comparative Nervous System
 Parker, H. W. Gecko; Iguana; Lizard (*in part*); Python (*in part*); Sea Serpent; Snakes (*in part*); Turtle (*in part*)
 Parker, Ralzemond Drake. Telephotography
 Parker, William Belmont. Atahualpa or Atabalipa; Bustamante, Antonio Sánchez de (*in part*); Cesnola, Luigi Palma di; Concessions; Coronado, Francisco Vasquez de; Durao, José de Santa Rita; Francia, José Gaspar Rodríguez (*in part*); Guzmán Blanco, Antonio; Hernández, José; Iturbide, Agustín de; Jiménez de Quesada, Gonzalo; Las Casas, Bartolomé de; Leguía, Augusto B.; López, Francisco Solano; Maximilian (Ferdinand Maximilian); Medina, José Toribio (*in part*); Mendoza, Antonio de; Mitre, Bartolomé; Olmedo, José Joaquín de; Paez, José Antonio; Palma, Ricardo; Pedro II; Rodó, José Enrique; Rosas, Juan Manuel de (*in part*); San Martín, José de; Sarmiento, Domingo Faustino; Sucre, Antonio José de
 Parker-Smith, A. Patents (*in part*)
 Parkes, Arthur Josiah. Lock
 Parkinson, Cyril Northcote. Gambier, James Gambier, Baron; Great Britain (*in part*)
 Parlett, Sir Harold George. Japanese Language
 Parmelee, Julius H. Railways (*in part*)
 Parmer, Raymond. Laws Relating to Seamen (*in part*)
 Parran, Thomas, M.D. Preventive Medicine
 Parrington, Vernon Louis. Hawthorne, Nathaniel
 Parsons, Edward Alexander. Louisiana
 Parsons, Frederick Gymer. Anatomy (*in part*); Arteries; Joints and Ligaments (*in part*); Liver, Anatomy of; Lymphatic System; Mouth and Salivary Glands (*in part*); Muscular System, Anatomy of; Nerve (*in part*); Nervous System; Olfactory System (*in part*); Pancreas; Pharynx; Reproductive

- System (*in part*); Respiratory System, Anatomy of; Scalp; Skeleton (*in part*); Skull; Spinal Cord (*in part*); Teeth; Veins
- Parsons, James Bayard. Alkali; Aludel; Alumina; Anion; Cation; Chemistry (*in part*); Copperas; Dalton's Law; Efflorescence; Elements, Chemical; Equivalent; Glauber's Salt; Hydrosulphite of Soda; Isotopes (*in part*); Peroxyacids; Plaster of Paris; Sodium (*in part*); Vitriol
- Parsons, Wilfrid, S.J. Democracy (*in part*)
- Partington, James Riddick. Nitrogen
- Partidge, Eric. Slang (*in part*)
- Passant, E. J. Consul (*in part*); Foreign Office (*in part*)
- Pastor, Antonio R. Spanish Language and Literature (*in part*)
- Pastor, Ludvig von. Papacy (*in part*)
- Paterson, Clifford Copland. Electric Lamps and Valves, Manufacture of (*in part*)
- Paterson, James Alexander, D.D. Numbers (*in part*)
- Paton, Rev. W. Missions (*in part*)
- Pattee, Fred Lewis. Short Story (*in part*)
- Patterson, Buel R. Wrestling (*in part*)
- Patterson, Frederick Douglas. Tuskegee Institute
- Patterson, Richard S. Seals (*in part*)
- Patterson, Woodford. Cornell University (*in part*)
- Pattison, Rev. Mark. Erasmus, Desiderius (*in part*); Grotius, Hugo (*in part*); Macaulay, Thomas Babington Macaulay, Baron (*in part*)
- Patton, C. L. Pinocle
- Paues, Anna C. Bible, English (*in part*)
- Pauling, Linus Carl. Ice; Periodic Law; Resonance, Theory of; Valence (*in part*)
- Paull, Wallace H. Tyre (*in part*)
- Paulsen, Carl G. Physical Natural Resources (*in part*)
- Paxson, Frederic Logan. American Frontier, The; Middle West, The (*in part*)
- Payne, Joseph Frank, M.D. Plague (*in part*)
- Peacock, David Henry. Camphor
- Peake, Arthur Samuel, D.D. Bible (*in part*)
- Peake, Harold John Edward. Archaeology (*in part*)
- Pear, Tom Hatherley. Imagery
- Pearl, Raymond. Death, Biological Aspects of
- Pearman, J. B. Bowls (*in part*); Croquet (*in part*); Handball (*in part*)
- Pearn, Bertie Reginald. Bengal (*in part*); Burma (*in part*); Central Provinces and Berar (*in part*)
- Pearson, H. S. Pecora
- Pearson, Paul Martin. Lyceums and Chautauquas
- Pearson, Ralph. Woodcuts and Wood-Engraving
- Pearson, Sir Ralph Sneyd. Timber Preservation
- Peat, Stanley. Carbohydrates (*in part*)
- Peck, Edson R. Atom (*in part*)
- Peck, Mary Gray. Catt, Carrie Lane Chapman
- Pederson, C. J. Antioxidants
- Peek, Frank W., Jr. Electrical Power Transmission (*in part*); Transformer (*in part*)
- Peekema, Wibo G. Banka (*in part*)
- Peel, Dorothy Constance (Mrs. C. S.). Pastry, Home Made
- Peele, Robert. Blasting; Boring; Shaft-Sinking (*in part*)
- Peers, Edgar Allison. Drama (*in part*); Franco Bahamonde, Francisco
- Peery, William. Field, Nathan
- Pee, Louise Jenison. Refrigerators (Household) (*in part*)
- Pee, T. Eric. Calendar (*in part*)
- Peffer, E. L. Hydrometers (*in part*)
- Pearce, Hayford. Byzantine Art (*in part*)
- Peissi, Pierre. Forges, Comité des
- Pelham, Henry Francis. Augustus; Nerva Marcus Cocceius (*in part*); Rome (*in part*)
- Pemberton, Ralph, M.D. Massage
- Pendel-Brodthurst, James. Bed (*in part*); Cabinet; Chair; Clocks (*in part*); Desk; Pawnbroking; Vernis Martin
- Pendleton, Robert L. Tropical Agriculture
- Pennell, Elizabeth Robins. Lithography (*in part*)
- Pennock, Grace L. Housekeeping (*in part*)
- Pennock, J. Roland. Administrative Regulation
- Penson, Lillian Margery. Colony
- Penzer, Norman Mosley. Zinc (*in part*)
- Percival, John. Wheat (*in part*)
- Perham, H. N. Bayonet (*in part*)
- Perkins, Arthur George. Dyes, Natural; Fustic, Yellow Wood or Old Fustic; Indigo (*in part*); Lac Dye; Logwood; Persian Berries; Purple; Quercitron Bark; Weld
- Perkins, Charles A. Third Degree (*in part*)
- Perkins, Frances. Labour Law (*in part*)
- Periman, Selig. Closed Shop; Company Unions; Employment Exchange (*in part*); General Strike (*in part*); Hours of Labour (*in part*); Trade Board (*in part*); Trade (Labour) Unions (*in part*)
- Perria, Jean. Brownian Movement
- Perry, Chesley R. Rotary Club (*in part*)
- Perry, Janet. Spanish Language and Literature (*in part*)
- Pershing, General John Joseph. Meuse-Argonne Operation; St. Mihiel (*in part*); United States (of America), The (*in part*)
- Peters, Fredus Nelson, Jr. Furan; Furfural
- Peterson, Florence. Labour Turnover
- Peterson, Mildred Othmer. Libraries (*in part*)
- Peterson, Roger T. Birds, Protection of (*in part*); Bird Sanctuaries (*in part*)
- Petrie, Sir William M. Flinders. Measures and Weights, Ancient; Pyramid; Sequence Dating
- Petrunkovitch, Alexander. Acarus; Arachnida; Black Widow; Eurypterida; Pedipalpi; Pentastomida; Scorpion; Spiders; Whip Scorpion; Xiphosura
- Pew, Marlen Edwin. Reporting (*in part*)
- Pfeiffer, George A. Polygons (*in part*); Solids, Geometric
- Pfister, Christian. Austrasia; Capitulary; Carolingians; Charibert; Charles Martel; Childbert; Childeric; Clotaire; Clotilda, Saint; Clovis; Dagobert I.; Franks; Fredegund; Germanic Laws, Early (*in part*); Gregory, St. of Tours; Huns; Mayor of the Palace; Pippin or Pepin; Salic Law (*in part*); Siegbert
- Phair, William A. Iron and Steel (*in part*)
- Phelps, Henry Willis. American Can Company, The
- Phelps, William Lyon, D.D. Cooper, James Fenimore
- Philbrick, Francis Samuel. American Law (*in part*); Declaration of Independence; Hamilton, Alexander; Jefferson, Thomas
- Philby, Harry St. John Bridger. Arabia (*in part*); Bell, Gertrude Margaret Lowthian; Hadhramaut (*in part*); Hasa (*in part*); Ibn Sa'ud 'Abd ul-'Aziz ibn 'Abd ur-Rahman ibn Faisal (*in part*); Jidda (*in part*); Kuwait (*in part*)
- Phillimore, George Grenville. Burial (*in part*)
- Phillimore, Walter George Frank Phillimore, 1st Baron. Admiralty, High Court of; Admiralty Jurisdiction (*in part*); Advowson; Judge-Advocate of the Fleet
- Phillips, Major C. E. S. Selenium Cells
- Phillips, C. John. Glass (*in part*); Glass Manufacture
- Phillips, Catherine Beatrice. Marie Antoinette (*in part*)
- Phillips, Rev. Charles Stanley. Edward "The Confessor"
- Phillips, Everett Franklin. Bee (*in part*); Honey
- Phillips, Gilbert Paul. Australia (*in part*)
- Phillips, Rev. Theodore Evelyn Reece. Jupiter; Mercury; Neptune (*in part*); Saturn (*in part*); Venus
- Phillips, Brigadier General Thomas Raphael. Tactics (*in part*)
- Phillips, Walter Alison. Aix-La-Chapelle, Congresses of; Alexander I (Aleksander Pavlovich); Alliance; Balance of Power; Baron; Berlin, Congress and Treaty of; Brest-
- Litovsk, Treaties of; Canon (*in part*); Carlsbad Decrees; Church History (*in part*); Congress; Dalmatic; Diplomacy; Dispensation; Dragon; Duke; Eastern Question, The; Esquire; Excellency; Faust or Faustus; French Revolution, The; Gentleman; Greek Independence, War of; Holy Alliance, The; Jacobins, The; King; London, Conferences of; Louis Philippe I.; Magyars; Mahmud II (*in part*); Mephistopheles; Nibelungenlied; Nicholas I (*in part*); Paris, Treaties of; Schleswig-Holstein Question (*in part*); Templars (*in part*); Verona, Congress of; Vestments; Walther von der Vogelweide
- Phipson, Sydney Lovell. Evidence (*in part*); Witness (*in part*)
- Piccirilli, Attilio. Sculpture Technique (*in part*)
- Pickels, Edward Greydon. Centrifuge
- Pickels, George W. Drainage of Land (*in part*)
- Pickering, B. M. Joel
- Pickford, Grace Evelyn. Annelida (*in part*); Earthworm; Echiurida; Priapulida; Sipunculida; Vermes
- Pierce, Vivian. Capital Punishment (*in part*)
- Pierce, W. Conway. Chemistry (*in part*)
- Pieters, Adrian John. Lespedeza (*in part*); Seed Trade (*in part*)
- Piggott, Major General Francis Stewart Gildero. Enomoto (Yenomoto), Buyo
- Pile, Seymour. Brass
- Pillsbury, Donald M., M.D. Psoriasis; Seborrhoea; Shingles; Skin Diseases
- Pillsbury, Walter Bowers. Bencke, Friedrich Eduard; Cattell, James McKean; Ebbinghaus, Herman; Janet, Pierre; Külpe, Oswald Pines, Herman. Butane; Olefin; Paraffin Hydrocarbons, Chemistry of
- Pinkerton, William M. Harvard University (*in part*)
- Pinson, Koppel S. Anti-Semitism (*in part*)
- Pintner, Rudolf. Examinations (*in part*)
- Pirenne, Henri. Belgium (*in part*)
- Pirenne, Jacques. Belgium (*in part*)
- Pitt, Colonel Robert Brindley. Cranes
- Plamenatz, John Petrov. Pasic, Nikola
- Plass, Everett Dudley, M.D. Obstetrics (*in part*)
- Platt, John Isaac. Alps; Apennines (*in part*); Atlas Mountains; Caucasus (*in part*); Glacier; Jura; Liverpool (*in part*); Manchester (*in part*); St. Helena (*in part*)
- Platt, Raye R. Andes; Orinoco; Patagonia (*in part*)
- Plummer, Rev. Charles. Alfred or Aelfred (The Great); Anglo-Saxon Chronicle; Bede, Bede or Baeda
- Pocock, Reginald Innes. Carnivora (*in part*); Edentata (*in part*); Fox (*in part*)
- Podmore, Frank. Automatic Writing
- Poëte (César), Marcel. Paris (*in part*)
- Poffenberger, Albert Theodore. Advertising (*in part*); Applied Psychology
- Polanyi, Michael, M.D. Chemiluminescence
- Pole, Sir Felix John Clewett. Great Western Railway Company (*in part*)
- Pollard, Albert Frederick. Coverdale, Miles
- Pollard, Alfred William. Bibliography; Book-Collecting (*in part*); Books (*in part*); Chaucer, Geoffrey; Colophon; Incunabula; Polyglott or Polyglot
- Pollard, Frederick Henry. Oxide (*in part*)
- Pollock, Rt. Hon. Sir Frederick. Contract (*in part*); Tort
- Pollock, Walter Herries. Musset, Alfred de (*in part*)
- Polyak, Stephen L. Basilar Membrane; Ear, Anatomy of; Eye, Human (*in part*)
- Poole, Austin L. Tours (*in part*)
- Poole, Reginald Lane. Wycliffe (or Wyclif), John (*in part*)
- Poole, Reginald Stuart. Egypt (*in part*)
- Pope, Arthur Upham. Bistam; Isfahan (*in part*); Persia (*in part*); Rugs and Carpets (*in part*)
- Popenoe, (Frederick) Wilson. Avocado; Banana; Breadfruit; Jujube; Litchi; Mango; Papaya; Pomegranate
- Popham, Arthur E. Aquatint; Etching (*in part*)

- part); Line Engraving
 Popovitch, Sava. Russian Art
 Porteous, Douglas Archibald. Superannuation (in part)
 Porter, Alfred William. Electrical (or Electrostatic) Machine (in part); Sky (in part); Surface Tension; Thermodynamics (in part)
 Porter, Horace Chamberlain. Coke, Coking and High Temperature Carbonization (in part)
 Porter, Kirk Harold. State Government
 Porter, Leroy V. New York Central System
 Porter, Rupert Howard. Seed Testing
 Porteus, Thomas Cruddas. Standish, Myles
 Possony, Stefan T. Europe (in part)
 Postgate, John Percival. Juvenal (Decimus Iunius Iuvenalis) (in part); Latin Literature (in part); Phaedrus (in part); Propertius, Sextus; Textual Criticism; Tibullus, Albius (in part)
 Postgate, Raymond William. Bakunin, Mikhail; Blanqui, Louis Auguste; Chartism; Churchill, Charles; Cluseret, Gustave Paul; Combination Laws; Commune (in part); Delescluze, Louis Charles; Flourens, Gustave; Hunt, Henry; Leipzig, Battle of; Municipal Trading (in part); News Agency (in part); O'Connor, Feargus Edward; Peterloo; Place, Francis; Radical; Sabotage; Wilkes, John
 Potter, David Morris. Long, Huey Pierce
 Potter, Edith Louise, M.D. Foetal Disorders
 Potter, George Richard. Switzerland (in part)
 Potter, Pitman Benjamin. League of Nations
 Potthoff, Carl J., M.D. Artificial Respiration; First Aid to the Injured
 Poucher, William A. Cosmetics (in part); Perfumes
 Poulton, Sir Edward Bagnall. Darwin, Charles Robert; Mimicry
 Pound, Louise. Ballad (in part); English Language (in part)
 Poupardin, René. Arles; Burgundy; Franche-Comté; Philip the Bold (in part); Philip the Good (in part); Provence (in part)
 Powell, Alfred Richard. Coke, Coking and High Temperature Carbonization (in part)
 Powell, Thomas Reed. Constitution and Constitutional Law (in part)
 Power, E. A. Fisheries (in part)
 Powicke, Sir Frederick Maurice. Middle Ages, The
 Pratt, Arthur D. Boilers (in part)
 Pratt, David D. Tars, Low-Temperature
 Pray, Carl E. Argentina (in part)
 Prendergast, J. S. Galen
 Prescott, Joseph. Joyce, James
 Pressey, Sidney L. Psychology (in part)
 Prest, Alan Richmond. Unemployment
 Prestage, Edgar. Garrett, João Baptista da Silva Leitão de Almeida (in part); Goes, Damiao de (in part); Herculano de Carvalho E Araujo, Alexandre (in part); Lopes, Fernão (in part); Manuel de Mello, Dom Francisco (in part); Portuguese Literature (in part)
 Preston, Wheeler B. British Empire; Ceylon (in part); Gibraltar (in part); Great Britain (in part); Hong Kong; Malta (in part); New Zealand (in part); Sarawak; Scotland (in part)
 Pribram, Alfred Francis. Achrenthal, Aloys Lexa Von; Austria, Empire of (in part); Berchtold von und zu Ungarschitz, Leopold; Renner, Karl
 Price, Charles C. Friedel-Crafts Reaction
 Price, Don K. City Manager; General Strike
 Price, Emmett W. Cattle (in part); Pig (in part); Sheep (in part)
 Price, Sir James Frederick George. Dole (in part); Unemployment Insurance (in part)
 Price, John. General Strike (in part); Trade Board (in part)
 Price, Robert. Chapman, John
 Priebisch, Robert. German Language
 Priest, Alan Reed. Seals (in part); Theatre (in part)
 Priestley, John Boynton. English Literature (in part)
 Prince, Harry M. Hotel (in part)
 Prince, John Dyneley. Chaldaea
 Prinnet, Léon Jacques Maxime. Beauharnais; Joinville (in part)
 Pring, John Norman. Electricity, Conduction of (in part); Electrolysis (in part)
 Pringle, Henry Fowles. Smith, Alfred Emmanuel
 Pringle-Pattison, Andrew Seth. Mysticism (in part); Philosophy and Philosophical Studies; Scepticism (in part); Theosophy; Weber's Law
 Prior, Edward S. Fine Arts
 Pritchett, Charles Herman. Government Corporations; Government Departments (in part)
 Proudman, Joseph. Tides
 Przibram, Hans. Heteromorphosis
 Pucci, Enrico, Monsignor. Vatican, The
 Purdom, Charles Benjamin. Garden Cities (in part)
 Pusey, Merlo J. Hughes, Charles Evans (in part)
 Pycraft, W. P. Egg (in part); Feather (in part); Hibernation; Nest (in part); Song Birds (in part)
 Pye-Smith, Philip Henry. Harvey, William (in part)
 Quick, Rev. Robert Herbert. Froebel, Friedrich Wilhelm August (in part)
 Quiggin, Mrs. A. H. Agriculture, Primitive; Basket (in part); Bows and Arrows; Dwellings, Primitive; Hunting and Fishing, Primitive (in part); Transport (in part)
 Quiggin, Edmund Crosby. Patrick, St. (in part); Scottish Literature (in part)
 Quigley, Hugh. Allgemeine-Elektrizitäts-Gesellschaft; British Electrical Manufacturers' Association (in part); Electrical Power: National and Regional Schemes (in part)
 Quiller-Couch, Sir Arthur Thomas. Brown, Thomas Edward
 Quine, Willard Van Orman. Frege, Gottlob
 Quirin, E. J. Dredges and Dredging (in part)
 Rabak, Frank. Hop
 Rabuffo, Vincent M. Ice Cream (in part)
 Racham, Bernard. Pottery and Porcelain (in part)
 Rackemann, Francis Minot, M.D. Allergy
 Radhakrishnan, Sir Sarvepalli. Indian Philosophy; Scherbatsky, Fedor
 Radice, Sheila. School and the Home
 Rait, Sir Robert Sangster. Casket Letters; Mary Queen of Scots (in part); Scotland (in part)
 Ralston, Robert Henry. Salt (in part)
 Ramsay, Sir William Mitchell, D.D. Smyrna (in part)
 Ramsaye, Terry. Motion Pictures (in part)
 Ramsbottom, J. Truffie
 Ramsdell, Lewis S. Haematite; Limonite; Psilomelane; Smaltite; Torbernite; Zincite
 Ramsey, Frank Plumpton. Russell, Bertrand
 Arthur William Russell (in part)
 Rand, Austin L. Audubon, John James; Egret; Lapwing; Starling; Stork; Sunbird; Sun Bittern; Surfbird
 Randall-MacIver, David. Apulia (in part); Comacines, The; Este; Etruscans, The; Piceas; Sicily (in part); Villanovans
 Ransome, Arthur. Trotsky, Lev Davidovich (in part)
 Rappaport, Irving. Hookworm
 Rasche, William Frank. Vocational Training (in part)
 Rastall, Robert Heron. Alabaster; Alluvium; Cerargyrite; Chert; Clay-With-Flints; Esker; Geology; Gypsum; Malachite; Oolite; Pegmatite; Quartz (in part); Wolframite or Wolfram
 Ratcliff, B. U. Debt Conversion
 Ratcliffe, Rev. E. C. Eucharist (in part)
 Rathbone, Eleanor F. Family (in part); Fawcett, Dame Millicent Garrett, G. B. E.
 Ratner, William. Cycling (in part)
 Ravdin, I. S., M.D. Haemorrhage
 Raven, Henry Cushier. Kangaroo
 Ravenstein, Ernest George. Map (in part)
 Rawle, Francis. Inheritance (in part)
 Rawlings, Arthur Lionel. Gyroscope (in part)
 Rawlinson, Rt. Rev. A. E. J., D.D. Gospel; Mark, Gospel of
 Rawlinson, Hugh George. Bombay (in part); Bombay State (in part)
 Ray, Sidney H. Papuan Languages
 Rayleigh, John William Strutt, 3rd Baron. Argon (in part); Sky (in part)
 Raymer, Robert George. Velázquez (de Cuéllar), Diego
 Raymond, Cornelia M. Vassar College (in part)
 Rayner, Mabel Mary Cheveley. Mycorrhiza
 Rayton, Wilbur B. Microscope
 Read, C. Stanford, M.D. Hypochondriasis; Hysteria; Insanity (in part); Insomnia (in part); Psychosis (in part); Psychotherapy
 Read, Herbert. Stained Glass (in part)
 Reboux, Paul. Gastronomy, Modern
 Reddaway, William Fiddian. Norway (in part)
 Redden, William R., M.D. Bandages and Bandaging
 Redfield, Robert. Durkheim, Emile
 Redmayne, Sir Richard Augustine Studdert. Aduit; Airway; Anthracite (in part); Cage; Choke-Damp; Coke, Coking and High Temperature Carbonization (in part); Fire-damp; Gob and Gob Fires; Low-Temperature Carbonization; Peat; Pulverized Fuel; Royalties, In Mining
 Redway, George William. Petersburg Campaign; Seven Days' Battle; Shenandoah Valley (in part)
 Reed, Alfred Zantlinger. Lawyer
 Reed, Clarence Arthur. Almond; Cashew; Chestnut; Filbert; Hickory; Nut; Pecan; Pistachionut; Walnut
 Reed, Henry M. American Radiator and Standard Sanitary Corporation
 Reed, Ollie Ezekiel. Cheese (in part); Milk (in part)
 Reed, Thomas Harrison. City Government
 Rees, James Frederick. Commerce
 Rees, John Morgan. Syndicalism (in part)
 Reeside, John Bernard, Jr. Cretaceous System
 Reeve, Frank Driver. New Mexico
 Reeves, Hon. William Pember. Grey, Sir George (in part); New Zealand (in part)
 Régamey, Raymond. Iron in Art (in part)
 Regan, C. Tate. Cat-Fish; Char; Cichlid; Cod; Cyprinodonts; Eel (in part); Ray; Selachians; Shark
 Reid, Edwy B. Agricultural Credit (in part)
 Reid, Sir George. Turner, Joseph Mallord William (in part)
 Reid, James Smith. Rutilius Claudius Namatianus; Statius, Publius Papinius (in part)
 Reid, Margaret G. Consumption; Cost of Living (in part); Standard of Living
 Reid, Robert William, M.D. Anatomy (in part)
 Reid, William Alfred. A.B.C. Powers; Buenos Aires (in part)
 Reighard, Jacob. Pisciculture (in part)
 Reiley, A. C. Typewriter
 Reilly, Charles H. Renaissance Architecture (in part)
 Reilly, Brigadier General Henry Joseph. Artillery (in part)
 Reimann, Hobart Ansteth, M.D. Pneumonia
 Reinhardt, Rev. Charles W., S.J. Old Catholics
 Reinhardt, Max. Theatre (in part)
 Reinmuth, P. H. Otto. Chemistry (in part); Grignard Reagents
 Reisman, Arthur. Draughts or Checkers
 Reittel, Charles. Scientific Management (in part)
 Reith of Stonehaven, John Charles Walsham Reith, 1st Baron. Broadcasting (in part)
 Rembaugh, Bertha. Arrest (in part); Bail (in part); Blackmail (in part); Bribery (in part)
 Rendle, Alfred Barton. Angiosperms (in part);

- Leaf (*in part*)
- Renton, Sir Alexander Wood. Arbitration (*in part*); Ejectment (*in part*); Emblements; Eminent Domain; Fixtures; Flat (*in part*); Ground Rent (*in part*); Inebriety, Law of (*in part*); Landlord and Tenant (*in part*); Letters Patent; Lodger and Lodgings; Maxims, Legal; Proclamation; Rent; Trade Marks (*in part*); Waste
- Retzer, Robert. Reinsurance (*in part*)
- Rew, Sir (R.) Henry. Agricultural Prices (*in part*); Agricultural Statistics (*in part*); Drainage, Arterial; Farm Rents (*in part*); Land Tenure; Economic and Agrarian Aspects (*in part*); Open-Field System (*in part*)
- Rez, Frederick Ferdinand. Chicago (*in part*)
- Rey, Lieutenant Colonel Sir Charles Fernand. Abyssinia (*in part*); Harar (*in part*); Kaffa; Tana
- Reyerson, Lloyd H. Carbon, Oxides of
- Rhodes, George C. Transatlantique, Compagnie Générale
- Rhys, Ernest. Bookselling (*in part*)
- Ricci, Corrado. Baroque Architecture
- Richards, A. Embryo; Embryology (*in part*); Invertebrate Embryology
- Richards, George Warren, D.D. Shakers (*in part*)
- Richards, Oscar W. Incubators (*in part*)
- Richards, Theodore William, M.D. Atom (*in part*)
- Richardson, Albert Edward. Modern Architecture, 18th and 19th Centuries (*in part*)
- Richardson, C. A. Pluralism
- Richardson, Charles Howard. Entomology (*in part*)
- Richardson, H. Archie. Hammer Throwing; Javelin Throwing; Jumping; Marathon Race; Putting the Shot
- Richardson, H. G. Sheep Shearing Machines (*in part*)
- Richardson, John Henry. Industrial Relations (*in part*)
- Richardson, John Reginald. Cyclotron
- Richardson, Leo S. Agricultural Societies and Shows (*in part*); Milk (*in part*); Soybean (*in part*)
- Richardson, Robert William. Bayamo; Buenos Aires (*in part*); Catamarca (province) (*in part*); Cienfuegos (*in part*); Córdoba (*in part*); Cotopaxi (*in part*); Cuba (*in part*); Entre Ríos (*in part*); Formosa (*in part*); Guaporé (*in part*); Guayas (*in part*); Iquassú (*in part*); Jujuy (*in part*); Lima (dept.); O'Higgins; Patagonia (*in part*); Plata, Rio de la or River Plate (*in part*); Rio Branco (*in part*); Salta (*in part*); San Juan (province) (*in part*); San Luis (*in part*); Santa Fé (province) (*in part*); Santiago del Estero (*in part*)
- Richardson, Wilds Preston. Cordova (*in part*)
- Richter, Gisela Marie Augusta. Gems in Art; Terra-Cotta (*in part*)
- Richter, Irma A. Bibiena (Bibbiena), Galli da (*in part*); Bouts, Dierick; Campin, Robert; Christus, Peter; Dosso Dossi, Giovanni; Duccio di Buoninsegna; Farniato, Paolo; Ferrari, Gaudenzio; Feuerbach, Anselm; Fiorenzo di Lorenzo; Franceschi, Piero de'; Gainsborough, Thomas; Gauguin, Paul; Ghirlandajo, Domenico, Gogh, Vincent Van; Goya y Lucientes, Francisco; Justus of Ghent; Liberale, Antonio; Lorenzetti; Luini, Bernardino; Mantegna, Andrea; Masaccio; Masolino da Panicale; Moretto, Il; Palma, Jacopo; Picasso, Pablo; Pisano, Vittore; Seurat, Georges; Solario, Andrea da; Theocopuli, Domenico; Titian (*in part*); Uccello, Paolo; Veronese, Paolo; Vivarini; Zurbaran, Francisco de
- Richter, Richard Biddle, M.D. Delirium; Neuralgia
- Riddell, John R. Colour Printing; Photogravure (Machine); Printing (*in part*)
- Riddle, Jackson W., M.D. Vaccine Therapy
- Ridenour, Louis Nicot, Jr. Radar (*in part*)
- Ridgway, Robert. Tunnel (*in part*)
- Ridley, General Clarence Self. Panama Canal (*in part*)
- Riehl, Herbert. Tropical Storms
- Riker, Dorothy Lois. Indiana (*in part*); Indianapolis (*in part*)
- Ripault, Louis. Herriot, Edouard (*in part*)
- Ripper, William. Cutlery
- Rishbeth, O. H. T. Australia (*in part*); New South Wales (*in part*); Queensland (*in part*); Tasmania (*in part*); Victoria (state) (*in part*); Western Australia (*in part*)
- Ritchie, Albert C. Maryland (*in part*)
- Ritchie, James. Sheep (*in part*)
- Ritson, John Anthony Sydney. Safety Lamp (*in part*)
- Ritt, Joseph Fels. Calculus, Differential and Integral (*in part*)
- Robb, Arthur T. News Agency (*in part*)
- Robb, Jane Sands, M.D. Heart, Anatomy of
- Robb, R. Marion. Phenazine
- Robbins, H. C. Press Association, The
- Robbins, W. W. Botany; Weeds (*in part*)
- Roberts, John Morris. Italy (*in part*)
- Roberts, Ray Harland. Photoperiodism (*in part*)
- Roberts, Richard Ellis. Ibsen, Henrik Johan
- Roberts, Sydney Castle. Boswell, James; Johnson, Samuel (*in part*)
- Robertson, Miss A. J. Anglo-Saxon Law (*in part*)
- Robertson, Sir Charles Grant. Reform Movement (*in part*)
- Robertson, Dennis Holme. Trade Cycle (*in part*)
- Robertson, Edward, D.D. Acre (*in part*); Ai; Baalbek; Bashan; Damascus (*in part*); Dead Sea; Ekron; Endor; Gadara; Galilee; Galilee, Sea of; Gath; Gaza (*in part*); Gerasa; Gerizim; Gethsemane; Gezer; Gibeon; Gil-ead; Gilgal; Hama (*in part*); Hasbeya; Hebron (*in part*); Hermon; Homs or Hims; Jamnia; Jebel; Jericho; Jezreel; Joppa; Kerak; Lachish; Latakia; Marash (*in part*); Nazareth; Olives, Mount of; Ophir; Philadelphia (Rabbath-Ammon); Samaria; Shechem; Shiloh; Sidon; Sodom and Gomorrah; Tiberias; Tripoli (*in part*); Tyre; Uz; Johann Peter
- Robertson, James Alexander. Philippine Islands (*in part*)
- Robertson, John George. Eulenspiegel (Ulen-spiegel), Till; Goethe, J. Wolfgang von; Grillparzer, Franz; Heine, Heinrich (*in part*); Meistersinger; Schiller, Johann Christoph Friedrich; Wieland, Christoph Martin
- Robertson, John Mackinnon. Coleridge, Samuel Taylor; Shakespeare, William (*in part*)
- Robertson, John Monteath. Argon
- Robertson, William Spence. Venezuela (*in part*)
- Robins, C. A. Idaho (*in part*)
- Robinson, B. B. Jute (*in part*); Kapok; Ramie
- Robinson, Major General Sir Charles Walker. Salamanca (*in part*); Vitoria (Spain)
- Robinson, Edgar Eugene. United States (of America), The (*in part*)
- Robinson, Henry M. Los Angeles (*in part*)
- Robinson, Rev. Henry Wheeler, Hon. D.D. Canticles; Habakkuk; Holy Spirit, The (*in part*); Hosea; Malachi; Micah (*in part*); Obadiah; Psalms (*in part*); Zechariah
- Robinson, James Harvey. Civilization
- Robinson, Lennox. Yeats, William Butler
- Robinson, Maude. Sculpture Technique (*in part*)
- Robinson, O. Preston. Chain Store (*in part*)
- Robinson, Sir Robert. Anthocyanins and Anthoxanthins (*in part*)
- Robinson, Theodore Henry, D.D. Aaron; Adam; Ahab; Ammonites; Amos; Benjamin; Calf, The Golden; Deborah; Deuteronomy; Exodus, The; Gideon (*in part*); Jacob (*in part*); Jeremiah (*in part*); Jeroboam; Joseph; Josiah; Lamentations; Levites (*in part*); Moses (*in part*)
- Robinson, Will G. South Dakota
- Robison, Admiral Samuel Shelburn. Midshipman (*in part*)
- Robison, Guy Colvin. Abalone (*in part*); Amphineura; Cephalopoda (*in part*); Cockle; Cowry; Cuttlefish (*in part*); Gastropoda (*in part*); Lamellibranchia (*in part*); Mollusca (*in part*); Mussel (*in part*); Nautilus; Octopus; Periwinkle; Scallop (*in part*); Scaphopoda; Slug; Snail; Species (*in part*); Squid; Variation (*in part*); Whelk (*in part*)
- Rock, John, M.D. Abortion
- Rockwell, William Walker, D.Th. Boniface
- Rockwood, Nathan Chamberlain. Aggregate; Cement (*in part*)
- Rodd, James Rennell, 1st Baron Rennell. Egypt (*in part*)
- Rodebush, Worth Huff. Dryness, Chemical
- Rodgers, William L. Farragut, David Glasgow
- Rogers, Austin Flint. Fulgurite
- Rogers, Major General Sir Leonard, M.D. Kala-Azar
- Rogers, Philip George. Germany (*in part*)
- Rogers, Tyler Stewart. Glass Fibres
- Rolleston, Sir Humphry (Davy), M.D. Diagnosis; Goitre; Longevity (*in part*); Therapeutics
- Rollins, Reed C. United States (of America), The (*in part*)
- Romanelli, Lieutenant Colonel Guido. Kun, Bela (*in part*)
- Romanes, J. Albertite; Bitumen; Ozokerite or Ozocerite
- Romberg, A. K. Battleship (*in part*)
- Romein, J. M. F. Vistula
- Romer, Alfred S. Brontosaurus; Dinosauria; Diplodocus; Labyrinthodontia; Ostracoderms; Palaeontology (*in part*); Stegosaurus; Triceratops
- Rooney, W. J. Earth Currents
- Root, Elihu. Permanent Court of International Justice
- Roover, Raymond de. Money, Mediaeval
- Ropes, James Hardy, D.D. Corinthians, Epistles to The; Ephesians, Epistle to The
- Rorem, Clarence Rufus. Hospital
- Roscoe, Edward Stanley. Laws Relating to Seamen (*in part*); Sea Laws (*in part*); Wreck (*in part*)
- Rose, Arthur. Distillation (*in part*)
- Rose, Charles Bedell. Fire Engines (*in part*)
- Rose, Herbert Jennings. Ancestor Worship; Annalists; Calendar (*in part*); Chronology (*in part*); Fate; Greek Literature (*in part*); Greek Religion (*in part*); Hera (*in part*); Hercules; Latin Literature (*in part*); Lycæon; Mystery (*in part*); Nemesis; Odysseus; Oedipus; Oracle (*in part*); Orestes; Prometheus (*in part*); Superstition; Thesmophoria; Vesta
- Rose, Horace Arthur. Afridi (*in part*); Caste (Indian); India (*in part*); Sikhs
- Rose, John Holland. English History (*in part*); Sieyès, Emanuel-Joseph (*in part*); Talleyrand-Périgord, Charles Maurice de
- Rose, John Kerr. Apple; Barley; Beef (*in part*); Cheese (*in part*); Cocoa; Copra; Ham
- Rose, Sir Thomas Kirke. Amalgamation (*in part*); Cyanide Process; Gold Mining and Metallurgy; Mint (*in part*); Silver: Metallurgy, Mining and Production (*in part*)
- Rosenbaum, Samuel R. Judicial Reform (*in part*)
- Rosenberg, Edward F., M.D. Rheumatoid Arthritis
- Rosenhain, Walter. Metallography; Metallurgy
- Rosenwald, Julius. Philanthropy (*in part*)
- Rosenzweig, Saul. Projective Methodsin Psychodiagnosis
- Ross, Sir Edward Denison. Bukhara (*in part*); Manchu Language; Mongolian Language and Literature (*in part*); Turkish Language and Literature (*in part*)
- Ross, Herbert Holdsworth. Stone Fly; Plecoptera
- Ross, Hugh Munro. Alchemy (*in part*)
- Ross, Nellie Tayloe. Mint (*in part*)
- Ross, R. Great Britain (*in part*)
- Rosse, Herman. Costume Design (*in part*)
- Rossetti, William Michael. Perino del Vaga; Shelley, Percy Bysshe (*in part*); Tintoretto, Jacopo Robusti (*in part*); Titian (*in part*)

- Ross-Johnson, Dennis. Port Operation (*in part*)
- Rost, Reinhold. Tamils (*in part*)
- Rostas, Laszlo. Exchange Control; Production, Census of (*in part*)
- Roth, Cecil. Brampton or Brandon, Sir Edward; Jews (*in part*)
- Rothman, Stephen, M.D. Tinea Versicolour
- Round, John Horace. Aids; Baronet; Battle Abbey Roll; Bayeux Tapestry, The (*in part*); Beauchamp; Castle (*in part*); Clare (family); Court Baron; Domesday Book; Earl; Earl Marshal; Fitzgerald; Geoffrey De Montbray; Knight-Service; Lord Great Chamberlain; Marquess or Marquis; Scutage or Escuage; Serjeanty; Talbot (family) (*in part*)
- Rounsefell, George Armytage. Herring
- Rouse, William Henry Denham. Classical Education (*in part*)
- Roush, Gar A. Briquetting (*in part*); Physical Natural Resources (*in part*)
- Roussin, Leander Gaspard. Greece (*in part*)
- Rowan, William. Birds, Migration of
- Rowe, Harold B. War Control of Food (*in part*)
- Rowe, Leo S. Pan American Conferences; Pan American Union
- Rowland, Dunbar. Mississippi (*in part*)
- Rowland, Eron (Mrs. Dunbar Rowland). McCord, Louise Susanna Cheves
- Rowntree, B. Seebohm. Poverty Line; Welfare Work
- Rowntree, Cecil. Bone (*in part*)
- Roxby, Percy Maude. Canton (*in part*); China (*in part*); Chin Hills; Manchuria (Manchoukuo) (*in part*); Mongolia (*in part*)
- Roy, Andrew Donald. Cost of Living (*in part*)
- Roy, Monseigneur Camille. Canadian Literature (*in French*)
- Royde-Smith, John Graham. Lenclos, Ninon de
- Roys, Carl S. Radio Receiver
- Rubinstein, Nicolai. Italy (*in part*)
- Rudler, Frederick William. Cat's-Eye; Celestine or Celestite; Marble (*in part*)
- Rudmose-Brown, R. N. Arctic Regions (*in part*); New Siberian Islands; Nicholas, Northern or Lenin Land; Novaya Zemlya; Spitsbergen (*in part*); Wrangel Island
- Rudolf, G. R. Average
- Rudolph, E. Leighton. Arkansas
- Ruehe, Harrison August. Butter
- Ruge, Raymond A. Ice Yachting
- Rundle, Commander H. J. M. Coast Guard (*in part*)
- Runner, Joseph James. Bad Lands
- Russell, Bertrand Arthur William, 3rd Earl Russell. Relativity: Philosophical Consequences
- Russell, Elbert. Friends, Society of (*in part*)
- Russell, Frederic A. Salesmanship
- Russell, Henry Norris. Stellar Constitution and Evolution
- Russell, Peter Edward. Spain (*in part*)
- Russell-Clarke, Alan Daubeney. Copyright (*in part*)
- Rutherford, Ernest, 1st Baron Rutherford. Radioactivity, Natural (*in part*)
- Ryan, Edward A., S. J. Xavier, Francis
- Ryan, James Hugh, S.T.D. Parochial Schools
- Ryan, M. J. Brehon Laws (*in part*)
- Ryden, George H. Delaware (*in part*)
- Ryder, J. D. Electronics in Industry
- Ryle, John Alfred, M.D. Pain, Significance of
- Sabonadière, A. Indian Law (*in part*)
- Sachs, Eleanor B. Fan
- Sachs, John Harrison. Anthraquinone (*in part*); Dyes, Synthetic
- Sacks, Captain John C. Fur Farming
- Sadgrove, W. Howard. Furniture Manufacture (*in part*); Upholstery (*in part*)
- Safford, Archibald. Distress
- Safrastian, A. Armenia; Asia Minor (*in part*); Kurdistan (*in part*); Mosul (vilayet) (*in part*)
- St. Cyres, Viscount (Stafford Henry Northcote). Casuistry; Jansenism (*in part*)
- St. Helier, The Rt. Hon. Lord (Sir Francis Henry Jeune). Divorce (*in part*)
- Saintsbury, George Edward Bateman. Balzac, Honoré De; Gautier, Theophile; Mérimée, Prosper; Romance; Thiers, Louis Adolphe (*in part*)
- Salaman, Malcolm Charles. Crayon; Glass Prints; Monotypes; Stipple and Crayon Engraving
- Salisbury, Sir Edward James. Australia (*in part*)
- Salmon, Edward. Banjermasin or Bandjarmasin (*in part*); Borneo (*in part*); Brunei (*in part*); Java (*in part*); Labuan (*in part*); Malay Archipelago (*in part*); Sumatra (*in part*)
- Salmon, Rev. Stewart Dingwall Fordyce, D.D. Logos (*in part*)
- Salter, Sir James Arthur. Allied Maritime Transport Council; War Control of Shipping
- Salter, William Henry. Psychical Research (*in part*)
- Saltonstall, Leverett. Massachusetts (*in part*)
- Salvadori, Max W. Farinacci, Roberto; Mussolini, Benito (*in part*)
- Salzman, Louis Francis. Aucassin and Nicolette; Bestiary; Minstrel
- Sampson, George. Biography (*in part*)
- Sampson, Ralph Allen. Time Measurement (*in part*)
- Sams, Henry W. Summer Schools (*in part*)
- Samuel, Bernard. Philadelphia (*in part*)
- Sanctis, Gaetano de. Hannibal
- Sandeman, Lieutenant Brady. World War II (*in part*)
- Sandys, Sir John Edwin. Pausanias (*in part*)
- Sanford, Vera. Ferrari, Lodovico; Hippocrates of Chios; Mathematical Notations
- Sanger, Charles Percy. Russell, Bertrand Arthur William Russell, 3rd Earl (*in part*)
- Sanger, Ralph G. Calculus, Differential and Integral (*in part*); Ellipse; Parabola; Paraboloid; Symmetric Functions
- Sanger, Sophy. Labour Law (*in part*)
- Sankey, John, 1st Viscount of Moreton. Criminal Appeal, Court of
- Sapir, Edward. Central and North American Languages
- Sargent, John Garibaldi. Attorney-General (*in part*)
- Sarton, George. Hipparchus
- Sauer, Louis Wendlin, M.D. Whooping Cough
- Saunders, Maurice. Lithography (*in part*)
- Saurat, Denis. Drama (*in part*); French Literature (*in part*)
- Sauvageot, Aurelien. Ural-Altaic Languages
- Savage, Harlow Dow. Dry Quenching
- Savage, Howard James. Athletic Sports (*in part*)
- Sawyer, Charles. Government Departments (*in part*)
- Sawyer, Charles Baldwin. Beryllium (*in part*)
- Sawyer, Wilbur Augustus, M.D. Yellow Fever
- Saxton, W. T. Gymnosperms (*in part*)
- Sayce, Rev. Archibald Henry, D.D. Assurbani-Pal; Babylonia and Assyria (*in part*); Caria; Persepolis (*in part*); Sardanapalus; Sennacherib; Shalmaneser
- Sayce, R. U. Cape Province (*in part*); Capetown (*in part*); Durban; Ermelo; Graaff Reinet (*in part*); Grahamstown (*in part*); Harrismith; Natal (*in part*); Orange Free State (*in part*); South Africa, Union of (*in part*); South-West Africa (*in part*); Transvaal (*in part*)
- Sayre, Daniel Clemens. Accelerometer; Aileron; Aviation, Hazards of; Biplane; Gliding (*in part*); Gyroplane; Le Bourget Airport; Tempelhof Field
- Scammell, J. M. Daras
- Scarborough, Dorothy. Negro, The American (*in part*)
- Schade, James W. Tyre (*in part*)
- Schaefer, Vincent Joseph. Snow
- Schaeffer, George W. Aqua Regia
- Schapera, I. Africa (*in part*); Bushman Languages; Chiefs; Dual Organization; Gerontocracy; Hottentots (*in part*)
- Schapiro, J. Salwyn. Anticlericalism
- Schelkunoff, Sergei A. Electromagnetic Waves
- Schiller, Ferdinand Canning Scott. Pragmatism
- Schilling, O. F. G. Elliptic Functions (*in part*)
- Schlesinger, Kathleen. Cittern; Crowd; Organ (*in part*); Pianoforte (*in part*); Parsifal Bell Instrument
- Schley, Major General Julian Larcombe. Docks (*in part*); Mississippi River (*in part*)
- Schmidt, Carl Frederic, M.D. Brain (*in part*)
- Schmidt, Karl Patterson. Alligators; Amphibaena; Argentina (*in part*); Asp; Axolotl; Basilisk; Batrachia; Black Snake; Bolivia (*in part*); Bullfrog; Caecilian (*in part*); Carnivora (*in part*); Cayman (or Caiman); Chile (*in part*); Colombia (*in part*); Crocodilian (*in part*); Cryptobranchus; Cuba (*in part*); Distribution of Animals (*in part*); Frog; Galápagos Islands (*in part*); Gavia; Hognose; Moccasin; Mugger; Newt; Python (*in part*); Pit Vipers; Rattlesnake; Salamander; Snakes (*in part*); Taxidermy (*in part*); Taxonomy; Tetrapoda; Toad; Tree-Frog; Turtle (*in part*); United States (of America), The (*in part*); Viper; Zoological Collecting (*in part*); Zoological Geography (*in part*)
- Schmidt, Rev. P. Wilhelm, D.Th. Numeral Systems
- Schmidt, Robert. Glass (*in part*)
- Schmitt, Bernadotte Everly. Hindenburg, Paul Von; Pan-Germanism; Rhineland, The; Versailles, Treaty of
- Schmitt, Waldo L. Branchiopoda (*in part*); Cirripedia (*in part*); Copepoda (*in part*); Crab; Crayfish; Crustacea (*in part*); Hermit Crab; Lobster; Malacostraca (*in part*); Shrimp
- Schneider, Henry C. Windmills and Wind Power (*in part*)
- Schneider, Herbert Wallace. Corporate State
- Schneirla, T. C. Education in Animals; Psychology, Comparative
- Schoch, Thomas J. Dextrin
- Scholefield, F. Cloth Finishing
- Scholes, Percy Alfred. Scriabin, Alexander Nikolaevich
- Schomp, Albert L. American Bank Note Company, The
- Schoth, Harry August. Vetch
- Schott, Paul Gerhard. Atlantic Ocean (*in part*); North Sea
- Schrenk, Helmuth H. Chemistry (*in part*)
- Schulman, Sidney, M.D. Paralysis
- Schultz, Edwin William, M.D. Infantile Paralysis
- Schultz, Norman Clemens. Amyl Acetate (*in part*); Butyl Acetates (*in part*); Glycols (*in part*)
- Schuman, Frederick Lewis. Hitler, Adolf
- Schumpeter, Joseph Alois. Capitalism
- Schürer, Emil. Philo (*in part*)
- Schwartz, George Leopold. Excess Profits Tax (*in part*)
- Scott, Rev. Charles Anderson, D.D. Jesus Christ (*in part*); Ulfilas (*in part*)
- Scott, Charles Felton. Engineering Education (*in part*)
- Scott, Franklin D. Bergen; Charles XIV John; Denmark (*in part*); Frederick IX; Halden; Lithuania; Spitsbergen (*in part*); Vilnius
- Scott, George A. H. Humane Societies
- Scott, Sir Henry Harold, M.D. Sprue
- Scott, Hugh Arthur. Concert; Extemporization; Leitmotiv; Tchaikovsky, Peter Ilich
- Scott, J. A., M.D. Medical Legislation (*in part*)
- Scott, John Waugh. Neo-Hegelianism
- Scott, Rt. Hon. Sir Leslie (Frederic). Factor (*in part*)
- Scott, Lester. Basketball (*in part*)
- Scott, Malcolm K. Lloyd's Register of Shipping
- Scrimgeour, John Stuart. Betting Tax; Entertainments Duty; Increment Value Duty
- Scroggs, William Oscar. Walker, William
- Scudder, Horace Elisha. Lowell, James Rus-

- sell; Stowe, Harriet Elizabeth
 Scullard, Howard Hayes. Lepidus (*in part*); Syria (*in part*)
 Seaborg, Glenn Theodore. Actinium; Plutonium; Protactinium; Radioactivity, Artificial; Transuranium Elements; Uranium
 Seares, Frederick Hanley. Photography, Celestial (*in part*)
 Sears, John Edward. Metrology (*in part*)
 Sears, Ogle Hesse. Soil (*in part*)
 Sears, Paul Bigelow. Plants and Plant Science (*in part*)
 Seaver, Fred Jay. Fungi (*in part*)
 Seecombe, Thomas. English Literature (*in part*); Gilbert, Sir William Schwenk; Lever, Charles James (*in part*); Marlowe, Christopher (*in part*); Tichborne Claimant, The
 Sée, Henri Eugène. Anne (of Brittany)
 Segré, Emilio. Astatine; Technetium
 Seibert, Florence Barbara. Tuberculin
 Seignobos, Charles. Europe (*in part*); Reform Movement (*in part*)
 Seitz, Frederick. Solid State, Theory of
 Seligman, Charles Gabriel, M.D. Africa (*in part*); Anthropology, Applied; Arabs; Azande, The; Barabra; Bari-Speaking Tribes; Beja (*in part*); Loatuko (*in part*); Nilotes; Nuba, The
 Seligman, Richard. Aluminum Bronze; Duralumin
 Seller, William Young. Juvenal (Decimus Iunius Iuvenalis) (*in part*); Latin Literature (*in part*); Lucilius, Gaius (*in part*); Virgil (*in part*)
 Sells, Dorothy M. Trade Board (*in part*)
 Selwood, Pierce Wilson. Magnetochemistry
 Seth-Smith, David. Aviary and Aviculture (*in part*)
 Seton-Watson, (George) Hugh Nicholas. Yugoslavia (*in part*)
 Seton-Watson, Robert William. Alexander I; Bosnia and Hercegovina; Croatia-Slavonia; Dalmatia (*in part*); Montenegro (*in part*); Peter I; Serbia (*in part*)
 Seton-Williams, M. V. Arabia (*in part*)
 Setzler, Frank Maryl. North America (*in part*)
 Severs, J. W. Chicago, Milwaukee, St. Paul and Pacific Railroad Company
 Seward, Ralph P. Bleaching Powder; Halogens; Hydrochloric Acid and Hydrogen Chloride; Iodine
 Seymour, Charles. Coolidge, Calvin; Harding, Warren Gamaliel; House, Edward Mandell; Lodge, Henry Cabot; Washington Conference; Wilson, Thomas Woodrow
 Shadwell, Arthur, M.D. Plague (*in part*); Prostitution; Temperance (*in part*)
 Shaffer, Laurance F. Adjustment (*in Psychology*)
 Shahan, Maurice Sommer. Cattle (*in part*); Pig (*in part*); Sheep (*in part*)
 Shakespeare, W. Singing
 Shambaugh, George E., Jr., M.D. Ear, Nose and Throat, Diseases of the
 Shand, Alexander Faulkner. Character
 Shands, Hazel Lee. Oats (*in part*); Rye
 Shantz, Homer LeRoy. Physical Natural Resources (*in part*)
 Sharp, Aaron J. Bryophyta (*in part*)
 Sharp, Robert Philip. Snow Line
 Sharp, William. Thoreau, Henry David (*in part*)
 Shattock, Rev. E. A. Morality, Primitive
 Shaughnessy, Howard John. Immunity (*in part*)
 Shaw, Alan George Lewers. Australia (*in part*)
 Shaw, C. Deaf and Dumb, Education and Welfare of The (*in part*)
 Shaw, Geoffrey William. Poland (*in part*); Rumania (*in part*)
 Shaw, George Bernard. Socialism: Principles and Outlook
 Shaw, Herman. Gravitation (*in part*)
 Shaw, James C. Naval Strategy and Tactics; Staff, Naval (*in part*)
 Shaw, Wilfred Byron. Michigan, University of (*in part*)
 Shearman, Hugh. Belfast; Ireland, Northern
 Shearman, Thomas Gaskell. George, Henry
 Shebbeare, Rev. Charles John, D.D. Atheism; Pantheism (*in part*); Trinity
 Shee, Sir George F. Life-Boat and Life Saving (*in part*)
 Shekarian, Brigadier General Haig. Chemical Warfare (*in part*)
 Shelley, A. N. C. Government Departments (*in part*)
 Shepardson, Francis Wayland. Fraternities, College
 Shepherd, Edwin Colston. World War II (*in part*)
 Sheppard, Captain E. W. Crimean War (*in part*); Frontier, Battles of The (*in part*)
 Sheppard, Samuel Edward. Photochemistry
 Sheppard, William Fleetwood. Interpolation; Probability and Error
 Sheringham, Hugh Tempest. Angling (*in part*)
 Sherman, Mary S., M.D. Bone, Diseases and Injuries of
 Sherman, Orrin G. Bonus, Employee (*in part*); Employee Representation (*in part*); Employee Stock Ownership (*in part*)
 Sherrill, M. H. Sugar (*in part*)
 Sherrington, Charles Ely Rose. Baghdad Railway; Channel Ferry; Railways (*in part*)
 Sherrington, Sir Charles Scott, M.D. Brain (*in part*); Spinal Cord (*in part*); Sympathetic System
 Sherwell, Arthur. Disinterested Management; "Gothenburg" Licensing System (*in part*); Licensed Victualler
 Sherwood, Frederick William. Blackstone, Sir William
 Shetelig, Haakon. Norway (*in part*)
 Shidle, Norman G. Motor Car (*in part*)
 Shields, Robert Hale. California (*in part*)
 Shklovsky, I. W. Andreyev, Leonid Nicolai-evich
 Shoe, Lucy Taxis. Astragal
 Shotwell, James T. Boniface, Saint; Golden Rose (*in part*); History; Louis IX (*in part*)
 Shoup, Carl. Excess Profits Tax (*in part*)
 Showalter, Albert Kenneth. Rainfall
 Showerman, Grant. Attis or Atys; Syncretism
 Shreve, R. Norris. Chemical Engineering
 Shull, A. Franklin. Parthenogenesis; Photo-periodism (*in part*)
 Shultz, Birl E. Bond (in Finance)
 Shute, David T. Fire Escapes (*in part*)
 Shibre, Rev. James, D.D. Madagascar (*in part*)
 Sidebotham, Herbert. Fisher, John Arbuthnot Fisher, 1st Baron (*in part*)
 Sidgwick, Arthur. Aeschylus
 Sidgwick, Henry. Ethics, History of (*in part*)
 Sidgwick, Nevil Vincent. Valence (*in part*)
 Siebel, Frederick Peter, Jr. Beer; Brewing
 Siebert, William Henry. Hardware (*in part*)
 Siegbahn, Karl Manne Georg. Spectroscopy, X-Ray (*in part*)
 Sikes, Edward Ernest. Hera (*in part*)
 Silberschmidt, Max. Zürich (*in part*)
 Silberstein, Ludwig. Tensor Analysis (*in part*)
 Silburn, Judith Ann. Fats in Cookery; Fruit Cookery; Gravies; Meat Cookery
 Sillar, Frederick C. War Graves (*in part*)
 Silcox, Lewis Ketcham. Locomotive (*in part*)
 Sillery, Anthony. Bechuanaland
 Sills, Kenneth Charles Morton. Maine (*in part*)
 Sime, J. Frederick II (*in part*)
 Simmons, E. C. Dollar
 Simmons, George Finlay. Albatross; Allen, Glover Morrill; Auks; Babbler; Barbet; Birds of Paradise; Bittern; Blackbird; Blackbird, Red-Winged; Blackcap; Blackcock; Bobwhite; Bowerbird; Brain-Fever Bird; Brambling; Budgetiger; Bufflehead; Bulbul; Bustard; Buzzard; Canary; Canvasback; Capercaille; Cassowary; Chaffinch; Chapman, Frank Michler; Chickadee; Coly; Crane; Dodo; Drongo; Eagle; Eider; Emu or Emeu; Falcon; Finfoot; Flamingo; Flicker; Flower-Pecker; Flycatcher; Francolin; Frigate Bird; Frogmouth; Fulmar; Gadwall; Gallinule; Gannet; Garefowl; Garganey; Gnatcatcher;

- Godwit; Goldcrest or Golden Crested; Golden-Eye; Goldfinch; Grackle; Grebe; Greenfinch or Green Linnet; Grouse; Guinea Fowl; Gull; Hammerkop or Hammerhead; Harpy; Harrier; Hawk; Heath Hen; Hedge Sparrow; Hemipode; Heron; Honey Eater; Honey Guide; Hoopoe; Hornbill; Horned Owl; House Sparrow; Hummingbird; Jacamar; Jacana; Jaeger; Jay; Junco; Kea; Kestrel; Killdeer; Kingbird; Knot; Lammergeyer; Limpkin; Linnet; Loon; Lory; Macaw; Merganser; Merlin; Monal, Monaul; Motmot; Spoonbill; Vulture; Woodcock
 Simmons, John F. Precedence (*in part*)
 Simon, André L. Bordeaux Wines; Graves, Wines of; Madeira Wines; Médoc Wines
 Simon, F. Rathenau, Walther
 Simon, Jocelyn Edward Salis. Divorce (*in part*)
 Simon, Marcel. Alsace-Lorraine (*in part*)
 Simons, Harry. Clothing Manufacture (*in part*); Worsted Manufacture
 Simonson, Lee. Stage Design (*in part*)
 Simpson, Rev. Canon David Capell, D.D. Achiachorus; Proverbs, Book of; Wisdom, Book of
 Simpson, George Gaylord. Amblypoda; Anypoda or Chalicotherioida; Anthracotherium; Arsinotherium; Dinotherium; Dryopithecus; Eohippus; Ganodonta or Taeniodonta; Hipparion; Hyracoida; Litopterna; Mastodon; Multituberculata; Oreadont; Sivatherium; Tillodontia; Titanothera; Toxodontia
 Simpson, J. J. Museums of Science (*in part*)
 Simpson, Percy. Shakespeare, William (*in part*)
 Sinclair, Frazier V. Cosmetics (*in part*)
 Sinclair, J. H. Ecuador (*in part*)
 Singer, Charles, M.D. Bacon, Francis (*in part*); Biology (*in part*); Constantine The African; Harvey, William (*in part*); Hippocrates and the Hippocratic Collection; Medicine, History of; Salerno (*in part*)
 Sirén, Osvald. Chinese Architecture; Chinese Sculpture
 Skeat, Walter William. Layamon (*in part*)
 Skidmore, Louis. Exhibition Architecture
 Skinner, Otis. Make-Up
 Skoumal, Aloys. Drama (*in part*)
 Slawson, Chester Baker. Gem
 Slessor, Sir Henry. Arbitration (*in part*); Privy Council, Judicial Committee of
 Sloan, Alfred Pritchard, Jr. General Motors Corporation
 Sloan, Matthew Scott. Electricity Supply; Commercial Aspects (*in part*)
 Sloane, William Milligan. Bancroft, George
 Sloman, H. A. Beryllium or Glucinum (*in part*)
 Slonimski, Antoni. Drama (*in part*)
 Slonimsky, Nicolas. Auric, Georges; Festivals, Music
 Slosson, Edwin Emery. Edison, Thomas Alva
 Small, Raymond Charles. Adhemar de Monteil; Baldwin I (Emperor of Romania); Baldwin I (Count of Edessa) (*in part*); Baldwin II (Count of Edessa) (*in part*); Baldwin IV; Crusades (*in part*); Cyprus (*in part*); Fulk (King of Jerusalem) (*in part*); Raymond; Raymond III; Robert Guiscard (*in part*); St. John of Jerusalem, Knights of the Order of the Hospital of (*in part*)
 Small, Lyndon Frederick. Beberine; Berberine; Cinchona Bark, Alkaloids of (*in part*); Narcine; Narcotine; Pilocarpine; Tropine
 Smart, William Marshall. Orbit
 Smirnov, Alexander. Italian Wars; Russo-Turkish Wars
 Smith, A. Lorrain. Lichens (*in part*)
 Smith, A. Tate. Stock Exchange or Bourse (*in part*)
 Smith, Alfred Emanuel. New York (State) (*in part*)
 Smith, Arthur Hamilton. Ring (*in part*)
 Smith, Austin E., M.D. Sulfonal Group, The
 Smith, Rev. B. T. D. Matthew, St.; Matthew, Gospel of St.
 Smith, Bernard. Permian; Triassic System or

- Trias
 Smith, Bruce. Police
 Smith, Cecil M. Musical Comedy
 Smith, Clifford P., C.S.B. Christian Science (*in part*); Eddy, Mary Baker
 Smith, David Clyde. Mangel
 Smith, David Eugene. Abacus; Algebra; Finger Numerals; Fraction; Gnomon; Numerals
 Smith, Denis Mack. Italy (*in part*)
 Smith, Captain Eben E., M.D. Medical Service, Navy
 Smith, Ernest Ellsworth, M.D. Medical Jurisprudence (*in part*)
 Smith, F. D. Saccharin
 Smith, G. E. Chess (*in part*)
 Smith, George Gregory. Ballad (*in part*); Barbour, John; Douglas, Gavin; Lyndsay, Sir David; Scottish Literature (*in part*)
 Smith, Gilbert Morgan. Algae; Bacillariophyceae or Diatoms; Kelp
 Smith, Harry S. Insect (*in part*)
 Smith, Hermon Dunlap. Dearborn, Henry
 Smith, Homer W. Excretion (Kidney)
 Smith, H. Grayson. Liquefaction of Gases (*in part*)
 Smith, J. D. Main. Chromium (*in part*)
 Smith, James Cruickshank. Spenser, Edmund
 Smith, James Kellum. American Academy in Rome, The
 Smith, John Alexander. Croce, Benedetto
 Smith, Rev. John Frederick. Schleiermacher, Friedrich Daniel Ernst (*in part*)
 Smith, John Merlin Powis. Ecclesiastes (*in part*)
 Smith, Leo F. Polytechnic (*in part*)
 Smith, Lybrand P. Gunnery, Naval (*in part*)
 Smith, May. Industrial Psychology
 Smith, Preserved. Renaissance (*in part*)
 Smith, Ralph C. Museum Architecture (*in part*)
 Smith, Raymond Stratton. Soil (*in part*)
 Smith, Reginald Allender. Archaeology (*in part*)
 Smith, Robert Ross. World War II (*in part*)
 Smith, Robert Sidney. Spain (*in part*)
 Smith, Sidney. Babylonia and Assyria (*in part*); Calendar (*in part*); Chronology (*in part*)
 Smith, Sydney Bernard. Aviation, Civil (*in part*)
 Smith, Thomas E. Optics
 Smith, William A. Printing (*in part*)
 Smith, William Benjamin. Cone; Conic Section; Co-Ordinates (*in part*); Cylinder (*in part*)
 Smith, William Owen Lester. Infant Schools; Parent Education (*in part*); School and Curriculum (*in part*); Summer Schools (*in part*)
 Smith, William Robertson. Baal (*in part*); Chronicles, Books of (*in part*); David (*in part*); Decalogue (*in part*); Haggai (*in part*); Judges, The Book of (*in part*); Moloch (*in part*); Nabataeans (*in part*); Nazirite or Nazirite; Sabbath (*in part*)
 Smith, William Roy. Compromise Measure of 1850; Missouri Compromise; Polk, James Knox
 Smith-Rose, Reginald Leslie. Popov, Aleksandr Stefanovich
 Smogorzewski, Kazimierz Maciej. Czechoslovakia (*in part*); Germany (*in part*); Poland (*in part*); Russia (*in part*); Switzerland (*in part*); World War II (*in part*); Yugoslavia (*in part*)
 Smoot, Reed. Mormonism; Latter-Day Saints, Church of Jesus Christ of (*in part*); Mormons or Latter-Day Saints (*in part*)
 Smuts, Field Marshal Rt. Hon. Jan Christiaan. Holism
 Smythe, A. R., F.R.C.V.S. Swine Fever
 Smythe, Richard Haviland. Shop Front Design (*in part*)
 Snedden, David. Continuation Schools (*in part*)
 Snow, Chauncey Depew. International Chamber of Commerce
 Snow, Henry Martin. Wagons-Lits, Compagnie Internationale Des
 Snyder, John W. Government Departments (*in part*)
 Snyder, Morton. Progressive Education Movement, The
 Snyder, Virgil. Line Geometry
 Snyman, Jacobus Petrus Lodewicus. South African Literature (*in part*)
 Sokolnikoff, Ivan Stephen. Vector Analysis (*in part*)
 Soles, Elmer M., O.D. Optometry
 Sollenberger, Judith Katrina. Easter; Independence Day; Thanksgiving Day
 Sollenberger, Paul. Chronographs (*in part*)
 Somervell, David Churchill. Edward VIII (*in part*); Victoria
 Sommerich, Otto C. Arbitration (*in part*)
 Sonneck, O. G. Foster, Stephen Collins
 Sorley, William Ritchie. Leibnitz or Leibniz, Gottfried Wilhelm (*in part*)
 Sorokin, Pitirim Alexandrovitch. Aristocracy
 Southwell, Sir Richard Vynne. Materials, Strength of; Mechanics
 Sowerwine, Elbert Orla. Anaconda Copper Mining Company
 Spaeth, John Duncan (Ernst). Rowing (*in part*)
 Spahr, Walter Earl. Stockbroker (*in part*)
 Spaight, James M. Aerial Law (*in part*)
 Sparrow, John. Forster, Edward Morgan; Housman, Alfred Edward
 Spate, Oskar Hermann Kristian. Australia (*in part*)
 Speare, M. Edmund. Coal and Coal Mining (*in part*)
 Speciael, Henri. Société Internationale D'Énergie Hydro-Électrique
 Spector, Sidney. Chief Justice; Court (*in part*)
 Spedding, Frank Harold. Cerium; Dysprosium; Gadolinium; Lutetium; Praseodymium; Promethium; Rare Earths
 Spence, Howard. Alum (*in part*)
 Spencer, Damon Alvin. Sheep (*in part*)
 Spencer, Domina Eberle. Photometry (*in part*)
 Spencer, Leonard James. Abrasives; Apatite; Apophyllite; Barytes; Biotite; Boracite; Bornite; Bournonite; Brochantite; Brookite; Brucite; Calcite; Chabazite; Chalcopyrite or Copper-Pyrites (*in part*); Chlorite; Covellite; Crocoite; Crystallography; Cuprite; Dolomite; Epidote; Galena; Goniometer (*in part*); Graphite (*in part*); Hyacinth or Jacinth; Lapis Lazuli; Leucite; Mica (*in part*); Mineralogy (*in part*); Olivine; Parisite; Pollux or Pollucite; Quartz (*in part*); Realgar; Rutile; Sodalite; Staurolite (*in part*); Stibnite; Sylvite; Tetradyomite; Tetrahedrite; Thorite; Topaz; Tourmaline; Witherite; Wollastonite; Zeolites
 Spender, E. Harold. Lloyd George, David (*in part*)
 Spender, J. Alfred. English History (*in part*)
 Sperry, Elmer A. Beacon (*in part*); Gyrocompass or Gyroscopic Compass (*in part*); Gyroscope (*in part*)
 Spiegelman, Mortimer. Birth Rate (*in part*); Death Rate (*in part*)
 Spielman, John Philip. Copper (*in part*)
 Spielmann, Marion Harry (Alexander). Gilbert, Sir Alfred; Pastel (*in part*); Repoussé; Roubillac (Roubillac), Louis François; Shakespeare, William (*in part*)
 Spinka, Matthew. Congregationalism (*in part*); Orthodox Eastern Church
 Spore, John B. Tactics (*in part*)
 Sprague, Charles A. Oregon
 Sprague, Frank Julian. Electric Traction (*in part*)
 Sprargen, William. Welding
 Spratt, Hereward Philip. Ship (*in part*)
 Spreng, Samuel Peter, D.D. Evangelical Church (*in part*)
 Springer, Burdell L. Aeronautics; Aeroplane (*in part*); Helicopter
 Springer, George T. Birling
 Springmeyer, J. E. Nevada (*in part*)
 Sproul, Robert Gordon. California, University of
 Sprout, Harold. Atlantic, Command of The (*in part*)
 Sprout, Margaret (Tuttle). Atlantic, Command of The (*in part*)
 Spry, William. Homestead and Exemption Laws
 Squire, William Barclay. Byrd, William
 Stabell, Peter Platou. Arbitration (*in part*)
 Stacey, Alfred E., Jr. Air Conditioning (*in part*)
 Stacey, Colonel Charles Perry. Fenians
 Stack, James Keane, M.D. Sepsis; Wound
 Stainback, I. M. Hawaii (*in part*); Honolulu (*in part*)
 Stamm, John Samuel, D.D. Evangelical Church (*in part*)
 Stamp, Josiah Charles Stamp, 1st Baron. Building Societies (*in part*); Capital Levy (*in part*); Income: Economic Definition; Inheritance: Economic Aspects
 Stamp, Laurence Dudley. Arakan; Bharno (*in part*); Flysch; Irrawaddy; Miocene; Rural Depopulation (*in part*); Tertiary
 Stancioff, Anna. Ferdinand, Maximilian Karl Leopold Maria
 Staniar, William. Belting For Power Transmission (*in part*); Power Transmission (*in part*)
 Stanislavsky, Constantine. Theatre (*in part*)
 Staples, S. F. Docks (*in part*)
 Starch, Daniel. Advertising (*in part*)
 Starrett, Vincent. Mystery Stories
 Starrett, William Aiken. Structural Engineering (*in part*)
 Stauffer, Russell Scott. Soil (*in part*)
 Stebbing, L. Susan. Logistic
 Stebbins, Percy. Life Insurance (*in part*)
 Stebbins, Joel. Photometry (*in part*)
 Stecher, Paul George. Xylene
 Stechow, Wolfgang. Both, Jan; Crayer, Gaspar de
 Steed, Henry Wickham. Fabrizio, Nicola
 Steele, Roy W. Indianapolis (*in part*)
 Stefansson, Vilhjalmur. Arctic Regions (*in part*); Eskimos
 Stein, C. D., V.M.D. Anthrax
 Stein, Leonard. Zionism (*in part*)
 Steinman, David Barnard. Bridges (*in part*); Carquinez Strait Bridge; Florianópolis Suspension Bridge
 Stenger, Vernon Arthur. Bromine
 Stenning, John Frederick. Bible (*in part*); Exodus, Book of; Leviticus; Targum
 Stenton, Doris Mary. Frankpledge; Justiciar; Magna Carta; Pipe Rolls; Purveyance; Tallage
 Stenton, Sir Frank Merry. Danelagh (*in part*); Dark Ages; Egypt (*in part*); English History (*in part*); Hide; Mark System; Normans (*in part*); Poland (*in part*); Witan or Witenagemot
 Stephen, Sir Leslie. Browning, Robert; Carlyle, Thomas (*in part*)
 Stephens, Henry Morse. Mazarin, Jules (*in part*); Mirabeau, Honoré Gabriel Riqueti (*in part*)
 Stephenson, Nathaniel W., Lincoln, Abraham
 Stephenson, R. J. Physical Units (*in part*)
 Stephenson, Thomas Alan. Anthozoa; Coelenterata; Ctenophora; Graptolites; Hydrozoa; Scyphozoa
 Stern, Ben M. Aviation, Civil (*in part*)
 Stern, Kurt G. Protoplasm (*in part*)
 Stevens, Ashton. Banjo
 Stevens, Courtney Edward. Germany (*in part*)
 Stevens, Wayne Edson. New Hampshire (*in part*)
 Stevenson, Adlai E. Illinois (*in part*)
 Stevenson, E. Nursery Schools (*in part*)
 Stevenson, Frederick J. Potato (*in part*)
 Stevenson, George, M.D. Psychiatry (*in part*)
 Stevenson, Robert Louis. Béranger, Pierre Jean de (*in part*)
 Steward, F. C. Inulin
 Steward, Julian H. South America (*in part*)
 Stewart, C. L. Allotments (*in part*); Agricultural Economics (*in part*); Agricultural Insurance; Farm Valuations; Land Tenure (*in part*)

- (part)*
 Steyermark, Julian A. Argentina (*in part*);
 Chile (*in part*); Peru (*in part*)
 Stibitz, George Robert. Mathematical Instru-
 ments
 Stieglitz, Edward J., M.D. Gerontology and
 Geriatrics
 Still, Sir George Frederic, M.D. Children's Diet
 Stillman, Paul Roscoe, D.D.S. Pyorrhoecia (*in*
part)
 Stimson, Henry Lewis. London Naval Con-
 ference, 1930, The (*in part*)
 Stine, Oscar Clemens. Agricultural Statistics
 (*in part*); Wheat (*in part*)
 Stoddart, Alexander. Poster (*in part*)
 Stoessel, Albert. Choral Singing (*in part*)
 Stokes, Charles Anderson. Carbon Black
 Stone, Doris Zemurray. Lenca
 Stone, Eric. Becket, Thomas (à); Bayeux Tap-
 istry, The (*in part*)
 Stone, Herbert Lawrence. Bermuda Rig; House
 Boat; Yacht; Yachting (*in part*)
 Stone, Robert Granville. Aerology, Aerologist;
 Air Mass; Drizzle; Fog; Haze; Horse Lat-
 itudes; Indian Summer; Mist; Rime; Shaw,
 Sir Napier; Sleet; Soft Hail; Synoptic
 Charts; Tornado
 Storch, Henry H. Hydrogenation
 Stormont, Major W. Lloyd. Triestin Line (*in*
part); Sitar Line
 Storr, Francis. Duel (*in part*); Games, Clas-
 sical
 Story, Isabelle E. National Park System (*in*
part)
 Stott, Verney. Density; Hydrometers (*in part*)
 Stout, George Leslie. Paintings, Conserva-
 tion of
 Strachey, Ray (Mrs. Oliver Strachey). Wom-
 en's Suffrage (*in part*)
 Strahan, James Andrew. Bill of Sale (*in part*);
 Equity; Executors and Administrators (*in*
part); Foreclosure (*in part*); Intestacy (*in*
part); Will or Testament (*in part*)
 Stranathan, James Docking. Gamma Rays;
 Radiation Rays (*in part*)
 Strange, Lieutenant Colonel Edward Fair-
 brother. Della Quercia or Della Fonte Jaco-
 po; Enamel (*in part*); Hirschige; Hokusai
 Katsushuka; Korin; Ogata; Kyōsai, Sho-Fu;
 Lacquer (*in part*); Utamaro
 Strangways, A. H. Fox. Indian Music
 Stratton, Samuel Wesley. Massachusetts In-
 stitute of Technology, The
 Straus, H. L. Totalizer
 Strawn, Silas H. American Bar Association
 Streat, Sir Edward Raymond. Cotton Board,
 British
 Strehlow, Theodor George H. Australian
 Languages
 Strickland, Gerald, 1st Baron Strickland.
 Malta (*in part*)
 Stripe, Carl. Steam Generation (*in part*)
 Stromberg, Austin. Motor Transport, Com-
 mercial (*in part*)
 Stromberg, Edward Helmer. Northwestern
 University
 Strong, Donald Stuart. Poll Tax (*in part*)
 Strong, Eugene. Roman Art (*in part*)
 Struve, Otto. Spectroscopy, Astronomical
 Stuart, H. C. Importing: In Practice (*in*
part)
 Stuart-Jones, Sir Henry. Caesar, Gaius Julius;
 Constantine; Roman Art (*in part*); Rome
 (*in part*)
 Stulman, Normand. Range Finders (*in part*)
 Sturt, Henry. Condillac, Étienne Bonnot de;
 Metempsychosis (*in part*); Nominalism
 Subotic, Dragutin. Serbo-Croat Language and
 Literature (*in part*)
 Sullivan, Harris Martin. Vacuum (*in part*)
 Sumner, Francis B. Colours of Animals (*in*
part)
 Sutcliffe, Ronald. Brandy (*in part*); Potato
 Spirit (*in part*); Spirits
 Sutherland, Charles Humphrey Vivian. Spain
 (*in part*)
 Sutherland, Lucy Stuart. English History (*in*
part)
 Sverdrup, Harald Ulrik. Atlantic Ocean (*in*
part); Atlantic, Command of the (*in part*);
 Indian Ocean (*in part*); Ocean and Ocean-
 ography (*in part*); Pacific Ocean (*in part*);
 Southern Ocean
 Swann, William Francis Gray. Photography,
 Celestial (*in part*)
 Swanson, Ernst W. Cassel, Gustav
 Swaythling, Samuel Montagu, 1st Baron.
 Arbitrage (*in part*)
 Sweeney, John F., S.J. Atonement
 Sweet, Frederick A. Art Sales
 Sweet, Henry. Grimm, Jacob Ludwig Carl (*in*
part)
 Sweet, William Warren, D.D. Methodism;
 Revival, Religious
 Swift, Ernest Haywood. Chemistry (*in part*)
 Swift, Gustavus Franklin. Swift & Company
 Swinburne, Algernon Charles. Beaumont and
 Fletcher (*in part*); Marlowe, Christopher (*in*
part); Mary Queen of Scots (*in part*)
 Swire, Joseph. Albania (*in part*); Machado,
 Bernardino (*in part*); Makonnen, Ras Tafari;
 William (Prince of Wied); Zog I
 Sykes, Brigadier General Sir Percy Moles-
 worth. Baluchistan (*in part*); Persia (*in part*);
 Persia, Campaigns in
 Sykes, William Stanley, M.D. Acetylene in
 Medicine
 Symington, W. Stuart. Government Depart-
 ments (*in part*)
 Symonds, John Addington. Machiavelli, Nic-
 colo; Petrarch (*in part*); Poggio (*in part*);
 Politian (*in part*); Renaissance, The (*in*
part); Tasso, Torquato (*in part*)
 Symons, Arthur. Goncourt, de (*in part*); Le-
 conte de Lisle, Charles Marie René; Mal-
 larmé, Stéphane; Verlaine, Paul; Villiers de
 L'Isle-Adam, Philippe Auguste Mathias,
 Comte de
 Szilagy, L. F. Siemens (*in part*)
 Tabor, Milton. Kansas (*in part*)
 Tabor, Richard John. Fungi (*in part*)
 Taft, Lorado. Saint-Gaudens, Augustus
 Taft, Philip. Strikes and Lockouts (*in part*)
 Tait, Peter Guthrie. Maxwell, James Clerk
 Tait, Thomas Smith. Russian Architecture (*in*
part)
 Talbot, Francis Xavier, S.J. Jesus, Society of
 Taliaferro, William H. Parasitology
 Tallents, Sir Stephen George. Empire Market-
 ing Board (*in part*)
 Tamagna, Frank M. Japan, Bank of; Yen
 Tanner, Fred Wilbur. Yeast
 Tanner, Joseph Robson. Peppys, Samuel (*in*
part)
 Tansill, Charles Callan. Albany Congress; An-
 napolis Convention
 Tapp, Harry R. Oil Heating, Domestic
 Tarshish, Lorie. Factors of Production
 Tate, Francis G. H. Brandy (*in part*); Gin (*in*
part); Potato Spirit (*in part*); Poteen;
 Whisky or Whiskey (*in part*)
 Tattersall, Creassey Edward Cecil. Rugs and
 Carpets (*in part*)
 Taube, Henry. Antimony; Arsenic; Bismuth;
 Hydrogen Peroxide
 Taunton, Ethelred. Cullen, Paul; Fisher, John
 Taussig, Frank William. Tariffs (*in part*)
 Taylor, Alan John Percivale. Austria (*in part*);
 Austria, Empire of (*in part*); Bethlen, Ste-
 phen (István), Count; Bismarck, Otto;
 Germany (*in part*)
 Taylor, Alfred Edward. Plato; Socrates
 Taylor, Alonzo Englebert, M.D. Food Supply
 of the World (*in part*)
 Taylor, Alrtheus Ambush. Fisk University (*in*
part)
 Taylor, Anne Dewees (Mrs. Henry C. Taylor).
 Agronomy; Espalier
 Taylor, Charles Carlisle. Mahan, Alfred Thayer
 Taylor, Claude. British Industries Fair (*in*
part)
 Taylor, Donald F. Columbian (*in part*)
 Taylor, Galen M. Sights
 Taylor, Griffith. Alberta (*in part*); Australia
 (*in part*); British Columbia (*in part*);
 Canada (*in part*); Labrador (*in part*);
 Manitoba (*in part*); New Brunswick (*in*
part); Newfoundland (*in part*); New South
 Wales (*in part*); Northwest Territories (*in*
part); Quebec (province) (*in part*)
 Taylor, Harold Victor. Fruit Farming (*in part*)
 Taylor, Lloyd William. Telephone (*in part*)
 Taylor, Norman. Azalea; Chrysanthemum (*in*
part); Cinchona; Cyclamen; Iris; Lilac or
 Pipe Tree; Magnolia; Orchids (*in part*);
 Pansy; Passion-Flower (*in part*); Poppy (*in*
part); Rhododendron (*in part*); Rose (*in*
part); Saxifrage
 Taylor, R. Pressure Chemistry
 Taylor, Richard. Cartoon (*in part*)
 Taylor, Thomas Weston Johns. Azo Com-
 pounds; Benzidine (*in part*); Fulminic Acid;
 Guanidine; Hydrozoic Acid; Oximes; Py-
 ridine; Quinoline
 Tead, Ordway. Leadership
 Telford, Rev. John Wesley (family); Wesley,
 John
 Teller, Edward. Nucleus (*in part*)
 Templeman, Geoffrey. English History (*in*
part)
 Templer, Lieutenant G. G. Ordnance (*in part*)
 Tennant, Frederick Robert, D.D. Agnosticism;
 Deism; Faith; Sin; Theology
 Tenney, Robert I. Malt (*in part*)
 Tennyson, Sir Charles Bruce Locker. Dump-
 ing
 Tether, C. Gordon. Gulden
 Tetlow, Henry. Cosmetics (*in part*)
 Thacker, Carlisle Monroe. Carbon Disulphide
 Thalbitzer, William. Eskimo Language
 Thatcher, Edward. Carving Tools
 Thatcher, Rev. Griffiths Wheeler, B.D. Abul-
 faraj; Arabia (*in part*); Arabian Philosophy
 (*in part*); Ash 'Ari; Hassān ibn Thābit;
 Hishām ibn al-Kalbī (*in part*); Ibn Farādī;
 Ibn Fārid; Jāhiz; Jurjānī; Nābigha Dhuby-
 ānī; Waqidi; Ya'qūbi; Zuhair
 Thaysen, A. C. Bacteriology in Industry
 Theisen, Earl. Motion Pictures (*in part*)
 Thibaudet, Albert. Bainville, Jacques; Barres,
 Maurice; Bergson, Henri
 Thiel, George Alfred. Marl
 Thirsk, Irene Joan. Corn Laws (*in part*)
 Thomas, Charles Lamar. Catalysis (*in part*)
 Thomas, Edward J. Abidhamma; Ananda;
 Barlaam and Josaphat; Buddha and Bud-
 dhism; Jataka; Lalamsin; Lumbini; Mahā-
 yana; Maiteyya; Pahlavi (*in part*); Zend-
 Avesta (*in part*)
 Thomas, Elbert Duncan. Utah (*in part*)
 Thomas, Frederick William. Indian Litera-
 ture
 Thomas, Henry. Bookbinding (*in part*)
 Thomas, Northcote Whitbridge. Automatism;
 Faith Healing
 Thomas, Prentice M. Cotton and the Cotton
 Industry (*in part*)
 Thomas, Robert S. Insignia, Military
 Thomas, W. Cave. Encaustic Painting
 Thomas, William. Adsorption
 Thompson, A. Hamilton. Chapel; Church (*in*
part)
 Thompson, Carl Dean. Municipal Trading (*in*
part)
 Thompson, Sir D'Arcy Wentworth. Fur-Seals
 Thompson, Sir Edward Maunde. Autographs;
 Diplomatic (*in part*); Papyrus; Parchment
 Thompson, Huston. Federal Trade Commis-
 sion, The
 Thompson, James Matthew. France (*in part*)
 Thompson, John Spencer. Life Insurance (*in*
part)
 Thompson, Reuben R. Cigar
 Thompson, Silvanus Phillips, M.D. Compass
 (*in part*)
 Thompson, Virginia. Indo-China, French (*in*
part); Malay States (*in part*); Siam (*in*
part)
 Thompson, Wallace. Blaine, James Gillespie;
 Bolivar, Simon; Caribbean Sea; Colón (*in*
part); Flores (*in part*); Fonseca Bay, or Gulf
 of; Guatemala, Nueva Guatemala or New
 Guatemala (*in part*); Havana (*in part*);

- León (*in part*); Miskito Coast (*in part*); Panamá (capital) (*in part*)
 Thomson, Sir Basil (Home). Crime; Frauds (*in part*)
 Thomson, David. Chatham, William Pitt, 1st Earl of; France (*in part*); Pétain, Henri Philippe Benoni Omer Joseph
 Thomson, George Pirie. Censorship (*in part*)
 Thomson, Sir John Arthur. Biology, Economic (*in part*); Birds (*in part*); Education in Animals; Evolutionary Ethics; Locomotion of Animals (*in part*); Naturalization of Plants and Animals; Parasitism; Symbiosis
 Thomson, Sir Joseph (John). Electric Waves
 Thomson, Leonard Monteath. South Africa, Union of (*in part*)
 Thomson, Philip Livingston. Audit Bureau of Circulations
 Thomson, Procter. Excise Tax
 Thomson, T. N. Sanitation of Buildings (*in part*)
 Thorndike, Edward Lee. Intelligence Tests
 Thorne, Wendell E. Capital, Export of
 Thornthwaite, Charles Warren. Drought
 Thornton, John L. Medical and Surgical Societies (*in part*)
 Thorpe, William Homan. Smell and Taste (*in part*)
 Thorson, Alfred T. Life-Boat and Life Saving (*in part*)
 Thuerk, Hugh Campbell. Electrification of Industry (*in part*)
 Thum, Ernest Edgar. High Speed Steel; Iron and Steel; Manganese Steel; Mushet Steel; Nickel-Chromium Steel; Nickel Steel; Presses and Presswork; Stainless Steel; Steels, Alloy; Tool Steel; Tungsten Steel; Vanadium Steel
 Thursfield, Sir James Richard. Parnell, Charles Stewart (*in part*)
 Tibble, John William. Free Verse
 Ties, O. W. Millipede; Myriapoda; Pauropoda
 Tiele, P. A. Plantin, Christophe
 Tigert, John James. Mann, Horace
 Tilden, William Tatem, Jr. Lawn Tennis and Tennis (*in part*)
 Tildesley, Miriam Louise. Dead, Disposal of the (*in part*)
 Till, T. Marston. Brush (*in part*)
 Tilley, Cecil Edgar. Amphibole; Amphibolite; Anorthoclase; Augite; Basalt; Batholith; Borolinite; Charnockite; Cordierite; Dumortierite; Eclogite; Enstatite; Epidiorite; Felspar or Feldspar; Garnet; Gneiss; Granite; Hornfels; Jolite; Kyanite; Labradorite (*in part*); Leucite Rocks; Metamorphism; Metasomatism; Mica-Schist; Microcline; Monzonite; Moonstone; Mullite; Napoleonite; New Zealand (*in part*); Orthoclase; Otterite; Petrology; Picrite; Plagioclase; Prehnite; Pyroxene; Scapolite (*in part*); Schorl; Serpentine; Sillimanite; Spilite; Spinel; Syenite; Tachylite or Tachylite; Tektite; Theralite; Tremolite; Variolite; Zoisite
 Tillyard, Henry Julius Wetenhall. Byzantine Music
 Timasheff, Nicholas S. Stammer, Rudolph
 Tipping, Avray. Interior Decoration (*in part*)
 Tippe, Oswald. Plants and Plant Science (*in part*)
 Tirtoff-Erté, Romain de. Dress (*in part*)
 Tisdale, Harry Robert. Archil
 Tizard, Sir Henry Thomas. Thermochemistry
 Tobey, James Alner. Bread and Bread Manufacture (*in part*); Flour and Flour Manufacture (*in part*); Food Preservation (*in part*)
 Tobin, Maurice J. Government Departments (*in part*)
 Tod, Marcus Niebuhr. Archidamus; Cleomenes; Demaratus; Leonidas (*in part*); Ly-sander; Pausanias; Pylos (*in part*); Sparta
 Todd, Frederick Porter. Training Corps, Officers' (*in part*); Uniforms (*in part*)
 Todd, John Aiton. Cotton Famine, 1861-1865 (*in part*); Customs Union
 Tolles, Frederick B. Friends, Society of (*in part*)
 Tolnai, V. Hungarian Language
 Tomita, Kojiro. Art (*in part*); Screen (*in part*)
 Tonks, Henry. Pastel (*in part*)
 Topalian, Sarkis. Armenian Literature (*in part*)
 Torrey, Charles Cutler, D.D. Ahasuerus; Daniel (*in part*); Esther (*in part*); Ezra; Ezra, Third Book of; Ezra and Nehemiah, Books of; Nethinim
 Tout, Thomas Frederick. Edward I; Edward II; Edward III; Edward, "The Black Prince"
 Tovey, Sir Donald Francis. Aria; Bach, Johan Sebastian (*in part*); Beethoven, Ludwig Van; Boccherini, Luigi; Bruckner, Anton (*in part*); Cantata; Chamber Music; Cherubini, Maria; Luigi Carlo Zenobia Salvatore; Chorale; Concerto; Contrapuntal Forms; Counterpoint; Couperin, François; Dvořák, Anton (*in part*); Fugue; Gluck, Christoph Willibald; Handel, George Frederick (*in part*); Harmony; Instrumentation; Lasso (Lassus), Orlando; Madrigal; Melody; Mendelssohn-Bartholdy, Jakob Ludwig Felix; Monteverdi or Monteverde, Claudio; Motet; Mozart, Wolfgang Amadeus; Music (*in part*); Opera; Oratorio; Overture; Palestrina, Giovanni Pierluigi da; Programme Music; Rhythm (*in part*); Scherzo; Sonata; Sonata Forms; Suite; Symphonic Poem; Symphony; Variations; Victoria (or Vittoria), Tommaso Ludovico da; Wagner, Wilhelm Richard (*in part*)
 Tovey, Rev. Duncan Crookes. Gray, Thomas (*in part*); Thomson, James (*in part*)
 Tower, James A. Transjordan (*in part*)
 Tower, Walter S. Iron and Steel (*in part*)
 Towner, Horace Mann. Aguadilla (*in part*); Arcibo; Guayama; Manati (*in part*); Mayaguez (*in part*); Ponce (*in part*); Porto Rico or Puerto Rico (*in part*); San Juan (*in part*)
 Townshend, Bailey. Tabulating Machines
 Toy, Crawford Howell. Ecclesiastes (*in part*)
 Toynbee, Arnold Joseph. Mustafa Kemal Atatürk (*in part*)
 Tracey, C. B. Berber
 Transehe, Nicolas A. Tierra Del Fuego
 Trask, Parker Davies. Sapropel; Shale, Oil
 Travers, Morris William. Liquefaction of Gases (*in part*)
 Trend, John Brande. Spanish Language and Literature (*in part*)
 Trent, William Peterfield. Lanier, Sidney
 Trinterud, L. J. Presbyterian; Reformed Churches, The
 Tripp, Sir (Herbert) Alker. Traffic and Traffic Regulation (*in part*)
 Tripp, L. Reed. Minimum Wage (*in part*)
 Tritton, Arthur Stanley. Sabaeans
 Troland, Girard B. Light Railways, Military (*in part*)
 Trotsky, Lev. Lenin, Vladimir Ilyich Ulyanov (*in part*)
 Trotter, Mildred. Skin and Exoskeleton
 Trubetzky, Prince N. S. Caucasian Languages
 Truesdell, Leon E. Census (*in part*); North America (*in part*); Rural Depopulation (*in part*); United States (of America), The (*in part*); Urbanization.
 Truman, Ethel. Flammarion, Nicolas Camille (*in part*); Lorentz, Hendrik Antoon
 Trumbull, Harlan L. Rubber: Production and Manufacture
 Trumpler, Robert Julius. Absorption of Light in Space; Eclipse (*in part*); Star Cluster
 Tryon, R. M. Bracken
 Tseng, Cheng Kwei. Agar
 Tucker, Ray. Democratic Party; Progressive Party, U.S. (*in part*); Truman, Harry S.
 Tuft, Louis, M.D. Asthma; Hay Fever
 Tuke, Dame Margaret Janson. Women, Education of (*in part*)
 Tukey, Harold Bradford. Horticulture
 Tulin, Leon Arthur. Riot (*in part*)
 Tunis, John R. Bowls (*in part*); Lawn Tennis and Tennis (*in part*)
 Tunncliffe, H. E. Hormones
 Tunstall, William Cuthbert Brian. The Ar-mada (*in part*); Chiogga (*in part*); Dutch Wars (*in part*); Grand Alliance, War of The (*in part*); La Hogue, Battle of (*in part*); Navarino, Battle of (*in part*); Quiberon, Campaign and Battle of (*in part*); Seven Years' War (*in part*); Spanish Succession, War Of The (*in part*)
 Turing, Harvey Doria. Angling (*in part*)
 Turner, Cuthbert Hamilton. Bible (*in part*)
 Turner, E. Raymond. Star Chamber
 Turner, Frederick Jackson. United States (of America), The (*in part*)
 Turner, George James. Clarendon, Constitutions of; County; Hundred; North Hampton, Assize of
 Turner, Sir George W. Munitions, Ministry of
 Turner, Howard A. Farm Rents (*in part*)
 Turner, Laurence A. Wood-Carving (*in part*)
 Turner, Ralph Lilley. Pali Language and Literature (*in part*); Romya Language; Sanskrit Language and Literature (*in part*)
 Turville-Petre, Gabriel. Icelandic Literature (*in part*)
 Tuthill, Edward. Kentucky (*in part*)
 Tuttle, Charles H. Insanity in Law (*in part*)
 Tuttle, Worth. Bierce, Ambrose; Dickinson, Emily
 Tweedy, Owen Meredith. Cairo (*in part*)
 Twenhofel, William H. Septaria
 Twentyman, A. E. Education, History of (*in part*); University Colleges
 Twiss, Sir Travers. Sea Laws (*in part*)
 Twitty, Victor Chandler. Vertebrate Embryology (*in part*)
 Twombly, Neil J., S.J. Thomas, St
 Twyman, Frank. Lens
 Tyler, Albert. Parthenogenesis, Artificial
 Tyler, A. Ranger. New York (State) (*in part*)
 Tyler, Royall. Byzantine Art (*in part*)
 Tylor, Sir Edward Burnett. Ordeal (*in part*)
 Tyson, B. A. Fisheries, Law of (*in part*)
 Ukers, William H. Tea
 Underhay, F. G. Patents (*in part*)
 Underhill, Evelyn (Mrs. Stuart Moore). Mysticism (*in part*)
 Underwood, Norman. Carbon Paper
 Untermeyer, Louis. Poetry (*in part*)
 Urban, Joseph. Theatre (*in part*)
 Urban, Wilbur Marshall. Value, Theory of
 Urey, Harold Clayton. Deuterium or Heavy Hydrogen
 Urwick, Lieutenant Colonel Lyndall. Scientific Management (*in part*)
 Osborne, Vice-Admiral Cecil Vivian. World War II (*in part*)
 Vaeth, Joseph Gordon. Airship; Airship Sheds
 Vagts, Alfred. Conscription (*in part*)
 Vallarta, Manuel Sandoval. Gravitation (*in part*)
 Van Alstyne, J. H. Elevators
 Van Auker, Captain Wilbur Rice. Ordnance (*in part*)
 Van Brunt, John. Steam Generation (*in part*)
 Van Buren, Albert William. Italy (*in part*)
 Vance, Lee J. Soda Fountain
 Van Cleave, Harley Jones. Acanthocephala; Kinorhyncha
 Van Cleef, Eugene. Transport (*in part*)
 Vandervelde, Emile. International, The (*in part*)
 Vandewalker, Nina C. Kindergarten (*in part*)
 Vandiver, H. S. Diophantine Equations; Fermat's Last Theorem
 Van Dyke, Henry, D.D. Emerson, Ralph Waldo
 Van Dyke, John Charles. Inness, George
 Van Gelder, H. E. Glass (*in part*); Pottery and Porcelain (*in part*)
 Van Tyne, Claude Halstead. American Revolution, The (*in part*)
 Van Urk, J. Blan. Hunting
 Van Vleck, E. Burr. Conformal Representation
 Van Vleck, J. H. Quantum Mechanics; Uncertainty Principle; Wave Mechanics
 Van Waters, Miriam. Children's Courts or Juvenile Courts (*in part*)
 Van Winkle, Walton, Jr. Adulteration

Vaughan, Herbert Millingchamp. James (James Francis Edward Stuart); Wales (*in part*)
 Veale, Douglas. Oxford University (*in part*)
 Veblen, Oswald. Differential Forms (*in part*); Projection, in Mathematics; Projective Geometry
 Veen, Adriaan van der. Drama (*in part*)
 Vennesland, Birgit. Enzymes
 Vernon-Harcourt, Leveson Francis. River and River Engineering (*in part*)
 Vernon-Harcourt, L. W. Lord High Steward
 Viall, Ethan. Thermit
 Viard, Jules. Jacquerie, The
 Viles, Jonas. Missouri (*in part*)
 Villard, Henry Serrano. Liberia (*in part*)
 Villari, Luigi. Bentivoglio, Giovanni; Borgia, Cesare; Carbonari; Cavour, Camillo Benso; Fanti, Manfredo (*in part*); Florence (*in part*); Frederick III; Italian Front, In the World War, 1914-1918; Mazzini, Giuseppe (*in part*); Naples, Kingdom of (*in part*); Pisa (*in part*); Rimini (*in part*); Savonarola, Girolamo (*in part*); Savoy, House of; Tuscany (*in part*); Victor Emmanuel II; Victor Emmanuel III (*in part*)
 Villari, Pasquale. Florence (*in part*); Medici (*in part*); Pisa (*in part*); Rimini (*in part*); Savonarola, Girolamo (*in part*)
 Vincent, George E. Community Chest (*in part*)
 Vincent, Melvin J. Los Angeles (*in part*)
 Vinogradoff, Sir Paul. Anglo-Saxon Law (*in part*); Folkland; Jurisprudence, Comparative (*in part*); Law of Succession; Manor (*in part*); Serfdom (*in part*); Socage; Village Communities; Villeinage
 Viot, Pierre. Civil Service (*in part*)
 Visser, Hein Cornelis. Arbitration (*in part*)
 Vivian, A. C. Beryllium or Glucinum (*in part*)
 Vivian, Sir Sylvanus (Percival). Campion, Thomas; Census (*in part*)
 Vlekke, Bernard H. M. Indonesia
 Vocadio, Otakar. Czech Language and Literature (*in part*)
 Vogt, Richard Rockhill. Acetylene
 Volkmann, Ernest W. Benzene; Phenol
 Vollmer, August. Investigation, Criminal (*in part*)
 Voronoff, Serge, M.D. Rejuvenation
 Vowles, Hugh P. Briquetting (*in part*)
 Wace, Alan John Bayard. Aegean Civilization (*in part*); Athens (*in part*); Greek Archaeology
 Waddell, Laurence Austine. Lhasa (*in part*)
 Wade, Mrs. E. K. Girl Guides (*in part*)
 Wade-Evans, Rev. Arthur Wade. Welsh Laws or Leges Britanniae
 Waesche, Russell Randolph. Coast Guard (*in part*); Lighthouses (*in part*)
 Wagon, E. Deutsche Bank (*in part*)
 Waite, John Barker. Larceny (*in part*)
 Wakerlin, George Earle. Blood Pressure
 Walch, Jan. Dutch Language and Literature (*in part*)
 Walford, Lionel Albert. Pilchard or Sardine; Tuna
 Walker, Captain A. H. Paravane, The
 Walker, D. L. Federation of British Industries
 Walker, Edmund Murton. Canada (*in part*)
 Walker, Rev. Edward Mewburn. Greece (*in part*); Theopompus; Xenophon
 Walker, Egbert H. Asia (*in part*)
 Walker, Sir Gilbert Thomas. Flight, Natural
 Walker, Harvey. Administrative Commission
 Walker, Hubert. Fire Engines (*in part*)
 Walker, J. Frederic. Formaldehyde
 Walker, J. H. Heating and Ventilation (*in part*)
 Walker, James. Ground Rent (*in part*); Intestacy (*in part*); Sheriff or Shire-Reeve
 Walker, Ralph Thomas. Ornament, Architectural
 Walker, Williston, D.D. Bacon, Leonard; Cotton, John; Hopkins, Samuel
 Wall, Bernard. Pius XII; Sturzo, Luigi
 Wall, Hubert Stanley. Continued Fractions; Infinite Products
 Wallace, David Duncan, Laurens, Henry;

South Carolina (*in part*)
 Wallace, Sir Donald Mackenzie. Alexander II; Shuvalov or Schouvaloff, Peter Andreivich
 Wallace, William. Arabian Philosophy (*in part*); Empedocles (*in part*); Hegelian Philosophy (*in part*); Schopenhauer, Arthur (*in part*)
 Wallace, William Stewart. Canada (*in part*); Quebec (*in part*)
 Wallace-Hadrill, John Michael. Chilperic; Germany (*in part*)
 Wallis, E. J. N. El Obeid; Kordofan
 Walrath, Florence Dahl. Foundling Hospitals (*in part*)
 Walsh, Thomas J. Montana (*in part*)
 Walston, Sir Charles. Argos (*in part*)
 Walters, Henry Beauchamp. Terra-Cotta (*in part*)
 Walton, Sir John Charles. Coolie; Government Departments (*in part*); Jinnah, Mohammed Ali; Pakistan
 Wang, Chi-Wu. Korea (*in part*)
 Warburton, George H. Almond Oil (*in part*); Beeswax (*in part*); Bone, Industrial Uses of (*in part*); Candle (*in part*); Essential Oils (*in part*); Oils, Fats and Waxes (*in part*); Olive Oil (*in part*); Palm Oil (*in part*); Tung Oil (*in part*); Whale Oil (*in part*)
 Ward, Sir Adolphus William. Drama (*in part*); Jonson, Ben (*in part*); Lodge, Thomas
 Ward, James. Herbart, Johann Friedrich (*in part*)
 Ward, John S. Marlow, D.D. Secret Societies (*in part*)
 Ward, Mary A. (Mrs. Humphry Ward). Lyly, Lilly or Lylie, John (*in part*)
 Wardlaw, William. Titanium; Tungsten
 Wardle, William Lansdell, D.D. Beelzebub; Cain; Cherubim; David (*in part*); Deluge; Eden; Japheth; Lamech; Manasseh (King of Judah); Manasseh (Tribe of Israel); Naphtali; Nimrod; Noah; Paradise; Reuben; Sabbath (*in part*); Samson; Samuel; Saul; Solomon; Uzziah
 Ware, E. E. Paint (*in part*)
 Ware, W. Porter. Shaving Mugs
 Warne, William E. Land Reclamation
 Warner, Edward Pearson. Aerial Law
 Warner, Eltinge Fowler. Shooting (*in part*)
 Warner, Sir Frank. Silk and Sericulture (*in part*)
 Warre, Rev. Edmond, D.D. Boat
 Warren, Dean M. Electric Lamps and Valves, Manufacture of (*in part*)
 Warren, Rev. Frederick Edward, B.D. Prayer, Book of Common (*in part*)
 Warren, George L. Nansen International Office for Refugees; Refugees and the Exchange of Populations (*in part*)
 Washburne, Carleton Wolsey. Supernormal Children, Education of
 Wasson, Thomas C. Dahomey; French Guinea (*in part*); Gao; Ivory Coast; Jenné; Mauritania
 Waterfield, Lina. Duse, Eleonora; Venice (*in part*)
 Waters, Edward Thomas. Diabetes Mellitus (*in part*)
 Watkins, George Benson. Glass, Safety; Glass, Ultra-Violet Ray Transmitting
 Watson, Sir Alfred William. Insurance, Introduction to
 Watson, David Meredith Seares. Chameleon; Cobra (*in part*); Comparative Anatomy (*in part*); Crocodilian (*in part*); Elephant; Embryology (*in part*); Mammoth (*in part*); Palaeontology (*in part*); Plesiosaurus (*in part*); Proboscidea (*in part*); Pterodactyl (*in part*); Reptiles; Skeleton (*in part*); Zoological Geography (*in part*)
 Watson, Rev. Canon Edward William, D.D. Ministry, The Christian
 Watson, F. I. Coursing; Football (*in part*); Greyhound Racing (*in part*)
 Watson, Floyd Rowe. Acoustics of Buildings
 Watson, George Neville. Spherical Harmonics
 Watson, James A. Scott. Sheep (*in part*)
 Watson, Kenneth M. Butadiene

Watson, William Henry Lowe. Apprenticeship (*in part*)
 Watt, Francis. Inns and Innkeepers (*in part*); Paterson, William (*in part*)
 Watt, James Muir. Auctions and Auctioneers (*in part*)
 Watts, Henry C. Airscrew (*in part*)
 Watts, William Walter. Bronze and Brass Ornamental Work (*in part*); Iron in Art (*in part*); Pewter
 Watts-Dunton, Theodore. Poetry (*in part*); Wycherley, William (*in part*)
 Waugh, Arthur. Pater, Walter Horatio; Patmore, Coventry Kersey Dighton
 Waugh, William Templeton. Montcalm, Louis-Joseph de Montcalm-Gozon
 Wavell, Field Marshall Archibald Percival, 1st Earl Wavell. Brest-Litovsk, Battles of; Carpathians, Battles of the; Caucasus, Campaign in the; Dunajec-San, Battles of The; Lemberg, Battles of; Lodz, Battle of; Luck or Lutsk, Battles of; Narew, Battles of the; Narocz, Battle of Lake; Palestine, Operations in; Przemysl, Sieges of; Seven Weeks' War; Vistula-San, Battles of the
 Weatherly, Cecil. Knighthood and Chivalry (*in part*); Saddlery and Harness
 Weaver, Charles Edwin. Oligocene
 Webb, Clement Charles Julian. Sacramento
 Weber, Frederick T. Portrait Painting (*in part*)
 Weber, Frederick W. Burnisher
 Weber, Friedrich. Arbitration (*in part*)
 Webster, Charles Kingsley. Vienna, Congress of
 Webster, Captain Frederick Annesley Michael. Athletic Sports (*in part*); Discus Throwing (*in part*); Running; Weight Throwing
 Webster, James Claude. Inns of Court and Chancery (*in part*)
 Wedgwood, Camilla H. Cousin Marriage; Dance (*in part*); Dead, Disposal of the (*in part*); Endogamy; Exchange Marriage; Exogamy; Weapons, Primitive; Weaving (*in part*)
 Weeks, Raymond. Foreign Languages, Teaching of (*in part*)
 Weerth, Ernest de. Costume Design (*in part*)
 Wehle, Harry Brandeis. Painting (*in part*)
 Wehrmann, Arthur M. Handball (*in part*)
 Weiner, Joseph Lee. Liquidation (*in part*)
 Weir, Robert Hendry. Aero Engines
 Weller, J. Marvin. Carboniferous System and Period
 Weller, Thomas Huckle, M.D. Tropical Medicine
 Wellington, John Harold. South Africa, Union of (*in part*)
 Wells, Alan Frank. Casual Labour (*in part*); Casual Ward; Charity (*in part*); Friendly Societies (*in part*)
 Wells, Harry Warren. Ionosphere
 Wells, Joseph. Oxford University (*in part*)
 Wells, William Thomas. Election; War Office (*in part*)
 Wenger, John Christian, D.Th. Mennonites (*in part*); Menno Simons
 Wenley, Robert Mark. Scepticism (*in part*)
 Wentworth, Chester Keeler. Boulder; Gravel
 Wentworth, Edward Norris. Stockyards
 Wentzel, Helene L. Colorado
 Wenzel, Rupert L. Bookworm; Coleoptera (*in part*); Firefly; Flour Beetle; Glowworm; Pine Beetle; Weevil (*in part*)
 Werden, Lincoln A. Angling (*in part*)
 Werner, Alice. Hausa (*in part*); Sandawe; Swahili Language
 Werner, M. R. Rosenwald, Julius; Tammany Hall (*in part*)
 Wernham, Richard Bruce. Elizabeth I; English History (*in part*)
 Werrenrath, Reinald. Song (*in part*)
 Werts, Hilary R., S.J. Celibacy
 Wesson, Charles Macon. Ordnance (*in part*)
 West, Arthur Gilbert Dixon. Microphone or Telephone Transmitter
 West, James Edward. Boy Scouts (*in part*)
 Westermann, Diedrich Hermann. African Languages

- Westermarck, Edward Alexander. Divorce (*in part*); Group Marriage (*in part*); Polyandry; Polygyny
- Westheimer, Frank Henry. Acids and Bases; Reaction Kinetics
- Westlake, John. Allegiance (*in part*); Domicile; Landlord and Tenant (*in part*)
- Westmore, Perc. Motion Pictures (*in part*)
- Weston, Edward. Photographic Art
- Weston, G. J. Bead Manufacture
- Weston, Jessie L. Arthurian Legend; Gawain; Grail, The Holy; Guenevere; Lancelot; Malory; Sir Thomas (*in part*); Map (or Mapes), Walter; Merlin; Perceval; Tristan or Tristram; Wolfram Von Eschenbach
- Weston, T. A. Flower (*in part*)
- Westphal, Ulrich F. Imidazole
- Wetmore, Alexander. Archaeopteryx; Diatryma; Herperornis; Ichthyornis; Ornithology (*in part*); Phororhacos
- Wever, Ernest Glen. Equilibrium, Sense of; Hearing
- Wexler, Harry. Greenhouse Effect of the Atmosphere; Lapse Rate of Temperature; Radiation Balance of the Earth
- Wexler, Raymond. Radar (*in part*)
- Whamouth, Joshua. Latin Language; Oscan; Sabellic
- Wheeler, Henry Paul, Jr. Helium
- Wheeler, Jane G. Borku or Borgu
- Wheeler, William Henry. Rockets (*in part*)
- Wheland, George Willard. Amides; Amines (*in part*); Atom (*in part*); Coumarone; Decolorizing; Erythritol; Formic Acid; Free Radicals (*in part*); Isomerism; Lactones; Molecule, Chemical; Parachor; Propiolic Acid; Pyrazines; Pyrene; Stereochemistry (*in part*); Stoichiometry; Xanthic Acid
- Whipple, Fred Lawrence. Jupiter (*in part*); Meteor (*in part*); Minor Planet (*in part*); Planet
- Whipple, Leonidas Rutledge. Censorship (*in part*)
- Whittaker, Katherine Pokan. Drama (*in part*)
- White, Edna Noble. Nursery Schools (*in part*)
- White, Major General Geoffrey. Driving (*in part*); Rule of the Road (*in part*)
- White, Henry Seely. Algebraic Forms; Trigonometry
- White, Irma Lenore Reed. United States (of America), The (*in part*)
- White, John Forbes. Rembrandt; Velazquez, Diego Rodriguez De Silva y (*in part*)
- White, Lee A. Michigan
- White, Leonard Dupree. Civil Service (*in part*)
- White, Orland Emile. Amazon (*in part*)
- White, Roy Barton. Western Union Telegraph Company, The (*in part*)
- White, Wilford Lefestey. United States (of America), The (*in part*)
- White, William C. Alexanderson, Ernst F. W.; De Forest, Lee; Electric Lamps and Valves
- Whitehill, Walter Muir. World War II (*in part*)
- Whitehorn, John Clare, M.D. Psychiatry (*in part*)
- Whitehouse, Wallace Edward. Sweden (*in part*); Switzerland (*in part*); Zealand (*in part*); Zürich (Canton)
- Whiteley, Martha Annie. Chemistry (*in part*)
- Whiting, P. W. Gynander or Gynandromorph
- Whitlock, Herbert Percy. Gems, Synthetic (*in part*)
- Whitmore, Frank Clifford. Molecular Rearrangements
- Whittaker, Sir Edmund. Relativity (*in part*); Space-Time (*in part*)
- Whittaker, William Gillies. Choral Singing (*in part*)
- Whittle, Lieutenant Colonel H. J. Croquet (*in part*)
- Whittlesey, Charles R. Banking (*in part*)
- Whittlesey, Derwent. Abidjan; Accra; Bamako; Bauchi; Cape Coast Castle; Dakar (*in part*); Elmina; Geopolitics; Kano; Lagos; Port Harcourt; Saint Louis; Sekondi; Senegambia; Slave Coast
- Whymant, A. Neville J. Babylonian and Assyria (*in part*); Caspian Languages; Clicks; Hottentots (*in part*); Hudson's Bay Company (*in part*); Huns (*in part*); Ishii, Kikujiro; Japanese Literature; Khiva (*in part*); Láo-Tsé (*in part*); Mongolian Language and Literature (*in part*); Mongols (*in part*); Polynesian Languages; Polynesian Literature; Siam (*in part*); Siamese Language and Literature (*in part*); Turkish Language and Literature (*in part*)
- Whyte, Frederic W. Du Maurier, George Louis Palmella Bussan
- Wichers, Edward. Atom (*in part*)
- Wickens, George Michael. Drama (*in part*)
- Wickersham, George Woodward. Taft, William Howard
- Wiegand, David E. Electromagnet (*in part*)
- Wieschhoff, Heinrich A. Adamawa; Bagirmi, Bagirmi or Baguirmi; Cameroons (*in part*); Cazanbe; Chinde; French Equatorial Africa; Gabun; German East Africa; Loango; Mozambique; Nyasaland Protectorate (*in part*); Portuguese East Africa or Mozambique (*in part*); Portuguese Guinea; Quelimane; Sofala; Unyamwezi; Unyoro (Bunyoro); Wadela
- Wigglesworth, V. B. Metamorphosis (*in part*); Insect (*in part*)
- Wigmore, Colonel John H. Fielding, Sir John Wiklund, K. B. Finno-Ugrian Languages
- Wilberforce, Sir Herbert William W. Summary Jurisdiction (*in part*)
- Wilbur, Ray Lyman, M.D. Leland Stanford Jr. University (Stanford University)
- Wilby, Francis Bowditch. West Point
- Wilcox, Walter W. Food Supply of the World (*in part*)
- Wilde, J. K. H. Rinderpest (*in part*)
- Wilder, Raymond Louis. Point Sets; Topology
- Wilder, Russell M., M.D. Metabolic Diseases
- Wildes, Karl Leland. Electrical Power: National and Regional Schemes (*in part*)
- Wiley, Louis. Ochs, Adolph Simon
- Wilfred, Thomas. Clavilux
- Wilkins, Richard A. Brass Manufactures (*in part*)
- Wilkinson, Walter Hugh John. Nepal (*in part*)
- Wilks, Samuel Stanley. Pearson, Karl
- Willard, Daniel. Baltimore and Ohio Railroad Company, The
- Willcox, Walter Francis. Census (*in part*)
- Willcox, Colonel Sir William Henry, M.D. Barbituric Acid; Drug Addiction (*in part*); Poison (*in part*)
- Willett, Hurd Curtis. Meteorology
- Williams, Rev. A. Lukyn, D.D. Aeldama; Gentile; Hosanna; Judas Iscariot or Scariot; Mammon
- Williams (Arthur Frederic) Basil. Botha, Louis; George III
- Williams, C. B. Migration of Animals
- Williams, Brigadier Edgar Trevor. World War II (*in part*)
- Williams, Howel. Agglomerate; Tuff
- Williams, James. Laws Relating to Seamen (*in part*); Prescription (*in part*); Torture (*in part*); Will or Testament (*in part*)
- Williams, John Eryl Hall. Criminal Law (*in part*)
- Williams, Lou. Agricola, Georg
- Williams, Ralph Vaughan. Folk-Song (*in part*)
- Williams, Robert T. Bookbinder
- Williams, Russell Byron. Wire Rope
- Williams, William S. Band Saws
- Williams, Y. S. Dockyards and Naval Bases (*in part*)
- Williamson, A. V. Indian Desert, The; Karachi; Sind (*in part*)
- Williamson, George Charles. Clouet, Francois; Clouet, Jean; Cooper, Alexander; Cooper, Samuel; Engleheart, George; Hoskins, John; Humphry, Ozias; Miniature Painting (*in part*); Pinwell, George John (*in part*); Plimer, Andrew; Prieur, Pierre; Smart, John
- Williamson, James. Aqueducts; Concrete; Ferro-Concrete
- Williamson, William Rulon. Pensions (*in part*)
- Willihnganz, Eugene. Battery (*in part*)
- Willis, Frank B. Republican Party, The (*in part*)
- Willis, Frederick Andrew Graves. Ireland, Church of
- Willison, Sir John Stephen. Laurier, Sir Wilfrid
- Willmann, Dorothy Julia. Sodality of Our Lady, The
- Willoughby, Edwin Elliot. Jaggard, William
- Wills, Albert P. Vector Analysis (*in part*)
- Wills, John Elliot. Agricultural Labourer (*in part*); Small Holdings (*in part*)
- Wilson, Field Marshal Henry Maitland Wilson, 1st Baron. World War II (*in part*)
- Wilson, Lieutenant Colonel Sir Arnold Talbot. Persia (*in part*)
- Wilson, Carl Louis. Flower (*in part*)
- Wilson, Charles Edward. General Electric Company
- Wilson, Sir Charles William. Asia Minor (*in part*); Diarbekr (*in part*)
- Wilson, David Alec. Carlyle, Thomas (*in part*)
- Wilson, Edward Foss. Wilson and Co., Inc.
- Wilson, Edwin Brayton. Brooklyn (*in part*)
- Wilson, Francis Graham. Liberty
- Wilson, Frank John. Counterfeit Money; Secret Service, U.S. (*in part*)
- Wilson, George Bailey. Drink Bill
- Wilson, George Grafton. Prize Courts and Prize Law (*in part*); Visit and Search (*in part*)
- Wilson, Graham Selby, M.D. Bacterial and Infectious Diseases
- Wilson, H. Fred. Trust Company (*in part*)
- Wilson, Harold Albert. Electricity
- Wilson, Herbert Wrigley. Northcliffe, Alfred Charles William Harmsworth, Viscount; Rothermere, Harold Sidney Harmsworth, 1st Viscount (*in part*)
- Wilson, James Robert, M.D. Diet and Dietetics; Infancy
- Wilson, Morley Evans. Pre-Cambrian
- Wilson, T. Carroll. Coffee
- Wilson, Thomas R. Exports: Statistics
- Wilson, William. Electrification of Industry (*in part*)
- Wilton, Captain S. T. H. Dockyards and Naval Bases (*in part*); Fuelling Stations (*in part*); Heligoland Bight; India (*in part*); Press Gang; World War I (*in part*)
- Wimer, David Cleveland. Soil (*in part*)
- Winfield, Percy Henry. Writ (*in part*)
- Winkler, A. J. Grape
- Winter, Charles. Children; Protective Laws (*in part*)
- Winterbotham, Brigadier Harold St. John Loyd. Surveying (*in part*)
- Winterich, John Tracy. Book Collecting (*in part*)
- Wirth, Henry E. Density (*in part*)
- Wiskemann, Elizabeth. Czechoslovakia (*in part*)
- Wissler, Clark. Hunting and Fishing, Primitive (*in part*)
- Withers, Hartley. Money Market (*in part*)
- Wolf, Abraham. Absolute; Abstract and Abstraction; Analogy; Apprehension (*in part*); A Priori and A Posteriori; Attention (*in part*); Belief; Category; Causality or Causation; Classification; Common Sense Philosophy; Conceptualism; Cosmology; Descartes, René; Duration and Time; Ethics; Ethics, History of (*in part*); Induction; Innate Ideas; Intelligence or Understanding; Intuition; Laughter; Law; Logic; Logic, History of (*in part*); Meaning; Mechanism; Metaphysics; Monism; Pantheism (*in part*); Philosophy, History of; Probability; Royal Society, The (*in part*); Scientific Method; Spinoza, Benedictus de
- Wolf, Lucien. Anti-Semitism (*in part*); Zionism (*in part*)
- Wolf, Stewart, M.D. Psychiatry (*in part*)
- Wolfe, Humbert. Moore, George; Poetry (*in part*)
- Wolff, Eugene. Eye, Human (*in part*)
- Wolff, Harold G., M.D. Psychiatry (*in part*)

- Wolff, Philippe. D'Isalguiet Anselme
Wollam, A. B. American Sugar Refining Company, The
Wollam, Park F. Uruguay (*in part*)
Wood, A. B. Sound
Wood, Charles P. Factory Construction and Planning
Wood, George McLane. Argentina (*in part*); Brazil (*in part*); Chile (*in part*); Ecuador (*in part*); Grand Canyon, The; Great Basin, The; Great Salt Lake; Venezuela (*in part*)
Wood, Herbert George, Hon., D.D. Bible (*in part*)
Wood, Richardson. Public Opinion Surveys
Wood, Robert E. Mail-Order Business (*in part*)
Wood, Robert Williams. Fluorescence and Phosphorescence
Wood, W. Birkbeck. American Civil War; Antietam, Battle of the; Atlanta, Battles Round; Bull Run (*in part*); Chickamauga; Nashville (*in part*)
Woodbury, David Oakes. Electrical Power Generation (*in part*); Test Pit
Woodcock, William H. Cement (*in part*)
Woodhouse, Thomas. Hessian (*in part*); Honeycomb; Hose-Pipe; Huckaback; Jute (*in part*); Linen and Linen Manufactures; Matting; Pile; Sailcloth and Sailmaking (*in part*)
Woodrow, Herbert. Attention (*in part*)
Woodruff, Lorande Loss. Protozoa
Woods, Maurice Henry. Birkenhead, Frederick Edwin Smith
Woodson, Carter Godwin. Peonage
Woodward, A. F. Canning, Commercial (*in part*)
Woodward, Sir Arthur Smith. Ichthyosauria; Iguanodon (*in part*)
Woodward, Ernest Llewellyn. Châlons-sur-Marne (*in part*)
Woolley, Dilworth Wayne. Vitamins
Woolley, Mary Emma. Women, Education of (*in part*)
Wooster, W. A. Agate; Amber; Bloodstone or Heliotrope; Carnelian or Cornelian; Chalcedony or Calcedony; Fluorspar; Jade; Jasper; Onyx; Opal
Working, E. J. Agricultural Prices (*in part*); Agricultural Statistics (*in part*)
Workman, E. John. Thunderstorms (*in part*)
Wornum, Ralph Nicholson. Arabesque
Wornum, W. E. Carmine (*in part*); Varnishes, Chemistry of (*in part*)
Worsfold, William Basil. Africa (*in part*); Cape Province (*in part*); Nigeria (*in part*); Rhodesia (*in part*)
Wray, Laurence. Household Appliances (*in part*)
Wright, A. H. Flax (*in part*); Hemp; Phormium or New Zealand Flax; Sunn
Wright, Charles. Lloyd's (*in part*)
Wright, Sir Charles Theodore Hagberg. Periodical (*in part*)
Wright, Orville. Wright, Wilbur (*in part*)
Wright, Quincy. Mandate (*in part*); Treaties; War (*in part*)
Wright, Sewall. Evolution, Organic (*in part*); Genetics of Population
Wright, Willard Hull. Trichinosis or Trichinosis
Wright, William Hammond. Mars (*in part*)
Wrong, George Mackinnon. Canada (*in part*); Ontario (*in part*)
Wulfsberg, Fredrik. Drama (*in part*)
Wyatt-Paine, W. Circuits (*in part*); Husband and Wife (*in part*); Inns and Innkeepers (*in part*); Lien (*in part*); Master and Servant
Wyckoff, Ralph D. Gravitation (*in part*)
Wyd, Henry Cecil Kennedy. English Language (*in part*)
Wylie, Sir Francis Verner. Suez Canal
Wyllie, Brigadier General Robert E. Colours, Military (*in part*); Flag (*in part*)
Yaglou, Constantin Prodromos. Fatigue (*in part*)
Yamey, Basil Selig. Chain Store (*in part*)
Yanofsky, Barney. Veterans of Foreign Wars
Yates, H. O. Chrysanthemum (*in part*)
Yellin, Samuel. Iron in Art (*in part*)
Yewdall, Alexander. Clothing Manufacture (*in part*)
Yoe, John H. Carbon; Carbonic Acid and Carbonates (*in part*)
Yorke, Philip Chesney. Anne (Queen of Great Britain and Ireland) (*in part*); Clanricarde, Ulick de Burgh; Cromwell, Richard
Young, Alexander Bell Filson. Dance (*in part*)
Young, Allyn Abbott. Labour; Land; Price; Rent: In Economics; Supply and Demand; Utility; Value
Young, Art (Arthur Henry). Cartoon (*in part*)
Young, Ernest. Siam (*in part*)
Young, Sir Frederic William. Salvaging
Young, Harland Harry. Gelatin
Young, John W. Geometry (*in part*)
Young, Kimball. Attitudes; Imitation; Psychology, History of (*in part*)
Young, Mahonri (Mackintosh). Sculpture Technique (*in part*)
Young, Owen D. Dawes, Charles Gates (*in part*)
Young, Paul Thomas. Motivation
Young, Richard Hugh. Guiana (*in part*)
Young, T. Cuyler. Persia (*in part*)
Younghusband, Major General Sir George John. Crown Jewels or Regalia (*in part*)
Yugow, A. A. Rouble (*in part*)
Yule, Sir Henry. Hsüan Tsang (*in part*); Kublai Khan; Lhasa (*in part*); Mandeville, Jehan de (*in part*); Polo, Marco (*in part*); Ricci, Matteo (*in part*)
Yust, Walter. Encyclopaedia (*in part*)
Zalowitz, Nathaniel. Yiddish Language and Literature (*in part*)
Zanzig, Augustus Delafield. Music, Teaching of (*in part*)
Zeisberg, Carl. Table Tennis
Zeller, John Henry. Pig (*in part*)
Zeuner, Frederick Everard. Quaternary
Zigler, Michael J. Skin, Sensory Functions of; Smell and Taste (*in part*)
Zimmer, George Frederick. Bunkering of Ships; Granaries and Grain Elevators (*in part*); Locomotive Coaling (*in part*); Mechanical Handling; Monorails and Telfers; Pneumatic Conveying; Ropeways and Cableways; Wagon Tipplers
Zimmerman, Carle Clark. Le Play, Pierre Guillaume Frédéric
Zimmerman, Percy White. Arboretum; Horsechestnut (*in part*); Tree (*in part*)
Zimmern, Sir Alfred. League of Nations and Education
Zink, Donald Guyer. Alcohol; Alcohol in Industry; Amyl Acetate (*in part*); Butyl Acetates (*in part*); Fusel Oil; Glycols (*in part*); Methyl Alcohol; Proof Spirit
Zolnai, Béla. Hungarian Literature
Zon, Raphael. Forests and Forestry; Physical Natural Resources (*in part*)
Zscheile, Frederick Paul. Anthocyanins and Anthoxanthins (*in part*); Chlorophyll, Chemistry of
Zubin, Joseph. Handwriting
Zworykin, Vladimir K. Television (*in part*)
Zygmund, Antoni. Fourier Series

FOUNDED

A.D. 1768

ENCYCLOPÆDIA BRITANNICA

A NEW SURVEY OF UNIVERSAL KNOWLEDGE

Volume

I

A to ANNOY

A THIS letter has stood at the head of the alphabet during the whole of the period that it can be traced historically. The name of the letter in the Phoenician period resembled the Hebrew name *aleph* and was taken over by the Greeks in the form of *alpha*. In the Phoenician alphabet the letter stood for a species of breathing or inherent sound, since vowels were not represented in the Semitic alphabets. The view that the Greeks received their alphabet directly from the Phoenicians has now been largely abandoned. The character may therefore have stood for a vowel in the alphabet before the Greeks took it over. It must indeed almost certainly have done so if it was in use among the peoples of Asia Minor previous to its use by the Greeks. Throughout its history variations have occurred in the form of the letter. The Phoenician form was . In the Lydian alphabet of the fifth century B.C. it appeared as , in the Carian alphabet  or . In the early Greek alphabet from the island of Thera, which may possibly be dated as far back as the eighth or ninth century B.C., its form was  or . In the Greek alphabet of classical times its form was usually . Early Italian and Latin forms are  and . As early as the middle of the second century A.D. we find  as a form of , and this is the ancestor of our present minuscule printed  by way of uncial  (fourth century) and  (eighth century), uncial

writing being the name given to the round hand which in late Roman times superseded the square capitals that had been suitable for inscription in stone. Under the influence of the uncial hand this form was adopted into Carolingian minuscules. Our rounded minuscule *a* derives from Latin cursive, in which in the fifth century A.D. appears the astonishing form . This is a hastily-written majuscule  distorted by its apex having fallen to the left. In the sixth century the cursive form was , and from this in the seventh century develops the form , from which the rounded form of the Irish and early English hands grew. The rounded capital  that sometimes appears in handwriting is the minuscule letter written large.

The sound for which the letter consistently stood in Greek and Latin, and doubtless, generally speaking, in its immediate pre-Greek history, was the open low back vowel, usually known in modern English as continental *a*. There are of course countless slight variations in the method of pronouncing this sound. In English the sound has undergone far-reaching changes during and since the Middle English period. These are due to *fronting*, that is to say, pronouncing the sound more towards the front of the mouth, or to *rounding*, slightly rounding the lips, which has the effect of causing the sound to be pronounced higher in the mouth. At the present time the letter represents six principal vowel-sounds: (1) its original value, the low back vowel, as in *father*;

(2) an intermediate vowel, as in *man*; (3) a closer vowel, further fronted, as in *hare*, occurring only before the liquid *r*; (4) a diphthong (*ei*) as in *take*, *spade*. This is the sound that the letter now normally represents when the vowel is long. (3) represents a stage in the development of the sound on its way from (1) to (4) which was arrested at this point when the vowel was followed

NAME OF FORM	APPROXIMATE DATE	FORM OF LETTER
PHOENICIAN	B.C. 1200	𐤀
CRETAN	1,100-900	Α
THERAEAN	700-600	Α
ARCHAIC LATIN	700-500	Α Α Α
ATTIC	600	α α
CORINTHIAN	600	Α Α
CHALCIDIAN	600	Α
IONIC	403	Α
ROMAN COLONIAL	PRE-CLASSICAL AND CLASSICAL TIMES	↗ ↗
URBAN ROMAN		Α
FALISCAN		Α and Ν
OSCAN		Α Α ↗
UMBRIAN		Α
CLASSICAL LATIN AND ONWARDS		Α

THE DEVELOPMENT OF THE LETTER A FROM PHOENICIAN TIMES, THROUGH CLASSICAL GREEK AND LATIN, TO THE PRESENT DAY

by *r*. A similar fronting of this sound took place in the Ionic-Attic dialects of Greek, where sounds derived from the *a*-sound and represented in other dialects by *α* are represented by *η*.

The two remaining developments of the sound are due to rounding: (5) the vowel of *water* and (6) the vowel of *was*. This development is due to the influence of the preceding bilabial spirant *w*.

(B. F. C. A.)

In *Music*, A is the name of the first note of the musical alphabet and constitutes the 6th degree of the scale of C. In respect of pitch A=435.4 vibrations per second, this being the standard pitch or *diapason normal*. A is the note always given to orchestral players, usually by the oboe, for tuning purposes.

(See PITCH, MUSICAL.)

A1 AT LLOYD'S, a popular expression denoting super-excellence, derived from the prestige of the world's chief shipping registry, Lloyd's Register of British and Foreign Shipping. In fact, the highest classification assigned to iron and steel ships is "100 A1." In this symbol, "100 A" denotes the condition of the hull, while the "1" denotes efficiency of equipment. "A1" is almost obsolete, being the symbol of the highest classification of wooden vessels.

(See LLOYD'S REGISTER OF SHIPPING.)

AA, the name of many small European rivers. The word is derived from the O. G. *aha*, cognate to the Latin *agua*, water (cf. Ger. *-ach*; Scand. *ä*, *aa*, pronounced *ö*). Among the streams

of this name are:—Two rivers in west Russia, falling into the Gulf of Riga with Riga lying between their mouths; a river in northern France flowing through St. Omer and Gravelines, and a river of Switzerland, in the cantons of Lucerne and Aargau, which carries the waters of Lakes Baldegger and Hallwiler into the Aar. In Germany there are the Westphalian Aa, joining the Werre at Herford, the Münster Aa, a tributary of the Ems, and others.

AABENRAA, a town of Denmark, in Aabenraa *amt*, at the head of Slesvig bay, being an arm of the Little Belt. It has a good harbour and a large carrying trade. Pop. (1950) 13,017. From 1864 to 1919 it was in the German province of Schleswig.

AACHEN (Fr. AIX-LA-CHAPELLE; Dutch AKEN), ancient city and spa, North Rhine-Westphalia, Ger., under the northern slopes of the Ardennes, on the Cologne-Brussels main line, 44 mi. W. by S. of Cologne. Pop. (1950) 129,811. Its municipal boundaries coincide on the west with the frontiers of Belgium and the Netherlands. In general appearance a prosperous, modern commercial town, it is full of mediaeval associations. The outer town is mainly new; while the ramparts of the old inner town are now promenades, with two ancient gates, Ponttor and Marschierfort, remaining. The hot sulphur springs have been celebrated for centuries. The conspicuous cluster of buildings in the centre of the city includes the cathedral and the Rathaus (town hall), a Gothic structure (1353-70) built on the ruins of Charlemagne's palace, which contains the magnificent coronation hall of the emperors (143 ft. by 61 ft.). The two original towers, Granusturm and Glockenturm, were all but destroyed by fire in 1883; their restoration was completed in 1902. Near the Rathaus is the Grashaus, restored in 1889 to house the municipal archives. The cathedral is in two distinct styles. The Romanesque *Octagon*, begun in 796, the finest extant Carolingian structure, was modelled on San Vitale at Ravenna, and consecrated by Pope Leo III in 805. Emperor Otto III rebuilt it, on the original lines, in 983, after its destruction by Norman raiders. It is surrounded on the first story by a gallery (the Hochmünster) with antique marble and granite columns, of various sizes, brought from Rome, Ravenna and Trier, removed by Napoleon to Paris, but restored after 1815. The mosaic representing Christ surrounded by "the four-and-twenty elders," which originally lined the cupola, was executed in 1881 from a 17th century copy of the ancient originals. The bronze west doors date from 804. Underneath the dome, tradition places the tomb of Charlemagne, said to have been opened by Otto III. in 1000 and to have shown the emperor's body on a marble chair which was removed and long used for coronations. It is now in the gallery. The site of the tomb is marked by a stone slab, with the inscription *Carlo Magno*, and above it hangs the famous bronze chandelier presented by the emperor Barbarossa in 1168. In the Hungarian chapel, to the south-west, is the rich Cathedral Treasury, with fine mediaeval work such as the 13th century gold casket containing the relics of Charlemagne. The Gothic choir was added during the 14th and 15th centuries and contains the tomb of the emperor Otto III. The pulpit, a gift of emperor Henry II., dates from c. 1020. The cathedral possesses many relics, the more sacred of which are exhibited only once every seven years, when they attract large crowds.

The churches of St. Foillan (founded in the 12th century, but twice rebuilt, in the 15th and 17th centuries, and restored in 1883) and St. Paul, with its beautiful stained-glass windows, are interesting. The Suermondt museum contains fine pictures by early German, Dutch and Flemish masters. There are many fine streets, squares and public monuments. The fountain in the market square is surmounted by a statue of Charlemagne. In the principal square, Friedrich-Wilhelmplatz, is the Elisenbrunnen, with its colonnade and garden, the chief resort of visitors taking the baths and waters.

Since the working of extensive coalfields in the district almost every branch of iron industry has been carried on. Cloth, glass, needles and pins are important products. The suburb of Burtscheid, incorporated with Aachen in 1897, has old-established manufactures of cloth and needles and contains, among frequented thermal springs, the Schwertbad-Quelle (171°F.), the warmest spring in Germany.

History.—The ancient city and watering place of Aachen represents the Aquisgranum of the Romans, named after Apollo Granus, who was worshipped in connection with hot springs. As early as A.D. 765 King Pippin had a "palace" there, in which it is probable that Charlemagne was born. The greatness of Aachen was due to the latter, who between 777 and 786 built a magnificent palace on the site of that of his father, raised the place to the rank of the second city of the Empire, and made it for a while the centre of Western culture and learning. From the coronation of Louis the Pious in 813 until that of Ferdinand I. in 1531 the sacring of the German kings took place at Aachen; as many as 32 emperors and kings were crowned there. Late in the 12th century (1172-76) the city was surrounded with walls by order of the emperor Frederick I., to whom (in 1166)



BY COURTESY OF REICHSZENTRALE FÜR DEUTSCHE VERKEHRSWERBUNG
THE RATHAUS OR TOWN HALL AT AACHEN, ERECTED IN 1353-70 ON THE SITE OF THE PALACE OF THE EMPEROR CHARLEMAGNE

and to his grandson Frederick II. (in 1215) it owed its first important civic rights. In the 16th century Aachen began to decline.

It lay too near the French frontier to be safe, and too remote from the centre of Germany to be convenient, as a capital; and in 1562 the election and coronation of Maximilian II. took place at Frankfurt-on-Main, a precedent followed till the extinction of the Empire. In 1815 it was given to Prussia. In Nov. 1918, at the conclusion of World War I, Aachen was occupied for a period by Belgian troops.

During World War II, because of its important aerodrome and railway connections, it was bombed many times by the Allies.

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AAHMES: see AMASIS.

AAL, also known as A'L, ACH, or AICH, the Hindustani names for the *Morinda tinctoria* and *Morinda citrifolia*, plants extensively cultivated in India on account of the reddish dye-stuff which their roots contain. The name is also applied to the dye, but the common trade name is *Suranji*. Its properties are due to the presence of a glucoside known as *Morindin*, which is compounded from glucose and probably a trioxy-methyl-anthraquinone.

AALBORG, seaport on the south bank of the Limfjord, North Jutland, Denmark, capital of Aalborg amt, and one of Denmark's oldest towns. Pop. (1940), 55,652. It is the seat of a bishop (1554) and has some old buildings, Jens Bangs Stenhus.

the castle called Aalborghus, the Holy Ghost monastery and the Budolfi church. The municipal privileges date from 1342. Industries include cement works, tobacco works, distilleries, chemical works (sulphuric acid and superphosphate), cloth mills and the ship yard.

AALEN, a town in Württemberg, Germany, situated on the Kocher, a tributary of the Neckar, at the foot of the Swabian Alps, about 50m. E. of Stuttgart. Pop. (1939) 16,003. Woollen and linen goods and ribbons are manufactured, and there are tanneries and large iron works. Aalen was a free imperial city from 1360 to 1802, when it was annexed to Württemberg.

AALESUND (or ÅLESUND), seaport of Norway, in Møre fylke (county), 160 mi. N. by E. of Bergen by sea. Pop. (est. 1936) 18,350. It is built on three islands, Nørvø, Aspø and Hissen, enclosing the harbour. Founded in 1824, Aalesund is an important export town for fish and fish products. It lies in a very productive fishing district; to the northwest lie the great cod-banks of Storeggen and Nyeggen. Vessels also fish off Iceland, while a fleet of sealing boats is sent to the Arctic ocean. There are numerous factories connected with the fish industry and oil refineries, engineering works and a seining factory. Aalesund is ordinarily a port of call for the Norwegian South American line (on account of the export of klip-fish) and for the routes Trondhjem-Hamburg, Trondhjem-France and Trondhjem-England, and also for most coasting vessels trading in western Norway. There is some tourist industry connected with the adjacent centres of Geiranger and Jørund fjords. In 1904 Aalesund was wasted by a terrible fire. In the following years the town was planned on new lines and the houses in the centre were built of brick. German troops occupied Aalesund in 1940.

AALI, MEHEMET, PASHA (1815-1871), Turkish statesman, was born at Constantinople, the son of a government official. He was ambassador in London (1842-45), and then foreign minister under Reshid Pasha. He took part in the congress of Vienna (1855) and in the congress of Paris (1856), and was five times grand vizier. Aali Pasha was one of the most zealous advocates of the introduction of Western reforms under the Sultans Abdul-Mejid and Abdul-Aziz. He died at Erenkoi in Asia Minor on Sept. 6, 1871.

AALSMEER, a town in the province of North Holland, Holland, situated in low country about 10 mi. S.W. of Amsterdam. Pop. (1940) 10,420. It has railway communication with Haarlem and Utrecht. The flat country with its fertile sandy soil, which can be easily watered, provides ideal conditions for horticulture, and the town is surrounded by flower gardens and plant nurseries. Large quantities of plants, bulbs and blooms are exported annually. Aalsmeer was taken by Germany in May 1940.

AAR or **AARE**, the largest river entirely within Switzerland. It rises in the great Aar glaciers, in the canton of Berne, west of the Grimsel pass. Beyond the Handegg waterfall the river traverses the Hasli Thal and expands into the Lake of Brienz, where it becomes navigable. It then crosses the swampy plain of the Böödeli, between Interlaken (left) and Unterseen (right), before again expanding into the Lake of Thun. Running north-north-west it encircles the lofty bluff on which the town of Berne is built, and then turns west, and later north. Near Aarberg its stream is diverted west by the Hagneck canal into the Lake of Bienne whence the Nidau canal runs east to Büren. Henceforth its long north-east valley drains the central lowland of north Switzerland, parallel to the Jura. The chief tributaries in this stretch are the Grosse Emme, Wigger, Suhr and Aa, all from the right. Below Brugg it receives first the Reuss, and then the Limmat or Linth. It now turns due north, and soon becomes itself an affluent of the Rhine (left), which it surpasses in volume when they unite at Coblenz, opposite Waldshut. Length of river, 181m. Area of basin, 6,804sq.m.

AARAU, the capital of the Swiss canton of Aargau. Pop. (1930), 11,666, mostly German-speaking Protestants. It is on the right bank of the Aar at the southern foot of the Jura, about 50m. by rail north-east of Berne, and 31m. north-west of Zürich. An ancient fortress, it was taken by the Bernese in 1415, and in 1798 became for a time the capital of the Helvetic republic.

Eight miles by rail north-east are the famous sulphur baths of Schinznach, near which is the ruined castle of Habsburg, the original home of that house. Industries include silk-ribbon weaving, foundries, cutlery, electrotechnical products and scientific instruments. Aarau is an important military centre.

AARDVARK (ard'vark), "earth-pig," the Dutch name for ant-eating mammals of the genus *Orycteropus*, confined to Africa

(see *EDENTATA*). The typical form is *O. a. afer*, or Cape-anteater from South Africa; other races are found northward, both in forest and plains country to Senegal and the Sudan. The body is stout, with arched back; the limbs are short and stout, armed with strong, blunt claws; the ears long; and the tail thick at the base and tapering gradually. The elongated head is set on a short thick neck, and at the extremity of the snout is a disc in which the nostrils open. The mouth is small and tubular, furnished with a long extensile tongue. A large individual measured 6 ft. 8 in. In colour the Cape aardvark is pale sandy or yellow, the hair being scanty and allowing the skin to show; the northern aardvark has a still thinner coat, a shorter tail and longer head and ears. These animals are nocturnal and burrowing. The strong claws make a hole in the side of the anthill, and the insects are collected on the extensile tongue.



THE CAPE AARDVARK OR ANTEATER OF AFRICA WHICH GROWS USUALLY TO A LENGTH OF 5 FT.

AARDWOLF (earth-wolf), a South and East African carnivorous mammal (*Proteles cristatus*), like a small striped hyena, but with a more pointed muzzle, sharper ears and a long erectile mane. It is burrowing in habit and feeds on termites.

AARGAU, a canton of north Switzerland, comprising the lower course of the River Aar (*q.v.*), whence its name. Its total area is 548 sq.mi. It forms the northeastern section of the great Swiss plateau which occupies the trough between the Alps and the Jura. Its fertile valleys alternate with pleasantly wooded hills.

In 1415 the Aargau region, previously the centre of the Habsburgs, was taken from them by the Swiss Confederates. Berne kept the southwest portion. In 1798 the Bernese part became the canton of Aargau of the Helvetic republic and the remainder of the Aargau region formed the canton of Baden. In 1803 the two halves (plus the Frick glen, ceded in 1802 by Austria to the Helvetic republic) were united under the name of Canton Aargau and admitted to membership in the Swiss confederation.

The population of the canton in 1941 was 269,873, almost exclusively German-speaking, with Protestants predominating. The canton, the capital of which is Aarau (*q.v.*), is governed by an executive council of five elected by direct vote. Principal industries include silk-ribbon weaving, electro-technique production and the production of tobacco and wines. Baden (*q.v.*), an important city of the canton, has a tourist industry dependent on its hot sulphur springs. The canton sends 12 members (on the basis of the 1941 census) to the federal *Nationalrat*.

AARHUS, seaport and second city of Denmark, capital of Aarhus amt, east coast of Jutland, on Aarhus bay. Pop. (1940) 99,881. It is first mentioned as a town in the 12th century, since when, at least, it has been the seat of a bishop. The town's first charter is dated 1441. Aarhus has a large harbour of three basins. It is the shipping and commercial centre for Jutland and is also known for its iron and oil industries. The district is low-lying, fertile and well wooded.

AARON, the traditional founder and head of the Jewish priesthood, who, in company with Moses, led the Israelites out of Egypt (see *EXODUS*, *THE*; *MOSES*). His association with Moses in this matter goes back to an ancient tradition, current in northern Israel, though the records derived from the south do not seem to mention him till after the Exile.

In the earlier narratives of the Pentateuch Aaron is mentioned in connection with four events only, (a) the Exodus itself, where he appears as the companion of Moses, (b) as supporting Moses at the battle of Rephidim, (c) as the maker of the golden calf (see *CALF*, *THE GOLDEN*) and (d) as rebelling, along with his sis-

ter Miriam, against the authority of Moses, on the ground that the latter had married a foreign wife (Num. xii.). It may be conjectured that his name did not occur in the original story from which the narrative of Ex. xxxii. was ultimately derived, but as it stands the passage suggests—as does also (d)—that there was a tradition of hostility between Moses and Aaron, rather than one of association.

Throughout the period of the monarchy (at least since the death of David) and even in Ezekiel, the legitimate priests at Jerusalem belong to the house of Zadok. It is only after the Exile that Aaron takes his place. In the whole of the sacerdotal literature, commonly ascribed to P, Aaron stands by the side of Moses. The latter is the representative of the secular power of Yahweh, Aaron is his religious vice-gerent. Thus he takes a share in producing the plagues in Egypt, stands by his brother's side (in the pre-exilic narratives he is called the brother of Miriam, but not of Moses) by the Red sea, wields the sacred rod, is chosen and miraculously vindicated as high priest, and is made the centre of the whole ritual system.

The process by which tradition changed Aaron from being a possible rival to Moses into his ecclesiastical counterpart, has never been satisfactorily explained. R. H. Kennett has advanced the theory that the Aaronides were originally the priests of Bethel, and that their post-exilic position in Jerusalem was due to a compromise made during or shortly after the Exile. This theory certainly offers an explanation of several difficulties, but there are others which it fails to meet, and hence it has not met with general acceptance. (T. H. R.)

AARON'S ROD, the popular name given to various tall flowering plants such as garden orpine, or live-for-ever, great mullein and goldenrod. In architecture the term is given to an ornamental rod with sprouting leaves, or sometimes with a serpent entwined round it (from the Biblical references in Exodus vii. 10 and Numbers xvii. 8).

AARSSENS OF AARSSEN, FRANCIS VAN (1572–1641), Dutch diplomatist and statesman. Johan van Oldenbarnevelt sent him, at the age of 26 years, as a diplomatic agent of the States-General of the United Provinces to the court of France. He helped to negotiate the 12 years' truce in 1606. Recalled from his post by Oldenbarnevelt in 1616, he was one of the "packed" court of judges who in 1619 condemned the aged statesman to death. For his share in this judicial murder a deep stain rests on the memory of AarsSENS. He was confidential adviser on foreign affairs to Maurice, prince of Orange, and afterwards to Frederick Henry, and was sent on special embassies to Venice, Germany and England.

AASEN, IVAR (1813–1896), Norwegian philologist and lexicographer, was born at Aasen i Orsten, in Søndmøre, Norway, Aug. 5, 1813. His first publication was a small collection of folk-songs in the Søndmøre dialect (1843). The *Grammar of the Norwegian Dialects* (1848) and the *Dictionary of the Norwegian Dialects* (1850) prepared the way for the wide cultivation of the popular language in Norwegian, since Aasen really did no less than construct, out of the different materials at his disposal, a popular language or definite *folke-maal* for Norway. With certain modifications, this artificial language is that which has been adopted ever since by those who write in dialect and which later enthusiasts have endeavoured to impose upon Norway as her official language in the place of Dano-Norwegian. Aasen composed poems and plays in the composite dialect and continued to enlarge and improve his grammars and his dictionary. Quite early in his career (1842) he had begun to receive a stipend to enable him to give his entire attention to his philological investigations, and the *Storting* treated him with more generosity as he grew older. Aasen holds perhaps an isolated place in literary history as the one man who has invented, or at least selected and constructed, a language which pleased so many thousands of his countrymen that they accepted it for their schools, their sermons and their songs. Aasen died in Christiania, Sept. 23, 1896.

AASVOGEL, the name by which the South African species of vultures (*q.v.*) are known. Literally it means "carrion-bird."

AB, the fifth month of the ecclesiastical year of the Jews. It corresponds to the period of July 15 to Aug. 15. The word is of Babylonian origin, adopted by the Jews after the Babylonian exile.

On the ninth is kept the Fast of Ab, or the Black Fast, to bewail the destruction of the first temple by Nebuchadrezzar (586 B.C.) and of the second by Titus (A.D. 70).

ABA, (1) a form of altazimuth instrument invented by, and called after, Antoine Thomson d'Abbadie; (2) a rough homespun manufactured in Bulgaria; (3) a long coarse shirt worn by the Bedouin Arabs.

ABĀBDA, a nomad tribe of Arabs who reach northward to the Kena-Kusayr road, in the country east of Luxor Dirán, Aswán and the Northern Atbai. They call themselves "sons of the Jinns," and they are the Gebadei of Pliny and probably the Troglodytes of classical writers. From time immemorial they have acted as guides to caravans through the Nubian desert and up the Nile valley as far as Sennar. Many of them are employed in the telegraph service across the Arabian desert. They are great trade carriers and visit far away districts. The Abābda of Egypt, numbering some 30,000, are governed by an hereditary "chief"; they generally speak Arabic mingled with Barabra words. As a tribe they claim descent from Selman, an Arab of the Beni Hilāl. They have adopted the dress and habits of the fellahin. In Nubia they live in villages, and their principal means of livelihood include agriculture, fishing, peddling, charcoal-burning, wood-gathering and trading in gums and drugs. The Abābda build huts with hurdles and mats or live in natural caves. Their chief means of transportation is the camel and their chief foods are milk and durra. They are very superstitious, believing, for example, that evil would overtake a family if a girl member should, after her marriage, ever set eyes on her mother; hence the Abābda husband has to make his home far from his wife's village. In the Mahdist troubles (1882-98) many "friendlies" were recruited from this tribe.

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ABACÁ FIBRE, the most valuable of all fibres for cordage, the product of *Musa textilis* (family Musaceae). This fibre is also known in the trade as manila and manila hemp, but abacá is a hard fibre and is entirely different from true hemp, which is a soft fibre and is the product of *Cannabis sativa*.

The abacá plant, which resembles in appearance the banana and plantain, to which it is closely related, is a perennial growing from short rootstocks. Numerous suckers grow from the rootstocks, forming a cluster of stalks 10 to 25 ft. in height. These stalks are formed by the broad, overlapping leaf stems and bear at the top a crown of large, undivided leaves. The point of growth is at the base, and the fibre is obtained from the outer portion of each successive leaf stem. The flower stalk is pushed up through the centre of the plant, bearing at the top flowers that are followed by fruits similar to small bananas but filled with black seeds. Abacá plants grown from seeds do not come true to type, and this plant is propagated from suckers or from rootstocks.

The abacá plant flowers when about two years old, at which stage it is in the most favourable condition for the production of fibre. The stalk is then cut down, and the outer fibre-bearing layer of each successive leaf stem is stripped off in the form of ribbons, known as "tuxies." The tuxies are pulled under a knife that is pressed against a block of wood by means of a bamboo spring. This scraping process removes the pulp and other waste material, leaving the cleaned fibre in the hands of the operator. The fibre so cleaned has only to be hung up to dry in the open air, when, without further treatment, it is ready to be graded and baled for shipment. A small machine that is an adaptation of the hand cleaning process is used rather extensively in the Philippines. In operating this machine, the tuxie is looped around a revolving wooden spindle, which draws it under the stripping knife. Large

automatic machines, of the same type as the sisal-cleaning machines, are used for cleaning abacá fibre in the Netherlands Indies and in countries of Latin America.

The quality or grade of abacá fibre is determined by the part of the stalk from which the fibre is obtained, by the amount of serration of the stripping knives and the degree of tension holding the knife against the block, and by prompt and careful drying of the fibre. The outer sheaths of the abacá stalk contain a rather short, strong but discoloured fibre; the middle sheaths produce a fibre of medium colour and good strength; the sheaths near the centre of the stalk have a very white, fine fibre of medium strength. In the process of cleaning abacá fibre, the use of coarsely serrated stripping knives and the lack of proper tension on the stripping knife result in the production of coarse, low-grade fibre. Delay and carelessness in drying affect both the colour and the strength of the fibre.

The exceptional strength of abacá fibre and its quality of resistance to the action of salt water make it particularly suitable for marine cordage. It is also largely used for well-drilling cables, hoisting ropes and various other types of rope where strength and durability are required. Henequen and sisal have largely replaced abacá as a binder twine fibre. In the Philippines the superior grades of abacá are used for textile fabrics, hats, slippers, rugs and various other articles. In Japan, large quantities of abacá fibre, and particularly the waste products, are used for the manufacture of paper. From the old and disintegrated ropes is made the well-known manila paper.

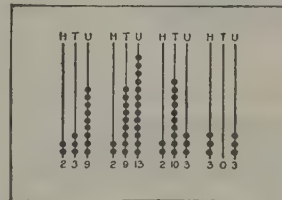
The abacá plant has been introduced into many different tropical regions, including the Netherlands Indies, India, the Andaman Islands, the West Indies and Central America; formerly the commercial production of this fibre was confined to the Philippine Islands. About 1921, shipments of abacá rootstocks were made from the Philippine Islands to Sumatra, where fairly large plantings were made. Despite some expansion of the industry there, it remained relatively unimportant. Small abacá plantings were also made in North Borneo. In 1925 a shipment of propagating material of the superior varieties of abacá was brought from the Philippine Islands to the Republic of Panama by the United States department of agriculture. It was determined by experimental plantings that the climatic and soil conditions of this region are suitable for the abacá plant; that this plant is resistant to the more serious diseases of the banana plant and that abacá fibre of excellent quality can be produced in tropical America. In 1937 and 1939 these plantings were expanded to about 2,000 acres, and in 1942 there was a larger expansion both in Panama and in other countries of Central America. (H. T. Es.)

ABACUS, an early device for tracing numerals on a dust covered board. There have been three standard types: (1) a board covered with dust, whence the derivation, or, at a later period, with wax, and serving the same purpose as a slate in the 19th

century or as the modern pad of paper; (2) a table marked with lines upon or between which were placed loose counters in the form of small discs of metal, bone, glass or other material, or (in China) in the form of rods; and (3) a table on which the counters were fastened by means of grooves.

The early counter abacus was a table with lines to represent units, tens, hundreds, etc., or to represent different units of value, like pounds, shillings and pence.

Addition on such an abacus was doubtless performed as represented in fig. 1, which shows the successive steps in the addition of 64 and 239. Subtraction was simply the process of taking away counters; multiplication was considered as repeated addition, and division as repeated subtraction. This type of abacus was known in the Mediterranean countries, and Herodotus (c. 450 B.C.) is authority for the statement that the Egyptians wrote their figures



FROM SMITH, "HISTORY OF MATHEMATICS"
FIG. 1.—A PROBABLE FORM OF
EARLY COMPUTATION

The lines represent hundreds, tens and units. The computation represented is:

$$239 + 64 = 29[13] = 2[10]3 = 303$$

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and reckoned with pebbles "bringing the hand from right to left," while the Greeks proceeded in the opposite direction. There are several references to the abacus in Roman literature, and what is apparently a Greek computing table was found in the 19th century on the island of Salamis.

Latin writers tell of three types of abacus in use in Rome,

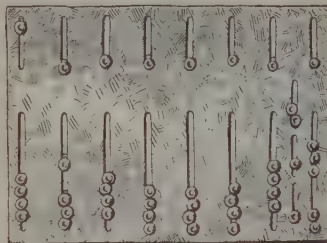


FIG. 2

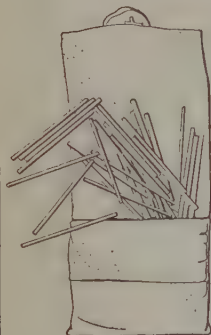


FIG. 3

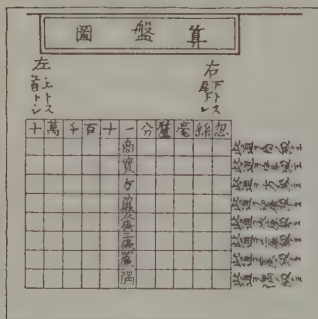


FIG. 4

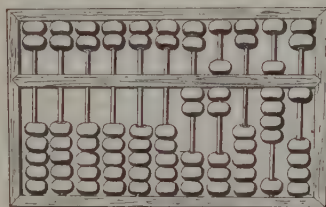


FIG. 5



FIG. 6

FROM SMITH, "HISTORY OF MATHEMATICS"

VARIOUS TYPES OF EARLY COMPUTING DEVICES

Fig. 2.—A late Roman abacus, whose source is unknown. This bronze piece of uncertain date has grooves in which the counters slide. Each upper button represents five units and each lower button one unit of the order in which the column stands.

Fig. 3.—Korean computing rods. Made of bone, these rods were used in the native Korean schools until the end of the 19th century.

Fig. 4.—A Japanese ruled "Sangi" board. Upon this board the computing rods ("Sangi") were placed to represent algebraic coefficients.

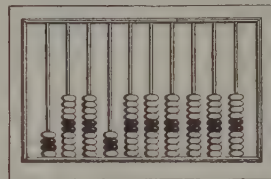
Fig. 5.—A modern Chinese abacus. The "suan-pan" was used as early as the 12th century. The number represented is 27091. Each upper bead has a value of five of its order and each lower bead the value of one of its order. Often employed in Chinese laundries.

Fig. 6.—A Japanese abacus. The "soroban" was in use as early as the 16th century. The number represented in the central part is 90278.

namely: (1) the sand board or the wax tablet, (2) a marked table for counters, and (3) a table with grooves in which the counters were free to slide. Fig. 2 shows a late Roman abacus now in the British museum, each upper button representing five units of the order in which the column stands, and each lower button

representing one unit of the same order. Cicero (*Phil. Frag.*, V, 59) speaks of the counters as *aera* (bronzes), but the common name was *calculi* (pebbles) or *abaculi*, the pieces being made of stone, ivory (Juvenal, xi, 131), metal or coloured glass (Pliny, *Hist. Nat.*, xxxvi, 26, 67).

The earliest type of abacus in China seems to have been the "bamboo rods" that served instead of counters. These were known as early as the 6th century B.C. and they survived in Korea until the close of the 19th century (fig. 3). They found their way into Japan about the year 600 and were known as *sangi* or *sanchu*. Until recent times they were used to represent algebraic coefficients, being placed on a board ruled as shown in fig. 4.



FROM SMITH, "HISTORY OF MATHEMATICS"

FIG. 7.—A RUSSIAN ABACUS

The "s'choty" of the Russians, "ohreb" of the Armenians or "ouba" of the Turks. The wires are slightly arched, a feature which is not shown in the illustration.



FROM SMITH, "HISTORY OF MATHEMATICS"

FIG. 8.—A MEDIAEVAL COMPUTING TABLE

This method of ruling the computing board was extensively used in the middle ages.

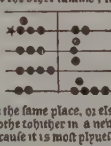
Since the 12th century the *suan-pan* (computing tray; see fig. 5) has been generally used throughout China. The chief difference between this and the Roman abacus lies in the fact that it has one more bead in each section. In the 16th century this type, slightly changed and bearing the kindred name of *soroban* (fig. 6), found its way into Japan, where it is still in use. An abacus differing considerably from the Roman or oriental types is found in the middle eastern countries. The Turks call it the *coulba*; the Armenians, the *choreb*; and the Russians, the *s'choty* (fig. 7). As in the case of the *suan-pan* and the *soroban*, this permits of rapid computation and serves a purpose similar to that of the modern calculating machines (*q.v.*).

There appeared in Europe in the middle ages the line abacus. This type of abacus consisted of a table ruled with horizontal lines

representing the successive powers of ten, each space representing half the value of the line immediately above it (fig. 8). This type was in use until well into the 18th century. A pupil who could compute on such a table was said to "know the lines," and the verb "to abacus" was used as the equivalent of the verb "to compute." The method employed may be inferred from a passage in Robert Recorde's *Ground of Artes* (about 1542) as shown in fig. 9.

ADDITION.

Matter.
*W*he each *lyn* in this *arte* is to *abbe* but two *lummes* at ones together: *h*ow be it, you maye *abbe* more, as *I* will tel you anon. Therefore whene you will *abbe* two *lummes*, you shall firste set downe one of them, it foureth not to be, and then by it *h*ow to a line crosse the other *lyn*es. And afterwarde sette downe the other *lumme*, so that that *lyn* maye be betwene them: as if you would *abbe* 255 to 8349, you must set four *lummes* as you see here.



FROM SMITH, "HISTORY OF MATHEMATICS"

This reduced page, from the edition of 1558, shows the first step in the addition of 2659 and 8342.

The discs that were used in computing were commonly known in Great Britain as "counters" (countures, countouris); in the Latin books as *projectiles* (*pro*, forward, + *jacere*, to throw), being thrown or cast upon the counting board, or as *denarii supputarii* (computing pennies); and in France as *jetons* (with many such variants as *gects*, *jectoires*, *jettons* and *jettons*, from *jacere*, to throw). In Germany a counter was called a *Rechenpfennig* or *Zählpfennig* (number penny). Such later expressions as "cast an account," "borrow one," "carry two," and possibly "lay a wager" have their origin in this kind of computation. The Court of the Exchequer, the "counting house," the "counter" in the modern shop, billiard counters, poker "chips," and various games trace their origin to the counting board.

Gerbert (c. 1000), who became Pope Sylvester II, invented an "arc abacus" in which each counter bore a certain Indo-Arabic numeral excepting the zero, the periods in groups of three being united by an arc. It had little recognition, however, for as soon as the significance of the zero became apparent (see NUMERALS) it was manifestly of no value.

(See CALCULATING MACHINES; FINGER NUMERALS.)

(D. E. S.)

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ABACUS, in architecture, the upper member of a column capital whose function is to provide a supporting surface for the structure above. In Egyptian capitals it is smaller than the parts below and in the late work it has great height. In the Greek Doric order it is a plain square slab, but in the Roman Doric it is usually crowned by a moulding. In the Greek Ionic order it is at first rectangular, to cap the projection of the volutes, but later becomes square, except at corner capitals where it is curved out over the angle volutes. In both Greek and Roman Corinthian orders and in the composite and four-sided or Scamozzi Ionic order it is moulded with concave sides and usually the corners are cut off slightly. In Romanesque architecture the abacus usually is square, with sides played or moulded, and in the Gothic, outside of England, it is square or octagonal and richly moulded. In English Gothic, however, circular forms are frequent, especially in 13th-century work. The diminutive, *abaciscus*, is applied to the squares of a tessellated pavement.

ABADAN (Iran), an island situated in the delta of the Shatt-al-Arab (q.v.), 40 mi. in length, from 2 to 12 mi. in breadth, bounded on the north and east by the Karun river (q.v.) and its tributary, the Bahmishir, on the west by the Shatt-al-Arab, and on the south by the Persian gulf. It is known to Arabs as Jazirat-ul-Khidhr from a tomb situated on the Bahmishir dedicated to the saint of that name. Abadan is referred to by the historian Nasir Khusrau, writing in the 13th century, as the most southerly settlement of Mesopotamia, and it is not improbable that it is identical with the site of the port Charax mentioned by Herodotus. The possession of this island was long in dispute between Persia and Turkey. It was definitely allotted to Persia by the treaty of Erzerum, 1847, the Turks however retaining control of the whole of the Shatt-al-Arab while ensuring to Persia freedom of navigation.

In 1909 the Anglo-Persian Oil Company, Ltd. (q.v.), under a lease agreement with the local overlord, the sheikh of Mohammerah, established its pipe-line terminus and refinery on the island between the hamlets of Braim and Bawardah, and this settlement, now known as Abadan (lat. 30° 21' N., long. 48° 17' E.), developed into a town of between 50,000 and 60,000 people, organized by the Iranian government as a municipality. Fifteen deep-water jetties have been built along the foreshore to facilitate the loading of tankers and the unloading of machinery, etc. Exports of oil during 1942 from Abadan totalled nearly 5,000,000 tons. During the same period imports of machinery, etc., unloaded at Abadan totalled about 85,000 tons, with a value of more than 164,000,000 rials. There is an excellent equipment of derricks and travelling cranes and several berths for good-sized vessels. The distance along the pipe line from Masjid Suleiman to Abadan is about 137 mi. Communication exists by a very good motor road from Abadan to Mohammerah, 9 mi.; from Abadan to Ahwaz up the pipe line, 78 mi., and thence to Masjid Suleiman, a further 68 mi. A motor road also exists from Basra (q.v.) to Sibah, opposite Abadan, on the right bank of the Shatt-al-Arab.

See J. W. Williamson, *In a Persian Oil Field*, 2nd. ed. (1930).

ABADDON, a Hebrew word meaning "destruction." In poetry it comes to mean "place of destruction," and so the underworld or Sheol (cf. Job xxvi, 6). In Rev. ix, 11 Abaddon is used of hell personified, the prince of the underworld. The term is here explained as Apollyon (q.v.), the "destroyer."

ABADEH, a small town of Iran, lying more than 6,000 ft.

above sea level in a fertile tract on the road between Isfahan and Shiraz. It has telegraph and post offices, and is famed for its woodwork; small boxes, trays and spoons with elaborately carved lacelike handles are made of pear and boxwood.

ABAE, a town in Greece, in the northeastern corner of Phocis, famous in early times for its oracle of Apollo, one of those consulted by Croesus (Herod. i, 46). Its rich treasures (Herod. viii, 33) were sacked by the Persians, and the temple remained ruinous. The oracle was, however, still consulted, e.g., by the Thebans before Leuctra (Paus. iv, 32, 5). The temple, burned again during the Sacred War, was very dilapidated when seen by Pausanias (x, 35); some restoration and the building of a new temple was undertaken by Hadrian. Privileges due to the sanctity of the shrine (*Bull. Corresp. Hell.* vi, 171), were confirmed to the people of Abae by the Romans. The polygonal walls of the acropolis may still be seen, with one gateway and traces of town walls below. See V. W. Yorke, "Excavations at Abae," *Journal of Hellenic Studies*, 16: 291-312 (London, 1896).

ABAILARD: see ABÉLARD, PETER.

ABAKANSK, or Abakan, capital of Khakass autonomous region in the Krasnoyarsk province of the R.S.F.S.R. Pop. of region (1939) 270,655. Area 19,276 sq.mi. It is situated in 54° 26' N. and 91° 15' E., north of the junction of the Abakan river with the Yenisei river; it is a river port with a wharf. It lies in the fertile and sheltered Minusinsk oasis and is linked by river to Krasnoyarsk on the Trans-Siberian railway; the railway from Achinsk to Minusinsk passes it on the west bank of the river. It is a centre for grain, potatoes, cattle, beekeeping products, etc., but is liable to occasional severe floods. Near it are *tumuli* of the Li-Kitai and statues 7 to 9 ft. high, covered with hieroglyphs. Abakansk had in 1939 a population of 13,500.

ABALONE (a Spanish word of unknown derivation), the name given in California to various species of molluscs of the widely distributed genus *Haliotis* ("ear shells," Ormers). The shell of these animals yields mother-of-pearl and is used in button-making and inlaying. The abalone was a favourite article of food among the Indians of California, and is still eaten there as well as in Japan and China. The Californian abalone is represented by various species; *Haliotis splendens*, *H. rufescens* and *H. cracherodii* are the most important ones. (See ORMER.)

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ABANA (or, as indicated to be read in the Hebrew text, *Amana*, classical *Chrysorrhoea*) and PHARPAR (Heb. *Parpar*) the "rivers of Damascus" (II Ki. v, 12). They are commonly identified with the two most important rivers of the district, the Barada, flowing through Damascus from its source in the Anti-Lebanon, and the 'Awaj, some 8 mi. S. of Damascus with its source in the Hermon range. The size of the rivers was probably of less moment than the sacredness of their waters. Abana (or Amana) may well be the Barada. A tributary, the Nahr Banias, perhaps retains an echo of the name. North of the 'Awaj is the independent Barbar in which we seem to have the name Pharpar. All the rivers of the district are either entirely dissipated in irrigation or eventually lose themselves in marshes to the east.

ABANCOURT, CHARLES XAVIER JOSEPH DE FRANQUEVILLE D' (1758-1792), French statesman, was Louis XVI's last minister of war (July 1792), and organized the defense of the Tuileries for Aug. 10. He was arrested for treason to the nation and sent to Orléans to be tried. At the end of August the assembly ordered Abancourt and the other prisoners at Orléans to be transferred to Paris. At Versailles the escort learned of the massacres at Paris, and Abancourt and his fellow-prisoners were murdered on Sept. 8, 1792.

ABANDONMENT, in law, the relinquishment of an interest, claim, privilege or possession. Its signification varies according to the branch of the law in which it is employed, but the more important uses of the word are summarized below.

ABANDONMENT OF AN ACTION is the discontinuance of proceedings commenced in the High Court of Justice either because

the plaintiff is convinced that he will not succeed in his action or for other reasons.

Previous to the Judicature act of 1875, considerable latitude was allowed as to the time when a suitor might abandon his action, and yet preserve his right to bring another action on the same suit; but since 1875 this right has been considerably curtailed, and a plaintiff who has delivered his reply, and afterward wishes to abandon his action, can generally obtain leave so to do only on condition of bringing no further proceedings in the matter. (See PRACTICE AND PROCEDURE.)

ABANDONMENT IN MARINE INSURANCE is the surrender of the ship or goods insured to the insurers, in the case of a constructive total loss of the thing insured. For the requisites and effects of abandonment in this sense see MARINE INSURANCE.

For the *abandonment* of a child of any age, see the article CHILDREN: PROTECTIVE LAWS.

ABANDONMENT OF DOMICILE is the ceasing to reside permanently in a former domicile coupled with the intention of choosing a new domicile. The presumptions which will guide the court in deciding whether a former domicile has been abandoned or not must be inferred from the facts of each individual case. (See DOMICILE.)

ABANDONMENT OF AN EASEMENT is the relinquishment of some accommodation or right in another's land, such as right of way, free access of light and air, etc. (See EASEMENT.)

ABANO, PIETRO D' (c. 1250–c. 1316), known also as PETRUS DE APONO or APONENSIS, Italian physician and philosopher, was born at Abano in 1250 or 1246. After studying medicine and philosophy at Paris he practised at Padua. He was twice brought to trial by the Inquisition on a charge of practising magic; on the first occasion he was acquitted, and he died before the second trial was completed. His best known works, in which he advocates the systems of Averroes and other Arabian writers, are the *Conciliator differentiarum quae inter philosophos et medicos versantur* and *De venenis eorumque remediis*.

ABANO TERME, a town in the province of Padua, Italy, on the eastern slope of Monti Euganei, 6m. S.W. by rail of Padua. Pop. (1936) 1,232 (town), 7,062 (commune). Its popular hot springs and mud baths were known to the Romans as *Aponi fons* or *Aquae Patavinæ*. Ancient remains have been found. The Italian *Comando Supremo* was fixed here from Jan. 1918 to the signing of the Armistice, Nov. 3, in the local Villa Giusti.

ABANTES, the traditional name of the ancient inhabitants of Euboea, to whom was also ascribed the building of the town of Abae in Phocis.

ABARBANEL: see ABRABANEL, ISAAC.

ABASGIA: see GEORGIA.

ABATED, an obsolescent technical term applied in masonry and metal work to portions sunk beneath the general surface, as in panels where the background is sunk so as to leave letters or ornament in relief.

ABATEMENT, a beating down or diminishing, a term used especially in various legal phrases.

Abatement of a nuisance is the remedy of destroying or removing, allowed by law to a person or public authority injured by a public nuisance, provided no breach of the peace is committed in doing so. In the case of private nuisances abatement is also allowed provided there be no breach of the peace, and no damage be occasioned beyond what the removal of the nuisance requires (see NUISANCE).

Abatement of freehold takes place where, after the death of the person last seized, a stranger enters upon lands before the entry of the heir or devisee, and keeps the latter out of possession. It differs from intrusion, which is a similar entry by a stranger on the death of a tenant for life, to the prejudice of the reversioner, or remainder man; and from disseisin, which is the forcible or fraudulent expulsion of a person seized of the freehold (see FREEHOLD).

Abatement of debts and legacies.—When the assets of a deceased person are not sufficient to satisfy fully all the various creditors, their debts must abate proportionately, and they must accept a dividend. Also, in the case of legacies, when the

funds or assets out of which they are payable are not sufficient to pay them in full, the legacies abate in proportion, unless there is a priority given specially to any particular legacy (see LEGACY). Annuities are subject to the same rule as general legacies.

Abatement in pleading, or plea in abatement, was directed to defeating or quashing a particular action by some matter, such as a defect in form or the personal incompetency of the parties suing, pleaded by the defendant. All pleas in abatement are now abolished (Rules of the Supreme Court Order 21). In criminal proceedings the plea in abatement was nullified by the Criminal Law act, 1826, which required the court to amend according to the truth, and the Criminal Procedure act, 1851, which rendered description of the defendant unnecessary.

Abatement in litigation.—In civil proceedings, no action abates by reason of the marriage, death or bankruptcy of any of the parties, if the cause of action survives or continues, and does not become defective by the assignment, creation or devolution of any estate or title *pendente lite* (R.S.C. Order 17). Criminal proceedings do not abate on the death of the prosecutor, being in theory instituted by the Crown, but the Crown itself may bring about their termination without any decision on the merits and without the assent of the prosecutor.

Abatement in heraldry is a badge in coat-armour, indicating degradation or dishonour. It is called also *rebatement*.

Abatement in taxation.—A reduction in assessment to taxation or in rate of tax, which is made to remove anomalies, mitigate hardship or refine a scale of duties. Abatements have long been a special feature of the British income-tax system. For many years a rough-and-ready graduated income-tax was formed by imposing a fixed poundage rate upon all incomes of whatever size, and providing in the Finance Act for (1) the total exemption of very small incomes and (2) the reduction or "abatement" of the assessments made upon incomes above the exemption limit and not exceeding certain moderate amounts. This abatement system has been swept away, but abatements of assessment to mitigate rate of tax are still made in respect of the maintenance of wife and young children and the payment of a life insurance premium. (See INCOME TAX.) In the United States abatement of State and local taxation is governed solely by statute, and the laws of the various States and the court decisions thereunder should therefore be consulted for specific information. Abatement of Federal taxation is also purely statutory; and the question is governed exclusively by numerous Acts of Congress, including Sec. 3220 of the Revised Statutes (as amended) and the various Federal revenue acts together with the regulations thereon. (See TAXATION.)

ABATI (ah-bah'te), **NICCOLO** or DEL' ABBATO (1512–1571), a celebrated fresco-painter of Modena, whose best works are there and at Bologna. He accompanied Primaticcio to France, and assisted in decorating the palace at Fontainebleau (1552–71). A fine example of his work, representing the martyrdom of St. Peter and St. Paul, is in the Dresden Gallery.

ABATIS, **ABATTIS** or **ABBATTIS** (a French word meaning a heap of material thrown), a term in field fortification for an obstacle formed of the branches of trees laid in a row, with the tops directed towards the enemy and interlaced or tied with wire. The abatis is used alone or in combination with wire-entanglements and other obstacles.

"A" BATTERY, a battery which provides heating current for the filament of a vacuum tube (see ELECTRON TUBE).

ABATTOIR: see SLAUGHTERHOUSE.

ABAUZIT (ah-bō-zē), **FIRMIN** (1679–1767), French scholar, was born of Protestant parents at Uzès, in Languedoc, Nov. 11, 1679, and died at Geneva, March 20, 1767. After the revocation of the Edict of Nantes in 1685 his family took refuge in Geneva, where he received his education. Abauzit visited Holland and England, and was one of the earliest defenders of the discoveries of Sir Isaac Newton. He declined an offer from William III to settle in England, also the offer of the chair of philosophy at Geneva. A sinecure as librarian to the city of Geneva gave him leisure to pursue his multifarious studies. J. J. Rousseau praises him in *Nouvelle Héloïse*, and Voltaire, when a visitor said he had come to see a great man, asked if he

had seen Abauzit. A collection of his writings was published at Geneva in 1770, and another in London in 1773.

Information regarding Abauzit will be found in J. Senebier's *Histoire littéraire de Genève*, Harwood's *Miscellanies* and W. Orme's *Bibliotheca Biblica* (1824).

'**ABBA 'ARIKA**, the name of the Babylonian 'amora of the 3rd century, who established at Sura the systematic study of the Rabbinic traditions which, using the Mishnah as text, led to the compilation of the Talmud. He is commonly known as Rab.

ABBADIDES, a Mohammedan dynasty which arose in Spain on the downfall of the western caliphate. The founder of the house was Abu'l-Qāsim Mohammed, the cadi of Seville in 1023. When he died in 1042, he had created a state which, though weak in itself, was strong as compared with the little powers about it. He had made his family the recognized leaders of the Mohammedans of Arab and native Spanish descent against the Berber element, whose chief was the king of Granada. Abbād, surnamed al-Motaqid, his son and successor, is one of the most remarkable figures in Spanish Mohammedan history. A poet and a lover of letters, he was also a poisoner, a drinker of wine, a sceptic and treacherous to the utmost degree. He killed with his own hand one of his sons who had rebelled against him. On one occasion he trapped a number of his enemies, the Berber chiefs of the Ronda, into visiting him in the Alcazar at Seville and got rid of them by smothering them in the hot room of a bath. It was his taste to preserve the skulls of the enemies he had killed—those of the poorer men to be used as flowerpots, while those of the princes were kept in special chests. His reign until his death on Feb. 28, 1069, was mainly spent in extending his power at the expense of his smaller neighbours and in conflicts with his chief rival, the king of Granada. After 1063 he was assailed by Ferdinand the Great of Castile and Leon, who marched to the gates of Seville and forced him to pay tribute. His son, Mohammed Abu'l-Qāsim—who reigned by the title of al-Motamid—was the third and last of the Abbādides. He went further in patronage of literature than his father, for he chose as his favourite and prime minister the poet Ibn Ammar. He carried on the feuds of his family with the Berbers and in his efforts to extend his dominions could be as faithless as his father. In 1080 he brought down upon himself the vengeance of Alphonso VI of Castile by a typical piece of slightly oriental barbarity. He had endeavoured to pay part of his tribute to the Christian king with false money. The fraud was detected by a Jew, who was one of the envoys of Alphonso. Al-Motamid, in a moment of folly and rage, crucified the Jew and imprisoned the Christian members of the mission. Alphonso retaliated by a destructive raid. When Alphonso took Toledo in 1085, al-Motamid called in Yusuf ibn Tashfin, the Almoravide (see SPAIN: *History* and *ALMORAVIDES*). During the six years which preceded his deposition in 1091, al-Motamid behaved with valour on the field, but with much meanness and political folly. It was probably during this period that he surrendered his beautiful daughter Zaida to the Christian king, who made her his concubine and is said by some authorities to have married her after she bore him a son, Sancho. In 1091 the Almoravides stormed Seville. Al-Motamid, who had fought bravely, was weak enough to order his sons to surrender the fortresses they still held, in order to save his own life. He died in prison in Africa in 1095.

See R. P. A. Dozy, *Histoire des Musulmans d'Espagne* (Leyden, 1861; 2nd ed., 1932); and *Historia Abbadidarum (Scriptorium Arabum loci de Abbadidis, Leyden, 1846)*. (D. H.)

ABBADIE, ANTOINE THOMSON D' (1810-1897), and **ARNAUD MICHEL D'** (1815-1893), travellers, were born in Dublin, of a French father and an Irish mother. The parents moved to France in 1818. In 1835 the French academy sent Antoine on a scientific mission to Brazil, the results being published in 1873 under the title of *Observations Relatives à la physique du globe faites au Brésil et en Éthiopie*. The younger Abbadie spent some time in Algeria before the two brothers started for Abyssinia in 1837, landing at Massawa in Feb. 1838. After collecting much information on the geography, geology, archaeology and natural history of Abyssinia, the brothers returned to France in 1848. The younger brother, Arnaud, paid another visit

to Abyssinia in 1853. Antoine became involved in various controversies relating both to his geographical results and his political activities in Abyssinia. Time and the investigations of subsequent explorers have shown that Abbadie was quite trustworthy as to his facts, though wrong in his contention that the Blue Nile was the main stream. The topographical results of his explorations were published in Paris in 1860-73 in *Géodésie de l'Éthiopie*. Of the *Géographie de l'Éthiopie* (1890) only one volume has been published. *Un Catalogue raisonné de manuscrits éthiopiens* (1859) contains a description of 234 Ethiopian manuscripts collected by Antoine. He published numerous papers dealing with the geography of Abyssinia, Ethiopian coins and ancient inscriptions. His *Reconnaisances magnétiques* (1890) is an account of the magnetic observations made by him in the course of several journeys to the Red sea and the Levant.

The general account of the travels of the two brothers was published by Arnaud in 1868 under the title of *Douze ans dans la Haute-Éthiopie*. Antoine died in 1897 and bequeathed an estate in the Pyrenees, yielding 40,000 francs a year, to the Academy of Sciences, on condition of its producing within 50 years a catalogue of 500,000 stars. His brother Arnaud died in 1893.

'**ABBAHU**, the name of a Palestinian rabbi who flourished c. 279-320. 'Abbahu encouraged the study of Greek by Jews. He is very often cited in the Talmud.

ABBA MARI (in full, Abba Mari ben Moses ben Joseph), French rabbi, was born at Lunel, near Montpellier, toward the end of the 13th century. He is also known as Yari from his birthplace (Heb. *Yerah*; i.e., "moon," *lune*), and he further took the name Astruc, Don Astruc or En Astruc of Lunel. In Montpellier, where he lived from 1303 to 1306, he was much distressed by the prevalence of Aristotelian rationalism, which, through the medium of the works of Maimonides, threatened the authority of the Old Testament, obedience to the law, and the belief in miracles and revelation. He, therefore, in a series of letters (afterward collected under the title *Minhat Kenaot*; i.e., "Jealousy Offering") called upon the famous rabbi Solomon ben Adret of Barcelona to come to the aid of orthodoxy. Ben Adret, with the approval of other prominent Spanish rabbis, sent a letter to the community at Montpellier proposing to forbid the study of philosophy to those who were less than 30 years of age, and, in spite of keen opposition from the liberal section, a decree in this sense was issued by Ben Adret in 1305. The result was a great schism among the Jews of Spain and southern France, and a new impulse was given to the study of philosophy by the unauthorized interference of the Spanish rabbis. On the expulsion of the Jews from France by Philip IV in 1306, Abba Mari settled at Perpignan, where he published the letters connected with the controversy.

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'**ABBÂS I** (1571-1629), shah of Persia, called the Great, was the son of Shah Mohammed Khudābanda (d. 1595). In 1581 he was proclaimed ruler of Khurāsān, and became shah in 1587 on his father's abdication. Confronted with anarchy in Persia and foreign invasion, he made peace with Turkey, subdued the rebels and attacked the Uzbegs, who were ravaging Khurāsān. In 1598 he regained Meshed, and shortly afterward defeated and expelled the Uzbegs. Three years later he reopened the war with Turkey, and in a series of campaigns in the northwest regained Tabriz (1604) and most of the Caucasian territories surrendered by the earlier treaty, including Georgia and Shirvan. The war continued, with intervals, to the end of his reign; in 1623 his troops occupied Baghdad, but failed to hold Mosul or to seize Basra. In 1622, with the aid of the English East India company, he expelled the Portuguese from the island of Hormuz, and much of its trade was diverted to Gombroon, renamed Bandar 'Abbās after him.

The military successes of Shah 'Abbās were largely the result of his reorganization of the army. In place of the tribal levies he created a regular force, thus not only gaining in efficiency but also reducing his dependence on the great nobles and tribal chiefs. An Englishman Sir Robert Sherley greatly improved the Persian

artillery. 'Abbās' reign was distinguished not only by military successes and administrative efficiency but also by the magnificence of his court and the splendid buildings that he erected, notably at his capital, Isfahan. He fostered industry and commerce by constructing highways, bridges and caravanserais, by granting privileges to his Armenian subjects and by encouraging the English and Dutch East India companies to trade in Persia. In religious matters he was generally tolerant. His fame was, however, tarnished by deeds of tyranny and cruelty; he put his eldest son to death and blinded another.

See L. L. Bellan, *Chah Abbas I, sa vie, son histoire* (Paris, 1932); Sir Edward Denison Ross (ed.), *Sir Anthony Sherley and His Persian Adventure* (London, 1933). (L. Lo.)

ABBAS I (1813–1854), pasha of Egypt, was a son of Tusun Pasha and grandson of Mohammed Ali. As a young man he fought in Syria under Ibrahim Pasha (*q.v.*), his real or supposed uncle. The death of Ibrahim in Nov. 1848 made Abbas regent of Egypt, and in Aug. 1849, just before the death of Mohammed Ali, he succeeded to the pashalik. He was reactionary, cruel, morose and taciturn and spent nearly all his time shut up in his palace. He undid, as far as he could, the works of his grandfather, good and bad. Among other things, he abolished trade monopolies, closed factories and schools and reduced the army to 9,000 men. At the instance of the British government he allowed the construction of a railway from Alexandria to Cairo. On July 13, 1854, he was murdered in Benha palace by two of his slaves.

ABBAS II, otherwise known as **ABBAS HILMI PASHA** (1874–1944), the last khedive of Egypt, was born in Cairo on July 14, 1874, and became the seventh ruler of the line of Mohammed Ali when he left his studies in Vienna to succeed his father, Tewfik Pasha, on Jan. 8, 1892. British official opinion attributed his marked Anglophobia to the early influence of his European education; but the tutelage of the British agent (the first Lord Cromer) was naturally galling, and there was already an incipient nationalism in Egypt. Abbas never came to good terms with the British although, after a visit to England in 1900, he declared himself ready to co-operate with them. He concerned himself with several matters of public interest; *e.g.*, irrigation, education and agriculture. But the attempt on his life by an Egyptian student in July 1914 during a visit to Constantinople suggests that he disappointed the nationalists. He was still in Constantinople when Turkey entered World War I; and his return was forbidden by the British, who declared a protectorate over Egypt and deposed him (Dec. 19, 1914). He was deprived of his estates in Egypt (though in Oct. 1930 he was granted a pension of £E30,000 a year). Having attempted, rather ineffectively, to collaborate with the Central Powers during World War I, he spent the remainder of his life in exile, chiefly in Switzerland. He died at Geneva on Dec. 21, 1944.

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ABBASIDS, the name generally given to the second of the two great dynasties of the Mohammedan empire (*see* CALIPHATE). The Abbasid caliphs based their claim on their descent from al-Abbas (566–652), son of 'Abd al-Muttalib, an uncle of Mohammed, and regarded themselves as the true heirs of the Prophet, as opposed to the descendants of his cousin Ali and the Omayyad caliphs of Damascus. In the first half of the 8th century they headed a propagandist movement which gained some success among the Arabs and Persians in Khurasan and broke into open rebellion in 747. The Khurasanian armies, marching westward, defeated the Omayyad caliph Marwan II on the Greater Zab in Jan. 750 and proclaimed Abū'l-Abbas, the great-grandson of al-Abbas, as caliph.

The new dynasty encouraged the development of commerce and the liberal arts. The reigns of Harun al-Rashid (786–809) and al-Ma'mūn (813–33) at Baghdad were periods of extraordinary splendour. But the empire as a whole stagnated and then decayed: independent governors established themselves in Africa and Khurasan. The ruin of the dynasty came, however, from those Turkish slaves who were constituted as a royal bodyguard by al-Mu-

taşim (833–42). After a century of fluctuating fortunes, the caliph Radi (934–41) and his successors were constrained to hand over most of the functions of government to the commanders of their armies. The dynasty lasted for another three centuries, but without exercising temporal power, until the Mongols under Hulagu captured Baghdad (Feb. 28, 1258). A branch of the family continued to maintain a feeble show of authority, confined to religious matters, in Egypt under the Mameluke sultans, but the dynasty finally disappeared when Mutawakkil III was taken to Constantinople as a prisoner by the Ottoman sultan Selim I (1517). (H. A. R. G.)

'ABBAS MIRZA (1783–1833), Persian prince, was a younger son of Feth Ali, shah of Persia, and was nominated to succeed him. But he predeceased his father and the succession fell to his son, Mohammed Mirza. 'Abbas Mirza conducted many campaigns against Russia between 1800 and 1813 when, by the treaty of Gulistan, Georgia and other provinces were ceded to Russia. In 1826–28 he and his son were again campaigning against Russia, again with no final success, for the khanates of Erivan and Nakhichevan were ceded to Russia. In the interval of the Russian wars he fought against the Turks, winning a complete victory near Erzerum in 1821. After the final peace with Russia 'Abbas Mirza set about the reorganization of the province of Khūrasān and died at Meshed in Dec. 1833. Although 'Abbas was unsuccessful in the wars against Russia, he displayed great skill as a general, and learned something from the European soldiers who helped him to reorganize his army. He was cultured and intelligent and lived more simply than was the royal custom.

ABBAS-TUMAN, a spa in the Georgian S.S.R. (41° 44' N., 42° 46' E.). Its hot sulphur springs (93½°–118½° F.) and astronomical observatory (4,240 ft.) are noted. Population 1,243.

ABBAYE, the name given to a group of French writers, painters and musicians who, in 1906, formed a community at Crèteil, where they set up a printing press and published their works. Their number included Roger Allard, René Arcos, Henri Barzun, Albert Doyen, Georges Duhamel, Jules Romains, Charles Vildrac, etc.

ABBAZIA, in the province of Fiume, Italy, 56 mi. S.E. of Trieste by rail. Pop. (1936), 5,605 (town), 8,642 (commune, which is called Volosca-Abbazia). It is on the Gulf of Quarnero at the foot of the Monte Maggiore (4,580 ft.), sheltered and surrounded by laurel woods. The average temperature is 50° F. (winter), and 77° F. (summer). The old abbey, San Giacomo al Palo, whence the town's name, is now a villa. Abbazia used to have 50,000 visitors each year. The whole seacoast to the north and south is rocky and picturesque.

ABBE, CLEVELAND (1838–1916), U.S. meteorologist and astronomer, was born in New York city on Dec. 3, 1838. His training as astronomer under B. A. Gould, Franz Brünnow and Friedrich Struve (Pulkova, 1865–66) and work at the U.S. naval observatory developed his interest in weather changes. As director of the Cincinnati, O., observatory, 1869–73, he demonstrated the practicability of weather forecasts based on daily telegraphic synoptic charts, and in 1870 joined the U.S. signal corps to organize and direct its weather forecasts. When this greatly expanded service was transferred to the department of agriculture in 1891, he went as senior professor of meteorology. Abbe was often and justly called the "father of the weather bureau." *The Monthly Weather Review*, which he edited, was due to his initiative, and he was influential in introducing the system of standard time.

Among his works are: *Report on Standard Time* (1879); *Mechanics of the Earth's Atmosphere* (1892–1910); *Preparatory Studies for Deductive Methods* (1890); *Relation between Climate and Crops* (1901); *Physical Basis of Long-range Forecasting* (1902).

ABBE, ERNST (1840–1905), German physicist, was born in Eisenach, Thuringia, Jan. 23, 1840. He was educated at Göttingen and Jena. In 1863 he became an instructor, and in 1870 was made a professor, in the University of Jena, at which in 1878 he was appointed director of the astronomical and meteorological observatories. In 1866 he became connected with the optical works of Carl Zeiss, was made a partner in 1875, and contributed in a very large degree through his experiments to the excellence of the instruments and lenses made by the firm. In 1884, with Zeiss

and Otto Schott, he established important works for the production of technical glass. Upon the death of Zeiss in 1888 he became the sole owner of the Zeiss optical works, which he reorganized as a co-operative establishment; the officials, the workmen and the university participated in its profits. He invented the Abbe refractometer and made many improvements in microscopic and photographic lenses. His *Gesammelte Abhandlungen* were published in 1903-06. He died in Jena, Jan. 14, 1905.

See F. Auerbach, *Ernst Abbe* (1918).

ABBESS, the superior of a community of nuns. The mode of election, position, rights and authority of an abbess correspond generally with those of an abbot (*q.v.*); but she cannot exercise priestly functions. An abbess is elected by the secret votes of the sisters, installed solemnly by episcopal benediction, and has the abbatial cross, staff and ring; she holds office usually for life. The Council of Trent fixed the qualifying age at 40, with 8 years of profession. In England abbesses attended ecclesiastical councils; *e.g.*, that of Becanfield in 694, where they signed before the presbyters. Abbesses presided over many of the early joint-houses of monks and nuns, *e.g.*, at Whitby; and later the whole double order of Fontevraud (founded c. 1100) was governed by an abbess. In the German Evangelical Church the title of abbess (*Aebtissin*) has survived for the heads of abbeys which since the Reformation have continued as *Stifter*; *i.e.*, collegiate foundations for the maintenance of unmarried women, generally of noble birth, called *Stiftsdamen*.

ABBEVILLE, a city in the western part of South Carolina, U.S., 20 mi. from the Savannah river; the county seat of Abbeville county. It is served by the Seaboard railway. The population was 5,377 in 1950, 4,930 in 1940 and 4,414 in 1930 by the federal census. Cotton, tobacco and poultry are raised in the region, and clay is mined near the city. There are cotton mills in the city. Abbeville was settled about 1710 and incorporated in 1840.

ABBEVILLE, a town of northern France, the capital of an arrondissement, department of Somme, on the Somme, 12 mi. from the English channel and 28 mi. N.W. of Amiens on the Northern railway. Pop. (1946) 16,780. It is built partly on an island and partly on both sides of the river, which is canalized from this point to the estuary. The tradition of settlement extends from the Palaeolithic through the late Bronze Age (when the area was very important).

Abbeville, chief town of Ponthieu, belonged in the 9th century to the abbey of St. Riquier, and afterward to the counts of Ponthieu. It passed to the Alençon and other French families, and afterward to the house of Castille, from whom by marriage it went to Edward I of England. French and English ruled it by turns till 1435 when it was ceded to the duke of Burgundy. In 1477 it was annexed by Louis XI, and held by branches of the family until it was reunited to the crown in 1696. The streets are narrow and present an almost mediaeval appearance. The church of St. Vulfran, erected in the 15th, 16th and 17th centuries, was not entirely completed. The façade is a magnificent specimen of flamboyant Gothic flanked by two Gothic towers. Abbeville has other old churches and an hôtel de ville, with a belfry of the 13th century. Among the old houses, the Maison de François I dates from the 16th century. Situated on one of the main entries into France it became a great British base during World War I. Abbeville is an industrial centre; in addition to its old-established manufacture of cloth, hemp-spinning, sugar-making, shipbuilding and locksmiths' work are carried on; there is active commerce in grain, but the port has little trade. It has a tribunal of commerce and a board of trade-arbitrators.

ABBEY, EDWIN AUSTIN (1852-1911), U.S. painter, was born at Philadelphia April 1, 1852. He left the schools of the Pennsylvania Academy of Fine Arts at the age of 19 to enter the art department of the publishing house of Harper and Brothers in New York, where, in company with such men as Howard Pyle, Charles Stanley Reinhart, Joseph Pennell and Alfred Parsons, he became very successful as an illustrator. In 1878 he was sent by the Harpers to England to gather material for illustrations of the poems of Robert Herrick. These, pub-

lished in 1882, attracted much attention, and were followed by illustrations for Goldsmith's *She Stoops to Conquer* (1887), for a volume of *Old Songs* (1889), and for the comedies (and a few of the tragedies) of Shakespeare. His water-colours and pastels were no less successful than the earlier illustrations in pen and ink. Abbey now became closely identified with the art life of England, and was elected to the Royal Institute of Painters in Water-Colours in 1883. Among his water-colours are "The Evil Eye" (1877); "The Rose in October" (1879); "An Old Song" (1886); "The Visitors" (1890), and "The Jongleur" (1892). Possibly his best-known pastels are "Beatrice," "Phyllis," and "Two Noble Kinsmen." In 1890 he made his first appearance with an oil painting, "A May Day Morn," at the Royal Academy in London. He exhibited "Richard duke of Gloucester and the Lady Anne" at the Royal Academy in 1896, and in that year was elected A.R.A., becoming a full R.A. in 1898. Apart from his other paintings, special mention must be made of the large frescoes entitled "The Quest of the Holy Grail," in the Boston Public Library, on which he was occupied for some years; and in 1901 he was commissioned by King Edward VII to paint a picture of the coronation, containing many portraits elaborately grouped. The dramatic subjects, and the brilliant colouring of his oil pictures, gave them pronounced individuality among the works of contemporary painters. Abbey became a member not only of the Royal Academy, but also of the National Academy of Design of New York, and honorary member of the Royal Bavarian Society, the Société Nationale des Beaux Arts (Paris), the American Water-Colour Society, etc. He received first-class gold medals at the International Art Exhibition of Vienna in 1898, at Philadelphia in 1898, at the Paris Exhibitions of 1889 and 1900, and at Berlin in 1903; and was made a chevalier of the French Legion of Honour.

The last years of his life were devoted to mural paintings for the capitol at Harrisburg, Pa. Of these he undertook three, one for the House of Representatives, another for the Senate Chamber and the third for the ceiling of the dome. In 1910 there was completed under his supervision the decoration of the Peers' corridor of the Houses of Parliament at Westminster. He is represented by work at the Metropolitan Museum of Art in New York, the Boston Museum of Fine Arts and the National Gallery, London. He died in London on Aug. 1, 1911.

ABBEY, a monastery, or conventual establishment, under the government of an abbot or an abbess (Lat. *abbatia*; from Syr. *abba*, father).

The earliest Christian monastic communities (*see* MONASTICISM) with which we are acquainted consisted of groups of cells or huts collected about a common centre, which was usually the abode of some anchorite celebrated for superior holiness or singular asceticism. The formation of such communities in the East precedes Christianity, the example having been already set by the Essenes in Judea and the Therapeutae in Egypt.

In the earliest age of Christian monasticism the ascetics were accustomed to live singly, independent of one another, at no great distance from some village, supporting themselves by the labour of their own hands, and distributing to the poor the surplus after the supply of their own scanty wants. Increasing religious fervour, aided by persecution, drove them farther and farther away from the abodes of men into mountain solitudes or lonely deserts. The deserts of Egypt swarmed with the "cells" or huts of these anchorites. Anthony, who had retired to the Egyptian Thebaid during the persecution of Maximin, A.D. 312, was the most celebrated among them for his austerities, his sanctity, and his power as an exorcist. His fame collected round him a host of followers, emulous of his sanctity. The deeper he withdrew into the wilderness the more numerous his disciples became. They refused to be separated from him, and built their cells round that of their spiritual father. Thus arose the first monastic community, consisting of anchorites living each in his own little dwelling, united together under one superior. By degrees order was introduced in the groups of huts. They were arranged in lines like the tents in an encampment, or the houses in a street. From this arrangement these lines of single cells came to be known as

Laurae, Λαῦραι, "streets" or "lanes." The real founder of coenobian (κοινός, common, and βίος, life) monasteries in the modern sense was Pachomius, an Egyptian of the beginning of the 4th century. The first community established by him was at Tabennae, an island of the Nile in Upper Egypt. Eight others were founded in his lifetime, numbering 3,000 monks. Within 50 years from his death his societies could reckon 50,000 members. These

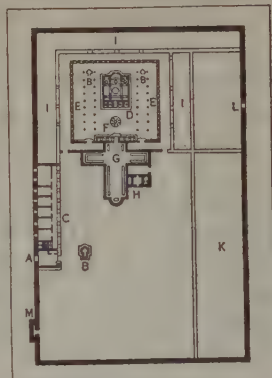
coenobia resembled villages peopled by a hard-working religious community, all of one sex. The buildings were detached, small, and of the humblest character. The coenobia of Syria belonged to the Pachomian institution. We learn many details concerning those in the vicinity of Antioch from Chrysostom's writings. The monks lived in separate huts, καλύβια, forming a religious hamlet on the mountain side. They were subject to an abbot, and observed a common rule. (They had no refectory, but ate their common meal, of bread and water only, when the day's labour was over, reclining on strewn grass, sometimes out of doors.) Four times in the day they joined in prayers and psalms.

The necessity for defence from hostile attacks, economy of space, and convenience of access from one part of the community to another, by degrees dictated a more compact and orderly arrangement of the buildings of a monastic coenobium. Large piles of building were erected, with strong outside walls, capable of resisting the assaults of an enemy, within which all the necessary edifices were ranged round one or more open courts, usually surrounded with cloisters. The usual Eastern arrangement is exemplified in the plan of the convent of Santa Laura, Mount Athos (Laura, the designation of a monastery generally, being converted into a female saint).

This monastery, like the oriental monasteries generally, is surrounded by a strong and lofty blank stone wall, enclosing an area of between 3 and 4 acres. The longer side extends to a length of about 500ft. There is only one main entrance, on the north side (A), defended by three separate iron doors. Near the entrance is a large tower (M), a constant feature in the monasteries of the Levant. There is a small postern gate at L. The *enceinte* comprises two large open courts, surrounded with buildings connected with cloister galleries of wood or stone. The outer court, which is much the larger, contains the granaries and storehouses (K), and the kitchen (H) and other offices connected with the refectory (G). Immediately adjacent to the gateway is a two-storied guest-house, opening from a cloister (C). The inner court is surrounded by a cloister (EE), from which open the monks' cells (II). In the centre of this court stands the cathedral or conventual church, a square building with an apse of the cruciform domical Byzantine type. In front of the church stands a marble fountain (F), covered by a dome supported on columns. Opening from the western side of the cloister, but actually standing in the outer court, is the refectory (G), a large cruciform building, about 100ft. each way, decorated within with frescoes of saints. At the upper end is a semi-circular recess, in which is placed the seat of the *hegumenos* or abbot. This apartment is chiefly used as a hall of meeting, the oriental monks usually taking their meals in their separate cells.

Benedictine.—Monasticism in the West owes its extension and development to Benedict of Nursia (born A.D. 480). His rule was diffused with miraculous rapidity from the parent foundation

on Monte Cassino through the whole of western Europe, and every country witnessed the erection of monasteries far exceeding anything that had yet been seen in spaciousness and splendour. Few great towns in Italy were without their Benedictine convent, and they quickly rose in all the great centres of population in England, France, and Spain. The number of these monasteries founded between A.D. 520 and 700 is amazing. Before the Council of Constance, A.D. 1415, no fewer than 15,070 abbeys had been established of this order alone. The buildings of a Benedictine abbey were uniformly arranged after one plan, modified where necessary (as at Durham and Worcester, where the monasteries stand close to the steep bank of a river) to accommodate the arrangement to local circumstances (see BENEDICTINES). We



AFTER LEMOIR

FIG. 1.—MONASTERY OF SANTA LAURA, MOUNT ATHOS. THE OLDER ABBEYS, CONSTRUCTED TO OFFER DEFENCE AGAINST ATTACKS, WERE BUILT WITH STRONG OUTER WALLS AND FEW ENTRANCES. SANTA LAURA HAD BUT TWO, THE MAIN ENTRANCE A AND THE POSTERN L

A. Gateway G. Refectory
B. Chapels H. Kitchen
C. Guest house I. Cells
D. Church K. Storehouses
E. Cloister L. Postern gate
F. Fountain M. Tower

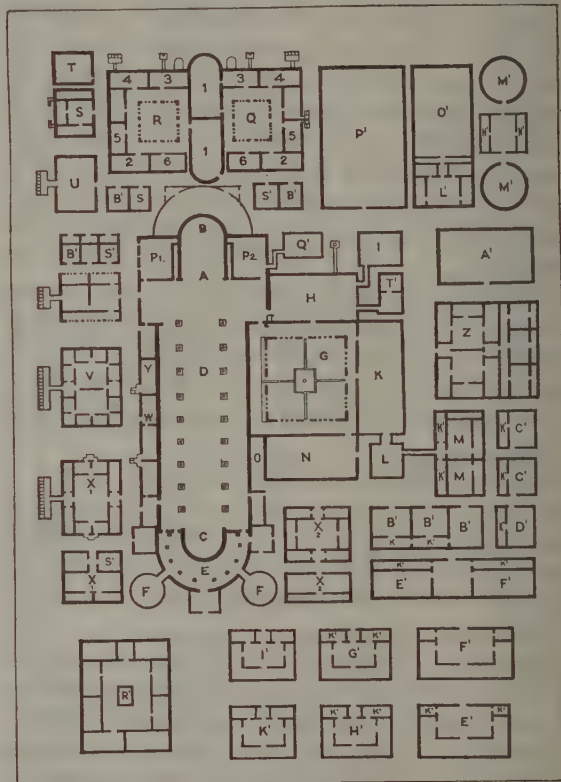


FIG. 2.—GROUND PLAN OF THE ABBEY OF ST. GALL, BUILT A.D. 820. THIS ABBEY FOLLOWED THE BENEDICTINE RULE OF BEING SELF-CONTAINED, AND HAD ITS OWN MILL AND BAKEHOUSE, TOGETHER WITH ACCOMMODATION FOR CARRYING ON ALL NECESSARY MECHANICAL ARTS

CHURCH: A. High Altar. B. Altar of St. Paul. C. Altar of St. Peter. D. Nave. E. Paradise. FF. Towers. MONASTIC BUILDINGS: G. Cloister. H. Calefactory with dormitory situated above. I. Necessary. K. Refectory. L. Kitchen. M. Bakehouse and Brewhouse. N. Cellar. O. Parlour. P1. Scriptorium, with library over. P2. Sacristy and vestry. Q. House of novices: 1. Chapel. 2. Refectory. 3. Calefactory. 4. Dormitory. 5. Master's room. 6. Chambers. R. Infirmary: 1-6 as above in house of novices. S. Doctor's house. T. Physio garden. U. House for blood-letting. V. School. W. School-

master's lodgings. X.X. Guest-house for those of superior rank. X.X. Guest-house for the poor. Y. Guest-chamber for strange monks. MENIAL DEPARTMENT: Z. Factory. A'. Threshing-floor. B'. Work-shops. C'. Mills. D'. Kiln. E'. Stables. F'. Cowsheds. G'. Goatsheds. H'. Piggsties. I'. Sheep-folds. K'. Servants' and workmen's sleeping-chambers. L'. Gardener's house. M'. Hen and duck house. N'. Poultry-keeper's house. O'. Garden. P'. Cemetery. Q'. Bakehouse for sacramental bread. R'. Unnamed on plan. S'. Kitchens. T'. Baths

have no existing examples of the earlier monasteries of the Benedictine order. But we have fortunately preserved to us an elaborate plan of the great Swiss monastery of St. Gall, erected about A.D. 820, which puts us in possession of the whole arrangements of a monastery of the first class towards the early part of the 9th century. This curious and interesting plan has been made the

subject of a memoir both by Keller (Zürich, 1844) and by Professor Robert Willis (*Arch. Journal*, 1848, vol. v., pp. 86-117). To the latter we are indebted for the substance of the following description, as well as for the plan, reduced from his elucidated transcript of the original preserved in the archives of the convent. The general appearance of the convent is that of a town of isolated houses with streets running between them. It is evidently planned in compliance with the Benedictine rule, which enjoined that, if possible, the monastery should contain within itself every necessary of life, as well as the buildings more intimately connected with the religious and social life of its inmates. It should comprise a mill, a bakehouse, stables, and cow-houses, together with accommodation for carrying on all necessary mechanical arts within the walls, so as to obviate the necessity of the monks going outside its limits.

The general distribution of the buildings may be thus described. The church, with its cloister to the south, occupies the centre of a quadrangular area, about 430ft. square. The buildings, as in all great monasteries, are distributed into groups. The church forms the nucleus, as the centre of the religious life of the community. In closest connection with the church is the group of buildings appropriated to the monastic life and its daily requirements—the refectory for eating, the dormitory for sleeping, the common room for social intercourse, the chapter-house for religious and disciplinary conference. These essential elements of monastic life are ranged about a cloister court, surrounded by a covered arcade, affording communication sheltered from the elements between the various buildings. The infirmary for sick monks, with the physician's house and physic garden, lies to the east. In the same group with the infirmary is the school for the novices. The outer school, with its headmaster's house against the opposite wall of the church, stands outside the convent enclosure, in close proximity to the abbot's house, that he might have a constant eye over them. The buildings devoted to hospitality are divided into three groups—one for the reception of distinguished guests, another for monks visiting the monastery, a third for poor travellers and pilgrims. The first and third are placed to the right and left of the common entrance of the monastery—the hospitium for distinguished guests being placed on the north side of the church, not far from the abbot's house; that for the poor on the south side next to the farm buildings. The monks are lodged in a guest-house built against the north wall of the church. The group of buildings connected with the material wants of the establishment is placed to the south and west of the church, and is distinctly separated from the monastic buildings. The kitchen, buttery, and offices are reached by a passage from the west end of the refectory and connected with the bakehouse and brewhouse, which are placed still farther away. The whole of the southern and western sides is devoted to workshops, stables and farm-buildings. The buildings, with some exceptions, seem to have been of one storey only, and all but the church were probably erected of wood.

Canterbury Cathedral.—A curious bird's-eye view of Canterbury cathedral and its annexed conventual buildings, taken about 1165, is preserved in the Great Psalter in the library of Trinity college, Cambridge. As elucidated by Prof. Willis,¹ it exhibits the plan of a great Benedictine monastery in the 12th century, and enables us to compare it with that of the 9th as seen at St. Gall. We see in both the same general principles of arrangement, which indeed belong to all Benedictine monasteries, enabling us to determine with precision the disposition of the various buildings, when little more than fragments of the walls exist. From some local reasons, however, the cloister and monastic buildings are placed on the north, instead, as is far more commonly the case, on the south of the church. There is also a separate chapter-house, which is wanting at St. Gall.

The buildings at Canterbury, as at St. Gall, form separate groups. The church forms the nucleus. In immediate contact with this, on the north side, lie the cloister and the group of

buildings devoted to the monastic life. Outside of these, to the west and east, are the "halls and chambers devoted to the exercise of hospitality, with which every monastery was provided, for the purpose of receiving as guests persons who visited it, whether clergy or laity, travellers, pilgrims, or paupers." To the north a large open court divides the monastic from the menial buildings, intentionally placed as remote as possible from the con-

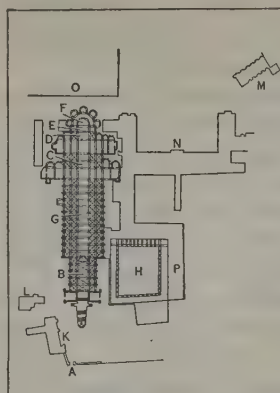


FIG. 3.—PLAN OF ABBEY OF CLUNY, FRANCE. AFTER VIOLETTÉ-DUC. CLUNY WAS THE MOST FAMOUS MONASTERY OF THE REFORMED ORDER OF BENEDICTINES. IT WAS SWEEPED AWAY AT THE END OF THE 18TH CENTURY

- | | |
|----------------|-------------------|
| A. Gateway | H. Cloister |
| B. Narthex | K. Abbot's house. |
| C. Choir | L. Guest-house |
| D. High altar | M. Bakehouse |
| E. Retro-altar | N. Abbey build- |
| F. Tomb of St. | ings |
| G. Nave | O. Garden |
| | P. Refectory |

ventual buildings proper, the stables, granaries, barn, bakehouse, brewhouse, laundries, etc., inhabited by the lay servants of the establishment. At the greatest possible distance from the church, beyond the precinct of the convent, is the eleemosynary department. The *almshouse* for the relief of the poor, with a great hall annexed, forms the paupers' hospitium.

Westminster Abbey.—Westminster abbey is another example of a great Benedictine abbey, identical in its general arrangements, so far as they can be traced, with those described above. The cloister and monastic buildings lay to the south side of the church. Parallel to the nave, on the south side of the cloister, was the refectory, with its lavatory at the door, and on the eastern side the remains of the dormitory, raised on a vaulted sub-structure and communicating with the south transept. The chapter-house opened out of the same alley of the cloister. The small cloister lay to the south-east of the larger cloister, and still farther to the east the remains of the infirmary with the *table hall*, the refectory of those who were able to leave their chambers. The abbot's house formed a small courtyard at the west entrance, close to the inner gateway. Considerable portions of this remain, including the abbot's parlour, celebrated as "the Jerusalem Chamber," his hall, now used for the Westminster king's scholars, and the kitchen and butteries beyond.

Cluny.—The history of monasticism is one of alternate periods of decay and revival. With growth in popular esteem came increase in material wealth, leading to luxury and worldliness. The first religious ardour cooled, the strictness of the rule was relaxed, until by the 10th century the decay of discipline was so complete in France that the monks are said to have been frequently unacquainted with the rule of St. Benedict, and even ignorant that they were bound by any rule at all. The reformation of abuses generally took the form of the establishment of new monastic orders, with new and more stringent rules, requiring a modification of the architectural arrangements. One of the earliest of these reformed orders was the *Cluniac*, taking its name from the little village of Cluny, 12m. N.W. of Mâcon, near which, about A.D. 909, a reformed Benedictine abbey was founded by William, duke of Aquitaine and count of Auvergne, under Berno, abbot of Beaume. He was succeeded by Odo, who is often regarded as the founder of the order. The fame of Cluny spread far and wide. Its rigid rule was adopted by a vast number of the old Benedictine abbeys, who placed themselves in affiliation to the mother society, while new foundations sprang up in large numbers, all owing allegiance to the "archabbot," established at Cluny. By the end of the 12th century the number of monasteries affiliated to Cluny in the various countries of western Europe amounted to 2,000. The monastic establishment of Cluny was one of the most extensive and magnificent in France. We may form some idea of its enormous dimensions from the fact recorded, that, when, A.D. 1245, Pope Innocent IV., accompanied

¹The Architectural History of the Conventual Buildings of the Monastery of Christ Church in Canterbury. By the Rev. Robert Willis. Printed for the Kent Archaeological Society, 1869.

by twelve cardinals, a patriarch, three archbishops, the two generals of the Carthusians and Cistercians, the king (St. Louis), and three of his sons, the queen mother, Baldwin, count of Flanders and emperor of Constantinople, the duke of Burgundy, and six lords, visited the abbey, the whole party, with their attendants, were lodged within the monastery without disarranging the monks, 400 in number. Nearly the whole of the abbey buildings, including the magnificent church, were swept away at the close of the 18th century. When the annexed ground-plan was taken, shortly before its destruction, nearly all the monastery, with the exception of the church, had been rebuilt.

The church, the ground-plan of which bears a remarkable resemblance to that of Lincoln cathedral, was of vast dimensions. It was 656ft. by 130ft. wide. The nave was 102ft. and the aisles 60ft. high. The nave (G) had double vaulted aisles on either side. Like Lincoln, it had an eastern as well as a western transept, each furnished with apsidal chapels to the east. The western transept was 213ft. long, and the eastern 123ft. The choir terminated in a semicircular apse (F), surrounded by five chapels, also semicircular. The western entrance was approached by an ante-church, or *narthex* (B), itself an aisled church of no mean dimensions; flanked by two towers, rising from a flight of steps bearing a stone cross. The first English house of the Cluniac order was that of Lewes, founded by the earl of Warren, c. A.D. 1077. Of this only a few fragments of the domestic buildings exist. The best preserved Cluniac houses in England are Castle Acre, Norfolk, and Wenlock, Shropshire.

The Cluniac revival, with all its brilliancy, was but short-lived. The celebrity of this, as of other orders, worked its moral ruin. With their growth in wealth and dignity the Cluniac foundations became as worldly in life and as relaxed in discipline as their predecessors, and a fresh reform was needed.

Cistercian.—The next great monastic revival, the Cistercian, arising in the last years of the 11th century, had a wider diffusion, and a longer and more honourable existence. The rapid growth and wide celebrity of the order are undoubtedly to be attributed to the enthusiastic piety of St. Bernard, abbot of the first of the monastic colonies, subsequently sent forth in such quick succession by the first Cistercian houses, the far-famed abbey of Clairvaux, A.D. 1116. The rigid self-abnegation, which was the ruling principle of this reformed congregation of the Benedictine order, extended itself to the churches and other buildings erected by them. The characteristic of the Cistercian abbeys was the extremest simplicity and a studied plainness. Only one tower—a central one—was permitted, and that was to be very low. Unnecessary pinnacles and turrets were prohibited. The windows were to be plain and undivided, and it was forbidden to decorate them with stained glass. All needless ornament was proscribed. The crosses must be of wood; the candlesticks of iron. The renunciation of the world was to be evidenced in all that met the eye. The same spirit manifested itself in the choice of the sites of their monasteries. The more dismal, the more hopeless a spot appeared, the more did it please their rigid mood. But they came not merely as ascetics, but as improvers. The Cistercian monasteries are, as a rule, found placed in deep well-watered valleys. They always stand on the border of a stream; not rarely, as at Fountains, the buildings extend over it. These valleys, now so rich and productive, wore a very different aspect when the brethren first chose them as the place of their retirement. Wide swamps, deep morasses, tangled thickets, wild impassable forests, were their prevailing features. The "bright valley," *Clara Vallis* of St. Bernard, was known as the "valley of Wormwood," infamous as a den of robbers.

All Cistercian monasteries, unless the circumstances of the locality forbade it, were arranged according to one plan. The general arrangement and distribution of the various buildings which went to make up one of these vast establishments may be gathered from that of St. Bernard's own abbey of Clairvaux, which is here given. It will be observed that the abbey precincts are surrounded by a strong wall, furnished at intervals with watch-towers and other defensive works. The wall is nearly encircled by a stream of water, artificially diverted from the

small rivulets which flow through the precincts, furnishing the establishment with an abundant supply in every part, for the irrigation of the gardens and orchards, the sanitary requirements of the brotherhood and for the use of the offices and workshops.

The precincts are divided across the centre by a wall, running from north to south, into an outer and inner ward—the former containing the menial, the latter the monastic buildings. The pre-



FIG. 4.—GENERAL PLAN OF CLAIRVAUX (CISTERCIAN). BUILT A.D. 1116. THE CISTERCIANS WERE A REFORMED CONGREGATION OF THE BENEDICTINE ORDER. CISTERCIAN ABBEYS WERE NOTED FOR THEIR SIMPLICITY OF DESIGN

A. Cloisters	H. Stables	O. Public press
B. Ovens, and corn and oil mills	I. Wine-press and hay chamber	P. Gateway
C. St. Bernard's cell	L. Workshops and workmen's lodgings	R. Remains of old monastery
D. Chief entrance	M. Slaughter-house	S. Oratory
E. Tanks for fish	N. Barns and stables	V. Tile-works
F. Guest-house		X. Tile-kiln
G. Abbot's house		Y. Water-courses

incts are entered by a gateway (P), at the extreme western extremity, giving admission to the lower ward. Here the barns, granaries, stables, shambles, workshop and workmen's lodgings

were placed, without any regard to symmetry, convenience being the only consideration. Advancing eastwards, we have before us the wall separating the outer and inner ward, and the gate-house (D) affording communication between the two. On passing through the gateway, the outer court of the inner ward was entered, with the western façade of the monastic church in front. Immediately on the right of the entrance was the abbot's house (G), in close proximity to the guest-house (F). On the other side of the court were the stables, for the accommodation of the horses of the guests and their attendants (H). The church occupied a central position. To the south was the great cloister (A), surrounded by the chief monastic buildings, and farther to

of the Cistercian houses allows us to accept this as a type of the monasteries of this order. The church (A) is the chief feature. It consists of a vast nave of eleven bays, entered by a narthex, with a transept and short apsidal choir. (It may be remarked that the eastern limb in all unaltered Cistercian churches is remarkably short, and usually square.) To the east of each limb of the transept are two square chapels, divided according to Cistercian rule by solid walls. Nine radiating chapels, similarly divided, surround the apse. The stalls of the monks, forming the ritual choir, occupy the four eastern bays of the nave. There was a second range of stalls in the extreme western bays of the nave for the *fratres conversi*, or lay brothers. To the south of the church, so as to secure as much sun as possible, the cloister was invariably placed, except when local reasons forbade it. Round the cloister (B) were ranged the buildings connected with the monks' daily life. The chapter-house (C) always opened out of the east walk of the cloister in a line with the south transept. In Cistercian houses this was quadrangular, and was divided by pillars and arches into two or three aisles. Between it and the transept we find the sacristy (X), and a small book-room (Y), *armarium*, where the brothers deposited the volumes borrowed from the library. On the other side of the chapter-house, to the south, is a passage (D) communicating with the courts and buildings beyond. This was sometimes known as the *parlour*, *colloquii locus*, the monks having the privilege of conversation here. Here also, when discipline became relaxed, traders, who had the liberty of admission, were allowed to display their goods. Beyond this we often find the *calefactorium* or *day-room*—an apartment warmed by flues beneath the pavement, where the brethren, half frozen during the night offices, betook themselves after the conclusion of lauds, to gain a little warmth, grease their sandals and get themselves ready for the work of the day. In the plan before us this apartment (E) opens from the south cloister walk, adjoining the refectory. The place usually assigned to it is occupied by the vaulted substructure of the dormitory (Z). The dormitory, as a rule, was placed on the east side of the cloister, running over the *calefactorium* and *chapter-house*, and joined the south transept, where a flight of steps admitted the brethren into the church for nocturnal services. Opening out of the dormitory was always the *necessarium*, planned with the greatest regard to health and cleanliness, a water-course invariably running from end to end. The refectory opens out of the south cloister at (G). The position of the refectory is usually a marked point of difference between Benedictine and Cistercian abbeys. In the former, as at Canterbury, the refectory ran east and west parallel to the nave of the church, on the side of the cloister farthest removed from it. In the Cistercian monasteries, to keep the noise and smell of dinner still farther away from the sacred building, the refectory was built north and south, at right angles to the axis of the church. It was often divided, sometimes into two, sometimes, as here, into three aisles. Outside the refectory door, in the cloister, was the *lavatory*, where the monks washed their hands at dinner-time. The buildings belonging to the material life of the monks lay near the refectory, as far as possible from the church, to the south-west. With a distinct entrance from the outer court was the kitchen court (F), with its buttery, scullery, and larder, and the important adjunct of a stream of running water. Farther to the west, projecting beyond the line of the west front of the church, were vast vaulted apartments (SS), serving as cellars and storehouses, above which was the dormitory of the *conversi*. Detached from these, and separated entirely from the monastic buildings, were various workshops, which convenience required to be banished to the outer precincts, a saw-mill and oil-mill (UU) turned by water, and a currier's shop (V), where the sandals and leathern girdles of the monks were made and repaired.

Returning to the cloister, a vaulted passage admitted to the small cloister (I), opening from the north side of which were eight small cells, assigned to the scribes employed in copying works for the library, which was placed in the upper story, accessible by a turret staircase. To the south of the small cloister a long hall will be noticed. This was a *lecture-hall*, or

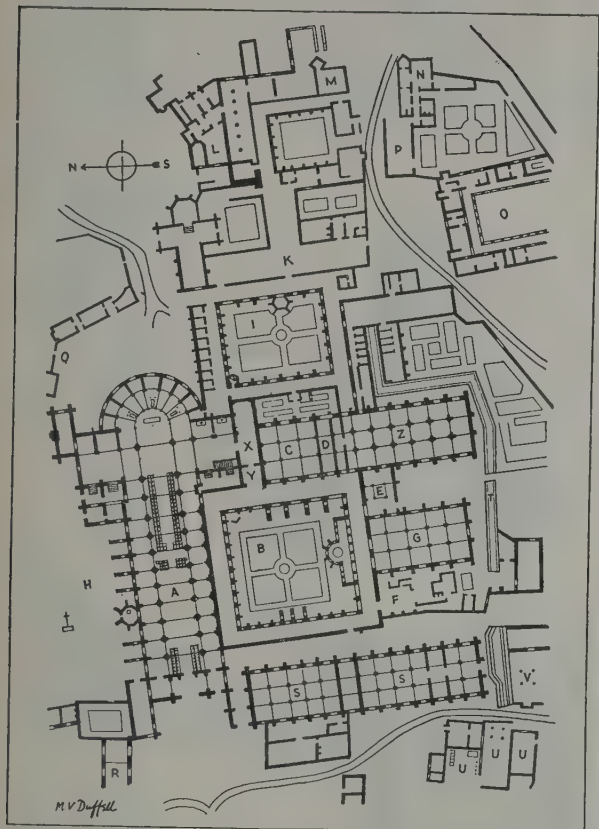


FIG. 5.—GENERAL PLAN OF THE MONASTIC BUILDINGS AT CLAIRVAUX. A WALL SEPARATED THE MONASTIC BUILDINGS OF CLAIRVAUX, HERE SHOWN ON A LARGER SCALE, FROM THE MENIAL DEPARTMENTS. THE POSITION OF THE REFECTIONARY IS USUALLY A MARKED POINT OF DIFFERENCE BETWEEN BENEDICTINE AND CISTERCIAN ABBEYS

- | | | |
|----------------------|------------------------|-----------------------|
| A. Church | L. Lodgings of novices | S. Cellars and store- |
| B. Cloister | M. Old guest-house | houses |
| C. Chapter-house | N. Old abbot's lodg- | T. Water-courses |
| D. Monks' parlour | ings | U. Saw-mill and oil- |
| E. Calefactorium | O. Cloister of super- | mill |
| F. Kitchen and court | numerary monks | V. Currier's workshop |
| G. Refectory | P. Abbot's hall | X. Sacristy |
| H. Cemetery | Q. Cell of St. Bernard | Y. Little library |
| I. Little cloister | R. Stables | Z. Undercroft of |
| K. Infirmary | | dormitory |

the east the smaller cloister, opening out of which were the infirmary, novices' lodgings, and quarters for the aged monks. Still farther to the east, divided from the monastic buildings by a wall, were the vegetable gardens and orchards, and tank for fish. The large fish-ponds, an indispensable adjunct to any ecclesiastical foundation, on the formation of which the monks lavished extreme care and pains, and which often remain as almost the only visible traces of these vast establishments, were placed outside the abbey walls.

Figure 5 furnishes the ground-plan of the distinctly monastic buildings on a larger scale. The usually unvarying arrangement

rather a hall for the religious disputations customary among the Cistercians. From this cloister opened the *infirmary* (K), with its hall, chapel, cells, blood-letting house, and other dependencies. At the eastern verge of the vast group of buildings we find the *novices' lodgings* (L), with a third cloister near the novices' quarters and the original guest-house (M). Detached from the great mass of the monastic edifices was the original abbot's house (N), with its dining-hall (P). Closely adjoining this, so that the eye of the father of the whole establishment should be constantly over those who stood the most in need of his watchful care—those who were training for the monastic life, and those who had worn themselves out in its duties—was a fourth cloister (O), with annexed buildings, devoted to the aged and infirm members of the establishment. The cemetery, the last resting-place of the brethren, lay to the north side of the nave of the church (H).

It will be seen from the above account that the arrangement of a Cistercian monastery was in accordance with a clearly defined system, and admirably adapted to its purpose. The base court nearest to the outer wall contained the buildings belonging to the functions of the body as agriculturists and employers of labour. Advancing into the inner court, the buildings devoted to hospitality are found close to the entrance; while those connected with the supply of the material wants of the brethren—the kitchen, cellars, etc.—form a court of themselves outside the cloister and quite detached from the church. The church, refectory, dormitory and other buildings belonging to the professional life of the brethren, surround the great cloister. The small cloister beyond, with its scribes' cells, library, hall for disputations, etc., is the centre of the literary life of the community. The requirements of sickness and old age are carefully provided for in the infirmary cloister and that for the aged and infirm members of the establishment. The same group contains the quarters of the novices.

The English Cistercian houses, of which there are such extensive and beautiful remains at Fountains, Rievaulx, Kirkstall, Tintern, Netley, etc., were mainly arranged after the same plan, with slight local variations.

Fountains Abbey.—Fountains abbey, first founded A.D. 1132, is one of the largest and best preserved Cistercian houses in England. Earlier buildings received considerable additions and alterations in the later period of the order, causing deviations from the strict Cistercian type. The church stands a short distance to the north of the River Skell, the buildings of the abbey stretching down to and even across the stream. We have the cloister (H) to the south, with the three-aisled chapter-house (I) and calefactory (L) opening from its eastern walk, and the refectory (S), with the kitchen (Q) and buttery (T) attached, at

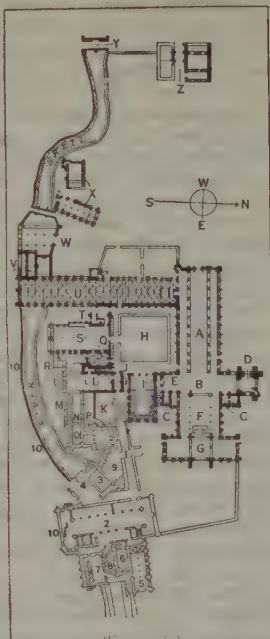


FIG. 6.—PLAN OF FOUNTAINS ABBEY, YORKSHIRE, FOUNDED A.D. 1132. ADDITIONS SHOWING A WIDE DEPARTURE FROM THE SIMPLICITY OF THE ORIGINAL FOUNDATIONS WERE MADE TO THE ABBEY IN SUCCEEDING CENTURIES UNTIL IT BECAME ONE OF THE MOST SPACIOUS IN ENGLAND

MONASTIC BUILDINGS: A. Nave of church. B. Transept. C. Chapels. D. Tower. E. Sacristy. F. Choir. G. Chapel of Nine Altars. H. Cloister. I. Chapter-house. K. Base court. L. Calefactory. M. Water-course. N. Cellar. O. Brewhouse. P. Prisons. Q. Kitchen. R. Offices. S. Refectory. T. Buttery. U. Cellars and storehouses. V. Necessary. W. Infirmary (?). X. Guest-houses. Y. Mill bridge. Z. Gatehouse.

ABBOT'S HOUSE: 1. Passage. 2. Great hall. 3. Refectory. 4. Buttery. 5. Storehouse. 6. Chapel. 7. Kitchen. 8. Ashpit. 9. Yard. 10. Kitchen tank

right angles to its southern walk. Parallel with the western walk is an immense vaulted substructure (U), incorrectly styled the cloisters, serving as cellars and store-rooms, and supporting the dormitory of the *conversi* above. This building extended across the river. At its south-west corner were the necessaries (V), also built, as usual, above the swiftly flowing stream. The monks' dormitory was in its usual position above the chapter-house, to the south of the transept. As peculiarities of arrangement may be noticed the position of the kitchen (Q), between the refectory and calefactory, and of the infirmary (W) (unless there is some error in its designation) above the river to the west, adjoining the guest-houses (XX). We may also call attention to the greatly lengthened choir, commenced by Abbot John of York, 1203-11, and carried on by his successor, terminating, like Durham cathedral, in an eastern transept, the work of Abbot John of Kent, 1220-47, and to the tower (D), added not long before the dissolution by Abbot Huby, 1494-1526, in a very unusual position at the northern end of the north transept. The abbot's house, the largest and most remarkable example of this class of buildings in the kingdom, stands south to the east of the church and cloister, from which it is divided by the kitchen court (K), surrounded by the ordinary domestic offices. A considerable portion of this house was erected on arches over the Skell. The size and character of this house, probably, at the time of its erection, the most spacious house of a subject in the kingdom, not a castle, bespeaks the wide departure of the Cistercian order from the stern simplicity of the original foundation. The hall (2) was one of the most spacious and magnificent apartments in mediæval times, measuring 170ft. by 70ft. Like the hall in the castle at Winchester, and Westminster hall, as originally built, it was divided by 18 pillars and arches, with 3' aisles. Among other apartments, for the designation of which we must refer to the ground-plan, was a domestic oratory or chapel, (6) 46½ft. by 23ft. and a kitchen (7), 50ft. by 38ft.

Feudal Character.—The arrangement of the building bespeaks the powerful feudal lord, not the humble father of a body of hard-working brethren, bound by vows to a life of poverty and self-denying toil. In the words of Dean Milman, "the superior, once a man bowed to the earth with humility, care-worn, pale, emaciated, with a coarse habit bound with a cord, with naked feet, had become an abbot on his curvetting palfrey, in rich attire, with his silver cross before him, travelling to take his place amid the lordliest of the realm." (*Lat. Christ.* vol. iii. p. 30.)

The buildings of the *Austin canons* or *Black canons* (so called from the colour of their habit) present few distinctive peculiarities: This order had its first seat in England at Colchester, where a house for Austin canons was founded about A.D. 1105, and it very soon spread widely. As an order of regular clergy, holding a middle position between monks and secular canons, almost resembling a community of parish priests living under rule, they adopted naves of great length to accommodate large congregations.

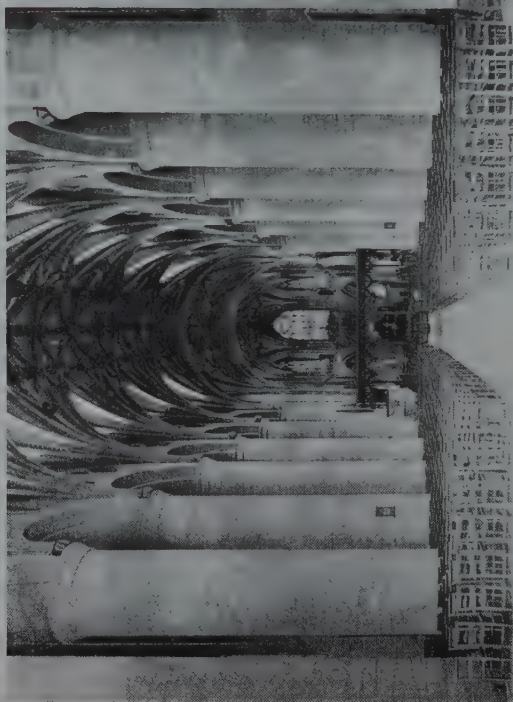
The *Premonstratensian* regular canons, or White canons, had as many as 35 houses in England, of which the most perfect remaining are those of Easby, Yorkshire, and Bayham, Kent. The head house of the order in England was Welbeck. This order was a reformed branch of the Austin canons, founded, A.D. 1119, by Norbert (born at Xanten, on the Lower Rhine, c. 1080) at Prémontré, a secluded marshy valley in the forest of Coucy in the diocese of Laon. The order spread widely. Even in the founder's lifetime it possessed houses in Syria and Palestine. It long maintained its rigid austerity, till in the course of years wealth impaired its discipline, and its members sank into indolence and luxury. The Premonstratensians were brought to England shortly after A.D. 1140, and were first settled at Newhouse, in Lincolnshire, near the Humber. The ground-plan of Easby abbey, owing to its situation on the edge of the steeply-sloping banks of the Swale, is singularly irregular. The cloister is duly placed on the south side of the church, and the chief buildings occupy their usual positions round it. But the cloister garth, as at Chichester, is not rectangular, and all the surrounding buildings are thus made to sprawl in a very awkward fashion. The church



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EUROPEAN ABBEY ARCHITECTURE

1. Canterbury Cathedral from the southwest, showing the distant tower known as the Angel or Bell Tower, which was completed in 1472
2. Chilandari, one of the Serbian monasteries at Mount Athos, founded in 1197 by Stephen Nemanja, showing the buildings grouped around a central church
3. Corner of the church of the monastery of Gregoriou, showing a monk tapping the semantor to summon the order to vespers
4. Cloisters of the convent of Santo Tomas at Avila, Spain
5. East end of the apse of the church of the monastery of the Laura, one of the twenty monasteries of the order of St. Basil, Mount Athos
6. A Franciscan hermitage, part of the great monastery at Assisi, Italy, built after the canonization of St. Francis in 1228
7. Cloister of the Carthusian monastery, Certosa di Pavia, situated some five miles north of Pavia. The monastery church is visible beyond



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INTERIORS OF MEDIAEVAL ENGLISH ABBEYS

1. Cloisters of Canterbury Cathedral, Benedictine Order, showing fan-vaulting of the late 14th century
2. Day room of Fountains Abbey, Cistercian Order, erected about 1132

3. Nave of Tewkesbury Abbey, built 1125, by the Benedictine order. The choir is of the 14th century

4. Jerusalem Chamber or Abbot's Parlour, in Westminster Abbey, built in the 11th century and used now for the Westminster King's scholars

follows the plan adopted by the Austin canons in their northern abbeys, and has only one aisle to the nave—that to the north; while the choir is long, narrow and aisleless. Each transept has an aisle to the east, forming three chapels.

The church at Bayham was destitute of aisles either to nave or choir. The latter terminated in a three-sided apse. This church is remarkable for its exceeding narrowness in proportion to its length. Extending in longitudinal dimensions 257ft., it is not more than 25ft. broad. Stern Premonstratensian canons wanted

which was first adopted by St. Bruno and his twelve companions at the original institution at Chartreux, near Grenoble, was maintained in all the Carthusian establishments throughout Europe, even after the ascetic severity of the order had been to some extent relaxed, and the primitive simplicity of their buildings had been exchanged for the magnificence of decoration which characterizes such foundations as the *Certosas* of Pavia and Florence. According to the rule of St. Bruno, all the members of a Carthusian brotherhood lived in the most absolute solitude and silence. Each occupied a small detached cottage, standing by itself in a small garden surrounded by high walls and connected by a common corridor or cloister. In these cottages or cells a Carthusian monk passed his time in the strictest asceticism, only leaving his solitary dwelling to attend the services of the Church, except on certain days when the brotherhood assembled in the refectory. The peculiarity of the arrangements of a Carthusian monastery, or *charter-house*, as it was called in England, from a corruption of the French *chartreux*, is exhibited in the plan of that of Clermont, after Viollet-le-Duc.

Clermont Abbey is surrounded by a wall, furnished at intervals with watch towers (R). The enclosure is divided into two courts, of which the eastern court, surrounded by a cloister, from which the cottages of the monks (I) open, is much the larger. The two courts are divided by the main buildings of the monastery, including the church, the sanctuary (A), divided from B, the monks' choir, by a screen with two altars, the smaller cloister to the south (S), surrounded by the chapter-house (E), the refectory (X)—these buildings occupying their normal position—and the chapel of Pontgibaud (K). The kitchen with its offices (V) lies behind the refectory, accessible from the outer court without entering the cloister. To the north of the church, beyond the sacristy (L), and the side chapels (M), we find the cell of the sub-prior (A') with its garden. The lodgings of the prior (G) occupy the centre of the outer court, immediately in front of the west door of the church, and face the gateway of the convent (O). A small raised court with a fountain (C) is before it. This outer court also contains the guest-chambers (P), the stables, and lodgings of the lay brothers (N), the barns and granaries (Q), the dovecot (H), and the bakehouse (T). At Z is the prison. (In this outer court, in all the earlier foundations, as at Witham, there was a smaller church in addition to the larger church of the monks.) The outer and inner courts are connected by a long passage (F), wide enough to admit a cart laden with wood to supply the cells of the brethren with fuel. The number of cells surrounding the great cloister is 18. They are all arranged on a uniform plan. Each little dwelling contains three rooms: a sitting room (C), warmed by a stove in winter; a sleeping-room (D), furnished with a bed, a table, a bench, and a book-case; and a closet (E). Between the cell and the cloister gallery (A) is a passage or corridor (B), cutting off the inmate of the cell from all sound or movement which might interrupt his meditations. The superior had free access to this corridor, and through open niches was able to inspect the garden without being seen. At I is the hatch or turn-table, in which the daily allowance of food was deposited by a brother appointed for that purpose, affording no view either inwards or outwards. H is the garden, cultivated by the occupant of the cell. At K is the wood-house. F is a covered walk, with the necessary at the end.

The above arrangements are found with scarcely any variation in all the charter-houses of western Europe. The Yorkshire Charter-house of Mount Grace, founded by Thomas Holland, the young duke of Surrey, nephew of Richard II. and marshal of England, during the revival of the popularity of the order, about A.D. 1397, is the most perfect and best preserved English example.

Mendicant Friars.—An article on monastic arrangements would be incomplete without some account of the convents of the Mendicant or Preaching Friars, including the Black Friars or Dominicans, the Grey or Franciscans, the White or Carmelites, the Eremites or Austin Friars. These orders arose at the beginning of the 13th century, when the Benedictines, together with their various reformed branches, had terminated their active mission, and Christian Europe was ready for a new religious

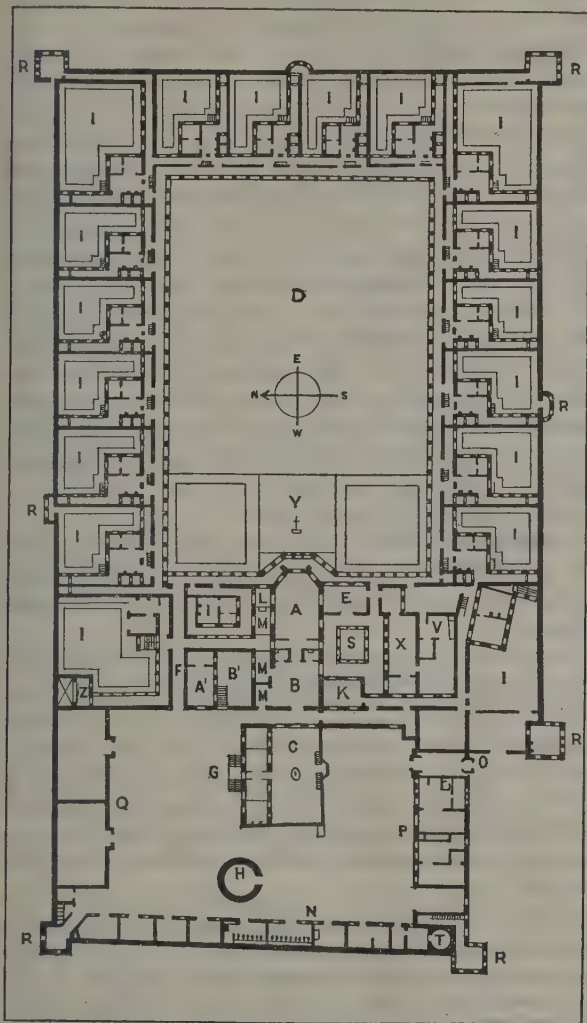


FIG. 7.—PLAN OF THE CARTHUSIAN MONASTERY OF CLERMONT, FRANCE. THE PRINCIPLES OF THE CARTHUSIAN ORDER DEMANDED A DISTINCT FORM OF MONASTIC INSTITUTION IN WHICH THE BROTHERHOOD COULD LIVE IN SOLITUDE AND SILENCE—HENCE THE SEPARATE CELLS

- | | | |
|---------------------|-------------------------|-------------------------|
| A. Church | K. Chapel of Pontgibaud | S. Little cloister |
| B. Monks' choir | L. Sacristy | T. Bakehouse |
| C. Prior's garden | M. Chapel | V. Kitchen |
| D. Great cloister | N. Stables | X. Refectory |
| E. Chapter-house | O. Gateway | Y. Cemetery |
| F. Passage | P. Guest-chambers | Z. Prison |
| G. Prior's lodgings | Q. Barns and granaries | A'. Cell of sub-prior |
| H. Dovecot | R. Watch-tower | B'. Garden of sub-prior |
| I. Cells | | |

no congregations, and cared for no possessions; therefore they built their church like a long room.

Carthusians.—The *Carthusian* order, on its establishment by St. Bruno, about A.D. 1084, developed a greatly modified form and arrangement of a monastic institution. The principle of this order, which combined the coenobitic with the solitary life, demanded the erection of buildings on a novel plan. This plan,

revival. Planting themselves, as a rule, in large towns, and by preference in the poorest and most densely populated districts, the Preaching Friars were obliged to adapt their buildings to the requirements of the site. Regularity of arrangement, therefore, was not possible, even if they had studied it. Their churches, built for the reception of large congregations of hearers rather than worshippers, form a class by themselves, totally unlike those of the elder orders in ground-plan and character. They were usually long parallelograms unbroken by transepts. The nave very usually consisted of two equal bodies, one containing the stalls of the brotherhood, the other left entirely free for the congregation. The constructional choir is often wanting, the whole church forming one uninterrupted structure, with a continuous range of windows. Taken as a whole, the remains of the establishments of the friars afford little warrant for the invective of Matthew Paris, benedictine of St. Albans: "The friars who have been founded scarcely 40 years have built residences as the palaces of kings. These are they who, enlarging day by day their sumptuous edifices and encircling them with lofty walls, lay up in them their incalculable treasures, transgressing the bounds of poverty and violating the fundamental rules of their profession."

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ABBON OF FLEURY or **ABBO FLORIACENSIS** (c. 945-1004), French scholar. He spent two years in England, and was abbot of Romsey. After his return to France he was made abbot of Fleury on the Loire (988). He was twice sent to Rome by King Robert the Pious (986-96), and on each occasion succeeded in warding off a threatened papal interdict. He was killed at La Réole in 1004, in endeavouring to quell a monkish revolt. He wrote an *Épître de vitis Romanorum pontificum*, besides controversial treatises, letters, etc. (see Migne, *Patrologia Latina*). His life, written by his disciple Aimoin of Fleury, in which much of Abbon's correspondence was reproduced, is of great importance as a source for the reign of Robert II., especially with reference to the papacy (cf. Migne, *op. cit.* vol. cxxxix.).

See Ch. Pfister, *Études sur le règne de Robert le Pieux* (1885); Cuissard-Gaucheron, "L'École de Fleury-sur-Loire à la fin du 10^e siècle," in *Mémoires de la société archéol. de l'Orléanais*, xiv. (Orléans, 1875); A. Molinier, *Sources de l'histoire de France*.

ABBOT, CHARLES GREELEY (1872-), American astrophysicist, was born in Wilton, N.H., on May 31, 1872. He graduated in 1894 from the Massachusetts Institute of Technology, and after a year of graduate study there joined the staff of the astrophysical observatory of the Smithsonian Institution. Here he served first as assistant, 1895-96, and then as acting director in charge from 1896 until 1907, when he was appointed director. He made original investigations in solar physics, studying especially the infra-red solar spectrum, the solar constant of radiation, the variability of solar and terrestrial temperatures and the utilization of solar heat. In connection with his researches he conducted expeditions to observe total eclipses of the sun in 1900, 1901, 1908 and 1919. In collaboration with S. P. Langley he completed the mapping of the infra-red spectrum, published in the *Annals* (vol. i.) of the astrophysical observatory. With F. E.

Fowle and L. B. Aldrich he published also in the *Annals* (vol. iii., iv.) proofs of the variability of the sun, as shown by experiments conducted simultaneously in California and Algeria and from observations made in expeditions to Arizona and Chile. In recognition of his discoveries he was awarded the Draper medal (1910) and the Rumford medal (1916). To scientific journals he has contributed numerous articles on the apparatus, methods and results of solar research. He published *The Sun* (1907), *Everyday Mysteries* (1923) and *The Earth and the Stars* (1925 and 1946). In 1918 he was made assistant secretary, and from 1928 to 1944 was secretary, of the Smithsonian institution.

ABBOT, EZRA (1819-1884), U.S. biblical scholar, was born at Jackson, Me., April 28, 1819. He graduated at Bowdoin college in 1840; and, after being principal of a public school in Cambridge, became assistant librarian of Harvard university, and from 1872 until his death Bussey Professor of New Testament Criticism and Interpretation in the Harvard divinity school. His studies were chiefly in oriental languages and the textual criticism of the New Testament, though he was a remarkable bibliographer. His publications were largely dispersed in the pages of reviews and other publications, but to the enlarged American edition of Smith's *Dictionary of the Bible* (1867-70), he contributed more than 400 articles besides greatly improving the bibliographical completeness of the work. His principal single production, representing his scholarly method and conservative conclusions, was *The Authorship of the Fourth Gospel* (1880; second edition, by J. H. Thayer, with other essays, 1889), up to that time probably the ablest defence, based on external evidence, of the Johannine authorship, and certainly the most complete treatment of the relation of Justin Martyr to this gospel. He died in Cambridge, Mass., March 21, 1884.

See S. J. Barrows, *Ezra Abbot* (1884).

ABBOT, GEORGE (1562-1633), Archbishop of Canterbury, was born on Oct. 19, 1562, at Guildford, Surrey, the son of a cloth-worker. Educated at Balliol College, Oxford, he became master of University College (1597) and dean of Winchester (1600).

He was one of those who prepared King James's Version of the Bible. James I. sent him to Scotland in 1608 to arrange for the establishment of episcopacy there. On his return he was preferred to the bishopric of Lichfield and Coventry (1609), London (1609) and Canterbury (1611). As vice-chancellor of the University of Oxford at different times between 1600 and 1605, he had come into conflict with Laud, and at court he supported Puritan measures. He promoted the marriage between the Elector Palatine and Princess Elizabeth, and resisted the proposal for the marriage of the Prince of Wales to the Spanish infant.

Under Charles I. he was suspended from his functions of primate for refusing to license the Assize sermon preached by Robert Sibthorp at Northampton (Feb. 22, 1627), advocating non-resistance to the royal demands, however arbitrary. He died at Croydon, Aug. 5, 1633, and was buried at Guildford, where he had endowed a hospital. Abbot's later years were clouded by the fact that in 1622 he had accidentally shot a keeper while hunting. His enemies maintained that the homicide, though accidental, disqualified him from office, and the matter had to be referred to a commission, on which King James had to exercise his casting vote in the archbishop's favour.

ABBOT, WILLIAM (1798-1843), English actor, was born in Chelsea, and made his first appearance on the stage at Bath in 1806, and his first London appearance in 1808. He created the parts of Appius Claudius in Sheridan Knowles's *Virginia* (1820) and of Modus in his *Hunchback* (1832). In 1827 he organized the company, including Macready and Miss Smithson, which acted Shakespeare in Paris. Two of Abbot's melodramas, *The Youthful Days of Frederick the Great* (1817) and *Swedish Patriotism* (1819), were produced at Covent Garden. He died in poverty at Baltimore, Maryland.

ABBOT, the head and chief governor of a community of monks, called also in the East *hegumenos* or *archimandrite*. The title abbot is derived ultimately from the Hebrew *ab*, "father," through

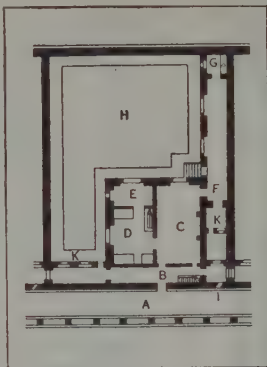


FIG. 8.—DETAIL PLAN OF A CARTHUSIAN CELL AT CLERMONT. THE GENERAL PLAN OF CLERMONT PROVIDES FOR SEPARATE CELLS FOR EACH MONK. THE ORDER WAS FOUNDED BY ST. BRUNO, 1084

A. Cloister gallery
B. Corridor
C. Living-room
D. Sleeping-room
E. Closet
F. Covered walk
G. Necessary
H. Garden
I. Hatch
J. Wood-house
K. Wood-house

the Syriac *abbas*, and had its origin in the monasteries of Syria, whence it spread through the East, and soon became accepted in all languages as the designation of the head of a monastery. But though general in the West, it was never universal. Among the Dominicans, Carmelites, Augustinians, etc., the superior was called *Prior*; among the Franciscans, *Custos* ("guardian").

In Egypt, the first home of monasticism, the abbot or archimandrite sometimes ruled over only one community, sometimes over several, each of which had its own abbot as well. By the rule of St. Benedict, which, until the reform of Cluny, governed monasticism in the West, the abbot has jurisdiction over only one community. The rule was subject to frequent violations; but it was not until the foundation of the Cluniac Order that the idea of a supreme abbot, exercising jurisdiction over all the houses of an order, was definitely recognized. New styles expressed this new relation; thus the abbot of Monte Cassino was called *abbas abbatum* ("abbot of abbots"), while the chiefs of other orders had the titles *abbas generalis* ("abbot general"), or *magister* ("master") or *minister generalis* ("minister general").

Monks, as a rule, were laymen, nor at the outset was the abbot any exception. All orders of clergy, therefore, took precedence of him. For religious offices the abbot and his monks were commanded to attend the nearest church.

Abbots were originally subject to episcopal jurisdiction, and continued generally so in the West till the 11th century. The first case recorded of the partial exemption of an abbot from episcopal control is that of Faustus, abbot of Lerins, at the council of Arles, A.D. 456; but the exorbitant claims and exactions of bishops rendered it increasingly frequent, and, in the 6th century, the practice of making religious houses responsible to the Pope alone received an impulse from Gregory the Great. These exceptions, introduced with a good object, had grown into a widespread evil by the 12th century, the bishop being deprived of all authority over the chief centres of influence in his diocese. Abbots more and more assumed almost episcopal state, and adopted the episcopal insignia of mitre, ring, gloves and sandals, a custom which arose out of the granting by the Pope of the right to wear the mitre to particular distinguished abbots.

The first undoubted instance is the bull by which Alexander II. in 1063 granted the use of the mitre to Egelsinus, abbot of St. Augustine at Canterbury (see *MITRE*).

The adoption of episcopal insignia by abbots was followed by an encroachment on episcopal functions, which was ineffectually guarded against by the Lateran Council, A.D. 1123. In A.D. 1489 they were permitted by Innocent IV. to confer both the subdiaconate and diaconate. They always and everywhere had the power of admitting their own monks and vesting them with the religious habit. Originally the bishop of the diocese chose the abbot out of the monks of the convent, but the right of election was transferred by jurisdiction to the monks themselves, reserving to the bishop the confirmation of the election and the benediction of the new abbot. In abbots exempt from episcopal jurisdiction the confirmation and benediction had to be conferred by the Pope in person, the house being taxed with the expenses of the new abbot's journey to Rome. An abbot had to be at least 25 years of age, of legitimate birth, and a monk of the house, unless it furnished no suitable candidate. The election was for life, unless the abbot was canonically deprived by the chiefs of his order, or, when he was directly subject to them, by the Pope or the bishop. The power of the abbot was absolute, limited only by the canons of the church and, until the general establishment of exemptions, by episcopal control. As a rule, however, implicit obedience was enforced.

The abbot was treated with the utmost reverence by the brethren of his house. If he gave a command, the monk receiving it was to kneel. No monk might sit in his presence, or leave it without his permission. In the East he was commanded to eat with the other monks. In the West the rule of St. Benedict appointed him a separate table, at which he might entertain guests and strangers. This permission opening the door to luxurious living, the Council of Aix, A.D. 817, decreed that the abbot should dine in the refectory on the same fare as the monks, unless he

had to entertain a guest. These ordinances proved, however, generally ineffectual, and contemporaneous literature abounds with satirical remarks and complaints concerning the inordinate extravagance of the tables of the abbots.

The ordinary dress of the abbot was according to rule to be the same as that of the monks. But by the 10th century the rule was commonly set aside, and we find frequent complaints of abbots adopting sumptuous attire. They sometimes even laid aside the monastic habit altogether. With the increase of wealth and power, abbots, in fact, lost much of their religious character, and vied in magnificence with the first nobles of the realm. They rode on mules with gilded bridles, rich saddles and housings, carrying hawks on their wrists, followed by an immense train of attendants. They associated on equal terms with laymen of the highest distinction, and shared all their pleasures and pursuits. This rank and power was, however, often used most beneficially. For instance, Richard Whiting, the last abbot of Glastonbury, judicially murdered by Henry VIII. in 1539, educated in his household as many as 300 sons of noblemen and gentlemen, besides others of a meaner rank, whom he fitted for the universities. The abbots of Cluny and Vendôme were, by virtue of their office, cardinals of the Roman church.

In process of time the title abbot was improperly transferred to clerics who had no connection with the monastic system, as to the principal of a body of parochial clergy. It even came to be adopted by purely secular officials. Thus the chief magistrate of the republic at Genoa was called *Abbas Populi* ("the abbot of the people"). Lay abbots were the outcome of the growth of the feudal system from the 8th century onwards. The practice of *commendation*, by which (to meet a temporary emergency) the revenues of the community were handed over to a lay lord and in return for his protection, early suggested to the emperors and kings the expedient of rewarding their warriors with rich abbeys held in *commendam*. During the Carolingian epoch the custom grew up of granting these as regular heritable fiefs or benefices, and by the 10th century the system was firmly established. The example of the kings was followed by the feudal nobles, sometimes by making a temporary concession permanent, sometimes without any form of commendation whatever.

These lay abbeys were not merely a question of overlordship, but implied the concentration in lay hands of all the rights, immunities and jurisdiction of the foundations; i.e., the more or less complete secularization of spiritual institutions. The lay abbot took his recognized rank in the feudal hierarchy, and was free to dispose of his fief as in the case of any other.

In conventual cathedrals, where the bishop occupied the place of the abbot, the functions usually devolving on the superior of the monastery were performed by a prior.

The title *abbé* (Ital. *abate*), as commonly used in the Roman Catholic church on the European continent, is the equivalent of the English "Father," being loosely applied to all who have received the tonsure. In the German Evangelical church the title of abbot (*Abt*) is sometimes bestowed, like *abbé*, as an honorary distinction, and sometimes survives to designate the heads of monasteries converted at the Reformation into collegiate foundations. Of these the most noteworthy is the abbey of Lokkum in Hanover, founded as a Cistercian house in 1163 by Count Wilbrand of Hallermund, and reformed in 1593.

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ABBOTSFORD, former residence of Sir Walter Scott, on south bank of the Tweed, about 3m. W. of Melrose, Roxburghshire, Scotland, and nearly 1m. from Abbotsford Ferry Station, L.N.E.R. branch line. Cartleyhole, nicknamed Clarty (muddy) Hole, a farm of 100ac., was bought by Scott (1811) when his lease of Ashiestiel, near by, lapsed; he added to it and finally bought Toftfield (afterwards Huntlyburn) in 1817, building his house in Scottish baronial style with relics from historical structures such as the doorway of the old Tolbooth in Edinburgh. A reverse of

fortune in 1825 involved Scott in debt, but the creditors made him a free gift of the library in 1830 and Robert Cadell the publisher cancelled all mortgages in 1847 in exchange for the family's share in the copyright of Sir Walter's works. The house remained in the hands of the Maxwell-Scotts, descendants of Scott. Abbottsford gave its name to the Abbottsford club, a successor of the Bannatyne and Maitland clubs, founded by W. B. D. D. Turnbull in 1834 in Scott's honour, for printing and publishing historical works connected with his writings. Its publications extended from 1835 to 1864.

ABBOTT, EDWIN ABBOTT (1838-1926), English schoolmaster and grammarian, succeeded G. F. Mortimer as headmaster of the City of London School in 1865. He was the author of a *Shakespearean Grammar* (1870), which is a permanent contribution to English philology, and of many theological works, among them the article on the Gospels in the 9th ed. of the *Encyclopædia Britannica*.

His brother, Evelyn Abbott (1843-1901), was a tutor of Balliol, Oxford, and author of a scholarly *History of Greece*.

ABBOTT, EMMA (1849-1891), American singer, was born in Chicago, Ill., and studied in Milan and Paris. She had a fine soprano voice, and appeared first in opera in London at Covent Garden, also singing at important concerts. She organized an opera company known by her name, and toured extensively in the United States, where she had a great reputation. In 1873 she married E. J. Wetherell. She died at Salt Lake City (Utah), Jan. 5, 1891.

ABBOTT, GEORGE (1889-), American playwright, was born in Forestville, N.Y., on June 25, 1889. He graduated at the University of Rochester (1911), where he wrote and acted for the dramatic club. The following year he studied dramatic writing with Prof. George Pierce Baker at Harvard, had a one-act play produced by the Harvard dramatic club, and won a prize play contest at the Keith Bijou theatre. In order to learn more about the stage and before having any plays accepted for professional productions he became an actor. He appeared in important rôles in *Zander the Great*, with Alice Brady; *Hell Bent for Heaven* and *Processional*, where his acting of the blinded Ishmaelite was particularly outstanding, and other Broadway productions. His first play to be produced, *Fall Guy* (published in the *Best Plays of 1924-25*), was written in collaboration with James Gleason; the next, *Love 'Em and Leave 'Em*, with John V. A. Weaver; *The Holy Terror*, with Winchell Smith; and *Four Walls*, with Dana Burnet. His *Broadway*, written with Phillip Dunning, was one of the dramatic successes of 1926-27 as was *Coquette* (with Ann Preston Bridgers) in 1927-28 and *Three Men on a Horse* (with J. C. Holm) eight years later. He also became well known as a producer of plays and motion pictures.

ABBOTT, GRACE (1878-1939), U.S. social reformer, was born in Grand Island, Neb., Nov. 17, 1878. She took her bachelor's degree from Grand Island college in 1898 and her master's degree from The University of Chicago in 1909. In 1908 she went to Hull House, Chicago, as director of the new Immigrants' Protective league. While director of the child-labour division, U.S. children's bureau (1917-19), she administered the first federal child-labour law. She was secretary of the Illinois State Immigrants' commission (1919-21) and chief of the U.S. children's bureau (1921-34), where she administered the Maternity and Infancy act (1922-29). She was U.S. delegate to the International Labour organization in 1935 and 1937 and was professor of public welfare at The University of Chicago from 1934 to 1939. She died June 19, 1939.

She wrote *The Immigrant and the Community* (1917), *Reports of Chief of Children's Bureau* (1922-34), *The Child and the State*, 2 vol. (1938), and *From Relief to Social Security* (1940). (E. Ar.)

ABBOTT, JACOB (1803-1879), American writer of books for the young, was born at Hallowell (Me.) on Nov. 14, 1803. He graduated at Bowdoin college in 1820; studied at Andover Theological Seminary. He was tutor in 1824-25, and from 1825 to 1829 was professor of mathematics and natural philosophy in Amherst college; was licensed to preach by the Hampshire Association in 1826; founded the Mt. Vernon School for young ladies

in Boston in 1829, and was principal until 1833; was pastor of Eliot Congregational church (which he founded) at Roxbury (Mass.), in 1834-35; and was, with his brothers, a founder, and in 1843-51 a principal, of Abbott's Institute, and in 1845-48 of the Mt. Vernon School for boys, in New York city. He was a prolific author, writing juvenile stories, brief histories and biographies, and religious books for the general reader, and a few works in popular science. He died on Oct. 31, 1879, at Farmington (Me.), where he had spent part of his time since 1839. The best known of his writings are those which feature the boyish paragon Rollo—*Rollo at Work*, *Rollo at Play*, *Rollo in Europe*, etc. (28 vol.). In these didactic tales Abbott did for one or two generations of young American readers a service not unlike that performed earlier by the author of *Sandford and Merton*. Of his other writings the best are the *Franconia Stories* (10 vol.), 22 vol. of biographical histories and the *Young Christian*.

See his *Young Christian, Memorial Edition, with a Sketch of the Author by One of His Sons*; i.e., Edward Abbott (1882), with a bibliography of his works; also Lyman Abbott, *Silhouettes of My Contemporaries* (1921).

ABBOTT, SIR JAMES (1807-1896), British soldier, educated at the Military college, Addiscombe. He served in the Bengal artillery at the siege of Bhurtpore. 1825-26. He was the first Englishman to visit Khyva, where he was sent on a mission in 1839. During the Sikh war of 1848-49, he held Hazara, of which he was commissioner (1847-54). He died Oct. 6, 1896.

See J. Abbott, *Narrative of a Journey from Herat to Khyva*, 2 vol., 3rd ed. (London, 1884).

ABBOTT, JOHN STEVENS ABBOTT (1805-1877), American writer, was born in Brunswick, Me., on Sept. 18, 1805. He was a brother of Jacob Abbott, with whom he was associated in the management of Abbott's Institute, New York city, and in the preparation of his series of brief historical biographies. He is best known, however, as the author of a partisan and unscholarly but very readable *History of Napoleon Bonaparte* (1855). Dr. Abbott graduated at Bowdoin college in 1825, studied at Andover theological seminary, and between 1830 and 1844, when he retired from the ministry, preached successively at Worcester, Roxbury and Nantucket, Massachusetts. He died at Fair Haven, Conn., on June 17, 1877. He was a voluminous writer of books on Christian ethics, and of popular histories.

ABBOTT, LYMAN (1835-1922), American divine and author, was born at Roxbury (Mass.), on Dec. 18, 1835, the son of Jacob Abbott. He graduated at New York university in 1853, studied law, and was admitted to the bar in 1856; but abandoning the legal profession, after studying theology with his uncle, J. S. C. Abbott, he was ordained a minister of the Congregational church in 1860. After pastorates in Terre Haute (Ind.), and New York City, he became an associate editor of *Harper's Magazine*, editor of the *Illustrated Christian Weekly*, and co-editor (1876-81) of *The Christian Union* with Henry Ward Beecher, whom he succeeded in 1888 as pastor of Plymouth church, Brooklyn. From this pastorate he resigned 11 years later. From 1881 he was editor-in-chief of *The Christian Union*, renamed *The Outlook* in 1893; this periodical reflected his efforts toward social reform and his humane and liberal theology. To the end of his long life he continued to take an active and authoritative part in the discussion of public questions. He died in New York City on Oct. 22, 1922.

The serenity and dignity of his life are reflected in his works which include, besides his many magazine articles, *Jesus of Nazareth* (1869); *Evolution of Christianity* (Lowell Lectures, 1896); *The Theology of an Evolutionist* (1897); *Christianity and Social Problems* (1897); *Life and Letters of Paul* (1898); *Problems of Life* (1900); *The Rights of Man* (1901); *Henry Ward Beecher* (1903); *The Christian Ministry* (1905); *The Personality of God* (1905); *Industrial Problems* (1905); *America in the Making* (1911); and *Reminiscences* (1915).

ABBOTT, WILBUR CORTEZ (1869-1947), U.S. educator and historian, was born in Kokomo, Ind., Dec. 28, 1869. Following his graduation from Wabash college, Crawfordsville, Ind., in 1892, he pursued graduate studies at Cornell university and in Europe. Upon returning from Europe, he taught history at the University of Michigan, Ann Arbor, 1897-99. Abbott was assistant professor of history at Dartmouth college, Hanover,

N.H., 1899-1902; professor of European history at the University of Kansas, Lawrence, 1902-08; and professor of history at Yale university, 1908-20, and at Harvard university, 1920-37. He was a research associate in history at Yale, 1938-46. He died on March 27, 1947. Among his published works are *The Expansion of Europe* (1918); and (ed., with others) *The Writings and Speeches of Oliver Cromwell*, 4 vol. (1937-47).

ABBOTTABAD, a town of Pakistan, 4,120 ft. above sea level, 63 mi. from Rawalpindi, formerly the headquarters of the Hazara district in the North-West Frontier province, called after its founder, Sir James Abbott, who settled this wild district after the annexation of the Punjab. Pop. (1941) 27,424. It was an important military cantonment and sanatorium, being the headquarters of a brigade in the Rawalpindi division of the northern Indian army. It is remarkable for the rock inscription of Asoka close by.

ABBREVIATION. Strictly a shortening, an abbreviation more particularly is a letter or group of letters taken from a word or words and employed to represent it or them for the sake of brevity. Abbreviations, both of single words and of phrases,

having a meaning more or less fixed and recognized, were common in ancient writings and inscriptions (*see* PALAEOGRAPHY). A common form of abbreviation is the substitution for a word of its initial letter; but one or more of the other letters are frequently added. Letters are often doubled to indicate a plural or a superlative. There is no occasion to explain here the common abbreviations for Christian names or for geographical place names (listed separately in vol. 24) or for the chemical elements (listed separately under ATOMIC WEIGHTS). Also omitted are those abbreviations which have passed into common usage as words in their own rights; *e.g.*, Cominform, gestapo, radar, etc.

No universally accepted rule as to the use of periods in abbreviations has been followed. One common method, and the one used in this article, is to use periods after the initials of all organizations except U.S. government agencies and some, but not all, organizations whose letters form pronounceable words such as WAVES, etc.

In cases where the abbreviation has multiple meanings, only the most common are given.

COMMON ABBREVIATIONS

a. alto; adjective; answer; accepted
A angstrom, the international wave-length unit, 1938
Å Ångström scale of wave lengths, 1868-1938
Ar. first class
AA anti-aircraft
AAA Agricultural Adjustment administration
A.A.A. American Automobile association
A.A.A.L. American Academy of Arts and Letters
A.A.A.S. American Association for the Advancement of Science
A.A.F. army air forces
A.A.G. assistant adjutant general
A.A.P.S. American Association for the Promotion of Science
A.A.S. fellow of the American academy (of Arts and Sciences)
A.A.U. Amateur Athletic union
A.A.U.P. American Association of University Professors
A.A.U.W. American Association of University Women
A.B. able-bodied seaman; bachelor of arts
abbr., abbrev. abbreviated; abbreviation
ABC American Broadcasting company
A.B.C. Argentina, Brazil and Chile
ab init. (*ab initio*) from the beginning
abl. ablative
Abp. archbishop
abr. abridged; abridgment
abs. absolute
ABSIE American Broadcasting Station in Europe
ac. acre(s)
a/c account
A.C. (*ante Christum*) before Christ; alternating current; army corps; air corps
acad. academy
acc. accusative
accel. (*accelerando*) increasing speed
A.C.S. American College of Surgeons; American Chemical society
ACTH adrenocorticotrophic hormone
ad., advt. advertisement
A.D. (*anno Domini*) in the year of our Lord
A.D.A. Americans for Democratic Action
adag. (*adagio*) slow
A.D.C. aide-de-camp
ad fin. (*ad finem*) at or to the end
ad inf. (*ad infinitum*) to infinity
ad init. (*ad initium*) at the beginning
ad int. (*ad interim*) in the meantime

adj. adjective
Adj. Gen. adjutant general
ad lib. (*ad libitum*) at one's pleasure
ad loc. (*ad locum*) at the place
Adm. admiral(ty)
adv. adverb
ad val. (*ad valorem*) according to value
A.E. and P. ambassador extraordinary and plenipotentiary
A.E.C. Atomic Energy commission (U.S.)
A.E.F. American expeditionary force
aet., aetat. (*aetatis*) aged
A.F. Anglo-French
A.F.C. air force cross (Brit.)
A.F.M. air force medal (Brit.); American Federation of Musicians
A.F. of L. American Federation of Labor
A.G.F. army ground forces
agr., agric. agriculture; agricultural
agt. agent
a.h. ampere hour(s)
A.H. (*anno Hegirae*) in the year of the hegira (Mohammedan era)
A.I.A. American Institute of Architects
A.I.E.E. American Institute of Electrical Engineers; associate of the Institution of Electrical Engineers (Brit.)
A.I.F. Australian imperial force
A.I.M. & M.E. American Institute of Mining and Metallurgical Engineers
A.L. American Legion
A.L.A. American Library association
Ald. alderman
A.L. of H. American Legion of Honor
A.L.P. American Labor party
alt. altitude; alternate
AM amplitude modulation
Am., Amer. American
A.M. (*ante meridiem*) before noon; (*anno mundi*) in the year of the world; master of arts
A.M.A. American Medical association
Amg. Allied military government of occupied territory
amp. ampere(s)
amt. amount(s)
Amvets. American Veterans of World War II
A.N. Anglo-Norman
A.N.A. associate of the National Academy of Design
anal. analysis
anc. ancient
A.N.C. army nurse corps
and. (*andante*) moderately slow
Angl. Anglican
anon. anonymous
ans. answer

ant. antonym
ant., antiq. antiquities; antiquarian
Anzac Australian and New Zealand army corps
A.O.H. Ancient Order of Hibernians
A.P. Associated Press
A.P.I. American Petroleum institute
A.P.O. army post office
app. appointed; appendix; apparent
approx. approximately
A.Q.M.G. assistant quartermaster general
Ar., Arab. Arabic; Arabian
A.R.A. associate of the Royal Academy; American Railway association
A.R.C. American Red Cross
arch. architecture; archaic
Archd. archdeacon; archduke
A.R.C.M. associate, Royal College of Music (Brit.)
A.R.C.S. associate, Royal College of Science (Brit.)
arg. argent (heraldic)
A.R.I.B.A. associate of the Royal Institute of British Architects
arith. arithmetic; arithmetical
Arm. Armoric
A.R.P. air-raid precautions
A.R.S.A. associate of the Royal Scottish academy
A.R.V. American revised version (Bib.)
AS, A.S. Anglo-Saxon
ASCAP American Society of Composers, Authors and Publishers
A.S.C.E. American Society of Civil Engineers
A.S.F. army service forces
A.S.M.E. American Society of Mechanical Engineers
ass., assn., assoc. association
asst. assistant
ASTP Army Special Training program
astr., astron. astronomical; astronomy
AT anti-tank
ATC air transport command
atm. atmosphere(s); atmospheric
A.T.S. auxiliary territorial service (Brit.)
atty. attorney
Atty. Gen. attorney general
at. wt. atomic weight
A.U. angstrom unit, 1938
A.U. Ångström unit, 1868-1938
A.U.C. (*anno urbis conditae*) from the founding of the city (Rome)
av., ave. avenue; average
A.V. authorized version of the Bible
A.V.C. American Veterans committee
avoir. avoidupois

A.W.O.L.	absent without leave	C.E.	civil engineer; Christian Endeavor; Church of England	C.S.T.	central standard time
AWVS	American Women's Voluntary services	CEA	Commodity Exchange authority	ctr.	centre
b.	born	C.E.D.	Committee for Economic Development	cu.	cubic
B.A.	bachelor of arts	C.E.F.	Canadian expeditionary force	cu.cm.	cubic centimetre(s)
bal.	balance	Celt.	Celtic	cu.ft.	cubic foot; cubic feet
Bapt.	Baptist	cent.	(<i>centum</i>) a hundred	cu.in.	cubic inch(es)
B.Arch.	bachelor of architecture	cel. par.	(<i>ceteris paribus</i>) other things being equal	C.V.O.	Companion of the (Royal) Victorian Order
bart., bt.	baronet	cf.	compare	CWA	Civil Works administration
B.B.C.	British Broadcasting corporation	C.G.	coast guard	CWAC	Canadian women's army corps
bbl.	barrel(s)	cg.	centigram(s)	cwt.	hundredweight(s)
B.C.	before Christ	c.g.s.	centimetre-gram-second(s)	C.Y.O.	Catholic Youth organization
BCG	Bacillus-Calmette Guérin	C.G.S.	(<i>Confédération Générale du Travail</i>) General Confederation of Labour (Fr.)	d.	(<i>denarius</i>) penny
B.D.	bachelor of divinity	C.G.T.	Companion of Honour (Brit.)	D.A.	district attorney
bd.ft.	board foot; board feet	Ch.	church	D.A.R.	Daughters of the American Revolution
Bé.	Baumé (degrees)	Chap.	chaplain	D.A.V.	Disabled American Veterans
B.Ed.	bachelor of education	Chem.E.	chemical engineer	dat.	dative
B.E.F.	British expeditionary force	C.I.E.	Companion (of the Order) of the Indian Empire (Brit.)	D.B.E.	Dame (Commander of the Order) of the British Empire
BES	bureau of employment security	Cie.	(<i>compagnie</i>) company	D.C.	(<i>da capo</i>) from the beginning; direct current
BEW	Board of Economic Warfare	c.i.f.	cost, insurance, freight	dcg.	decagram(s)
b.f.	boldface	C.I.O.	Congress of Industrial Organizations	dcl.	decalitre(s)
b.h.p.	brake horsepower	cl.	centilitre(s)	D.C.L.	doctor of civil law
Bib.	Bible, biblical	clk.	clerk	dcm.	decimetre(s)
bibliog.	bibliography; bibliographer	C.M.	common metre(s)	D.C.M.	distinguished conduct medal (Brit.); district court martial
biog.	biography; biographical	cm.	centimetre(s)	D.D.	doctor of divinity
bk.	bank; book; bark	C.M.G.	Companion (of the Order) of St. Michael and St. George (Brit.)	D.D.M.	doctor of dental medicine
bkt.	basket(s)	cml.	commercial	D.D.S.	doctor of dental surgery
b.l.	bill of lading	C.O.	commanding officer	DDT	dichloro-diphenyl-trichloroethane
bidg.	building	Co.	company; county	decim.	decimetre(s)
B.L.E.	Brotherhood of Locomotive Engineers	c.o., c/o	care of	decrese.	(<i>decrecendo</i>) with gradually decreasing volume
blk.	black; block	C.O.D.	cash on delivery	deg.	degree(s)
BLS	bureau of labour statistics	col.	colony; column	del.	(<i>delineavit</i>) he or she drew it
blvd.,	boulevard	coll.	collector; collection; college	dele.	(<i>deleatur</i>) delete
boul.	board measure	colloq.	colloquial; colloquialism; colloquially	Dem.	Democrat; Democratic
b.m.	bachelor of medicine	com.	commerce; commission; committee	D.Eng.	doctor of engineering
B.M.I.	Broadcast Music, Inc.	Comdr.,	commander	dep.	deputy
bn.	battalion	Comm.	commandant	dept.	department
B.O.A.C.	British Overseas Airways corporation	Comdt.	commandant	DF	direction-finding
b.p.	boiling point	COMINCH	commander in chief of the U.S. fleet	D.F.C.	distinguished flying cross (Brit.)
Bp.	bishop	Com. in	commander in chief	dg.	decigram(s)
B.P.O.E.	Benevolent and Protective Order of Elks	Chf.	comparative; compare; compound; compounded	D.G.	(<i>Dei gratia</i>) by the grace of God
Brig.	brigade; brigadier	comp.	common version (Bib.)	diam.	diameter
Brig. Gen.	brigadier general	Com. Ver.	(<i>contra</i>) against	dict.	dictator; dictionary
B.it.	British	conf.	conference	diff.	difference
Bros.	brothers	Cong.	congregation; Congregational; Congregationalist; congress	dim.	(<i>diminuendo</i>) with gradually diminishing volume
B.S., B.Sc.	bachelor of science or sciences	conj.	conjunction	dl.	decilitre(s)
B.S.A.	Boy Scouts of America	const.	constitution; constable; constant	DLC	Disaster Loan corporation
B.Th.	bachelor of theology	constr.	construction	D.Litt.	doctor of letters
B.T.U.	British thermal unit(s)	cont.	contents; continued	D.L.O.	dead-letter office
bu.	bushel(s)	co-op.	co-operative	dm.	decimetre(s)
bull.	bulletin	cop., Copt.	Coptic	DME	distance measuring equipment
B.V.M.	the Blessed Virgin Mary	Corp.	corporate; corporation	D.M.S.	doctor of medical science
bx.	box(es)	corr.	correspond; correspondent; corresponding; corrected	D.Mus.	doctor of music
c.	(<i>circa</i>) about	cos	cosine	D.N.B.	(<i>Deutsches Nachrichten Bureau</i>) nazi official news agency
c., ¢, ct.	cent	cot, ctn	cotangent	do.	(<i>ditto</i>) the same
c., cap.,	chapter	C.P.	chemically pure; common pleas; court of probate	dol.	dollar, now expressed by \$
ch., chap.	(<i>caput</i>) chapter	cp.	candlepower	dopa	dihydroxyphenylalanine
C.	centigrade	C.P.A.	Canadian Pacific Air Lines Ltd.; certified public accountant	doz.	dozen
C.A.	chartered accountant; coast artillery	C.P.O.	chief petty officer	DP	displaced person
CAA	Civil Aeronautics administration	C.R.	(<i>Custos Rotulorum</i>) Keeper of the Rolls	dpt.	department
CAB	Civil Aeronautics board	Cr.	creditor; credit	Dr.	debtor; doctor
cal.	calorie(s)	crs.	(<i>crescendo</i>) with gradually increasing volume	dr.	drachm(s) or dram(s)
Cantab.	(<i>Cantabrigiensis</i>) of Cambridge (university)	CSC	civil service commission	D.S.C.	distinguished service cross
Capt.	captain	csc	coscant	D.Sc.	doctor of science
car., k.	carat(s)	C.S.I.	Companion (of the Order) of the Star of India	D.S.M.	distinguished service medal (Companion of the) Distinguished Service Order
Card.	cardinal	C.S.O.	chief signal officer; chief staff officer	D.S.T.	daylight saving time
cat.	catalogue			Du.	Dutch
Cath.	Catholic; cathedral			Duo.	duodecimo
cav.	cavalry			D.V.	(<i>Deo volente</i>) God willing
C.B.	Companion (of the Order) of the Bath (Brit.)			D.V.M.	doctor of veterinary medicine
C.B.E.	Commander, Order of the British Empire			D.V.S.	doctor of veterinary surgery
CBS	Columbia Broadcasting system			dwt.	pennyweight
c.c.	cubic centimetre(s)			E	excellence in production (U.S. army and navy award)
CCC	Civilian Conservation corps; Commodity Credit corporation			E.	east
C.D.S.,	Companion of the Distinguished Service Order (Brit.)			ea.	each
D.S.O.	Companion of the Distinguished Service Order (Brit.)			E. & O.E.	errors and omissions excepted
				Ebor.	(<i>Eboracensis</i>) of York

ECA European Cooperation administration
ed. editor; edition; educated
Edin. Edinburgh
E.E. Early English; electrical engineer; errors excepted
E.E. & M.P. envoy extraordinary and minister plenipotentiary
e.g. (*exempli gratia*) for example
e.m.f. electromagnetic force
E.M.F. electromagnetic force
Emp. empire; emperor
ency., encyc.
E.N.E. east-northeast
Eng. English
E.N.W. east-northwest
ERP European Recovery program (Marshall plan)
E.S.E. east-southeast
esp., espec. especially
Esq. esquire
est. established; estimated
E.S.T. eastern standard time
E.S.U., UES electrostatic unit(s)
E.S.W. east-southwest
et alii or *aliae* and others;
(et alibi) and elsewhere
(et cetera) and so forth
E.T.O. European theatre of operations
(et sequens, sequentes or sequentia) and the following
ev. electron volt(s)
ex. example
exp. export
f. farad(s)
f., fem. feminine
f. (*forte*) loud, powerful
F. Fahrenheit
F.A. field artillery
F. and A.M. Free and Accepted Masons
facsim. facsimile
F.A.O. Food and Agriculture organization
F.B.A. fellow of the British academy
FBI Federal Bureau of Investigation
FCA Farm Credit administration
FCC Federal Communications commission
FCIC Federal Corp Insurance corporation
F.C.S. fellow of the Chemical society
F.D. (*fidei defensor*) Defender of the Faith (Brit.); fire department
FDA Federal Drug administration
FDIC Federal Deposit Insurance corporation
FEA Foreign Economic administration
fec. (*fecit*) he (or she) made (or did) (it)
F.E.C. Far Eastern commission
fed. federal
F.E.P.C. Fair Employment Practices committee
FERA Federal Emergency Relief administration
ff. (*fortissimo*) very loud; following (pages)
F.F.I. French Forces of the Interior
F.G.S. fellow of the Geological society
FHA Federal Housing administration
F.I.C. fellow of the Institute of Chemistry (of Great Britain and Ireland)
fig., figuratively; figure(s)
Finn. Finnish
fl. flourished
fl. oz. fluid ounce(s)
F.L.S. fellow of the Linnaean society
FM frequency modulation
F.M. field marshal
fm. fathom(s)
F.O. foreign office
fo., fol. folio
f.o.b. free on board
FPC Federal Power commission

FPHA Federal Public Housing authority
f.p.s. foot-pound-second; feet per second
F.P.S. fellow of the Philological society (Brit.)
Fr. French
fr. franc(s); from; father
F.R.A.I. fellow of the Royal Anthropological institute (of Great Britain and Ireland)
F.R.A.S. fellow of the Royal Astronomical society (Brit.)
F.R.C.P. fellow of the Royal College of Physicians, London
F.R.C.P.E. fellow of the Royal College of Physicians of Edinburgh
F.R.C.S. fellow of the Royal College of Surgeons, London
F.R.C.V.S. fellow of the Royal College of Veterinary Surgeons (Brit.)
FRED Federal Real Estate board
F.R.G.S. fellow of the Royal Geographical society, London
F.R.Hist.S. fellow of the Royal Historical society, London
F.R.H.S. fellow of the Royal Horticultural society, London
F.R.I.B.A. fellow of the Royal Institute of British Architects
F.R.S. fellow of the Royal society (of London)
F.R.S.E. fellow of the Royal Society of Edinburgh
F.R.S.L. fellow of the Royal Society of Literature (of the United Kingdom)
FSA Farm Security administration; Federal Security agency
F.S.A. fellow of the Society of Antiquaries (of London)
FSLIC Federal Savings and Loan Insurance corporation
F.S.S. fellow of the Statistical society (of London)
ft. foot; feet
FTC Federal Trade commission
ft. lb. foot pound(s)
furlong(s)
f.v. (*folio verso*) on the back of the page
FWA Federal Works agency
F.Z.S. fellow of the Zoological society, London
g. gram(s)
gal. gallon(s)
GAO general accounting office
G.A.R. Grand Army of the Republic
gaz. gazette; gazetteer
G.B.E. (Knight, Dame) Grand (Cross, Order) of the British Empire
GCA ground controlled approach
g.cal. gram calorie(s)
G.C.B. (Knight) Grand Cross (of the Order) of the Bath
G.C.I.E. (Knight) Grand Commander (of the Order) of the Indian Empire
G.C.M.G. (Knight) of the Grand Cross (of the Order) of St. Michael and St. George
G.C.S.I. (Knight) Grand Commander (of the Order) of the Star of India
G.C.V.O. (Knight) Grand Cross of the (Royal) Victorian Order
gen. genitive; general
Gen. general (title)
Ger. German
G.H.Q. general headquarters
gi. gill(s)
G.I. government issue, a U.S. soldier
G.M.T. Greenwich mean time
G.O.C. general officer commanding
G.O.P. Grand Old Party (Republican)
Goth. Gothic
Gov. governor
govt. government
GPO government printing office

G.P.O. general post office
Gr. Greek
gr. grain(s)
ha. hectare(s)
hdkf. handkerchief
hdqrs. headquarters
Heb., Hebr. Hebrew(s)
her. heraldic; heraldry
hg. hectogram(s)
H.H. His or Her Highness; His Holiness (the pope)
hhd. hoghead(s)
HHFA Housing and Home Finance agency
H.I.H. His or Her Imperial Highness
H.I.M. His or Her Imperial Majesty (*hic jacet sepultus*) here lies buried
hl. hectolitre(s)
HLBB Home Loan Bank board
hm. hectometre(s)
H.M. His or Her Majesty
H.M.S. His or Her Majesty's ship, or service
H.M.S.O. His or Her Majesty's stationery office
HOLC Home Owners' Loan corporation
Hon. honourable; honorary
hosp. hospital
h.p. horsepower
H.Q. headquarters
H.R. house of representatives; house of representatives bill
hr. hour(s)
H.R.H. His or Her Royal Highness
H.S.H. His or Her Serene Highness
ht. height
ib., ibid. (*ibidem*) in the same place
I.C.A.O. International Civil Aviation organization
ICC Interstate Commerce Com.
Icel. Icelandic
I.C.L. 4-A Intercollegiate Association of Amateur Athletics in America
id. (*idem*) the same
i.e. (*id est*) that is
I.E.F.C. International Emergency Food committee
I.G. inspector general
i.h.p. indicated horsepower
IHS a symbol representing the Greek name of Jesus
I.L.G.W.U. International Ladies' Garment Workers' union
ill., illus. illustration; illustrated
I.L.O. International Labour organization
ILS instrument landing system
imp. imperative; imperfect (tense); imperial; (*imprimatur*) let it be printed
in. inch(es)
Inc. incorporated
incl. inclosure; inclusive
incog. (*incognito*) unknown
ind. index
Ind. Indian
indiv. individual
inf. infantry; infinitive
inf. (*infra*) below
init. initial
I.N.R.I. (*Iesus Nazarenus Rex Iudaeorum*) Jesus of Nazareth, King of the Jews
I.N.S. International News service
ins. insurance
insp. inspector
Inst. institute; institution
instant, the present month
instr. instrument
insur. insurance
int. interest
internat. international
introd. introduction; introductory
inv. invoice
invt. inventory
I.O.F. Independent Order of Foresters
I.O.G.T. Independent Order of Good Templars

I.O.O.F.	Independent Order of Odd Fellows	Lieut. Gen.	lieutenant general	MLB	Maritime Labor board
I.O.U.	I owe you	lin.	linear	M.Litt.	master of letters
I.Q.	intelligence quotient	Linn.	Linnaeus; Linnaean	Mlle.	mademoiselle
i.q.	(<i>idem quod</i>) the same as	liq.	liquid	mm.	millimetre(s)
Ir.	Irish	lit.	literally; literature; literary	μm	millimicron(s)
I.R.O.	International Refugee organization	Lith.	Lithuanian	Mme(s).	madame; mesdames
Is.	islands	lith.	lithograph; lithography	m.m.f.	magnetomotive force
I.S.O.	(Companion of the) Imperial Service Order	Litt.D.	doctor of letters	M.O.	medical officer; money order
It., Ital.	Italian	L.J.	lord justice	mo.	month
it., ital.	italics	L.L., L. Lat.	low Latin; Law Latin	mod.	modern; (<i>moderato</i>) moderately fast
I.T.O.	International Trade organization	LL.B.	bachelor of laws	M.O.I.	ministry of information (Brit.)
I.T.U.	International Telecommunications union	LL.D.	doctor of laws	mol.	molecule(s)
I.W.W.	Industrial Workers of the World	loc. cit.	(<i>loco citato</i>) in the place cited	mol. wt.	molecular weight
J., Jour.	journal	log	logarithm	m.p.	melting point
J.A.G.	judge advocate general	long.	longitude	M.P.	member of parliament; military police
Jav.	Javanese	loq.	(<i>loquitur</i>) he (or she) speaks	m.p.h.	miles per hour
J.C.D.	doctor of civil law	LP	long-playing (phonograph records)	Mr.	master
J.D.	doctor of laws	L.P.S.	lord privy seal (Brit.)	M.R.	Master of the Rolls (Brit.)
j.g.	junior grade	L.R.A.M.	Licentiate of the Royal Academy of Music (Brit.)	M.R.A.S.	member of the Royal Asiatic society (of Great Britain and Ireland); member of the Royal Academy of Science (Brit.)
jour.	journal; journey	L.R.C.P.	Licentiate of the Royal College of Physicians (Brit.)	M.R.C.P.	member of the Royal College of Physicians (London)
J.P.	justice of the peace	L.R.C.P.E.	Licentiate of the Royal College of Physicians, Edinburgh	M.R.C.S.	member of the Royal College of Surgeons (Brit.)
Jr.	junior	L.R.C.S.	Licentiate of the Royal College of Surgeons (Brit.)	M.R.C.V.S.	member of the Royal College of Veterinary Surgeons (Brit.)
k.	carat(s)	L.S.	(<i>locus sigilli</i>) place of the seal	M.R.P.	(<i>Mouvement Républicain Populaire</i>) Republican Popular movement (Fr.)
K.	Kelvin	L.S.A.	Licentiate of the Society of Apothecaries	Mrs.	mistress
K.B.E.	Knight (Commander of the Order) of the British Empire	l.s.d.	(<i>librae, solidi, denarii</i>) pounds, shillings, pence	ms., mss.	manuscript; manuscripts
K.C.	king's counsel; Knights of Columbus	L.S.D.	landing ship dock	M.S., M.Sc.	master of science
kc.	kilocycle(s)	L.S.M.	landing ship medium	Msgr.	monsignor
K.C.B.	Knight Commander (of the Order) of the Bath	L.S.T.	landing ship tank	M.S.T.	mountain standard time
K.C.I.E.	Knight Commander (of the Order) of the Indian Empire	lt.	long ton(s)	Mt., mts.	mount, mountains
K.C.M.G.	Knight Commander (of the Order) of St. Michael and St. George	Ltd.	limited	μ	micron(s); micro-
K.C.S.I.	Knight Commander (of the Order) of the Star of India	Luth.	Lutheran	μv	microvolt(s)
K.C.V.O.	Knight Commander of the (Royal) Victorian Order	m.	married; metre(s); minim; masculine; milli-	mus.	museum; music; musical
K.G.	Knight (of the Order) of the Garter	M.	(<i>meridies</i>) meridian, noon; mark(s); (<i>mille</i>) thousand(s); monsieur	mv	millivolt(s)
kg.	kilogram(s)	M.A.	master of arts	M.V.O.	member of the (Royal) Victorian Order
kg.cal.	kilogram calorie(s); kilocalorie(s)	Maj.	major	myth.	mythology; mythological
K.K.K.	Ku Klux Klan	Maj. Gen.	major general	n.	noun
kl.	kilolitre(s)	Marq.	marquis	n., nn.	note(s)
K.L.M.	Koninklijke Luchtvaart Maatschappij voor Nederland en Kolonien N.V. (Dutch airline)	masc.	masculine	N.	north
km.	kilometre(s)	max.	maximum	N.A.	National Academician
K.P.	Knights of Pythias; Knight (of the Order) of St. Patrick (Brit.); kitchen police	M.B.E.	Member (of the Order) of the British Empire	N.A.A.C.P.	National Association for the Advancement of Colored People
kr.	kroner; króna; krónur	mc.	megacycle(s)	N.A.B.	National Association of Broadcasters
Kt.	knight	M.C.	master of ceremonies; member of congress; military cross; medical corps; marine corps	N.A.C.	National Arts club
K.T.	Knight(s) Templar; Knight (of the Order) of the Thistle (Scot.)	M.D.	doctor of medicine	NACA	National Advisory Committee for Aeronautics
kv.	kilovolt(s)	mdse.	merchandise	N.A.M.	National Association of Manufacturers
kva.	kilovolt ampere(s)	Middle Eng.	Middle English; mechanical engineer; mining engineer	N.A.N.A.	North American Newspaper alliance
kw.	kilowatt(s)	mech.	mechanics; mechanical	N.A.S.	National Academy of Sciences
kw.hr.	kilowatt hour(s)	med.	medicine; medical; mediaeval	nat.	national; natural
l.	litre(s)	mem.	(<i>memento</i>) memorandum	naut.	nautical
l., ll.	line(s)	m.e.p.	mean effective pressure	nav.	naval; navigation
L., £	(<i>libra</i>) pound(s) (money)	Messrs.,	messieurs	n.b.	(<i>nota bene</i>) note well; take notice
L., lib.	(<i>liber</i>) book	MM.	messieurs	NBC	National Broadcasting company
lat.	latitude	Met.	metropolitan	N.C.A.A.	National Collegiate Athletic association
Lat.	Latin	Meth.	Methodist	N.C.O.,	noncom.
lb.	(<i>libra</i>) pound(s) (weight)	Mev	million electron volt(s)	N.C.W.C.	National Catholic Welfare conference
l.c.	lower case; letter of credit	m.f.	(<i>mezzo forte</i>) moderately loud	N.C.Y.C.	National Catholic Youth council
l.c., loc. cit.	(<i>loco citato</i>) in the place cited	mfd., mfg.	manufactured; manufacturing	N.E.	northeast
L.C.	landing craft; Library of Congress; lord chamberlain; lord chancellor	mfrs.	manufacturers	N.E.A.	Newspaper Enterprise association; National Education association
L.C.C.	London County council	mg.	milligram(s)	N.E.D.	New English Dictionary
L.C.J.	lord chief justice	Mgr.	monsignor; manager	N.E.L.A.	National Electric Light Assoc.
L.G.	Low German	m.g.s.	metre-gram-second(s)	nem.con.	(<i>nemine contradicente</i>) no one contradicting; unanimous
L.H.D.	doctor of humanities	M.H.G.	Middle High German	N.E.P.	New Economic policy (U.S.S.R.)
lib.	(<i>liber</i>) book; library; librarian	mi.	mile(s)	neut.	neuter
Lieut., Lt.	lieutenant	M.I.E.E.	member of the Institution of Electrical Engineers (Brit.)	New Test.,	New Testament
Lieut. Col.	lieutenant colonel	mil, milit.	military	N.T.	
Lieut. Com.	lieutenant commander	M.I.M.E.	member of the Institution of Mining Engineers (Brit.)		
		M.I.Mech.	member of the Institution of Mechanical Engineers (Brit.)		
		min.	minute(s); minimum		
		Min.Plen.	minister plenipotentiary		
		misc.	miscellaneous		
		ml.	millilitre(s)		
		M.L.	Mediaeval, or Middle, Latin		

N.F.S.	National Fire service (Brit.)	P.A.S.I.	Professional Associate of the (Chartered) Surveyors' institution (Brit.)	Q.M.G.	quartermaster general
N.Gr.	New Greek	pat.	patent	qr.	quarter; quarterly; quire
N.H.I.	National Health insurance (Brit.)	patd.	patented	q.s. or	quant. (<i>quantum sufficit</i>) as much as is sufficient
NIRA	National Industrial Recovery act or administration	Pat. Off.	patent office	qt.	quart(s)
NKVD	(<i>Narodnyi Komissariat Vnutrennykh Del</i>) Peoples Commissariat of Internal Affairs, including soviet secret state police	payt.	payment	Q.T.	(on the) quiet
N.L.	New Latin	pc.	piece	Q.v.	(<i>quod vide</i>) which see; (<i>quantum vis</i>) as much as you will
NLRB	National Labor Relations board	PC	patrol craft (boat)	R.	(<i>rex, regina</i>) king, queen; (<i>re-cipe</i>) take
NMB	National Mediation board	P.C.	privy councillor; police constable	R.A.	rear admiral; Royal academy (of Arts, London), royal art; royal artillery
N.M.U.	National Maritime union	P.D.	police department	rabb.	rabbinical
N.N.E.	north-northeast	pd.	paid	rad.	(<i>radix</i>) root
N.N.W.	north-northwest	P.E.	Protestant Episcopal	R.A.F.	royal air force
no.	(<i>numero</i>) number	per., pers.	person; personal	rall.	(<i>rallentando</i>) gradually slower
nom.	nominative; nominated	pert.	pertaining	R.A.M.	Royal Academy of Music (Brit.)
non seq.	(<i>non sequitur</i>) it does not follow	PETN	pentaerythritoltetranitrate	R.A.M.C.	royal army medical corps (Brit.)
Nor.,	Norman	p.f.	(<i>pia forte</i>) a little louder	R. & I.	(<i>rex et imperator</i>) king and emperor
N.P.	notary public	P.F.C.	private first class	R.A.S.C.	royal army service corps (Brit.)
n.p.t.	normal (blood) pressure and temperature	pdf.	preferred	R.B.A.	Royal (Society of) British Artists
NRA	National (Industrial) Recovery administration	phar.	pharmacy; pharmaceutical	R.C.	Roman Catholic; Red Cross
NRPB	National Resources Planning board	Ph.B.	bachelor of philosophy	RCA	Radio Corporation of America
N.S.	New Style (calendar)	Ph.C.	pharmaceutical chemist	R.C.A.F.	Royal Canadian air force
N.W.	northwest	Ph.D.	doctor of philosophy	R.E.	royal engineers (Brit.)
NWLB	National War Labor board	phr.	phrase	Ré.	Réaumur's thermometrical scale
NYA	National Youth administration	phys.	physics	REA	Rural Electrification administration
O.B.E.	Order of the British Empire	<i>pinx.</i> , <i>pat.</i>	(<i>pinxit</i>) he or she painted it	recd.	received
obj.	objective; objection	<i>pix.</i>	(<i>pixicato</i>) plucked	reg., regt.	regiment
obs.	observation; observatory; obsolete	pk.	peck(s)	Reg. Prof.	regius professor
OC	Office of Censorship	pkg.	package(s)	rel.	religion; relative
O.C.	officer commanding	pl.	plural; place; plate	Rep.	Republican; report; representative
O.C.S.	Officer Candidate school	P.M.	past master; postmaster; (<i>post meridiem</i>) afternoon; provost marshal	ret.	retired
O.D.	officer of the day; olive drab; overdraft	P.O.	post office; postal order	rev.	revolution; revenue
O.E.	Old English	P.O.D.	post office department	Rev.	reverend
O.E.E.C.	Organization for European Economic Cooperation	P.O.E.	port of embarkation	RFC	Reconstruction Finance corporation
OEM	Office for Emergency Management	pop.	population	R.F.D.	rural free delivery
OES	Office of Economic Stabilization	p.p.w.	prisoner of war	Rh	Rhesus factor
OEW	Office of Economic Warfare	P.P.	parish priest	R.I.B.A.	Royal Institution of British Architects
O.F.	Old French	p.p.	(<i>pianissimo</i>) very soft	R.I.P.	(<i>requiescat in pace</i>) may he or she rest in peace
OFF	Office of Facts and Figures	<i>p.p.c.</i>	(<i>pour prendre congé</i>) to take leave	rit.	(<i>ritardando</i>) gradually slower
off.	official	P.P.S.	(<i>post postscriptum</i>) an additional postscript	river	
O. Gael.	Old Gaelic	P.R.	(<i>populus Romanus</i>) the Roman people	R.M.	royal marines; resident magistrate
OGR	Office of Government Reports	pr.	pair; price; pronoun	R.M.A.	Royal Military academy (Woolwich)
O.H.G.	Old High German	PRA	Public Roads administration	R.M.C.	Royal Military college (Sandhurst)
O.H.M.S.	On His or Her Majesty's service	prep.	preposition	R.N.	royal navy; registered nurse
O.M.	Order of Merit (Brit.)	pres.	president; present	R.N.V.R.	royal navy volunteer reserve
O.N.	Old Norse	Presb.	Presbyterian	ro.	rood
op.	opus; opera	press.	pressure(s)	Rom.	Roman; romance
OPA	Office of Price Administration	prin.	principal	R.O.T.C.	Reserve Officers' Training corps
op.cit.	(<i>opere citato</i>) in the work cited	proc.	proceedings	r.p.m.	revolutions per minute
OPM	Office of Production Management	Prof.	professor	r.p.s.	revolutions per second
opp.	opposite; opposed	pron.	pronoun; pronunciation	R.R.	railroad
O.R.C.	Officers' Reserve corps	prop.	proprietor	R.R.B.	Railroad Retirement board
orch.	orchestra	prop.	provisional; provost; province	R.S.V.P.	(<i>répondez s'il vous plaît</i>) please reply
org.	organic; organized	<i>prox.</i>	(<i>proximo</i> [mense]) next month	Rt. Hon.	right honourable
orig.	original; origin; originally	Prus.	Prussian	Rt. Rev.	right reverend
O.S.	Old Style (calendar); Old Saxon	P.S.	(<i>postscriptum</i>) postscript	R.V.	revised version (Bib.)
O.S.A.	Order of St. Augustine	pseud.	pseudonym	Ry.	railway
O.S.B.	Order of St. Benedict	P.S.T.	Pacific standard time	s.	(<i>solidus</i>) shilling
O.S.F.	Order of St. Francis	pt.	part; pint(s); point; port	S.	San; south
OSRD	Office of Scientific Research and Development	p.t. or pro tem.	(<i>pro tempore</i>) for the time being	S.	senate bill
OSS	Office of Strategic Services	PT	motor torpedo (boat)	S.A.E.	Society of Automotive Engineers
O.T.	Old Testament	P.T.A.	National Congress of Parents and Teachers	Sans.	Sanskrit; Sanskrit
O.T.C.	Officers' Training camp or corps	PTM	pulse time modulation	Sansk.	Sons of the American Revolution
O.T.S.	Officers' Training school	P.T.O.	please turn over	Sax.	Saxon
OWI	Office of War Information	pub.	publication; published; public	SBA	standard beam approach
Oxon.	(<i>Oxonia, Oxoniensis</i>) Oxford; of Oxford	pvt.	private	sc., ss.	(<i>scilicet</i>) namely
oz.	ounce(s)	PWA	Public Works administration	S.C.	signal corps
p., pp.	page; pages	pwt.	pennyweight	sc. or scr.	scruple
p.	(<i>piano</i>) soft	q., ql.	quintal	sc.	small capital letters
P.A.C.	Political Action committee (C.I.O.)	Q., Qu.	query; question	S.C.A.P.	supreme commander for the Allied Powers
par.	paragraph	Q.E.D.	(<i>quod erat demonstrandum</i>) which was to be demonstrated	Sc.D.	doctor of science
parl.	parliament; parliamentary	Q.E.F.	(<i>quod erat faciendum</i>) which was to be done		
		q.l.	(<i>quantum libet</i>) as much as you please		
		Q.M.	quartermaster		
		Q.M.C.	quartermaster corps		

sci.	science	sym.	symbol	v.	volt(s)
sculp., sc., sculpt.	(<i>sculpit</i>) he or she carved or engraved it	syn.	synonym; synonymous	v. or vid.	(<i>vide</i>) see
s.d.	(<i>sine die</i>) without (appointing) a day (on which to assemble again)	t., tsp.	teaspoon(s)	V, vs.	verse
S.E.	southeast	T.	ton(s)	V	victory (World War II; as in V-mail, V-for-Victory, etc.)
sec	secant	tan	tangent	V.	verb; violin
sec.	section; second(s)	tart.	tartaric	VA	Veterans' administration
SEC	Securities and Exchange Com.	TASS	(<i>Telegraphnoye Agenstvo Sovyetskovo Soyuzo</i>) soviet news agency	V.A.	vicar apostolic; vice-admiral
Secy.	secretary	t.b.	tubercle bacillus, tuberculosis	val.	valley
sen.	senate; senator	Tbs., Tbsp.	tablespoon(s)	Vat.	vatican
seq., sq., seqq.	(<i>sequens, sequentia</i>) the following	T.C.A.	Trans-Canada Air Lines	V.C.	vice-chancellor; Victoria cross
ser.	series	T.E.	topographical engineer	V.D.	venerable disease
sf.	(<i>sforzando</i>) with emphasis	terr.	territory	V-E	victory in Europe (World War II)
sf., sergt.	sergeant	Teut.	Teutonic; teuton	vers.	versed sine
S.H.A.E.F.	supreme headquarters Allied Expeditionary force	t.i.d.	(<i>ter in die</i>) three times daily (pharm.)	vet.	veterinary; veteran
sic	literally; so	T.N.T.	trinitrotoluene	V.F.W.	Veterans of Foreign Wars
sin	sine	tp.	township	V.G.	vicar general
sing.	singular	tr.	translated; translator; trans-pose; treasurer; trustee	VHF	very high frequency
666	hexachlorobenzene, insecticide for intestinal parasites	trans.	transferred; transaction; trans-lation	vil.	village; vilayet
S.J.	Society of Jesus	treas.	treasurer; treasury	Vis., Visc., Visct.	viscount
Slav.	Slavonic	trem.	(<i>tremolo</i>) trembling; fluttering	viz.	(<i>videlicet</i>) namely
SMA	Surplus Marketing administration	trig.	trigonometry	V-J	victory in Japan (World War II)
Soc.	society	T.U.C.	Trades Union congress or council (Brit.)	v.l.	(<i>varia lectio</i>) variant reading(s)
sop.	soprano	TV	television	vocab.	vocabulary
SOS	wireless distress signal at sea (<i>sostenuto</i>) sustained	TVA	Tennessee Valley authority	V-i	(<i>Vergeltungswaffe, eins.</i> : vengeance weapon one) German buzz-bomb
S.P.	shore patrol	2,4-D	a weed killer	vol.	volume(s); volunteers; volcano
sp.	spelling	twp.	township	vox pop.	(<i>vox populi</i>) voice of the people
SPAB	Supply, Priorities and Allocations board	T.W.U.	Transport Workers' union (Brit.)	V.P.	vice-president
SPAR	women's reserve of the United States coast guard (contraction of coast guard motto, <i>semper paratus</i> [always prepared])	typ.	typographer	v.s.	(<i>vide supra</i>) see above
S.P.C.A.	Society for the Prevention of Cruelty to Animals	U., Univ.	university	V.S.	veterinary surgeon
S.P.C.C.	Society for the Prevention of Cruelty to Children	U.A.W.	United Automobile Workers	W.	west
spec.	special; specification	u.c.	upper case	w.	watt(s)
specif.	specifically	U.D.C.	United Daughters of the Confederacy	WAC	women's army corps
S.P.G.	Society for the Propagation of the Gospel (Brit.)	UES, E.S.U.	electrostatic unit(s)	W.A.A.F.	women's auxiliary air force (services) (Brit.)
sp.gr.	specific gravity	ult.	(<i>ultimo</i>) last (month)	WAFS	women's auxiliary ferrying squadron
sq.	square; squadron	UMT	universal military training	WASP	women's air force service pilot
sq.ft.	square foot; square feet	U.M.W.	United Mine Workers	watt hr.	watt hour(s)
Sr.	senior; señor	U.N.	United Nations	WAVES	women appointed for volunteer emergency service (United States naval reserve)
Sra.	señora	U.N.E.S.-C.O.	United Nations Educational, Scientific and Cultural organization	W.C.T.U.	Woman's Christian Temperance union
S.R.O.	standing room only	Unit.	Unitarian	WFA	war food administration
Srta.	señorita	U.N.R.R.A.	United Nations Relief and Rehabilitation administration	W.F.T.U.	World Federation of Trade Unions
SS., s.s.	saints; steamship	U.P.	United Press	W.H.O.	World Health organization
SSB	Social Security board	u.s.	(<i>ubi supra</i>) in the place above mentioned	WLB	War Labor board
S.S.E.	south-southeast	U.S.A.	United States army	WMC	War Manpower commission
S.S.W.	south-southwest	U.S.C.G.	United States coast guard	WPA	Work Projects administration
st.	stanza	USES	United States employment service	WPB	War Production board
St.	Saint; strait; stone; street	USFET	U.S. forces in the European theatre	WRA	War Relocation authority
Sta.	santa; station	USHA	United States Housing authority or administration	WRENS,	
stac.	(<i>staccato</i>) distinct; separated	USIS	U.S. Information service	W.R.N.S.	women's royal naval service
Ste.	sainte	USM.	United States mail	W.S.	writer to the signet (in Scotland) (equivalent to attorney)
S.T.P.	professor of sacred theology	U.S.M.A.	United States Military academy	WSA	War Shipping administration
str.	strait(s)	U.S.M.C.	United States marine corps	wt.	weight
subj.	subject; subjunctive	U.S.N.	United States navy	yd.	yard(s)
sup.	(<i>supra</i>) above	U.S.N.A.	United States Naval academy	Y.M.C.A.	Young Men's Christian association
suppl.	supplement	U.S.N.R.	United States naval reserve	Y.M.-Cath.A.	Young Men's Catholic association
supt.	superintendent	U.S.O.	United Service organizations (for National Defense)	Y.M.H.A.	Young Men's Hebrew association
surg.	surgeon; surgery	U.S.P.	United States Pharmacopoeia	Y.P.S.C.E.	Young People's Society of Christian Endeavor
s.v.	(<i>sub voce</i>) under the word (or heading)	USPHS	U.S. public health service	yr.	year(s); younger; your
S.W.O.C.	Steel Workers Organizing Com.	U.S.S.	United States ship; United States senate	Y.W.C.A.	Young Womens Christian association
		U.S.S.S.	United States secret service	Y.W.H.A.	Young Women's Hebrew association
		U.S.W.A.	United Steel Workers of America	Z.S.	zoological society
		v.	(<i>versus</i>) against		

ABBREVIATORS, officials in the papal chancery, whose business was to draft the pope's bulls, briefs and consistorial decrees before these were written out *in extenso* by the *scriptores*. They are first mentioned in *Extravagantes* of John XXII. Pius II fixed their number at 70, and formed them into a college of prelates. Pius VII reduced their number to 17. The college was abolished in 1908 by Pius X, who transferred its duties to the *Collegium Promotoriorum Apostolicorum*. (See *CURIA ROMANA*.)

A.B.C. POWERS, a designation which came into use shortly before World War I for the three leading South American powers—Argentina, Brazil and Chile. For many years previously a current of opinion had prevailed in several republics of South America favouring an alliance to counteract certain political tendencies of the United States and particularly the Monroe Doctrine. Recalling unsettled boundaries and other political problems, statesmen of certain Latin American republics had, from

time to time, provided for arbitration agreements or other means of mutual assistance in case of emergencies. Among such was the treaty between Brazil and Chile in 1899; between Argentina and Chile in 1902; and between Argentina and Brazil in 1905. These pacts have been regarded as the forerunners of the three-power *entente cordiale* that gradually developed and was discussed at the first Pan-American Scientific Congress, held at Santiago, Chile, in 1908-09. In 1915 Argentina, Brazil and Chile concluded among themselves a group of treaties of peace and arbitration.

On April 25, 1914, when war between the United States and Mexico appeared imminent, the Governments of Argentina, Brazil and Chile, through their diplomatic representatives at Washington, Dr. Rómulo S. Naón, Sr. Domicio da Gama, and Don Eduardo Suárez, respectively, addressed the secretary of State of the United States tendering their services as mediators. This mediation was accepted by President Woodrow Wilson, who appointed as United States delegates Justice Joseph R. Lamar and Frederick W. Lehmann, while Mexico chose as her representatives Sres. Emilio Rabasa, Augustin Rodriguez and Luis Elguero. These A.B.C. mediators, together with the Americans and the Mexicans, met in a series of sessions at Niagara Falls, Canada. The deliberations began on May 18, 1914, and were continued until August of the same year. The result of the conference was thus summarized by the Brazilian delegate, Senhor da Gama, as follows: "We have established, through agreement between the parties most directly interested, and in complete harmony with the sentiments of the Government of the United States, that it is a principle of American policy to have our national problems always given a fair examination and settled without foreign interference."

(W. A. R.)

ABDALLATIF or **ABD-UL-LATIF** (1162-1231), physician and traveller, was born and died in Baghdad. A memoir of Abdallatif, written by himself, has been preserved with additions by Ibn-Abu-Osaiba (Ibn abi Usaibia), a contemporary. He visited Mosul, Damascus and Egypt and then joined the circle of learned men whom Saladin gathered around him at Jerusalem. He taught medicine and philosophy at Cairo and at Damascus for a number of years, and afterwards, for a shorter period, at Aleppo.

Of the numerous works—mostly on medicine—which Osaiba ascribes to him, one only, his graphic and detailed *Account of Egypt*, appears to be known in Europe. The manuscript, discovered by Edward Pococke, the Orientalist, and preserved in the Bodleian Library, contains a vivid description of a famine caused by the Nile failing to overflow its banks. It was translated into Latin by Professor White of Oxford in 1800 and into French, with valuable notes, by De Sacy in 1810.

‘ABD-AR-RAHMAN, the name borne by five princes of the Omayyad dynasty, amirs and caliphs of Cordova.

‘ABD-AR-RAHMAN I. (756-788) founded the branch of the family which ruled for nearly three centuries in Mohammedan Spain. When the Omayyads were overthrown in the East by the Abbasids, ‘Abd-ar-Rahman ibn Moawya, grandson of the caliph Histrām, was a young man of about 20 years of age. Together with his brother Yahya, he took refuge with Bedouin tribes in the desert. The Abbasids hunted their enemies down without mercy. Yahya was slain, and ‘Abd-ar-Rahman saved himself by fleeing first to Syria and thence to northern Africa which had fallen into the hands of local rulers, formerly amirs or lieutenants of the Omayyad caliphs, but now aiming at independence. In the midst of all his perils, which read like stories from the *Arabian Nights*, ‘Abd-ar-Rahman had been encouraged by a prophecy of his great-uncle Maslama that he would restore the fortunes of the family. He was followed in all his wanderings by a few faithful clients of the Omayyads. In 755 he was in hiding near Ceuta, and he sent an agent over to Spain to ask for the support of other clients of the family, descendants of the conquerors of Spain, who were numerous, in the province of Elvira, the modern Granada. On the invitation of his partisans he landed at Almuñecar, to the east of Malaga, on Aug. 14, 755. In the course of 756 a campaign was fought in the valley of the Guadalquivir, which ended, on May 16, in the defeat of the emir Yūsuf outside Cordova. ‘Abd-ar-Rahman's army was so ill provided that he mounted almost the

only good war-horse in it; he had no banner, and one was improvised by unwinding a green turban and binding it round the head of a spear. The turban and the spear became the banner of the Spanish Omayyads. Yūsuf recognized ‘Abd-ar-Rahman as emir of Spain in July 756.

‘ABD-AR-RAHMAN II. (822-852), son of the emir Hakam, was one of the weaker of the Spanish Omayyads. He was a prince with a taste for music and literature.

‘ABD-AR-RAHMAN III. (912-961) was the greatest and the most successful of the princes of his dynasty in Spain. He succeeded his grandfather ‘Abdallāh when he was barely 22 and reigned for half a century. ‘Abd-ar-Rahman III. came to the throne when the country was exhausted by more than a generation of tribal conflict among the Arabs, and of strife between them and the Mohammedans of native Spanish descent. Spainards who were openly or secretly Christians had acted with the renegades. These elements were not averse from supporting a strong ruler who would protect them against the Arab aristocracy. These restless nobles were the most serious of ‘Abd-ar-Rahman's enemies. Next to them came the Fatimites of Egypt and northern Africa, who claimed the caliphate, and who aimed at extending their rule over the Mohammedan world, at least in the west. ‘Abd-ar-Rahman subdued the nobles by means of a mercenary army, which included Christians. He repelled the Fatimites, partly by supporting their enemies in Africa and partly by claiming the caliphate for himself. His ancestors in Spain had been content with the title of sultan. The caliphate was thought only to belong to the prince who ruled over the sacred cities of Mecca and Medina. But the force of this tradition had been so far weakened that ‘Abd-ar-Rahman could proclaim himself caliph on Jan. 16, 929. His worst enemies were always his fellow Mohammedans. After he was defeated by the Christians at Alhandega in 939 through the treason of the Arab nobles in his army he never again took the field.

In the agony of the Omayyad dynasty in Spain, two princes of the house were proclaimed caliphs for a very short time, ‘Abd-ar-Rahman IV. Mortada (1017), and ‘Abd-ar-Rahman V. Mostadir (1023-24). Both were the mere puppets of factions, who deserted them at once. ‘Abd-ar-Rahman IV. was murdered in the year in which he was proclaimed, at Guadiz, when fleeing from a battle in which he had been deserted by his supporters. ‘Abd-ar-Rahman V. was proclaimed caliph in Dec. 1023 at Cordova, and murdered in Jan. 1024 by a mob of unemployed workmen, headed by one of his own cousins.

The history of the Omayyads in Spain is the subject of the *Histoire des Musulmans d'Espagne* by R. Dozy (Leyden, 1861). See also **SPAIN**: From A.D. 406 to the Conquest of Granada.

ABD-EL-AZIZ IV. (1878-1943), sultan of Morocco, son of Sultan Mulai el Hasan III. by a Circassian wife. He was 16 years of age on his father's death in 1894. By the wise action of Si Ahmad bin Musa, the chamberlain of el Hasan, Abd-el-Aziz's accession to the sultanate was ensured with but little fighting. Si Ahmad became regent and for six years showed himself a capable ruler. On his death in 1900 the regency ended, and Abd-el-Aziz took the reins of government into his own hands, with an Arab from the south, el Menebhi, for his chief adviser. Urged by his Circassian mother, the sultan sought advice and counsel from Europe and endeavoured to act up to it. But disinterested advice was difficult to obtain, and in spite of the unquestionable desire of the young ruler to do the best for the country, wild extravagance both in action and expenditure resulted, leaving the sultan with depleted exchequer and the confidence of his people impaired. His intimacy with foreigners and his imitation of their ways were sufficient to rouse fanaticism and create dissatisfaction. Europeans were accused of having spoiled the sultan and of being desirous of spoiling the country. When British engineers were employed to survey the route for a railway between Mequinez and Fez this was reported as indicating an absolute sale of the country. The fanaticism of the people was aroused and a revolt broke out near the Algerian frontier. Such was the condition of things when the news of the Anglo-French Agreement of 1904 came as a blow to Abd-el-Aziz, who had relied

on England for support and protection against the inroads of France. On the advice of Germany he proposed the assembly of an international conference at Algieras in 1906 to consult upon methods of reform, the sultan's desire being to ensure a condition of affairs which would leave foreigners with no excuse for interference in the control of the country. The sultan gave his adherence to the Act of the Algieras Conference, but the state of anarchy into which Morocco fell during the latter half of 1906 and the beginning of 1907 exposed the weakness of his government. In May 1907 the southern tribes invited Mulai Hafid, an elder brother of Abd-el-Aziz, and viceroy at Marrakesh, to become sultan, and in the following August Hafid was proclaimed sovereign. In the meantime the murder of Europeans at Casablanca had led to the occupation of that port by France. In September Abd-el-Aziz arrived at Rabat from Fez to seek the support of the European powers against his brother. From France he was later enabled to negotiate a loan. His leaning to Christians aroused further opposition and in January 1908 he was declared deposed by the ulema of Fez, who offered the throne to Hafid. After months of inactivity Abd-el-Aziz made an effort to restore his authority, and quitting Rabat in July he marched on Marrakesh. His force was completely overthrown (Aug. 19) when near that city, and Abd-el-Aziz fled to Settatt within the French lines round Casablanca. In November he came to terms with his brother, and thereafter took up his residence in Tangier as a pensioner of the new sultan. (See MOROCCO: *History*.)

ABD-EL-KADER (1807?–1883), amir of Mascara, the great opponent of the conquest of Algeria by France, was born near Mascara in 1807 or 1808. His family were *sherifs* or descendants of Mohammed, and his father, Mahi-ed-Din, was celebrated throughout north Africa for his piety and charity. Abd-el-Kader received an excellent education in theology and philosophy, in horsemanship and in other manly exercises. A pilgrimage to Mecca and Medina and to the tomb of Sidi Abd-el-Kader El Jalili at Baghdad stimulated his religious enthusiasm. While in Egypt in 1827, Abd-el-Kader was impressed by the reforms then being carried out by Mohammed Ali, and the knowledge he then gained affected his career. Mahi-ed-Din and his son returned to Mascara shortly before the French occupation of Algiers destroyed the government of the Dey (July 1830). Coming forward as the champion of Islam against the infidels, Abd-el-Kader was proclaimed amir at Mascara in 1832. In a short time he had rallied to his standard all the tribes of western Algeria. The story of his 15 years' struggle against the French is given under ALGERIA. Up to the beginning of 1842 the contest went in favour of the amir; thereafter he found in Marshal Bugeaud an opponent who proved, in the end, his master. Throughout this period Abd-el-Kader showed himself a born leader of men, a great soldier, a capable administrator, a persuasive orator, a chivalrous opponent. His ultimate failure was due in considerable measure to the refusal of the Kabyles, Berber mountain tribes whose Mohammedanism was somewhat loosely held, to make common cause with the Arabs against the French. On Dec. 21, 1847 Abd-el-Kader surrendered to General Lamoricière at Sidi Brahimi. On the 23rd, his submission was formally made to the duc d'Aumale, then governor of Algeria. In violation of the promise that he would be allowed to go to Alexandria or St. Jean d'Acre, Abd-el-Kader and his family were detained in France, where he remained until Oct. 1852, when he was released by Napoleon III. on taking an oath never again to disturb Algeria. The amir then lived in Brusa, removing in 1855 to Damascus. In July 1860, when the Muslims attacked the Christian quarters of Damascus, Abd-el-Kader saved large numbers of Christians.

When the Algerians revolted, Abd-el-Kader, in 1871, counselled submission to France. After 1847 he composed a philosophical treatise, of which a French translation was published in 1858 under the title of *Rappel à l'intelligent, Avis à l'indifférent*. He also wrote a book about the Arab horse. He died at Damascus on May 26, 1883.

See Commdt. J. Pichon, *Abd el Kader, 1807–83* (1899); Alex. Bellemare, *Abd-el-Kader: sa vie politique et militaire* (1863); Col. C. H. Churchill, *The Life of Abdel Kader* (1867).

ABDEL KRIM (1881–), Mohammed ben Abdel Krim el-Khatabe, a Moroccan chieftain, son of a caid of the Beni Uriaghel tribe in the mountainous country that extends inland from Alhucemas bay on the Rif coast of Morocco. His father was a person of no particular importance or family, but, being a man of progressive ideas and in contact with the Spaniards at Melilla, he gave his two sons an education to which few of the Rifian tribesmen aspire. While Mohammed, the future Rifian leader, was taught Spanish and a smattering of European knowledge, his brother, Mohammed, was sent to Spain and educated as a mining engineer. (It is customary among the peoples of northern Africa and Egypt to give brothers the same name if it is an illustrious one.) Abdel Krim was employed in the office of native affairs at Melilla, while his brother worked in the interests of certain mining groups.

In 1919 a quarrel between Abdel Krim and General Silvestre, of the Spanish army, led to the former's flight from Melilla. He took to the mountains of his tribe, where his brother joined him. Both swore revenge, and instituted a fierce resistance to the occupation of the Rif by the Spaniards. In 1921 Abdel Krim avenged himself of the slight he had received from Silvestre. With only a few hundred tribesmen, he attacked the Spanish advanced post of Anual and captured it. Silvestre was killed, or committed suicide. The fall of Anual spread panic through the Spanish army of 19,000 men. The Spanish posts were deserted, and the troops fled in disorderly retreat. Before the fighting was ended 16,000 of the 19,000 men had been massacred. The remainder mostly crossed into the French zone. The Rifian tribesmen were guilty of every kind of treachery and atrocity, their revenge for acts of which they accused the Spaniards, more especially that of forcible interference with their women, an unpardonable offence in their eyes. The Rif reached the walls of Melilla, and, had they chosen, they could have captured the town and massacred its population of 50,000 civilians. But gluttoned with bloodshed and loaded with loot, they desisted.

This signal defeat of the Spaniards vastly increased Abdel Krim's reputation amongst the tribes. The Jabala, inhabiting the western portion of the Spanish zone, joined his cause and in 1924 the Spaniards were obliged to abandon all their inland positions and retreat on Tetuan and the sea, suffering heavy losses in the retirement. By the end of that year Abdel Krim, having rid himself by capture of his only rival, Raisuli, was master of the situation, and set to work to prepare a fresh campaign against the Spaniards. But a new danger threatened him from the south. The French, gradually occupying the zone to which they laid claim under existing treaties, were advancing northward, and Abdel Krim was forced to go to the aid of the threatened tribes. His army and the revolted tribesmen invaded the French protectorate, and by June 1925 threatened Fez.

French reinforcements were hurriedly dispatched from France and Algeria, and by October the French protectorate territory was clear of the enemy, and a French army of 160,000 men, under Marshal Pétain, was on the borders of the Rif. In September the Spaniards had successfully disembarked a force in Alhucemas bay and Ajdir had been taken. By Nov. 1, 1925 the French and Spanish armies had been obliged by the weather to abandon an active campaign, and were digging themselves into winter quarters, but Abdel Krim, though weakened and threatened, was by no means beaten. This man of great ability and astounding energy fortified his mountain fastnesses and collected new forces to continue his campaign against two European armies, but in vain. He surrendered to France in May 1926, and was exiled to the island of Réunion. See MOROCCO: *History*.

See Walter Harris, *France, Spain and the Rif* (1927).

(W. B. H.)

ABDERA, ancient town, coast of Thrace, near the mouth of the Nestos, almost opposite Thasos. Its mythical foundation was attributed to Heracles; historically it was a colony from Clazomenae in the 7th century B.C. But its prosperity dates from 544 B.C., when the majority of the people of Teos migrated to Abdera to escape Persian oppression (Herod. i. 168). The town seems to have declined in importance after the middle of the 4th

century. The air of Abdera was proverbial as causing stupidity; but among its citizens was the philosopher Democritus. The ruins on Cape Balastra cover seven small hills, and extend from an east to a west harbour; on the south-west hills are remains of the mediaeval settlement of Polystylon.

See *Mittheil. d. deutsch. Inst. Athens*, xii (1887), p. 161 (Regel); *Mém. de l'Acad. des Inscriptions*, xxxix 211; K. F. Hermann, *Ges. Abh.* 90-111, 370 ff.; S. Casson, *Macedon, Thrace and Illyria* (1926); Pauly-Wissowa, s.v.

ABDERA, an ancient seaport on the south coast of Spain, between Malaga and New Carthage, in the district inhabited by the Bastuli. Founded by the Carthaginians, it became an important town in the Roman province of Hispania Baetica. It was on a hill above the modern Adra (*q.v.*). Its most ancient coins bear the Phœnician inscription, *abdr̄t*, with the head of Heracles (Melkarth) and a tunny-fish; those of Tiberius (who seems to have made the place a colony), show the chief temple of the town with two tunny-fish erect in the form of columns.

ABDICATION, the act whereby a person in office renounces the same before the expiry of the time for which it is held. (Lat. *abdication*, from *ab*, from, and *dicare*, to proclaim as not belonging to one.) In Roman law, the term is especially applied to the disowning of a member of a family, as the disinheriting of a son, but the word is seldom used except in the sense of surrendering the supreme power in a State. Despotism is at liberty to divest themselves of their powers at any time, but it is otherwise with a limited monarchy. The throne of Great Britain cannot be lawfully abdicated unless with the consent of the two houses of parliament. When James II fled in 1688, the question was discussed in parliament whether he had forfeited the throne or had abdicated. Later abdications include:

Pu-yi (China) Feb. 12, 1912; Nicholas II (Russia) March 15, 1917; Ferdinand I (Bulgaria) Oct. 3, 1918; William II (Germany) Nov. 9, 1918; Frederick Augustus III (Saxony) Nov. 9, 1918; Charles I (Austria-Hungary) Nov. 12, 1918; Louis III (Bavaria) Nov. 13, 1918; Frederick II (Baden) Nov. 22, 1918; William II (Württemberg) Dec. 2, 1918; George II (Greece) Dec. 18, 1923, but restored to the throne Nov. 1935; Edward VIII (Great Britain) Dec. 11, 1936; Carol II (Rumania) Sept. 6, 1940; Mihai (Michael) I (Rumania) Dec. 30, 1947; Wilhelmina (Netherlands) Sept. 4, 1948.

ABDOMEN, the belly, the body cavity lying between the chest or thorax above and the pelvis below. The diaphragm is its upper boundary. There is no wall or clear-cut boundary between it and the pelvis. It contains organs of digestion and the spleen which are surrounded by the peritoneum which is a serous membrane. (See ANATOMY; ALIMENTARY CANAL.)

ABDOMEN, SURGERY OF. The diseases of this region are dealt with generally in the article ALIMENTARY SYSTEM, DISEASES OF THE, and under their own names (*e.g.*, APPENDICITIS). For the surgery of each abdominal organ see STOMACH; KIDNEY, DISEASES OF; LIVER AND GALL-BLADDER, DISEASES OF, etc.

Exploratory Laparotomy.—In many cases of intra-abdominal disease the surgeon cannot say what is wrong without making an incision and examining by sight or touch. Under conditions of strict asepsis this is not a perilous or serious procedure. When an opening is made in such circumstances—provided only it is done soon enough—the successful treatment of the case often becomes a simple matter.

A great impetus was given to the surgery of wounded, mortified, or diseased pieces of intestine by the introduction from Chicago of a contrivance named, after the inventor, *Murphy's button*. This consists of a short nickel-plated tube in two pieces, which are secured in the divided ends of the bowel so that when the pieces are subsequently "married" the adjusted ends of the bowel are securely fixed together and the canal rendered practicable. In the course of time the button loosens itself into the interior of the bowel and comes away with the motions. In many other types of case the button has proved convenient and successful, but sometimes ulceration occurs around the rim of the metal button, or the loosened metal causes trouble in its passage along the alimentary canal. Some surgeons therefore prefer a bobbin of decalcified bone or similar soft material, while others rely upon direct suturing of the parts. The last-named method has in-

creased in favour. The cause of death in intestinal obstruction is usually absorption of poisonous substances formed in the bowel above the obstruction. Usually, therefore, the surgeon completes his operation for the relief of obstruction by drawing out a loop of the distended bowel, incising and evacuating it, and then carefully suturing and returning it.

Rectal or subcutaneous injections of saline or other fluid and early adoption of a sitting position for the patient are other measures often adopted.

Wounds of the Abdomen.—The treatment of gunshot wounds of the abdomen differs according to circumstances. If the wound be caused by a rifle bullet travelling at high speed, the intra-abdominal pressure is usually sufficient to prevent escape of intestinal contents; complete rest and avoidance of surgery is the procedure of choice, and the chance of recovery is great though several coils of intestine may have been pierced. But if the wound be caused by a fragment of high explosive shell, or a revolver shot or a stab this is not the case. To avoid the onset of peritonitis, early operation, suture of the wounded gut and washing out of the peritoneal cavity afford the only chance for the patient. The "expectant" treatment which proved best in the South African War (1899-1902) was at first followed in the World War, but soon was abandoned in favour of laparotomy.

Intussusception.—This is a terribly fatal disease of infants and children, in which a piece of bowel slips into, and is gripped by, the piece next below it. Formerly attempts were made to reduce the invagination by passing air or water up the rectum under pressure, but now early recourse is had to abdominal surgery with far better results.

Cancer of the Intestine.—With the introduction of aseptic surgery the bowel can be reached through the peritoneum easily and safely. If the cancerous mass is fairly movable the affected piece of bowel is excised, the cut ends are united and the continuity of the alimentary canal is re-established. When the lowest part of the bowel was found to be cancerous, the surgeon used formerly to secure an escape for the contents of the bowel by making an opening into the colon in the left loin. But in recent years this operation of *lumbar colotomy* has been almost entirely replaced by opening the colon in the left groin.

ABDUCTION, a law term denoting the forcible or unlawful removal of a person. The Offences against the Person Act 1861, by s. 53, makes it felony for any one from motives of lucre to take away or detain against her will, with intent to marry or carnally know her, etc., any woman of any age who has any interest in any real or personal estate, or is an heiress presumptive, or co-heiress, or presumptive next of kin to any one having such an interest; or for any one to cause such a woman to be married or carnally known by any other person; or for any one with such intent to allure, take away, or detain any such woman under the age of 21, out of the possession and against the will of her parents or guardians. By s. 54, forcible taking away or detention against her will of any woman of any age with like intent is felony. The same act, by s. 55, makes abduction without even any such intent a misdemeanour, where an unmarried girl under the age of 16 is unlawfully taken out of the possession and against the will of her parents or guardians. The girl's consent is immaterial, nor is it a defence that the person charged reasonably believed that the girl was 16 or over. By s. 56, stealing a child under the age of 14 with intent to deprive parents or guardian of such child is also a felony. The Criminal Law Amendment Act 1885 made still more stringent provisions with reference to abduction by making the procuration or attempted procuration of any virtuous female under the age of twenty-one years a misdemeanour, as well as the abduction of any girl under eighteen years of age with the intent that she shall be carnally known, or the detaining of any female against her will on any premises, with intent to have, or that another person may have, carnal knowledge of her.

In the United States, in some of the States, mere unchastity is no defence. The burden of proof is on the defendant that the woman abducted was unchaste, the presumption of her chastity standing unless otherwise proved.

ABDUL AZIZ (ahhâ-döl ah-zêz) (1830-1876), sultan of Turkey, second son of Sultan Mahmud II, was born Feb. 9, 1830, and succeeded his brother Abdul-Mejid as sultan 1861. He took advantage of the constant issue of state loans to acquire wealth which was squandered extravagantly, and received large sums from Ismail Pasha, the khedive of Egypt, for signing the firman of 1866, which made succession to the khedivate hereditary from father to son in direct line, as well as subsequent firmans of 1867, 1869 and 1872, extending the khedive's prerogatives. In 1870 Abdul Aziz signed the firman creating the Bulgarian exarchate, thus separating the Bulgarian church from the Greek church at Constantinople. The insurrection of 1875 in Bosnia and Hercegovina and the abortive revolts in Bulgaria (Sept. 1875 and May 1876) together with the sultan's incapacity and extravagance in Turkey itself caused an outbreak of Moslem discontent and fanaticism culminating in the Bulgarian atrocities, and in the murder of two consuls at Salonika. Abdul Aziz was deposed May 29, 1876, by a group of prominent politicians, and his death, four days later, is attributed to suicide.

Abdul Aziz was the first Ottoman sultan to visit western Europe (1867).

ABDUL-HAMID I (1725-1789), sultan of Turkey, son of Ahmed III, succeeded his brother Mustafa III in 1773, and died on April 7, 1789. For the disastrous wars with Russia which marked his reign *see* TURKEY.

ABDUL-HAMID II (1842-1918), sultan of Turkey, son of Sultan Abdul-Mejid, was born on Sept. 21, 1842, and succeeded to the throne on the deposition of his brother, Murad V, on Aug. 31, 1876. He was brought to power by the group of liberals, led by Midhat Pasha, that had deposed his predecessor; and he inaugurated his reign by proclaiming a constitution. The first Ottoman parliament met on Dec. 23, 1876, the very day that the conference of the great powers in Constantinople began its deliberations. But the circumstances of the country at his accession were ill-adapted for liberal developments.

An empty treasury, the revolts in Serbia and Montenegro, the feeling aroused throughout Europe by the savage methods adopted in stamping out the Bulgarian rebellion, all combined to prove to the new sultan that he could expect little aid from the powers. But he obstinately opposed the pressing requests of the powers that the necessary reforms should be instituted. In 1878 the constitution was suspended. The exile in 1880 and the death in 1884 of Midhat followed, and a dictatorship was established which lasted until 1908.

Early in 1877 the disastrous war with Russia began. The hard terms, embodied in the treaty of San Stefano, to which Abdul-Hamid was forced to consent, were to some extent amended at Berlin, thanks in the main to British diplomacy (*see* EUROPE; *History*); but by this time the sultan had lost all confidence in England and thought that he discerned in Germany the future friend of Turkey. He employed Germans to reorganize his finances and army and determined to suppress all liberal tendencies and gradually to take the reins of absolute power into his own hands. Financial embarrassments forced him to consent to foreign control over the debt and to issue the decree of Dec. 1881, under which many of the revenues of the empire were handed over to the public debt administration for the benefit of the bondholders. Trouble in Egypt, where a discredited khedive had to be deposed, and trouble on the Greek frontier and in Montenegro, where the powers were determined that the decisions of the Berlin congress should be carried into effect, were more or less satisfactorily overcome. In his attitude toward Arabi, the would-be saviour of Egypt, Abdul-Hamid showed less than his usual astuteness, and the resulting consolidation of England's hold over the country contributed still further to his estrangement from Turkey's old ally. In 1881 the French occupied Tunisia. The union in 1885 of Bulgaria with Eastern Rumelia was another blow.

For several years the sultan preserved toward Bulgaria an attitude skilfully calculated to avoid running counter either to Russian or to German wishes. Germany's friendship was not entirely disinterested and had to be fostered with a railway or loan concession from time to time, until in 1899 the Baghdad railway

was conceded.

Meanwhile the sultan had succeeded in reducing his ministers to the position of secretaries and in concentrating the whole administration of the country into his own hands at Yildiz. But internal dissension was not thereby lessened. Crete was constantly in turmoil, the Greeks were dissatisfied, and from about 1890 the Armenians began a violent agitation with a view to obtaining the reforms promised them at Berlin. Minor troubles had occurred in 1892 and 1893 at Marsovan and Tokat. In 1894 a more serious rebellion in the mountainous region of Sassun was ruthlessly stamped out. The powers insistently demanded reforms, the eventual grant of which in the autumn of 1895 was the signal for a series of massacres in the Armenian provinces and in Constantinople itself.

The reforms became more or less a dead letter. Crete indeed profited by the grant of extended privileges, but these did not satisfy its turbulent population, and early in 1897 a Greek expedition sailed to unite the island to Greece. War followed, in which Turkey was easily successful and gained a small rectification of frontier; then a few months later Crete was taken over *en dépôt* by the Four Powers (Germany and Austria not participating) and Prince George of Greece was appointed their mandatory. In the next year the sultan received the visit of the German emperor and empress.

Abdul-Hamid had always resisted the pressure of the European powers to the last moment, in order to seem to yield only to overwhelming force, while posing as the champion of Islam against aggressive Christendom. Pan-Islamic propaganda was encouraged; the privileges of foreigners in the Ottoman empire (often an obstacle to government) were curtailed; the new railway to the Holy Places was pressed on, and emissaries were sent to distant countries preaching Islam and the caliph's supremacy. This appeal to Moslem sentiment was, however, powerless against the disaffection due to perennial misgovernment.

In Mesopotamia and Yemen disturbance was endemic; nearer home, a semblance of loyalty was maintained in the army and among the Moslem population by a system of delation and espionage and by wholesale arrests; while, obsessed by terror of assassination, the sultan withdrew himself into fortified seclusion in the palace of Yildiz.

Macedonian Crisis.—The humiliation of the situation in Macedonia (*q.v.*), together with the resentment in the army against the palace spies, brought matters to a crisis. The remarkable revolution associated with the names of Niazi Bey and Enver Bey, the Young Turk leaders, and the Committee of Union and Progress is described elsewhere (*see* TURKEY; *History*); here it must suffice to say that Abdul-Hamid, on learning of the threat of the Salonika troops to march on Constantinople (July 22), at once capitulated. On July 24 an *iradé* announced the restoration of the suspended constitution of 1876 and a Young Turk government was formed; next day, further *iradés* abolished espionage and the censorship and ordered the release of political prisoners. On Dec. 10 the sultan opened the Turkish parliament with a speech from the throne in which he said that the first parliament had been "temporarily dissolved until the education of the people had been brought to a sufficiently high level by the extension of instruction throughout the empire."

The correct attitude of the sultan did not save him from the suspicion of intriguing with the powerful reactionary elements in the state, a suspicion confirmed by his attitude toward the counter revolution of April 13, when an insurrection of the soldiers and the Moslem populace of the capital overthrew the committee and the ministry. The committee, restored by the Salonika troops, now decided on Abdul-Hamid's deposition, and on April 27 his brother Reshid Efendi was proclaimed sultan as Mohammed V. The former sultan was confined at Salonika.

When Salonika capitulated to the Greeks in the Balkan War (1912) Abdul-Hamid was brought back to Constantinople. In 1915 he was removed to Magnesia, in Asia Minor, where he died on Feb. 10, 1918.

See Sir E. Pears, *Life of Abdul-Hamid* (London, 1917); C. Hacquard, *La Turquie sous Abdul-Hamid II* (Brussels, 1901).

ABDULINO, town in the Chkalov region of the Russian S.F.S.R. Pop. 13,690. It is on the boundary between Kuibyshev and Bashkiria on the Uk river, north of the railway from Kuibyshev to Ufa, and is a market for local products.

ABDUL MEJID (ahbd-ool mē-jēd') (1823-1861), sultan of Turkey, was born April 23, 1823, and succeeded his father, Mahmud II., on July 2, 1839. Mahmud appears to have been unable to effect the reforms he desired in the mode of educating his children, so that his son received no better education than that usually given to Turkish princes in the harem. Abdul Mejid succeeded to the throne at a moment of crisis. The news was on its way to Constantinople that the Turkish army had been defeated at Nezib by that of the rebel Egyptian viceroy, Mohammed Ali; and the Turkish fleet was on its way to Alexandria, where it was handed over by its commander, Ahmed Pasha, to the enemy, on the pretext that the young sultan's advisers were sold to Russia. Through the intervention of the European Powers Mohammed Ali was obliged to come to terms, and the Ottoman Empire was saved. See MOHAMMED ALI.

Abdul Mejid set at once about carrying out the reforms to which Mahmud had devoted himself. In Nov. 1839 was proclaimed an edict, known as the *Tanzimāt*, or Hatt-i-sherif of Gulhané, consolidating and enforcing these reforms; this was supplemented at the close of the Crimean War by a similar statute issued in Feb. 1856. These enactments provided that all classes of the sultan's subjects should have security for their lives and property; that taxes should be fairly imposed and justice impartially administered; and that all should have full religious liberty and equal civil rights. The scheme was opposed by the governing classes and the *ulema*, or privileged religious teachers, and was but partially put in force, especially in the remoter parts of the empire; and more than one conspiracy was formed against the sultan's life on account of it.

Of the other measures of reform promoted by Abdul Mejid the more important were: the institution of a council of public instruction (1838), the reorganization of the army (1843-44), and of a ministry of public instruction (1857), the abolition of an odious and unfairly imposed capitation tax, the repression of slave trading, and various provisions for the better administration of the public service and for the advancement of commerce, including the establishment of a mixed commercial court at Constantinople. For the general history of his times—the disturbances and insurrections in different parts of his dominions throughout his reign, and the great war successfully carried on against Russia by Turkey, and by Britain, France and Sardinia, in the interest of Turkey (1853-56)—see TURKEY and CRIMEAN WAR. When Kossuth and others sought refuge in Turkey, after the failure of the Hungarian rising in 1849, the sultan refused to surrender them. It is to his credit, too, that he would not allow the conspirators against his own life to be put to death. He was described as a kind and honourable man, if somewhat weak and easily led.

His extravagance, especially towards the end of his life, was excessive. He died on June 25, 1861, and was succeeded by his brother, Abdul Aziz (*q.v.*), as the oldest survivor of the family of Osman. He left several sons, of whom two, Murad V. and Abdul Hamid II., eventually succeeded to the throne.

ABDUR RAHMAN KHAN (c. 1844-1901), amir of Afghanistan, was the son of Afzul Khan, eldest son of the amir Dost Mohammed Khan (*q.v.*). Before his death in 1863, Dost Mohammed had nominated as his successor Sher Ali, his third son, passing over the two elder brothers, Afzul Khan and Azim Khan; and at first the new amir was quietly recognized. But after a few months Afzul Khan raised an insurrection in the northern province, between the Hindu Kush mountains and the Oxus, where he had been governing when his father died; and then began a fierce contest for power among the sons of Dost Mohammed which lasted for nearly five years. In this war Abdur Rahman soon became distinguished for ability and daring energy. Although his father, Afzul Khan, who had none of these qualities, came to terms with the amir Sher Ali, the son's behaviour in the northern province soon excited the amir's suspicion, and Abdur Rahman, when

he was summoned to Kabul, fled across the Oxus into Bukhara. Sher Ali threw Afzul Khan into prison, and a serious revolt followed in south Afghanistan; but the amir had scarcely suppressed it when Abdur Rahman's reappearance in the north was a signal for a mutiny of the troops stationed in those parts and a gathering of armed bands to his standard. After some delay and desultory fighting, he and his uncle Azim Khan occupied Kabul (Feb. 1866).

The amir Sher Ali marched against them from Kandahar; but in the battle that ensued at Sheikhabad on May 9, he was deserted by a large body of his troops and was defeated. Abdur Rahman then released his father, Afzul Khan, from prison in Ghazni and installed him as amir of Afghanistan.

Notwithstanding the new amir's incapacity and some jealousy between the real leaders, Abdur Rahman and his uncle, they again routed Sher Ali's forces and occupied Kandahar in 1867; and when at the end of that year Afzul Khan died, Azim Khan succeeded to the rulership, with Abdur Rahman as his governor in the northern province.

But toward the end of 1868 Sher Ali's return and a general rising in his favour, resulting in their defeat at Zurmat on Jan. 3, 1869, forced them both to seek refuge in Persia, from where Abdur Rahman proceeded afterward to place himself under Russian protection at Samarkand. Azim died in Persia in Oct. 1869. At the end of the second Afghan War, in 1880, Abdur Rahman was recognized by the British as amir of Kabul.

In 1893 the amir showed his usual ability in the settlement of the frontier question with Sir Mortimer Durand's mission. Abdur Rahman died on Oct. 1, 1901, being succeeded by his son Habibullah. (See AFGHANISTAN: History.)

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À BECKETT, GILBERT ABBOTT (1811-1856), English humorous writer, was born in north London on Jan. 9, 1811. He belonged to a family claiming descent from the father of St. Thomas Becket. His elder brother, Sir William à Beckett (1806-1869), became chief justice of Victoria (Australia). Gilbert Abbott à Beckett was educated at Westminster School, was called to the bar at Gray's Inn in 1841, and in 1849 became a metropolitan police magistrate.

He edited *Figaro in London*, and was one of the original staff of *Punch* and a contributor all his life. He produced some 50 or 60 plays, among them dramatized versions of Dickens' shorter stories in collaboration with Mark Lemon. He died at Boulogne Aug. 30, 1856.

His eldest son, GILBERT ARTHUR À BECKETT (1837-1891) was born at Hammersmith on April 7, 1837. On leaving Christ Church, Oxford, he was entered at Lincoln's Inn, but gave his attention chiefly to the drama, producing *Diamonds and Hearts* at the Haymarket in 1867, which was followed by other light comedies.

His pieces include numerous burlesques and pantomimes, the libretti of *Savonarola* (Hamburg, 1884) and of *The Canterbury Pilgrims* (Drury Lane, 1884) for the music of Dr. (afterward Sir) C. V. Stanford. *The Happy Land* (Court Theatre, 1873), a political burlesque of W. S. Gilbert's *Wicked World*, was written in collaboration with F. L. Tomline. For the last ten years of his life he was on the regular staff of *Punch*. He died on Oct. 15, 1891.

A younger son, ARTHUR WILLIAM À BECKETT (1844-1909), a well-known journalist and a man of letters, was also on the staff of *Punch* from 1874-1902, and gave an account of his father and his own reminiscences in *The À Becketts of Punch* (1903). He died in London on Jan. 14, 1909.

See also M. H. Spielmann, *The History of Punch* (1895).

ABEDNEGO, the name given in Babylon to Azariah, one of the companions of Daniel (Dan. i. 7, etc.). Probably a corruption of Abednebo, "servant of Nebo," or perhaps of Abednego for Abednergal, "servant of the god Nergal."

ABEKEN, HEINRICH (1809-1872), German theologian and Prussian official, was born at Berlin on Aug. 8, 1809. In 1848

he entered the Prussian ministry for foreign affairs and in 1853 was promoted to be privy councillor of legation (Geheimer Legationsrath). He was employed by Bismarck in the writing of official despatches and often accompanied King William on his journeys as representative of the foreign office and was with him during the campaigns of 1866 and 1870-71.

See *Heinrich Abeken, ein schlichtes Leben in bewegter Zeit* (1898), by his widow. English translation by Mrs. C. E. Barrett-Lennard and M. W. Hofer (with portraits 1911). This is valuable by reason of the letters written from the Prussian headquarters.

ABEL (Hebrew *Hebel, breath*), second son of Adam, slain by Cain, his elder brother (Gen. iv, 1-15). The narrative in Genesis is supplemented in the New Testament ("By faith Abel offered unto God a more excellent sacrifice than Cain," Heb. xi, 4; Cain slew Abel "because his own works were evil, and his brother's righteous," 1 John iii, 12). The name probably means "herdsman" (*cf.* Jabal), as distinguished from the agriculturist Cain. Possibly Abel was originally a South Judæan demigod or hero; see Winckler, *Gesch. Israels*, ii, p. 189; E. Meyer, *Israeliten*, p. 395. Augustine (*De Haeresibus*, lxxxvii) mentions a sect of *Abelites*, in northern Africa.

ABEL, JOHN JACOB (1857-1938), U.S. pharmacologist and physiologist, was born in Cleveland, O., on May 19, 1857. He began life as a teacher and in 1879-82 was a principal and superintendent of schools in Indiana. In 1883 he graduated from the University of Michigan and, after a year at Johns Hopkins university, he devoted six years (1884-90) to the study of chemistry and medicine at Berlin, Strasbourg, Vienna and other European universities. He was lecturer on materia-medica in the University of Michigan in 1890-91 and then entered the faculty of Johns Hopkins university where in 1893 he became professor of pharmacology and physiological chemistry. He made extensive investigations of the chemical composition of animal tissues and fluids and also of the function and isolation of special chemical principles of the animal organism. A noteworthy example of the latter was his isolation of the blood-pressure-raising constituent of the suprarenal glands (epinephrine) in the form of a benzoyl derivative. He made researches also on carbamic acid, the action of phthaleins, the poisons of mushrooms, albumoses in the tissues, hydrolytic products of proteins, histamin, insulin and various related subjects, in connection with which he has published many important papers. Two of his contributions to medical science were the isolation of adrenalin and the isolation of insulin in crystal form.

ABEL, KARL FRIEDRICH (1725-87), German musician, was born in Cöthen and died in London, where he lived during the greater part of his career. He was a great player on the viola da gamba, composed much music for that instrument and was one of the most prominent figures in the London musical life of his day. He studied under Johann Sebastian Bach at the Leipzig Thomasschule; played for ten years (1748-58) under A. Hasse in the band formed at Dresden by the elector of Saxony; and then, going to England, became (in 1759) chamber-musician to Queen Charlotte. The friendship between Johann Christian Bach, 11th son of Sebastian, who had also settled in London, and Abel led, in 1764 or 1765, to the establishment, at first under the auspices of the notorious Mrs. Cornelys, of the famous concerts subsequently known as the Bach and Abel concerts. The Hanover Square rooms were opened, on Feb. 1, 1775, by one of these concerts, at which, too, Haydn's symphonies were first performed in England. He was a man of striking presence, as several fine portraits, including two by Gainsborough, attest.

ABEL, NIELS HENRIK (1802-1829), Norwegian mathematician, was born at Findöe on Aug. 5, 1802, and died at Froland. One of the major creators of modern mathematics, Abel gave 19th century algebra, analysis and logical rigour some of their strongest impulses. The second of seven children of an impecunious pastor, he grew up in such poverty that his constitution was weakened irreparably, and he died of tuberculosis in his 27th year. Through all his poverty and illness he retained his courage and geniality. Poor himself, he shared what little he earned with

his widowed mother and brothers and sisters.

Abel discovered his extraordinary mathematical talent when he was about 15, and within a year was mastering the works of Isaac Newton, Leonhard Euler, Carl Gauss and Joseph Lagrange. Somewhat shocked by the naive formalism of Euler's infinite algorithms, he made it one of his main projects to remedy the logical defects in the analysis of his time. He thus became one of the first rigourists and one of the most influential. His was the first satisfactory proof, for example, of the general binomial theorem. His discussion of convergence opened a new era in analysis. Prompted by his teacher, B. M. Holmboë (who in 1839 edited the first edition of Abel's works), he attempted the algebraic solution of the general quintic, and believed he had succeeded. When he realized his mistake, he conceived the revolutionary idea of trying to prove the impossibility of an algebraic solution. He succeeded. This is one of the outstanding landmarks in the methodology of mathematics.

On the completion of his course at the University of Kristiania (Oslo) in June 1822, he was subsidized by the Norwegian government so that he might continue his researches. In Aug. 1825, his mathematical friends persuaded the government, then having severe financial difficulties of its own, to grant him sufficient funds for a year's travel and study in France and Germany. He had planned to call on Gauss, to whom he had sent a copy of his memoir on the quintic; but hearing that Gauss had tossed it aside with the exclamation, "Here is another of those monstrosities!", he revised his plans. While in Berlin, he had the good fortune to meet A. L. Crelle (*q.v.*), who urged him to proceed with his epoch-making creation of the theory of elliptic functions. Although Abel's mathematics was beyond Crelle's understanding, he sensed that he was dealing with a mathematician of the first rank, and published many of Abel's papers in the first volumes of his great *Journal*.

Distracted by the sociability of Berlin, Abel sought seclusion at Freiburg. There he organized his masterpiece, *Memoir on a General Property of a Very Extensive Class of Transcendental Functions*. This work is concerned with algebraic functions and their integrals; it started one of the most extensive departments of mathematical analysis of the 19th century, and was responsible for a vast development of algebraic geometry.

Late in July 1826, Abel went to Paris, where he was politely received. His masterpiece was presented to the Paris Academy of Sciences in Oct. 1826, where it was mislaid till 1841, when it was recovered after an enquiry by a representative of the Norwegian government and published. During the printing, the original manuscript was lost. The main result in the memoir, known as "Abel's theorem," was described as "only a marvellous exercise in the integral calculus." As such, it revealed mathematical genius of a new order. Adrien Legendre, who generously encouraged Abel, described the theorem (in the words of Horace) as *monumentum aere perennius*.

By May 1827, Abel was destitute. He returned to Kristiania, fatally ill. The professorship he had hoped to obtain at the university had been reluctantly taken by Holmboë at the insistence of the government. His last days were spent at Froland, in the house of an English family where his fiancée was governess. "I will fight for my life!" he shouted in his delirium. He died on April 6, 1829. Two days after his death, Crelle wrote to say that he had succeeded in getting Abel appointed to the professorship of mathematics in the University of Berlin. (E. T. B.)

ABÉLARD, PETER (1079-1142), scholastic philosopher, was born in Pallet (Palais), not far from Nantes, in 1079. He was the eldest son of a noble Breton house. He studied first under Roscelin, the extreme nominalist, and then went to the cathedral school of Notre Dame, whose master was William of Champeaux, the disciple of St. Anselm, and most advanced of realists. After a short time he overcame the master in discussion, and thus began a long duel that issued in the downfall of the philosophic theory of realism, till then dominant in the early middle ages.

When William procured his expulsion from Paris, he set up a school of his own at Melun, whence he removed to Corbeil, nearer

Paris, finally becoming master of the school of St. Geneviève. He next turned to theology and attended the lectures of Anselm at Laon. His triumph over the theologian was complete; the pupil was able to give lectures, without previous training or special study, which were more popular than those of the master. Abélard was now at the height of his fame. In 1115 he was made canon and master of Notre Dame, whither the fame of his learning and his personal charm drew students from all countries. (Fulk of Deuil, *Ep. ad Abaelardum*.)

Few teachers ever held such sway as Abélard now did for a time; but a change in his fortunes was at hand. He fell in love with the beautiful and learned Héloïse, niece of Canon Fulbert, and seduced her. After the birth of their son, they were secretly married, though Héloïse appealed to Abélard not to sacrifice his independence and chances of advancement. When the marriage became known, Héloïse retired to the convent of Argenteuil. Fulbert, believing that Abélard planned to be rid of her, took a barbarous revenge, breaking into his chamber by night and perpetrating upon him the most brutal mutilation. Abélard, in despair, became a monk at St. Denys, and Héloïse took the veil.

After a year Abélard opened a school of theology at the priory of Maisoncelle (1120). His lectures were heard again by crowds of students, and all his old influence seemed to have returned; but old enmities were revived also. His adversaries fell foul of his rationalistic interpretation of the Trinitarian dogma. Charging him with the heresy of Sabellius in a provincial synod held at Soissons in 1121, they procured a condemnation of his teaching, made him burn his book and shut him up in the convent of St. Médard at Soissons. When he returned to St. Denys, another dispute arose. He cited Bede to prove that Dionysius the Areopagite had been bishop of Corinth and not, as the monks held, bishop of Athens. When this historical heresy led to the inevitable persecution, Abélard withdrew to a desert place near Nogent-sur-Seine and turned hermit. His retreat becoming known, students flocked to him from Paris, and in gratitude for the consolation they brought him, he consecrated the new oratory they built for him by the name of the Paraclete.

Upon the return of new dangers, or at least of fears, Abélard accepted an invitation to preside over the abbey of St. Gildas de Rhuys, in Lower Brittany. The abbey was poor, disorderly and depraved; yet for nearly ten years he endured it, and it was only under peril of violent death that he fled from his charge. Meanwhile he had been able, on the breaking up of Héloïse's convent at Argenteuil, to establish her as head of a new religious house at the deserted Paraclete. After his flight from St. Gildas, he wrote, among other things, his famous *Historia Calamitatum*, and thus moved Héloïse to pen her three *Letters*, which have kept their place among the great love letters of the world. In 1136 he was lecturing on Mount St. Geneviève (when he was heard by John of Salisbury), but it was only for a brief space. As far back as the Paraclete days he had been the opponent of Bernard of Clairvaux, who upheld the principle of fervent and unhesitating faith, from which rational inquiry like his was sheer revolt, and Abélard now came into conflict with this uncompromising spirit. In 1141 a council met at Sens, before which Abélard, formally arraigned upon a number of heretical charges, was prepared to plead his cause; but when Bernard had opened the case, suddenly Abélard appealed to Rome. The stroke availed him nothing; for Bernard, who had power, notwithstanding, to get a condemnation passed at the council, did not rest till a second condemnation was procured at Rome in the following year. Meanwhile, on his way thither to urge his plea in person, Abélard had broken down at the abbey of Cluny; and there, an utterly fallen man, only not bereft of his intellectual force, he lingered but a few months. Removed for the relief of his sufferings to the priory of St. Marcel, near Chalon-sur-Saône, he died April 21, 1142. Héloïse died in 1164, and the two now lie in the well-known tomb in the cemetery of Père Lachaise in Paris.

Great as was the influence exerted by Abélard on the minds of his contemporaries and the course of mediæval thought, he has been little known in modern times but for his relations with Héloïse. Indeed, it was not till 1836, when Cousin issued the

collection entitled *Ouvrages inédits d'Abélard*, that his philosophical performance could be judged at first hand; of his strictly philosophical works only one, the ethical treatise *Scito te ipsum*, having been published earlier (1721). Cousin's collection, besides giving extracts from the theological work, *Sic et Non* (an assemblage of opposite opinions on doctrinal points, culled from the Fathers as a basis for discussion, the main interest in which lies in the fact that there is no attempt to reconcile the different opinions), includes the *Dialectica*, commentaries on logical works of Aristotle, Porphyry and Boëthius, and a fragment, *De Generibus et Speciebus*, which, with the psychological treatise *De Intellectibus* (published apart by Cousin in *Fragmens Philosophiques*, vol. ii) is now considered upon internal evidence not to be by Abélard himself. A genuine work, the *Glossulæ super Porphyrium*, from which Charles de Rémusat, in his classical monograph *Abélard* (1845), has given extracts, remains in manuscript.

The general importance of Abélard lies in his having fixed more decisively than anyone before him the scholastic manner of philosophizing, with its object of giving a formally rational expression to the received ecclesiastical doctrine. However his own particular interpretations may have been condemned, they were conceived in essentially the same spirit as the general scheme of thought afterwards elaborated in the 13th century with approval from the heads of the church. Through him was prepared the ascendancy of the philosophical authority of Aristotle, which became firmly established in the half-century after his death, when first the completed *Organon*, and gradually all the other works of the Greek thinker, came to be known in the schools; before his time it was rather upon the authority of Plato that the prevailing realism sought to lean. As regards his so-called conceptualism and his attitude to the question of universals, see SCHOLASTICISM.

Outside of his dialectic, it was in ethics that Abélard showed greatest activity of philosophical thought, laying very particular stress upon the subjective intention as determining, if not the moral character, at least the moral value, of human action. His thought in this direction, wherein he anticipated something of modern speculation, is the more remarkable because his scholastic successors hardly ventured to bring the principles and rules of conduct under pure philosophical discussion, even after the ethical inquiries of Aristotle became known to them.

BIBLIOGRAPHY.—Abélard's own works remain the best sources for his life, especially his *Historia Calamitatum*, an autobiography, and the correspondence with Héloïse. Charles de Rémusat's *Abélard* (1845) remains an authority; it must be distinguished from his drama *Abélard* (1877). McCabe's life of Abélard is written closely from the sources. See also U. Chevalier, *Répertoire des sources hist. du moyen âge*, "Abailard," (bibl.), and H. Rashdall, *Universities of Europe in the Middle Ages* (Oxford, 1895). A new translation of the famous *Letters* of Héloïse, by George Moore, appeared in 1926.

ABELIN, JOHANN PHILIPP, (d. c. 1635) German chronicler. He wrote numerous histories over the pseudonyms of Philipp Arlanibäus, Abeleus and Johann Ludwig Gottfried or Gotofredus. His best known work is the *Theatrum Europæum*, a series of chronicles of the chief events in the history of the world down to 1619. He compiled the first two volumes. It was continued by various writers and grew to 21 volumes (Frankf. 1633-1738). The chief interest of the work is its illustration by the beautiful copperplate engravings of Matthäus Merian (1593-1650).

See G. Droysen, *Arlanibæus, Godofredus, Abelinus* (1864); and notice in *Allgemeine Deutsche Biographie*.

ABELL, SIR WESTCOTT STILE (1877-), naval engineer. He was professor of naval architecture at Liverpool university, 1910-14, and chief ship surveyor at Lloyd's Register of Shipping from 1914 to 1928, when he was appointed professor of naval architecture at Armstrong college, Newcastle-upon-Tyne. A member of various boards, including two committees of the Board of Trade, on the Internationalization of the Load Line of Ships in 1913, and on Shipping and Shipbuilding in 1916, he became technical adviser to Controller of Shipping in 1917 and was president of the Institute of Marine Engineers 1924-25. He was created K.B.E. in 1920. Writings include *The Ship and her Work*.

ABEL OF BETH-MAACAH, a city in Maacah, one of the genuinely "Israelite" cities (see 2 Sam. xx, 18). The question of the Aramaean and Edomite composition of Israel involves a consideration of the territories occupied in early times by the tribes and their progenitor (Deut. xxvi, 5). Abel and Dan were considered as definitely Israelite cities (see *The Cambridge Ancient History*, 1926, vol. ii, pp. 368-69).

ABEL TEST, the close-test process of determining the flash-point of petroleum, invented by Sir Frederick Abel and embodied in the British Petroleum Act of 1879. The test is employed to ascertain whether a sample of petroleum may be safely used at a given temperature.

The Abel apparatus simply raises the temperature of the sample under test until the resultant combination of oil vapour and air forms an explosive mixture and causes a flash. The minimum limit of flash-point under British law is 73°, and most civilized countries have provided a similar test of inflammability. (See **PETROLEUM**.)

ABENCERRAGES, a family or faction that is said to have held a prominent position in the Moorish kingdom of Granada in the 15th century. The name appears to have been derived from Yussuf-ben-Serragh, the head of the tribe in the time of Mohammed VII. It is familiar from the interesting romance of Ginés Perez de Hita, *Guerras civiles de Granada*, which celebrates the feuds of the Abencerrages and the rival family of the Zegris. The hall of the Abencerrages in the Alhambra takes its name from being the reputed scene of the massacre of the family.

ABENDANA, the name of two Jewish theologians. (1) JACOB (1630-95), rabbi (Hakham) of the Spanish Jews in London from 1680. (2) ISAAC (c. 1650-1710), his brother, teacher of Hebrew at Cambridge and afterwards at Oxford. He compiled a Jewish calendar and wrote *Discourses on the Ecclesiastical and Civil Policy of the Jews* (1706).

ABENEZRA (Ibn Ezra), whose full name was Abraham ben Meir Ibn Ezra (1092 or 1093-1167), Jewish poet and scholar, was a native of Toledo. He had already gained a reputation as a thinker and poet before he left Spain, some time before 1140, and began the travels in northern Africa, in England, France and Italy which extended over a quarter of a century. He translated the writings of Hayyūj, the father of modern Hebrew grammar, from Arabic into Hebrew, and himself wrote treatises on the subject, the most important of which are *Moznayim* ("the Scales"), written in 1140, and *Zahot* ("Correctness"), written in 1141. His writings include works on philosophy, astronomy and mathematics; but his fame is derived chiefly from his commentaries on the Scriptures. Ibn Ezra sought to establish the simple sense of the text, basing his interpretation on solid grammatical principles. The commentary on the Pentateuch was first printed at Naples in 1488; in this edition a second commentary on Exodus takes the place of the original one. The great editions of the Hebrew Bible contain other commentaries by Ibn Ezra on Isaiah, the Minor Prophets, Job and Daniel; and his name was attached to commentaries on Proverbs, Ezra and Nehemiah, which were really the work of Moses Kimhi.

The *Yōsōd Mēra* (1158), the best known of his writings on the philosophy of religion, explains the reasons for the biblical commandments.

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ABENSBURG, a town and spa of Germany, in Bavaria, on the Abens, a tributary of the Danube, 18 mi. S.W. of Regensburg. Pop. (1933) 2,392. Some Roman remains exist in the neighbourhood of the town, which was known to the Romans as *Castra Abusina*. Here Napoleon defeated the Austrians under the Archduke Louis and Gen. Hiller on April 20, 1809.

ABEOKUTA, a town of British West Africa, the capital of the Egba division of the Yoruba people and of the province of Abeokuta, southern Nigeria. It is situated in 7° 8' N., 3° 25' E., on the Ogun river, 64 mi. north of Lagos by railway or 81 mi. by water. Population (1938 census) 69,502. Abeokuta is surrounded by mud walls 18 mi. in extent and lies in a beautiful and fertile country, the surface of which is broken by masses of gray granite. Besides the usual mud-built houses there are several buildings (including public offices) of modern design. Palm-oil, timber, yams and shea-butter are the chief articles of trade.

Abeokuta (a word meaning "under the rocks"), dating from 1825, owes its origin to incessant inroads of slave-hunters from Dahomey and Ibadan, which compelled the village populations to take refuge in this rocky stronghold, which became the capital of the Egba state, the ruling chief being styled *Alake* (Ake is the principal quarter of Abeokuta and is the name of the ancient Egba capital). The Egba carried on a long war with Ibadan and claimed the right to close the trade routes to Lagos. This brought them from 1865 onward into collision with the British, but in 1893 a treaty was signed which, while preserving Egba independence in internal affairs, brought the state under direct British influence. Christian missions had been in Abeokuta since 1843 and gained many converts; in 1867 the Christians were expelled. They returned some years later and now form an influential part of the population. The town is the headquarters of the Yoruba branch of the Church Missionary society.

After 1899 when the railway from Lagos reached Abeokuta there was a large increase in trade. Meanwhile the Egbas had set up a government based on European models, and in 1904 the *Alake* created some interest in his country by a visit to England. But side by side with an administration on modern lines (including fiscal barriers) "there existed," to quote Sir F. D. Lugard, "the ancient régime with all its abuses—extortionate demands from the peasantry, corruption and bribery in the courts, arbitrary imprisonment and forced labour." These conditions could not be tolerated and in 1914 by a new agreement the Egbas renounced "independence," and their country, with Jebu and other districts, was constituted the province of Abeokuta. Since then the *Alake* and his council have carried on the native administration under the supervision of a British resident. In 1917 a somewhat serious rising occurred in the province; it was the only instance of the peace being disturbed in Nigeria during World War I.

See Sir F. D. Lugard's *Report on Nigeria* (pub. in 1920) as a White Paper (cmd. 468); an article on Abeokuta by Sir Wm. Macgregor, *African Society's Journal* No. xii (July, 1904); and Sir W. N. Geary, *Nigeria under British Rule* (1927).

ABERAVON: see **PORT TALBOT**.

ABERCARN, urban district, Monmouthshire, England. Pop. (est. 1938) 18,510. Area, 14.91 sq.mi. It is situated in the middle portion of the Ebbw valley and like the other towns of the north and east of the coal field had an early association with iron smelting and then relied more and more on the export of coal, but tin plates are manufactured in large quantities. Like the other towns of the coal field, it is mainly a long street along the valley. It shared the deep industrial depression in the neighbourhood in the 1930s. Abercarn has a station on the Great Western railway branch line from Newport and is in the Abertillery parliamentary division.

ABERCORN, JAMES HAMILTON, 1ST EARL OF (c. 1575-1618), was the eldest son of Claud Hamilton, Lord Paisley (4th son of James, 2nd Earl of Arran, and Duke of Chatelherault), and of Margaret, daughter of George, 6th Lord Seton. He was made sheriff of Linlithgow in 1600, received large grants of lands in Scotland and Ireland, was created in 1603 Baron of Abercorn and on July 10, 1606, was rewarded for his services in the matter of the union by being made Earl of Abercorn and Baron Hamilton, Mount Castle and Kilpatrick. He married Marion, daughter of Thomas, 5th Lord Boyd, and left five sons, of whom the eldest, Baron of Strabane, succeeded him as 2nd Earl of Abercorn. He died on March 23, 1618. The title of Abercorn, held by the head of the Hamilton family, became a marquise in 1790 and a dukedom in 1868.

ABERCORN, JAMES HAMILTON, 2ND DUKE OF (1838–1913), British politician, born on Aug. 24, 1838, succeeded his father, the 1st Duke, in 1885. His sister, the Duchess of Buccleuch, was for many years mistress of the robes to Queen Victoria and to Queen Alexandra. The duke became a member of the household of the Prince of Wales (afterwards Edward VII.). He was a strong supporter of the Unionist Party in the House of Lords, and was chairman of the British South Africa Company. He died in London on Jan. 3, 1913.

ABERCORN, JAMES ALBERT EDWARD HAMILTON, 3RD DUKE OF (1869–), British politician, son of the preceding, was born on Nov. 1, 1869, and was educated at Eton. Lord James Hamilton was M.P. for Londonderry, 1900–13, a leader of the Unionist Party in Ulster, and treasurer of H.M. Household in 1903–05. After the passage of the Government of Ireland Act, he became a senator of Northern Ireland, and in 1922 was appointed governor.

ABERCROMBIE, LASCELLES (1881–1938), English poet, was born at Ashton-upon-Mersey, Cheshire, Jan. 9, 1881, and educated at Malvern and Victoria university, Manchester, where he studied science. His first work, *Interludes and Poems*, appeared in 1908. Other works are: *Mary and the Bramble* (1910); *Emblems of Love* (1912); *Deborah* (1912); *Speculative Dialogues* (1913); and *Collected Poems* (Oxford Poets, 1930). He was lecturer in poetry, Liverpool university, 1919–22; professor of English literature at Leeds university, 1922–29, and at London university 1929–35; and Goldsmith Reader in English at Oxford, 1935–38. To his students he emphasized the essential greatness of the writers he dealt with, rather than cumbersome details. His critical study of *Thomas Hardy* (1912), the *Theory of Poetry* (1924), his volume of collected lectures, *The Idea of Great Poetry* (1925), and *Liberty of Interpreting* (1930), and *Poetry—Its Music and Meaning* (1932), are important contributions to modern critical literature. His works include some plays in blank verse, among them *Phoenix* (1923).

ABERCROMBY, DAVID, a 17th century Scottish physician. His *Nova medicinae praxis* was reprinted after his death in Paris (1740). His *Tuta ac efficax huius venereae saepe absque mercurio ac semper absque salivatione mercuriali curando methodus* (1684) was translated into French, Dutch and German. In his *Discourse on Wit* (1685) he expounds the Scottish philosophy of common sense. The exact date of his death is unknown, but according to Haller he was alive early in the 18th century.

ABERCROMBY, PATRICK (1656–c. 1716), Scottish physician and author, was born at Forfar, and educated at St. Andrews. He is best known as the author of the *Martial Achievements of the Scots Nation* (fol. 1711–16), in which he had the assistance of many learned contemporaries. As a pamphleteer on behalf of the Union he crossed swords with Daniel Defoe.

ABERCROMBY, SIR RALPH (1734–1801), British soldier, eldest son of George Abercromby, of Tullibody, Clackmannanshire, was born Oct. 7, 1734. Educated at Rugby and at Edinburgh University, he was sent in 1754 to Leipzig to study civil law, with a view to his proceeding to the Scottish bar. But he received a commission in the 3rd Dragoon Guards in March 1756. He served with his regiment in the Seven Years' War, and study of the methods of the great Frederick moulded his military character and formed his tactical ideas. In 1781 he became colonel of the King's Irish infantry. When that regiment was disbanded in 1783, he retired upon half pay. Hitherto he had scarcely been engaged in active service, mainly because of his disapproval of the policy of the Government, and especially because of his sympathies with the American colonists in their struggles for independence; and his retirement was no doubt the result of similar feelings. But on the declaration of war by France against England in 1793, he returned to the Army, and was appointed to the command of a brigade under the Duke of York, for service in Holland. He commanded the advanced guard in the action at Le Cateau, and was wounded at Nijmegen. The duty fell to him of protecting the British Army in its disastrous retreat out of Holland in the winter of 1794–95. In 1795 he received a knighthood of the Bath, and in the same

year he was appointed to succeed Sir Charles Grey as commander-in-chief of the British forces in the West Indies. In 1796 he seized Grenada, and then took the settlements of Demerara and Essequibo, and the islands of St. Lucia, St. Vincent and Trinidad. He held, in 1797–98, the chief command of the forces in Ireland. He sought to restore the discipline of the army, and declined to allow the military to be called out, except when it was indispensable for the maintenance of order. Finding that all his efforts were thwarted by the Government in Ireland, he resigned the command. After acting as commander-in-chief in Scotland, Sir Ralph was second-in-command to the Duke of York in the second disastrous expedition to Holland in 1797. In 1801 he was sent with an Army to turn the French out of Egypt. The disembarkation on March 2 of the troops at Aboukir Bay, in the face of strenuous opposition, is justly ranked among the most daring and brilliant exploits of the British Army. The French made a surprise attack on the British camp near Alexandria (March 21, 1801), and Abercromby fell in the moment of victory. He was struck by a spent ball, which could not be extracted, and died on board the flagship seven days after the battle. By a vote of the House of Commons, a monument was erected in his honour in St. Paul's Cathedral. His widow was created Baroness Abercromby of Tullibody and Aboukir Bay, and a pension of £2,000 a year was settled on her and her two successors in the title.

A memoir of the later years of his life (1793–1801) by his third son, James (who was Speaker of the House of Commons, 1835–39, and became Lord Dunfermline), was published in 1861. For a shorter account of Sir Ralph Abercromby see Wilkinson, *Twelve British Soldiers* (London, 1899).

ABERDARE, HENRY AUSTIN BRUCE, 1ST BARON (1815–95), English statesman, was born at Duffryn, Aberdare, Glamorganshire, on April 16, 1815. He was called to the bar in 1837, and was stipendiary magistrate for Merthyr Tydvil and Aberdare, 1847–52. The discovery of coal in the Duffryn and Aberdare estates of the family made him a rich man. He sat in the House of Commons for Merthyr Tydvil from 1852–68 and for Renfrewshire from 1869–73, when he became a peer. He was under-secretary at the Home Office (1862–64), vice-president of the board of education (1864–66), home secretary (1868–73), and lord president of the council (1873–74). After the defeat of the Liberal Government in 1874 Lord Aberdare turned to social and economic questions. From 1882, when he became chairman of the National African Company incorporated under charter in 1886 as the Royal Niger Company, he was closely associated with West African affairs. He presided over several royal commissions, and promoted university education in Wales. He died in London on Feb. 25, 1895.

ABERDARE, industrial town and urban district of Glamorganshire, Wales, at the confluence of the Dar and Cynon (the latter being a tributary of the Taff). Pop. (est. 1938) 43,030. Area, 25 sq.mi. The neighbouring moorlands show evidences of occupation in pre-Roman times, and a site about 4 mi. to the north-west of the town is reputed to be the scene of a Norman victory over the native forces under Rhys ap Tewdwr in the 11th century. Aberdare remained but a small nucleus among the scattered farms of the moorlands until the beginning of the 19th century when the place grew rapidly owing to the abundance of its coal and iron ore, and the population of the whole parish (which was only 1,486 in 1801) increased tenfold during the first half of the century. Ironworks were established at Llwydcoed and Abernant in 1799 and 1800 respectively, followed by others at Gadlys and Aberaman in 1827 and 1847. The building of the Glamorgan canal in 1811 connected these ironworks with the coast, but the rapid development of the railways superseded the canals and at the same time gave an impetus to the iron trade between 1820 and 1870 and a consequent rapid growth of the town. These ironworks have not been worked since 1875, and the only supplementary industry remaining in the town is a small tinplate works at Gadlys (established in 1868). Previous to 1836, most of the coal worked in the parish was consumed locally, chiefly in the ironworks, but in that year the working of steam coal for export was begun, pits were sunk in rapid succession, and the coal trade, which at

least since 1875 has been the chief support of the town, soon reached huge dimensions. There are several brickworks and breweries. This town was severely affected by the depression of the 1930s, 37.1% of the insured population being unemployed in May 1934. Until 1918 Aberdeen was included for parliamentary representation with the borough of Merthyr Tydfil, but since then it returns a member jointly with the urban district of Mountain Ash.

ABERDEEN, GEORGE GORDON, 1ST EARL OF (1637-1720), lord chancellor of Scotland, was the son of Sir George Gordon of Haddo, who had been executed by the Presbyterians in 1664. He was born Oct. 3, 1637, and studied at Aberdeen and abroad. He was called to the bar in 1668 and gained a great reputation as a lawyer. He was president of the court of session in 1681 and lord chancellor of Scotland from 1682 to 1684. He was created earl of Aberdeen in 1682.

Burnet reflects unfavourably upon him, calls him "a proud and covetous man," and declares "the new chancellor exceeded all that had gone before him." He executed the laws enforcing religious conformity with severity, and filled the parish churches, but resisted the excessive measures of tyranny prescribed by the English government; and in consequence of an intrigue of the Duke of Queensberry and Lord Perth, who gained the duchess of Portsmouth with a present of £27,000, he was dismissed in 1684. He remained a non-juror during the whole of William's reign, and took the oaths for the first time after Anne's accession, on May 11, 1703. In the affair of the Union in 1707, he protested against the completion of the treaty till the act declaring the Scots aliens should be repealed, but refused to support the opposition to the measure itself. He died on April 20, 1720.

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ABERDEEN, GEORGE GORDON, 4TH EARL OF (1784-1860), British statesman, was born in Edinburgh on Jan. 28, 1784, the son of George Gordon, Lord Haddo. At the age of 11, when he was left an orphan, he went to reside with Henry Dundas, afterwards Lord Melville; and three years later he was permitted by Scots law to select William Pitt and Dundas as his curators, or guardians. At Harrow and at St. John's college, Cambridge, he proved himself a gifted classical scholar, though modern history shared his interest; and his education was completed by an extended tour of Europe which took him to the Far East. On the death of his grandfather in 1801 he succeeded to the peerage, and four years later he married Catherine Hamilton, daughter of Lord Abercorn.

His connection with Pitt and Dundas, and his native ability, favoured him for a political career, and in 1812 he travelled as ambassador extraordinary to Austria, where he signed the Treaty of Töplitz in 1813. He remained on the Continent as one of the most active British representatives throughout the negotiations which led to the Treaty of Paris; then he returned to England, and for some years lived in comparative retirement. The year 1815 saw his marriage to Harriet, Lady Hamilton, his first wife having died three years before.

In Jan. 1828 he joined the cabinet of the duke of Wellington, and in the following June he became secretary of state for foreign affairs. Resigning in 1830 with Wellington, he did not again take office until the short administration of 1834 and 1835, when he was colonial secretary to Sir Robert Peel; but in 1841 he joined the latter's cabinet as foreign secretary and commenced the most fruitful and successful period of his public life. He now acquired more power than he had ever possessed with Wellington, to whom he had felt himself subordinate; and this new authority he devoted first to establishing friendly relations with France. Public opinion in both countries exhibited hostility, so that the marriage of Isabella II. of Spain and the imprisonment of Pritchard in Tahiti might have led to a quarrel; but Aberdeen was fortunate in having the confidence of Guizot, and it was largely through their

efforts that a satisfactory understanding was maintained. He was equally successful in avoiding a rupture with the United States, which might easily have resulted from the question involving the boundary between that country and Canada. The north-east frontier was first settled amicably by the Webster-Ashburton Treaty of 1842, but in 1844 the new democratic administration in the States claimed from Britain the whole of the Pacific coast as far as Russian Alaska. To this demand Peel's Government refused to yield, and Aberdeen crowned his successful term at the Foreign Office with the Oregon Treaty of 1846, which fixed the boundary along the forty-ninth degree of latitude.

In 1845 he supported Peel in a proposal to suspend the duty on foreign corn, and left office with him in July 1846. After Peel's death in 1850, Aberdeen was recognized as leader of the Peelites, and in 1852, at the head of a coalition ministry of his own party and the Whigs, he became first lord of the Treasury. Although united on free trade and on questions of domestic reform generally, a cabinet including Lord Palmerston and Lord John Russell, in addition to Aberdeen, was certain to differ on foreign policy; and contemporaries realized that the task of the prime minister was one of unusual difficulty. "In the present cabinet," wrote Charles Greville, in his *Memoirs*, "are five or six men of equal or nearly equal, pretensions . . . every one of these five or six considering himself abler and more important than their premier." Nevertheless, the first year of this administration was successful, and it was due to Aberdeen's steady support that Gladstone's great budget of 1853 was accepted by the cabinet; but the weakness of Aberdeen and of the cabinet soon became apparent in the negotiations which preceded the Crimean War. That the prime minister wished to maintain the peace is unquestionable, but whether he acted wisely to this end is more obscure. His foreign policy was essentially one of peace and non-intervention; but his character is perhaps best described by a writer who says "his strength was not equal to his goodness."

The Vienna note, by which the four powers sought to find terms which were agreeable to both Russia and Turkey, was largely the result of Aberdeen's endeavours; and when Turkey refused to accept the proposed agreement, Aberdeen would not have offered her British support had not the publication of a secret Russian document in Berlin thrown doubt upon the Tsar's intentions. Even then he sought to preserve the peace by presenting a new note early in Dec. 1853 to the two countries; but when he wished to insist upon Turkey's acceptance of these terms, Lord John Russell refused to support him. Rather than risk a break up of the cabinet, Aberdeen consented to a compromise of which advantage was taken by those who desired war; and Turkey was thus enabled to force England with her into the disastrous struggle. The stories of misery and mismanagement from the seat of war deprived the Government of public favour. Russell resigned; and in Jan. 1855, he was followed by Aberdeen, who interpreted a motion by J. A. Roebuck as one of no confidence. He died in London, on Dec. 14th, 1860, and was buried in the family vault at Stanmore. He left four children by his second wife, who died in Aug. 1833; the eldest son, George John James, succeeded as 5th earl; his youngest son, Arthur Hamilton, was created Baron Stanmore in 1893. Aberdeen wrote *An Inquiry into the Principles of Beauty in Grecian Architecture*, which was published in London, 1822. A bust of him by Matthew Noble is in Westminster Abbey, and his portrait was painted by Sir T. Lawrence.

See Sir T. Martin, *Life of the Prince Consort* (1875-80); A. W. Kinglake, *Invasion of the Crimea* (1877-88); Spencer Walpole, *History of England* (1878-86), C. C. F. Greville, *Memoirs*, edited by H. Reeve (1888); Spencer Walpole, *Life of Lord John Russell* (1889); Lord Stanmore, *The Earl of Aberdeen* (1893); J. Morley, *Life of Gladstone* (1903).

ABERDEEN, a royal and parliamentary burgh, city and county of a city, the capital of Aberdeenshire and chief seaport in the north of Scotland. Pop. (est. 1938) 178,199. It is the fourth Scottish town in population, industry and wealth, and stands on a bay of the North Sea between the mouths of Don and Dee, 130½ mi. N.E. of Edinburgh by the L.N.E.R. Though the residential suburb of Old Aberdeen, extending from the city suburbs to the southern banks of the Don, has a separate charter, history and

privileges, there is no distinction between it and New Aberdeen for parliamentary, municipal or other purposes. Aberdeen derives its popular name of the "Granite City" from its building stone, which under sunshine after rain gleams white and justifies the town's more poetical designation of the "Silver City by the Sea." The land area of the city is 17.22 sq. mi. The burghs of Old Aberdeen and Woodside, and the district of Torry, to the south of the Dee, were incorporated in 1895. After 1928 the city comprised 12 wards and 21 ecclesiastical parishes. It is under the jurisdiction of a council with lord provost, bailies, treasurer and dean of guild. The corporation prior to World War II began to give a good deal of attention to improving the town as a holiday resort.

Streets and Buildings.—Roughly, the extended city runs north and south. From the new bridge of Don to the "auld brig" of Dee there is tramway communication via King street, Union street and Holburn road—a distance of over five miles. The name of the ancient castle of Aberdeen, long since demolished, is preserved in Castle street, Castlegate and Castlehill. From Castle street the imposing Union street 70 ft. wide runs west-south-west for nearly a mile, and contains the principal shops and most of the modern public buildings, all of granite. Part of the street crosses the Denburn ravine by a fine granite arch of 132ft. span; portions of the older town fringe the gorge, 50 ft. below the level of Union street. The Trinity Hall of the incorporated trades, originating between 1398 and 1527, and having charitable funds, contains some fine portraits attributed to George Jamesone, who was a native of Aberdeen and one of the earlier British portrait painters. Castle street continues Union street eastwards, and has the fine structures of the municipal and county buildings in Franco-Scottish Gothic (1867–78), the sheriff court house and the town hall, with excellent portraits; from the south-west corner a tower commands a fine view. At the upper end of Castle street stands the Salvation Army Citadel, one of the most imposing "barracks" possessed by this organization. In front of it is the beautiful Market Cross, one of the most notable of its kind in Scotland, an open-arched, hexagonal structure, 21ft. in diameter and 18ft. high, dating originally from 1682, when it replaced an earlier cross, and rebuilt on its present site in 1842. On an eminence east of Castle street are the military barracks, Aberdeen being the depot of supplies for the Gordon Highlanders. The fish market on the Albert Basin is an important centre of activity. The art gallery and museum is at Schoolhill, the Macdonald Hall containing portraits of contemporary artists by themselves being unique of its kind in Great Britain. In Sept. 1925 the city's war memorial was opened; it consists of a domed court, or hall of remembrance, attached to the art gallery and museum. Other extensions, enlarging the facilities of the art gallery and museum, opened at the same time include Cowdray Hall, used for lectures, with the Cowdray Museum, of Applied Arts beneath it.

The see of Aberdeen is represented by the Old Cathedral of St. Machar, the only granite cathedral in the British Isles; the beginnings of the present structure date from the 14th century and were completed by Bishops Elphinstone (1484–1511) and Gavin Dunbar (1520). On the flat panelled ceiling are the heraldic shields of princes, noblemen and bishops who shared in its erection. The name of St. Machar (or Mochonna) is referred by tradition to a disciple of St. Columba who founded a chapel here for the conversion of the Picts. The bishopric, traditionally founded at Mortlach (Banffshire) by King Malcolm II. in 1010, in honour of a victory over the Danes, was transferred to Aberdeen by King David I. about the year 1137, a bull of Pope Adrian IV. dated 1157 "confirming all grants made by the kings of the Scots." "The church of Aberdeen" which is mentioned in the same bull, together with the church of St. Machar, is held to refer to the old church of St. Nicholas, of which there remains the Drum and Collision aisles which now link the east and west churches and an eastern crypt. The John Knox parish church was rebuilt in 1911; the Roman Catholic cathedral (Gothic, 1859) is in Huntly street. The episcopal cathedral of St. Andrews is the mother church of the Protestant Episcopal Church in the United

States.

The Dee is crossed by four bridges, including the railway bridge. Till 1832 the old bridge of Dee built by Bishops Elphinstone and Dunbar (and rebuilt in 1718–23 and 1842) formed the only entry to the city from the south. The bridge of Don, consisting of five granite arches, was built in 1827–32. The Auld Brig o' Balgownie, said to have been built by Robert the Bruce in the 13th century, and celebrated by Byron in the tenth canto of *Don Juan*, is one of the oldest historical bridges still in use. The parks and open



BY COURTESY OF LONDON, MIDLAND AND SCOTTISH RAILWAY

THE "AULD BRIG O' BALGOWNIE" AT ABERDEEN, SUPPOSEDLY BUILT BY ROBERT THE BRUCE (1274–1329), AND CELEBRATED IN BYRON'S POEM, "DON JUAN"

spaces include Duthie Park (45 acres), the gift of Miss Elizabeth Crombie. Duthie of Ruthrieston; Victoria Park (13 acres) and its extension Westburn Park (13 acres); Stewart Park (11 acres), after Sir D. Stewart, lord provost in 1893; and Hazelhead Park. Capacious golf links and a bathing beach border the sea.

Education.—Aberdeen university consists of King's college in Old Aberdeen, founded by Bishop Elphinstone (q.v.) in 1494, and Marischal college, in Broad street, founded in 1593 by George Keith, 5th earl Marischal, the two colleges being incorporated together, 1860. In all 34 chairs, 3 readerships and 68 lectureships had been founded by 1943. Handsome new buildings have been erected. Important additions to the resources of the university are the Rowett institute for research in animal nutrition and the Macaulay institute for soil research. Donations have been received for scholarships and bursaries, and the Carnegie Trust has made grants for the erection of buildings.

King's forms a quadrangle with interior court; the Crown Tower and the Chapel, the oldest parts, date from 1500. The choir of the chapel contains the original oak canopied stalls, misericore seats and lofty open screens in French flamboyant style. The principal at the time of the Reformation armed his folk to save the building from the barons of the Mearns (the modern Kincardineshire) after they had robbed St. Machar's of its bells and lead. The building of Marischal college was erected in 1836–41 and has been greatly extended since. Dr. Charles Mitchell gave the great graduation hall and the Mitchell tower (233 ft.), opened in 1895, on the 400th anniversary of the university's foundation. A lintel stone from the old buildings of Marischal college is preserved at the foot of the Mitchell tower, bearing the famous inscription: THAY HAIF SAID · QUHAT SAY THAY · LAT THAME SAY, the circumstances giving rise to which are believed to embody the founder's retort to criticisms passed against him for his appropriation (by gift from the Crown) of lands and revenues belonging to the suppressed Cistercian abbey of Deer. A botanic garden was presented to the university in 1899.

Aberdeen, St. Andrews, Edinburgh and Glasgow universities combine to return three members to Parliament. The United Free Church college is in Tudor Gothic (1850). The Grammar school, reputedly first heard of in 1256, was removed in 1861–63 from Schoolhill to new buildings off Skene street. Robert Gordon founded (1729) and Alexander Simpson further endowed (1816) Gordon's Hospital for instruction and maintenance of sons of poor burghesses of guild and trade; in 1881 it became Robert Gordon's college for secondary and technical education.

Harbour.—A formerly defective harbour with a bar has been greatly deepened under various Acts since 1773. The north pier,

built partly by John Smeaton in 1775–81 and partly by Thomas Telford in 1810–15, extends nearly 2,000 ft. into the North sea. It increases the depth of water on the bar from a few feet to 32 ft. at high water, and 19½ ft. at low water, spring tides. The wet Victoria dock of 29 ac., and with 6,000 ft. of quay, was completed in 1848. Adjoining it is the upper dock. By the Harbour act of 1868, 90 ac. of new ground (in addition to 25 ac. formerly made up) were provided on the north side of the Dee for the Albert basin (with a graving dock), quays and warehouses. A breakwater of concrete, 1,050 ft. long, was constructed on the south side of the stream, and a third floating dock was built in 1911.

Industry.—Gray granite has long been quarried, and blocked and dressed paving “setts,” curb and building stones and monumental work exported. Aberdeen is an important centre of the Scottish fisheries, the antiquity of which is shown by the mention of the provision of “dried fish from Aberdeen” in the royal wardrobe accounts of the 13th century. Other industries include jute, paper, agricultural materials, sail, rope and timber manufactures, engineering, chemical works, soap and candles and distilling. In the days of wooden ships shipbuilding flourished, the town being noted for its fast clippers, many of which established records in the “tea races.” The introduction of trawling revived this to some extent, and there are large shipbuilding and repairing yards.

History.—Aberdeen was important as far back as the 12th century. Corporate rights were granted by a royal charter of King William the Lion (1179), from whose times down to the 14th century the Scottish kings maintained a royal residence in Aberdeen. The city received other royal charters later. After it was burned by the English king Edward III in 1336, the new town which was built was called New Aberdeen to distinguish it from Old Aberdeen. The burgh records are the oldest in Scotland, being complete with one brief break from 1398 to the present day. During the struggles between the royalists and the Covenanters the city was plundered by both. In the Scottish wars of independence led by William Wallace and Robert Bruce, Aberdeen gave its aid to both. The motto on the city arms of “Bon Accord” traditionally commemorates the watchword used by the Aberdonians aiding Robert Bruce. In 1715 the earl of Mar proclaimed the Old Pretender at Aberdeen.

Once strongly fortified, the gates of the city were all removed by 1770. The importance of Aberdeen as a royal burgh and trading port placed it from the earliest times in the first rank of Scottish towns, a position which its great cathedral and, later, the fame of its university both served to maintain.

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ABERDEEN, a city of northeastern Mississippi, U.S., on the Tombigbee river; the county seat of Monroe county. It is on federal highway 45, and is served by the Frisco and the Illinois Central railways. There is a municipal airport. The population was 5,282 in 1950, 4,746 in 1940 and 3,925 in 1930 by the federal census. Industries include lumbering, a bentonite plant, garment plant, frozen food locker and cotton compress. Aberdeen was incorporated in 1837 and named by the founder, Robert Gordon, a Scotchman.

ABERDEEN, a city of South Dakota, U.S., the county seat of Brown county. It is in the northeastern part of the state, on fed-

eral highway 12, about 270 mi. W. by N. of Minneapolis, Minn., and is served by the Chicago, Milwaukee, St. Paul and Pacific, the Great Northern, the Chicago and North Western and the Minneapolis and St. Louis railroads. The population was 20,976 in 1950.

Aberdeen is the financial and trading centre of the northern part of the state, a fine agricultural region, producing grain, potatoes, hay and flax. Retail sales in 1948 amounted to \$38,862,000, ranking Aberdeen among the first 15 cities of the United States in retail sales volume per capita. Northern State Teachers college was established there in 1901. Largest teachers college in the state, it had an enrolment of approximately 700 at mid-20th century. It maintains a summer biological station at Enemy Swim lake near Waubay. Aberdeen was settled in 1880 and was chartered as a city in 1883.

ABERDEEN, a port of entry, the largest city of Grays Harbor county, Wash., U.S., at the head of Grays Harbor, 49 mi. W. of Olympia. It has an area of 10.5 sq.mi.; is built on both sides of the Chehalis and the Wishkah rivers; and adjoins the city of Hoquiam (q.v.) on the west, and the town of Cosmopolis (population 1950, 1,161) on the east. The population of Aberdeen increased from 3,747 in 1900 to 18,846 in 1940 (about 20% foreign-born white, Scandinavians predominating) by the federal census and 19,475 in 1950. The three municipalities form one community, with a population of more than 31,000; served by the Northern Pacific, the Union Pacific and the Chicago, Milwaukee, St. Paul and Pacific railways, by autostages and by steamship lines to all world ports. Its products are plywood, pulp and paper, lumber, furniture, shingles, veneer, fish, fisheries by-products and cranberries.

Grays Harbor was discovered in 1792 by Capt. Robert Gray of Boston, on a trading voyage around the world. Aberdeen was founded in 1867 by Samuel Benn, who in 1873 established a cannery, and in 1883 planned the town site. It was incorporated in 1890.

ABERDEEN AND TEMAIR, JOHN CAMPBELL GORDON, 1ST MARQUESS OF (1847–1934), P.C., G.C.M.G., G.C.V.O., K.T., second son of the fifth earl of Aberdeen, was born in Edinburgh Aug. 3, 1847. He was educated at Oxford and succeeded his brother as sixth earl of Aberdeen in 1870, taking his seat in the house of lords early in 1873 and at once plunging into committee work. After being lord high commissioner to the general assembly of the Church of Scotland from 1881 to 1885—an office he again filled in 1915—William Ewart Gladstone appointed him lord lieutenant of Ireland in his short administration (Feb.–July) of 1886. Soon after the Liberals' next accession to power he became governor-general of Canada (1893) and after his return to England in 1898 took little part in politics. In Dec. 1905 he was again appointed lord lieutenant of Ireland; he held this office till May 1915, and in the following January received the title of marquess of Aberdeen and Temair (Tara). Both in Canada and in Ireland Lord Aberdeen's terms of office were distinguished by the cordial relationship which he maintained with the different peoples over whom he presided. He died March 7, 1934, and was succeeded by his son, the earl of Haddo (1879–).

In 1877 Lord Aberdeen married the Hon. Ishbel Maria Majoribanks, a daughter of Lord Tweedmouth.

See *We Two: Reminiscences of Lord and Lady Aberdeen* (1925).

ABERDEEN PROVING GROUND is located on the west side of the upper Chesapeake bay, U.S., covering about 75,000 ac. between Bush river and Swan creek in Maryland. A U.S. army installation under the jurisdiction of the ordnance department, it was originally acquired Oct. 16, 1917, and was made a permanent army post in Jan. 1919. Research and development of all ordnance items, including test activities and computations of firing tables and other technical data, are primary functions of the proving grounds. The ordnance school, ordnance department board, Aberdeen Ordnance depot and an air force base, Phillips field, are also located there. Some of the testing activities are performed at White Sands, N.M.

ABERDEENSHIRE, a northeastern county of Scotland, bounded north and east by the North sea, south by Kincardine, Angus and Perth and west by Inverness and Banff. It has a

coast line of 65 mi., and is the sixth Scottish county in land area, occupying 1,261,440 ac. or 1,971 sq.mi. The county is generally hilly, since from the south-west, near the centre of Scotland, the Grampians send out various branches in a general north-easterly direction. The county is watered by the rivers Dee, Don, Ythan, Ugie and Deveron—names, especially the two first, associated with some of the finest valley scenery on the eastward slope of Scotland. The upper valley of the Dee, about Braemar, penetrates the central mass of crystalline schists belonging to the metamorphic rocks of the eastern highlands, with extensive intrusions of later granites, which, on the border with Banffshire, rise in the fine mass of Ben Macdhuì (4,296ft.) to a height second only to that of Ben Nevis among the mountains of the British Isles. This mountain commands views of one of the most beautiful parts of the central highlands, with the summits of Braeriach (4,248ft.), Cairntoul (4,241ft.) and Cairngorm (Banffshire) near by, the columnar cliffs of Corrie Etchachan, and Loch Avon in its deep gully, 2,500ft. above sea-level. Among many other heights, "dark" Lochnagar, south-east of Braemar, is famed through a well-known song of Byron; and Ben-wachie, on the Banffshire border, through John Imlah's verse "O gin I were where Gadie rins." The shire is popularly divided into five districts. Of these the first is Mar, mostly between Dee and Don, the southern half of the county with the city of Aberdeen. The soil on the Dee is sandy, and on the Don loamy. The second district, Formartine, between the lower Don and Ythan, has a sandy coast, succeeded inland by a clayey, fertile, cultivated tract, and then by low hills, moors, mosses and tilled land. Buchan, the third district, lies north of the Ythan, and comprises the north-east part of the county. The surface is bare, low, flat or gently undulating and in places peaty. The coast is in parts bold and rocky, and at the Bulters of Buchan, 6m. south of Peterhead, the sea enters a basin by a natural arch and boils up violently in stormy weather. Buchan Ness is the most easterly point of Scotland. The fourth district, Garioch, in the centre of the shire, is beautiful, undulating, loamy and fertile. Strathbogie, the fifth district south of the Deveron, mostly consists of hills, moors and mosses.

Geology.—The schists extend east from the central mass to Formartine and Peterhead. East down Dee and Don and north across the plain of Buchan towards Rattray head and Fraserburgh there is a development of biotite gneiss, partly of sedimentary and perhaps partly of igneous origin. A belt of slate quarried for roofing purposes runs along the west border of the county from Turriff by Auchterless and the Foudland hills towards the Tap o'Noth near Gartly. The metamorphic rocks have been invaded in almost every part of the county by igneous materials, some before, and by far the larger series after the folding of the strata. There are chalybeate springs at Peterhead and Pananich near Ballater. The later granites subsequent to the plication of the schists have a wide distribution on the Ben Macdhuì and Ben Avon range, and on Lochnagar; they stretch east from Ballater by Tarland to Aberdeen and north to Bennachie. Isolated masses appear at Peterhead and at Strichen. The Aberdeen granites have been widely used for building and paving, and extensively quarried at Rubislaw, Peterhead, Kemnay and elsewhere. The glacial deposits in the county indicate an eastward movement off the high ground at the head of Dee and Don, while the mass spreading outwards from the Moray Firth invaded the low plateau of Buchan; but at a certain stage there was a marked defection northwards parallel with the coast, as proved by the deposit of red clay north of Aberdeen. At a later date the local glaciers laid down materials on top of the red clay. The rivers abound with salmon and trout. Loch Muick, the largest of the few lakes in the county, 1,310ft. above the sea, 2½m. long and ½ to ¾m. broad, lies some 8½m. south-west of Ballater, and has Altnagiuthasach, a royal shooting-box, near its south-west end. Red deer (in Braemar), grouse, and partridges are plentiful.

The climate of the upper Dee and Don valleys has a reputation as the driest and most bracing in the British isles, and grain is cultivable up to 1,600ft. above sea-level—considerably higher

than elsewhere in the north of Great Britain. At Loch Muick vegetables, currants, laurels and roses flourish; the larch grows well, and elsewhere in Braemar natural timber, especially Scots fir in addition to larch, is particularly fine. Ash-trees, 5ft. in girth, are found at 1,300ft. elevation.

History.—The country now forming the shires of Aberdeen and Banff was originally peopled by northern Picts, whom Ptolemy called Taixali. Evidence of effective Roman occupation is lacking, though so-called Roman camps have been discovered on the upper Ythan and Deveron. Traces of the native inhabitants, however, are numerous. Weems or earth-houses are fairly common in the west. Relics of crannogs or lake-dwellings exist at Loch Ceander, or Kinnord, 5m. N.E. of Ballater, at Loch Goul in the parish of New Machar, and elsewhere. Duns or forts occur on hills at Dunecth, where the dun encloses an area of two acres, Barra near Old Meldrum, Tap o'Noth, Dunnideer near Inch and other places. Monoliths, standing stones and stone circles abound, and there are many early Christian sculptured stones. Efforts to convert the Picts were begun by Ternan in the 5th century and continued by Columba (who founded a monastery at Old Deer), Drostan, Maluog and Machar, but dissensions within the Columban Church and the expulsion of the clergy from Pictland by the Pictish king Nectan in the 8th century, undid most of the progress that had been made. The Vikings and Danes periodically raided the coast, but when (1040) Macbeth ascended the throne of Scotland the Northmen, under the guidance of Thorfinn, refrained from further trouble in the north-east. Macbeth was afterwards slain at Lumphanan (1057), a cairn on Perkhill marking the spot. Along with numerous Anglo-Saxon exiles after the Norman conquest of England there also came to Aberdeenshire Flemings who introduced various industries, Saxons who brought farming, and Scandinavians who taught nautical skill. The Celts revolted more than once, but Malcolm Canmore and his successors crushed them and confiscated their lands. In the 12th and 13th centuries some of the great Aberdeenshire families arose, including the earl of Mar (c. 1122), the Leslies, Freskins (ancestors of the dukes of Sutherland), Durwards, Bysets, Comyns and Cheynes, and in most cases their founders were immigrants. The Celtic thanes and their retainers slowly fused with the settlers. They declined to take advantage of the disturbed condition of the country during the wars of the Scots independence, and made common cause with the bulk of the nation. Though John Comyn (d. 1300?), one of the competitors for the throne, had considerable interests in the shire, his claim received locally little support. In 1296 Edward I. made a triumphal march to the north to terrorize the more turbulent nobles. Next year William Wallace surprised the English garrison in Aberdeen, but failed to capture the castle. In 1303 Edward again visited the county, halting at the castle of Kildrummy, then in the possession of Robert Bruce, and made Aberdeen his headquarters during several months. After Robert Bruce's death (1329) there was intermittent anarchy in the shire. Aberdeen itself was burned by the English in 1336, and the resettlement of the districts of Buchan and Strathbogie occasioned constant quarrels on the part of the dispossessed. Moreover, the Crown embroiled itself by trying to subdue some of the Highland chieftains. This policy culminated in the invasion of Aberdeenshire by Donald, lord of the Isles, who was, however, defeated at Harlaw, near Inverurie, by the earl of Mar in 1411. In the 15th century Sir Alexander Forbes was created Lord Forbes (c. 1442), and Sir Alexander Seton Lord Gordon in 1437 and earl of Huntly in 1445. Bitter feuds raged between these families but the Gordons' domains, already vast, were enhanced by the acquisition, through marriage, of the earldom of Sutherland (1514). Meanwhile commerce with the Low Countries, Poland and the Baltic had grown apace, Campvere, near Flushing in Holland, becoming the emporium of the Scottish traders, while education was fostered by the foundation of King's college at Aberdeen in 1494 (Marischal college followed a century later). At the Reformation so little intuition had the clergy of the drift of opinion that at the very time that religious structures were being despoiled in the south, the building

and decoration of churches went on in the shire. The change was acquiesced in without much tumult, though rioting took place in Aberdeen and St. Machar's cathedral in the city suffered damage. The 4th earl of Huntly offered some resistance, on behalf of the Catholics, to the influence of Lord James Stuart, afterwards the regent, Moray, but was defeated and killed at Corrichie on the Hill of Fare in 1562. As years passed it was apparent that Presbyterianism was less generally acceptable than episcopacy, of which system Aberdeenshire remained for generations the stronghold in Scotland. In 1638 the National Covenant was ordered to be subscribed, a demand so grudgingly responded to that the earl of Montrose visited the shire in the following year to enforce acceptance. The Cavaliers, not being disposed to



VIEW OF THE CENTRE OF ABERDEEN, SCOTLAND, SOMETIMES CALLED "THE GRANITE CITY," THE CHIEF CITY OF ABERDEENSHIRE

yield, dispersed an armed gathering of Covenanters in the affair called the Trot of Turriff (1639), in which the first blood of the Civil War was shed. The Covenanters obtained the upper hand in a few weeks, when Montrose appeared at the bridge of Dee and compelled the surrender of Aberdeen, which had no choice but to cast in its lot with the victors. Montrose, however, soon changed sides, and defeated the Covenanters under Lord Balfour of Burleigh (1644), and again after a stiff fight on July 2, 1645, at Alford. Peace was temporarily restored on the "engagement" of the Scots commissioners to assist Charles I. On his return from Holland in 1650 Charles II was welcomed in Aberdeen, but in little more than a year General Monk entered the city at the head of the Cromwellian regiments. The English garrison remained till 1659, and next year the Restoration was effusively hailed, and prelacy was again in the ascendant. After the Revolution (1688) episcopacy passed under a cloud, and as George I was antipathetic to the clergy, it happened that Jacobitism and episcopalianism came to be regarded in the shire as identical. The earl of Mar raised the standard of revolt in Braemar (Sept. 6, 1715); a fortnight later James was proclaimed at Aberdeen cross; the Pretender landed at Peterhead on Dec. 22, and in Feb. 1716 he was back again in France. The collapse of the first rising ruined many of the lairds, and when the second rebellion occurred 30 years afterwards the county in the main was apathetic, though the insurgents held Aberdeen for five months, and Lord Lewis Gordon won a trifling victory for Prince Charles Edward at Inverurie (Dec. 23, 1745).

Population and Government.—The population in 1938 was estimated at 325,231. In 1931, only 777 spoke Gaelic, all of whom spoke English also. As late as 1830 Gaelic was the common tongue almost throughout Braemar at least. The chief towns, with populations (est. 1938), are the large burgh of Aberdeen (178,199), and Peterhead (13,056), Fraserburgh (10,388), Huntly (3,985), Inverurie (4,728), and Turriff (2,562) of the ten small burghs. Aberdeen, Kintore and Inverurie are royal burghs. The supreme court of justiciary sits in Aberdeen to try cases from the counties of Aberdeen, Banff and Kincardine. The three counties are under a sheriff, and there are three sheriffs-substitute resident in Aberdeen, who sit also at Fraserburgh, Huntly and

Peterhead. The county, with Kincardineshire, sends three members to parliament. The county town, Aberdeen, returns two members.

Agriculture.—Except in favoured tracts, as in Formartine and Garioch, the glacial drift soils are generally poor, gravelly or peaty; but in no part of Scotland has careful cultivation more successfully increased productivity. About two-thirds of the population depend on agriculture. Farms are small compared with those in the southeastern counties. Of the 9,889 holdings in 1938 almost half were between 5 and 50 ac. Oats are the predominant crop (172,055 ac. in 1938), wheat has practically gone out of cultivation (188 ac.), but turnips and swedes (73,698 ac.) and barley (11,669 ac.) are grown. The county is by far the greatest for oat growing in Scotland and is second only to East Lothian for barley. Great numbers (185,277 in 1938) of the home-bred crosses of cattle are fattened for London and local markets, and Irish animals are imported on an extensive scale for the same purpose.

Fisheries.—The white and herring fishery is the next most important industry to agriculture, its development having been due almost exclusively to the introduction of steam trawlers. Aberdeen is the chief Scottish centre for trawling and great line fishing, and the chief port for white fish. Fraserburgh is one of the largest centres of the North sea herring fishing. Haddocks are salted and rock-dried (speldings) or smoked (finnans). The ports and creeks are divided between the fishery districts of Peterhead, Fraserburgh and Aberdeen, the last of which includes also three Kincardineshire ports. The herring season for Aberdeen, Peterhead and Fraserburgh is from June to September, at which time the ports are crowded with boats from other Scottish districts. There are valuable salmon-fishings—rod, net and stake-net—on Dee, Don, Ythan and Ugie.

Communications.—From the south Aberdeen city is approached by the L.M.S.R. (via Perth, Forfar and Stonehaven), and the L.N.E.R. (via Dundee, Montrose and Stonehaven). A line of the latter company runs via Kintore and Huntly to Keith and Elgin. Branch lines from Aberdeen to Ballater by Deeside, from Aberdeen to Fraserburgh (with a branch at Maud for Peterhead and at Ellon for Cruden bay and Boddam), from Kintore to Alford, and from Inverurie to Old Meldrum and also to Macduff. By sea there is regular communication with London, Leith, Newcastle and Hull, Inverness, Wick and other ports, the Orkneys and Shetlands, and the Continent. The highest macadamized road crossing the East Grampians rises to a point 2,200 ft. above sea level.

ABERDOUR, village and civil parish, Fifeshire, Scotland. Pop. (1931), 2,055. On the shore of the Firth of Forth, 17½ mi. N.W. of Edinburgh by the L.N.E.R., 7 mi. N.W. of Leith by steamer, it is a favoured bathing resort. There are ruins of a castle and a church with fine Norman work. About 3 mi. S.W. is Donibristle House, the seat of the earl of Murray (Moray). The island of Inchcolm, or island of Columba, ¼ mi. from shore, is in the parish. Remains of 13th-century fresco have been found.

ABERDOVEY (äb-ur-düv'i) (ABERDVY), a village on the north side of the Dyfi Estuary, Merionethshire, Wales. Population (1931) 1,203. Its site has associations in Welsh folklore with coastal submergence (see CARDIGANSHIRE). During the 17th, 18th and 19th centuries it had a considerable coasting and fishing trade, the export of slates from Corris and Aberllefenni being considerable. Aberdovey also exported lead ore from the mines of the Dyfi region. With the development of private motor traffic on a large scale after 1918 Aberdovey became increasingly a resort for visitors from the large towns of England.

ABERFOYLE, village and civil parish, Perthshire, Scotland, 34½ mi. N.W. of Glasgow by the L.N.E.R. Population (1931) 1,014. The village is at the base of Craigmore (1,271 ft. high) and on the Laggan, a headwater of the Forth. In 1885 the duke of Montrose built a road over the east shoulder of Craigmore to the Trossachs but this does not take motor traffic. The Laggan drains the small lochs Ard and Chon, the first of which is the scene of incidents in Scott's *Rob Roy*. There are slate quarries on Craigmore.

ABERGAVERN (äb-ur-gén'ī or äb-ur-gä-vén'ī), municipal borough, Monmouthshire, England, at the converge of roads from Crickhowell, Ross, Hereford, Newport and Merthyr, at the confluence of the Gaveny with the Usk. Population (1938) 7,925. Area, 3.75 sq.mi. There are evidences of the early occupation of the area on the hills around and the focus which became Abergavenny was the Roman Gobannium, a small fort guarding the road up the Usk. The town grew under the protection of the Norman lords of Abergavenny and there are remains of a castle built by Hamelin de Ballon in the 11th century. The mediaeval walled town contained a Benedictine monastery which later became the church of St. Mary, which contains many interesting monuments. Owing to its situation, the town was frequently embroiled in the border warfare of the 12th and 13th centuries and was burned by Owen Glendower (q.v.) in 1404. At the dissolution of the priory part of its endowment went towards a free grammar school. In 1639 Abergavenny received a charter of incorporation with bailiff and burgesses. Like most towns of similar history it showed strong conservative tendencies during the Civil Wars when the town suffered badly at the hands of Fairfax (1646), and again in 1688 when it lost its charter for its strong Jacobean demonstrations. The market was important as early as 1200 and further reference is made to it in 1657, but with the better roads and greater movement of the 18th and 19th centuries cattle and horse fairs became more important. In the 18th and early 19th centuries Abergavenny prospered as a market and social centre. It was also famous for its Welsh flannel. Abergavenny was incorporated in 1899. Its boundaries were extended in 1935. It is in the parliamentary division of Monmouth.

ABERIGH-MACKAY, GEORGE ROBERT (1848–1881), Anglo-Indian writer, is known by his famous *Twenty-one Days in India* (1878–79), a satire upon Anglo-Indian society and ways of thinking.

ABERNETHY, JOHN (1680–1740), Irish Presbyterian divine, was born at Coleraine, county Londonderry, on Oct. 19 1680. He was educated at Glasgow, Edinburgh and Dublin, and was pastor of a church at Antrim for 14 years. In 1717 he was assigned by the synod to Usher's Quay, Dublin. He declined to obey, and remained at Antrim. This refusal became a test case of the authority of the ecclesiastical courts, and Irish Presbyterianism was split into two camps of "subscribers" and "non-subscribers." Out-and-out evangelical as John Abernethy was, there can be no question that he and his associates sowed the seeds of that after-struggle (1821–40) in which, under the leadership of Dr. Henry Cooke, the Arian and Socinian elements of the Irish Presbyterian Church were thrown out. In 1726 the "non-subscribers," in spite of pleading against separation by Abernethy, were cut off from the Irish Presbyterian Church. In 1730, although a "non-subscriber," he was invited to Wood Street, Dublin, whither he removed. In 1731 Abernethy made a stand against the Test Act, "against all laws that, upon account of mere differences of religious opinions and forms of worship, excluded men of integrity and ability from serving their country." He was nearly a century in advance of his age in his repudiation of tests and disabilities. He had to reason with those who denied that a Roman Catholic or Dissenter could be a "man of integrity and ability." His *Tracts*—afterwards collected—did fresh service, generations later, and his name is honoured by all who love freedom of conscience and opinion.

See Dr. Duchal's *Life*, prefixed to *Sermons* (1762); *Diary* in ms., 6 vols. 4to; Reid's *Presbyterian Church in Ireland*, iii. 234.

ABERNETHY, JOHN (1764–1831), British surgeon, was born in London on April 3 1764. He was apprenticed in 1779 to Sir Charles Blincke, then assistant surgeon to St. Bartholomew's Hospital, and studied under Sir William Buzard at the London Hospital and under John Hunter. When Blincke became surgeon to the hospital, Abernethy became assistant surgeon. He began to lecture to students in his house. The lectures were so crowded that the governors of the hospital decided to build a regular lecture theatre. Abernethy's best known work is *Surgical observations on the constitutional Origin and Treatment of Local Diseases* (1809). He had enjoyed great celebrity in private practice,

enhanced, it is said, by his rough manners. He was surgeon to the hospital 1815–27, and died at Enfield April 20 1831.

A collected edition of his works was published in 1830. A biography, *Memoirs of John Abernethy*, by George Macilwain, appeared in 1853.

ABERRATION IN OPTICAL SYSTEMS, the deviation of light rays from certain points through which they should pass in order to satisfy the conditions necessary for distinct focus. *Spherical* aberration results in distortion of the image, and *chromatic* aberration produces coloured fringes around an otherwise white image. (See OPTICS; PHOTOGRAPHY: Apparatus.)

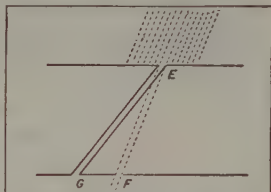
ABERRATION OF LIGHT. This is an astronomical phenomenon depending on the fact that light is not propagated instantaneously. Our observations of the heavenly bodies are taken from the earth, a planet whose speed of motion is not incomparably smaller than that of the light; the result is that the apparent position of a star in the sky does not correspond to its true direction from the earth. We are accustomed to assume intuitively that a body is "where we see it to be"; or, since the distance cannot always be judged, that at any rate it is in the direction in which we see it. But actually vision gives only an indirect acquaintance with its position. That which affects our eyes is the light which has travelled to us from the object; we have, therefore, to take into consideration the circumstances of propagation of the light. It is well known that a light-ray changes direction in passing from one transparent medium to another, e.g., water to air, and that its course is curved in a medium of varying density such as our atmosphere; an object seen by these dislocated or curved rays is displaced from its correct position, and the corresponding correction for *refraction* by the earth's atmosphere is highly important in determining the positions of stars. The correction for *aberration* is also concerned with the propagation of light; it arises from the fact that our actual judgment of the direction of a ray involves a combination of the earth's motion and the motion of the light.

The most elementary explanation can be given in terms of the old corpuscular theory of light—which was the theory accepted at the time aberration was discovered. If we think of the ray of light as a stream of missiles proceeding from the star with a speed of 186,000 m. a second, it is clear that the apparent direction from which the missiles come will be affected by our own velocity if that is not too insignificant in comparison. A common illustration is that of a man walking through a rain-storm with the drops falling vertically; the faster he walks, the more inclined is the position in which he must hold his umbrella to shield off the "missiles." The argument can be re-stated in terms of the wave theory of light without essential alteration; but reference should be made to an account of that theory for an explanation of the signification of "rays of light."

A rough way of aligning the direction of a star is to point a long narrow tube so that we can see the star through it. The alinement is given by the two apertures at the ends of the tube, which must be such that the small pencil of rays admitted through one can make an exit through the other and thus reach the observer's eye. The upper part of the diagram shows the rays of light coming from a star; the upper aperture E admits a narrow beam which continues in the original direction, so that F is the position in which the exit aperture has to be placed. Suppose that whilst the light travels the distance EF the earth moves through a distance GF; then the required direction of our tube is GE. It will then admit the light at E, and, by the time the light has travelled down the tube, the lower aperture will have reached the position F and the light will pass out. It will be seen that the tube GE does not point in the true direction of the star FE. The same principle applies when the tube is furnished with lenses, as in a telescope.

The alinement is the same whether the tube is long or short, and we can conveniently appreciate the relative proportions if we take EF to be 186,000 miles. The light then takes 1 second to pass from E to F; and in 1 second the earth travels in its orbit $1\frac{1}{2}$ m., represented by GF. Thus GF is $\frac{1}{10,000}$ of EF. The greatest possible angle between the observed direction and the true direction is $\frac{1}{10,000}$ of a radian, or more accurately $20.47''$;

this is called the *constant of aberration*. For comparison the apparent radius of Jupiter is about $20''$; so that (when the aberration is a maximum) we see the centre of Jupiter when we are actually looking towards the edge of disc. As the direction of the earth's motion changes throughout the year so the direction of the aberration displacement of the star changes; the star is always displaced towards the "apex of the earth's way," i.e., the point of the sky towards which the earth's motion is directed. The star apparently moves in an ellipse around its true position as centre, making a circuit once a year. For a star at the pole of the ecliptic this ellipse is a circle of radius $20.47''$; for other parts of the sky the path may be regarded as a parallel circle which is projected into an ellipse by foreshortening. The major axis of the ellipse is always $20.47''$, but the minor axis depends on the latitude (i.e., distance from ecliptic) of the star.



Discovery of Aberration.—The discovery of the aberration of light in 1725, due to James Bradley (1693–1762) is one of the most important in the whole domain of astronomy; and in pure physics it has provoked a succession of investigations culminating in the theory of relativity. It was entirely unexpected, and it was only by extraordinary perseverance and perspicuity that Bradley was able to explain it in 1729. The discovery arose in the course of an attempt to discover whether the stars had appreciable parallaxes. We now know that stellar parallaxes are less than a second of arc, and the first authentic parallax was not measured until a century later. Many observers had, however, claimed to have discovered such parallaxes. In 1680 Jean Picard in his *Voyage d'Uraniborg* stated, as the result of ten years' observations, that the Pole Star exhibited variations of position amounting to $40''$ annually; some astronomers endeavoured to explain this by parallax, but the motion was at variance with that which parallax would occasion. J. Flamsteed, from measurements in 1689 and succeeding years with his mural quadrant, concluded that the declination of the Pole Star was $40''$ less in July than September. R. Hooke in 1674 concluded from his observations that γ Draconis was $23''$ more northerly in July than October.

When James Bradley and Samuel Molyneux entered this sphere of astronomical research in 1725 there was much uncertainty as to whether genuine stellar parallaxes had been detected or not; and it was with the intention of answering this question definitely that they erected a large telescope in the house of the latter at Kew. They determined to re-investigate γ Draconis, a star selected because it passed almost through the zenith in the latitude of London; its position would therefore not be affected by troublesome and uncertain corrections for refraction. The telescope constructed by George Graham (1675–1751), a celebrated instrument-maker, was affixed to a vertical chimney-stack; the eye-piece could be moved a little laterally so as to measure deviation from the vertical by means of a screw, the vertical being fixed by a plumb-line. The first observations were made on the 3rd, 5th, 11th, 12th Dec., 1725. On the 17th Bradley found the star to be moving southwards, and confirmed this on the 20th. (The change of position by aberration at this time of the year is rapid, and amounts to about $3.2''$ in ten days.) The star was found to continue its southerly course until March when it was about $20''$ south of the December position. By the middle of April it was apparent that it was returning north again. In September it reached its northerly limit, the extreme range between March and September being $40''$.

Although the observers were seeking an apparent shift of the star, they immediately realized that what they had found could not be attributed to parallax. The maximum range of parallactic shift for γ Draconis should be between June and December. Aberration and parallax are easily distinguished by this three months' difference of phase; the displacement of a star due to aberration is always at right angles to that due to parallax. Bradley and Molyneux discussed several hypotheses in the hope

of arriving at an explanation. One hypothesis was that the direction of the earth's axis and therefore of the plumb-line varied, causing an apparent displacement of the star when its position was measured with respect to the plumb-line. Observations were therefore made of another star on the opposite side of the pole; from a comparison of the displacements with those of γ Draconis it was found that they could not be explained by a shift of the earth's axis. The precaution, however, was fruitful; for by long continued observation Bradley ultimately established that shifts due to a change of the earth's axis actually occurred; and he was led to his second famous discovery—*nutation*. Bradley realized that observations of many more stars were required in order to determine the laws governing this mysterious effect. For this purpose he set up a more convenient telescope at the Rectory, Wanstead, the residence of the widow of his uncle, James Pound, who had guided him in his early astronomical work. This telescope, erected in Aug. 1727 had a range of 64° on each side of the zenith and thus covered a much larger area of the sky than the Kew instrument. Fifty stars were kept under close observation. Bradley disentangled from these observations the conclusion that a star had its extreme declinations at the times of the year when it passed through the zenith at 6 o'clock morning or evening.

The true theory of the phenomenon was discovered by an accident reminding us of the more apocryphal story of Newton and the apple-tree. Sailing on the Thames, Bradley noticed the shifting of the vane on the mast, as the boat altered her course; the shift was not due to unsteadiness of the wind, but to the combining of the changing motion of the boat with the steady velocity of the wind. This suggested that the changing direction of the ray from the star was the result of combining the changing motion of the earth with the steady velocity of the starlight. The finite velocity of light had been discovered by Roemer 60 years earlier.

Astronomical Effects.—In modern astronomy the aberration due to the earth's orbital motion is included along with precession and nutation as part of the "star correction" applied to reduce from Apparent to Mean Place. A small correction for diurnal aberration is also applied, arising from the motion of the observer caused by the diurnal rotation of the earth. For planets and comets a different procedure is adopted. It must be remembered that, even after allowing for the aberration, we see the body not where it is now but where it was when the light left it. Thus the corrected direction FE joins the position of the earth at the instant of observation to the position of the planet some minutes or hours before. Using the previous diagram but with a new connotation, let E be the planet when the light left it, and let F be the position of the earth when the light arrives. Whilst the light travels from E to F the earth travels from G to F, so that the *apparent direction* of the planet GE is the actual direction joining the positions of the earth and planet at the time when the light left the planet. Accordingly we do not trouble about the hybrid direction FE. We accept GE uncorrected; but we apply a correction to the time of observation, antedating it by the light-time. This simple procedure is inapplicable to the stars whose light-time is many years, because it assumes that the earth's velocity has been constant throughout the interval. But it answers a question often raised—whether we ought not to apply a correction on account of the aberration due to the motion of the whole solar system through space towards a point in Hercules. This motion, being uniform, admits of the above treatment; and the answer is that no correction is required provided that it is understood that the observation relates to the state of things when the light left the star; the aberration rather helpfully "puts back the sun" to the earlier date which must in any case pertain to the star.

Since the velocity of light is known with great accuracy the observed value of the constant of aberration determines the earth's orbital velocity. This can also be calculated when we know the radius of the earth's orbit from observations of the solar parallax. There has long been a rivalry between the constant of aberration and the solar parallax as to which shall provide the more accurate determination; at present the degree of

accuracy seems to be about equal, and the two methods are in satisfactory accord.

Aberration and Aether.—In the explanation of aberration we pictured the light as travelling in a straight line from the star uninfluenced by the motion of the earth carrying the observer. On the wave theory this would not be true if the aether in our neighbourhood were carried along with the earth; for when the light reaches this moving region of the aether its course will be disturbed, the motion of the aether (if the phrase has any literal meaning) being superposed on the ordinary velocity of the light traversing it. According to the modern idea of the atom, introduced by Rutherford in 1911, the electrons and atomic nuclei are so minute that the aether can slip through the void interior of the atom as easily as through the solar system, and there is no longer any reason to anticipate a convection; but in the last century it seemed almost contrary to reason to imagine solid matter pushing its way through the aetherial medium without serious disturbance. Apart from this prejudice, experimental evidence in the last century suggested that the aether in the lower part of our atmosphere was travelling with the earth, and further that moving matter such as a stream of water partially dragged the aether with it. Thus in 1818 Arago pointed out that the refraction by a prism (depending on the ratio of the velocities of light in air and glass) ought to be altered by the motion of the prism through the aether; since no such alteration was observed he concluded that the surrounding aether shared the motion of the prism. Fresnel explained this effect by a "dragging co-efficient," his hypothesis being that the "condensed" aether carrying the light inside the prism did not have the full motion of the prism but was only partially dragged in the same direction. This was apparently verified by Fizeau in 1851, who sent light in opposite directions round a circulating stream of water and thus studied its velocity with and against the current. In 1871 Airy performed his water-telescope experiment (originally suggested by Boscovitch) in which he measured the constant of aberration with a telescope that had its tube filled with water. Reasoning crudely, the aberration should have been increased, since the velocity of light in water is less than in air; but the normal value was obtained. Fresnel had already predicted that there would be a compensation when account was taken of the alteration of refraction at the surface of the moving liquid.

In the light of Fresnel's theory, it seemed to emerge from these results that the aether-drag was limited to the interior of the moving bodies, and that its effects were compensated by changes of refraction at the surface of the bodies, except when (as in Fizeau's experiment) differential motions were concerned. Thus the aether just outside the solid earth would be stagnant as the theory of aberration requires. But in 1887 Michelson and Morley made a much more delicate attempt to detect the difference of velocity of the earth and surrounding aether (*see RELATIVITY*); this seemed to decide that the aether was carried with the earth. Thus the conflict between stagnant and convected aether was brought to a head, the former being demanded by astronomical aberration and the latter by the Michelson-Morley experiment and certain later experiments involving similar principles.

The astronomical observations prove that the ray as it reaches the telescope is travelling in the same direction as when it started from the star; this, however, does not entirely rule out possible motions of the aether near the earth. It was shown by Sir George Stokes (1845) that the necessary and sufficient condition was that the motion should be of the kind known as "irrotational" in hydrodynamics. This would allow the kind of disturbance which might be anticipated from the earth's pushing its way through a fluid aether, since there is a well-known irrotational solution of the problem of a sphere moving through a liquid; but it does little to help the present difficulty since it involves a sliding of the aether over the surface of the sphere, which is precisely the point denied by the Michelson-Morley experiment. If the aether is allowed to be compressible (the density having, however, no effect on the velocity of light) an irrotational solution can be found which does not involve any slip of the aether at the earth's surface. This was pointed out by Planck, but the condensation

required is so extreme, that the loop-hole cannot be considered very seriously. The reconciliation was ultimately effected by the theoretical investigations of Lorentz and Larmor. Their work showed that the electrical structure of matter involves an alteration of length of all material objects in the direction of their velocity through the aether, which would compensate the effect looked for in the Michelson-Morley experiment—confirming a suggestion originally made by FitzGerald. When allowance is made for this contraction, none of the numerous experiments are capable of testing the relative motion of the earth and aether. The position about 1900-05 can be summed up as follows:—The earth moves through the stagnant aether without disturbing it, as the original explanation of astronomical aberration demands. The objection that bodies carried on the earth show no effects of this relative motion falls to the ground because it turns out that in all the experiments the effects are precisely compensated. For the further developments originating from these ideas reference should be made to the article *RELATIVITY*.

Astronomical aberration provides no means of determining a uniform motion through the aether; this will be apparent from what we have said as to the aberration from the motion of the solar system through space. But it provides a means of determining differences of velocity, such as the differences in the earth's orbital motion at different times of the year. Equally it can test any possible difference of aether-drift at different levels, *e.g.*, at the top and bottom of a mountain. Prof. D. C. Miller's recent attempt to test this by performing the Michelson-Morley experiment at the top of a mountain appears to us to have been misconceived; for even if (contrary to current theory) the experiment can reveal aether-drift, it is by no means comparable in accuracy with the test by astronomical observations, which assure us that the light of the stars is not deflected by any change of the aether current between a mountain observatory and the sea-level. All observable effects of aberration are due to relative velocity or change of velocity. On absolute velocity it is silent; and there is reason to believe that all other experiments are silent also—a conclusion which has led to the principle of relativity.

BIBLIOGRAPHY.—For Bradley's work *see* S. Rigaud, *Memoirs of Bradley* (1832) or H. H. Turner, *Astronomical Discovery* (1904). The practical application in astronomy is treated in all text-books on spherical astronomy. For the long controversy regarding stagnant and convected aether *see* J. Larmor, *Aether and Matter* (1900) and E. T. Whittaker, *A History of the Theory of Aether and Electricity* (1910). (A. S. E.)

ABERSYCHAN: *see* PONTYPOOL.

ABERTILLERY, urban district, Monmouthshire, England, 16 mi. N.W. of Newport, on the G.W.R. Pop. (1938) 28,320. Area, 10.1 sq.mi. It lies in the mountainous mining district of Monmouthshire and Glamorganshire, in the valley of the Ebbw Fach, and the large industrial population is mainly employed in the numerous coal mines, ironworks and tinplate works. The upper reaches of the valley were formerly important as iron smelting regions and coal was worked early at Abertillery. This region, like most of South Wales, suffered badly in the depression of the 1930s.

ABERT RIM, a striking rock formation in south central Oregon, U.S.A., is one of the largest fault scarps in the world. The rim runs along the eastern edge of Abert lake for 19 mi., rising about 2,000 ft. above the lake, and has an 800-ft. lava cap ending in a sheer precipice.

Lieut. John Charles Frémont and his men discovered Abert Rim and lake in Dec. 1843. Legend says that a party of Indians chased a wagon train of white people across the level plateau which slopes gradually from the east up to the summit of the rim, and drove them, unsuspecting, over the cliff. In the vicinity of Abert lake are found crude pictographs on rocks, rock foundations of dwellings of primitive people, arrowheads and skeletons.

Rhinoceros and camel fossil remains, and those of many other animals have been found nearby.

ABERYSTWYTH (ab-ur-üst'with), municipal borough, watering place and university town, in the Cardiganshire parlia-

mentary division, on the shores of Cardigan bay, Wales, at the mouth of the artificially united Rheidol and Ystwyth rivers. Pop. (est. 1938) 9,309. Area, 1.78 sq.mi. There appears to be a long tradition of settlement in the neighbourhood, for on a prominent hill (Pendinas) overlooking the south of the town is one of the largest hill-top earthworks in central Wales. With the clearing of the lowland, Pendinas was superseded by Llanbadarn Fawr, a village situated on a dry bend above the flood plain of the Rheidol about 1½ mi. E. of the town. The existence of three Norman motte and bailey castles in the neighbourhood suggests loose military tenure in early Plantagenet times. The most interesting of these sites is Castell Aberystwyth situated above the bend of the Ystwyth about 1½ mi. S. of the town. It gave its name to the Edwardian stone castle erected near the fishing village that grew up at the river mouths. The history of the castle was a troublesome one, as was to be expected from its position in the heart of Wales, but future developments centred in the little community that gathered beneath it, and not in Llanbadarn Fawr. Traces of the mediaeval town wall are still to be seen.

Aberystwyth shared in the mining (lead), agricultural and sea trade movements of the early 19th century and seems to have become at this time the social centre for the surrounding area. It has since extended northwards and eastwards over the newly drained marshy ground that surrounded the mediaeval settlement, and has gained favour as a summer health resort, especially since the development of the railway. The latter, however, killed the coastal trade and much of the seafaring habit; the harbour is now derelict (see CARDIGANSHIRE). As a link between the northern and southern parts of Welsh Wales, Aberystwyth became the site of the first University college of Wales, opened in 1872 and incorporated by charter in 1889, and of the National Library of Wales, opened in 1911. In 1906 the Welsh Calvinistic Methodist Theological college was moved here from Trevecca. Aberystwyth, whose first charter was granted in 1277, was a contributory parliamentary borough until 1885. A town planning scheme is in operation.

ABETTI, ANTONIO (1846–1928), Italian astronomer, was born on June 19, 1846, at Gorizia, Italy. He was educated at Pisa. After working in the observatories at Pisa and Padua, Abetti became director of the Arcetri observatory, Florence, in 1894; he remained there until he retired in 1921. He made a special study of the minor planets and wrote a number of papers on this subject. Abetti was a member of the Academie dei Lincei; he died on Feb. 20, 1928.

Abetti wrote *Construction of a Sundial in a Vertical Plane* (1876); *Differences in Longitude between Rome, Padua and Arcetri* (1891); and *Annals of Arcetri Observatory* (1896–1911).

ABETTOR, a law term implying one who is present, actually or constructively, and aids and abets another to commit an offence. An abettor differs from an accessory (*q.v.*) in that he must be present at the commission of the crime; all abettors (with certain exceptions) are principals in the second degree, and, in the absence of specific statutory provision to the contrary, are punishable to the same extent as the actual perpetrator of the offence.

ABEYANCE, a state of expectancy in respect of property, titles or office, when the right to them is not vested in any ascertained one person, but awaits the appearance or determination of the true owner. In law, the term abeyance can only be applied to such future estates as have not yet vested or possibly may not vest. The freehold of a benefice, on the death of the incumbent, is said to be in abeyance until the next incumbent takes possession. A common use of the term is in the case of peerage dignities. If a peerage which passes to heirs-general, like the ancient baronies by writ, is held by a man whose heir-at-law is neither a male, nor a woman who is an only child, it goes into abeyance on his death between two or more sisters or their heirs, and is held by no one till the abeyance is terminated; if eventually only one person represents the claims of all the sisters, he or she can claim the termination of the abeyance as a matter of right. The Crown can also call the peerage out of abeyance at any moment, on petition, in favour of any

one of the sisters or their heirs between whom it is in abeyance. It is common, but incorrect, to speak of peerage dignities which are dormant (*i.e.*, unclaimed) as being in abeyance. (See PEERAGE.)

ABGAR, a name borne by a line of Mesopotamian kings, 29 in number, who reigned in Osroene and had their capital at Edessa in the last century before and the first century after the birth of Christ. According to an old tradition, one of these princes, perhaps Abgar V. (Ukkāmā or Uchomo, "the black"), being afflicted with leprosy, sent a letter to Jesus, acknowledging his divinity, craving his help and offering him an asylum in his own residence, but Jesus wrote a letter declining to go, promising, however, that after his ascension he would send one of his disciples. Eusebius states that in due course Judas, son of Thaddaeus, was sent (A.D. 29). The letters are given by Eusebius (*Ecclesiastical History*, i. 13), who declares that the Syriac document from which he translates them had been preserved in the archives at Edessa from the time of Abgar.

This legend has survived in various forms, and has given rise to much discussion. The correspondence was rejected as apocryphal by Pope Gelasius and a Roman synod (c. 495); though, it is true, this view has not been shared universally by the Roman Church. Among Protestants the spuriousness of the letters is almost universally admitted. Lipsius (*Die Edessenische Abgarsage*, 1880) has pointed out anachronisms which seem to indicate that the story is quite unhistorical. The first king of Edessa of whom we have any trustworthy information is Abgar VIII. bar Ma'nu (A.D. 176–213). It is suggested that the legend arose from a desire to trace the Christianizing of his kingdom to an apostolic source.

See Lipsius, *Die Edessenische Abgarsage kritisch untersucht* (1880); Tixeront, *Les Origines de l'église d'Edesse et la légende d'A.* (1888); for the Epistles see APOCRYPHAL LITERATURE, sect. "Epistles."

ABGESANG: see AUFGESANG.

ABHIDHAMMA, the name of one of the three divisions into which the Buddhist scriptures are divided. (see BUDDHA AND BUDDHISM). It consists in the Pali Canon of seven works: 1. *Dhammasangani* (enumeration of mental states). 2. *Vibhanga* (analysis). 3. *Kathā-vatthu* (subjects of discussion). 4. *Puggala-paññatti* (on classes of individuals). 5. *Dhātu-kathā* (on mental elements). 6. *Yamaka* (pairs of ethical states). 7. *Paṭṭhāna* (relations of ethical states). These have been published by the Pali Text society, and the first, third and fourth have been translated (see below). Most of the works consist of the analysis and classification of psychical states from an ethical standpoint, but the *Kathā-vatthu* gives a list of dogmas disputed between the 18 sects. The Ceylon Chronicles say that it was spoken or promulgated (not composed) by Tissa Moggaliputta at the third council in 247 B.C. As Mrs. Rhys Davids has shown, it must have been compiled gradually. It is probably one of the latest of the works, but none of them are primitive, and some schools, according to Tāranātha, denied that Abhidhamma was the word of Buddha. The oldest name for this literature is *mātikā*, "lists," *i.e.* of the questions discussed, and it is mentioned under this name in several parts of the canon, but from this nothing can be inferred as to the age of the extant works. The Sarvāstivāda school had a similar set of seven works, which exist now only in a Chinese version. They have been analysed by Prof. Takakusu in the article mentioned below. The subject was first examined by Burnouf, who relied on the Mahāyāna canon as found in Tibetan, in which Abhidharma (Pāli, Abhidhamma) is represented by the *Prajñāpāramitā* and such works. These teach a doctrine of negativism, or as Prof. Stcherbatsky terms it, relativity, and hence Abhidharma was translated "metaphysics." But this is quite absent from the earlier schools, in which the term means "higher dharma."

See *Buddhist Psychology*, translation of *Dhamma-sangani*, and *Points of Controversy*, translation of *Kathā-vatthu*, by Mrs. Rhys Davids (1900 and 1915); E. Burnouf, *Introduction à l'histoire du bouddhisme indien* (1845); Tāranātha, *Geschichte des Buddhismus*, translated by A. Schiefner, St. Petersburg, 1869; "On the Abhidhamma books of the Sarvāstivādins," by Prof. Takakusu, in *Journal of the Pāli Text Society*, 1905; *Designation of human types*, translation of *Puggala-paññatti*, by B. C. Law (1924). (E. J. T.)

ABHORRERS, the name given in 1679 to the persons who expressed their "abhorrence" at the action of those who had signed petitions urging King Charles II to assemble parliament. Feeling against Roman Catholics, and especially against James, duke of York, was running strongly; the Exclusion bill had been passed by the house of commons, and the popularity of James, duke of Monmouth, was very great. To prevent this bill from passing into law, Charles had dissolved parliament in July 1679, and in the following October had prorogued its successor without allowing it to meet. He was then deluged with petitions urging him to call it together, and this agitation was opposed by Sir George Jeffreys (*q.v.*) and Francis Wythens, who presented addresses expressing "abhorrence" of the "Petitioners," and thus initiated the movement of the ABHORRERS, who supported the action of the king. "The frolic went all over England," said Roger North; and the addresses of the Abhorers which reached the king from all parts of the country formed a counterblast to those of the Petitioners. It is said that the terms Whig and Tory were first applied to English political parties in consequence of this dispute. (*See WHIG AND TORY.*)

ABIATHAR, in the Old Testament, son of Ahimelech, priest of Nob. He alone escaped from the massacre carried out by Doeg. Fleeing to David, he remained with him throughout his wanderings and his reign. He was loyal through the rebellion of Absalom, but supported Adonijah against Solomon, and was banished to Anathoth. He probably represents an early rival house to that of Zadok, the official priestly family of Jerusalem down to the exile. (*See especially I Sam. xxii, seq., II Sam. xv, xx, I Ki. i, ii, iv.*)

ABICH, OTTO WILHELM HERMANN VON (1806–1886), German mineralogist, geologist and traveller, was born in Berlin on Dec. 11, 1806, and died in Vienna on July 1, 1886. His earliest scientific work related to spinels and other minerals, and later he made special studies of fumaroles, of the mineral deposits around volcanic vents and of the structure of volcanoes. The mineral abichite was named after him.

His works include: *Vues illustratives de quelques phénomènes géologiques, prises sur le Vésuve et l'Etna, pendant les années 1833 et 1834* (Berlin, 1836); *Ueber die Natur und den Zusammenhang der vulcanischen Bildungen* (Brunswick, 1841); *Geologische Forschungen in den Kaukasischen Ländern* (1878, 1882 and 1887).

ABIDJAN (5° 27' N., 4° W.), is the rising, government-fostered metropolis of Ivory Coast, French West Africa. Its pop. (17,500, official est. 1936) makes it the largest centre in the colony (8th in F.W.A.); in European inhabitants (1,060) it is materially outranked only by Dakar. It stands on a low promontory of the mainland shore of Ebrié lagoon, opposite a place where the sand bar that forms the coastline is narrow (875 yd.), and a submarine valley, the Bottomless Pit, brings deep water close to shore (*see map*).

The town dates from 1903, when it was made the terminus of a railroad penetrating the dense coastal forest. Subsequent extensions of the rails enhanced its commercial value, but for a generation want of port facilities prevented its growth. Attempts to maintain a canal through the bar in 1906–08 failed. In 1923 Ebrié lagoon was linked to its neighbour next west by a 7 mi. canal, making a waterway 125 mi. long navigable for small craft. Later

the railroad was extended 7 mi. (via causeway and pontoon bridge across the lagoon) to an ocean terminal on the bar, Port Bouet. There a 1,350-ft. pier projecting beyond the breakers to expedite lighterage has been in use from 1931. This gives Abidjan wharf facilities equivalent to the original port of the vicinity—Grand Bassam, a typical *comptoir* set up about 1850 on the bar 22 mi. east, where the Comoé river brings down timber, an early and still important product. In 1934 the capital of Ivory Coast colony was moved to Abidjan from Bingerville (on the mainland 9 mi. east), the remaining European station of the district. Combined advantages have promoted Abidjan's growth, partly at the expense of its neighbours. There remains at Bingerville an agricultural station, and at Grand Bassam the superior law court, besides some port business and the squaring of logs for export. World War II halted a project to cut the bar and build jetties immediately west of the Bottomless Pit, to permit ocean shipping to berth at Abidjan, where the lagoon is 45 ft. deep.

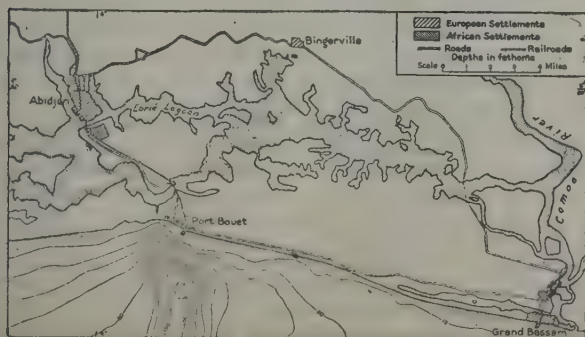
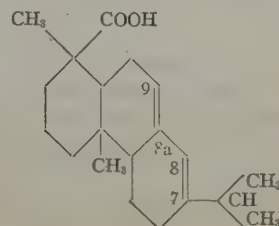
The town plat covers the full width of its peninsular site, with government buildings and the commercial centre adjacent to the proposed port at the tip. Residences and miscellaneous services scatter on either side of the central thoroughfare, which leads to the main highway north. City lots ranged in blocks take the place of the traditional African compounds. Two residential suburbs for Africans are separated from the European town, one by the lagoon, the other by a wooded tract. All sections are serviced with electricity, and with water pumped from municipal wells sunk 60–80 ft. into a sandy substratum adequate for all presumptive needs. There are semiofficial chambers of commerce and agriculture, and a government hospital. Motor roads reach the near-by settlements, and two motorable routes penetrate the colony as part of the intercolonial highway system. (D. Wix.)

ABIETIC ACID. The term abietic acid has been used indiscriminately to describe a number of resin-acid mixtures and, in some cases, purified naturally-occurring rosin. Abietic acid actually is a pure chemical compound with molecular formula $C_{20}H_{30}O_2$; it is a representative of the naturally-occurring resin acids with the same formula. These latter, in turn, are the major constituents of gum oleoresin, the exudate that flows from the trunks of conifers upon systematic scarification, and of the rosin (colophony) that is solvent-extracted from the aged stumps of pine trees. The name abietic acid was derived from the species of French pine, *Pinus abies*, from which the acid was first isolated (F. Schulz) in 1917. In the United States, however, the long leaf (*Pinus palustris*) and slash pines (*Pinus caribaea*) are the chief sources of rosin in which 30%–40% abietic acid is present.

The pure acid crystallizes from methanol, upon the addition of water, as triangular plates in the monoclinic system with a melting point of 171°–175° C., and an optical rotation of $[\alpha]_D^{24} -106^\circ$

(of a 1% solution in absolute ethanol). It exhibits its most intense absorption band in the ultra-violet region at 241 m μ wave length. In characterizing resin acids, only the last two properties, optical rotation and ultra-violet absorption are used since the melting points of these substances are not indicative of degree of purity. The acid is soluble in all common organic solvents.

Abietic acid was shown (L. Ruzicka) to be a carboxylic acid derivative of trimethylisopropylhydrophenanthrene, which has the molecular formula $C_{20}H_{32}$. Absorption in the ultra-violet region at 241 m μ indicated the presence of a system of double bonds conjugated between two rings. Their positions were eventually proved (Louis F. Fieser, William P. Campbell, L. Ruzicka) to be those shown in the following formula.



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Upon treatment of abietic acid with strong acids, an equilibrium mixture of isomeric acids is formed which contains approximately 85% of the original acid. If the free acid is heated at high temperatures, a similar effect is observed, although the final equilibrium achieved by this process does not have the same composition as that prepared by acid isomerization. Because of this tendency of abietic acid for isomerization and its tendency to undergo air oxidation, it must be kept out of contact with strong acids and air during reactions and while being held in storage.

The pure acid is isolated from rosin in the following manner: the rosin is first isomerized with mineral acid to increase the abietic acid content from 35% to 50%. An acetone solution of the isomerized rosin is treated with diamylamine to obtain the crystalline, insoluble salt of abietic acid which is recrystallized to the optimum rotation, $[\alpha]_D^{24} - 60^\circ$, and the pure acid with rotation

$[\alpha]_D^{24} - 106^\circ$, isolated by decomposition of the salt with boric acid.

For determining the purity of a sample or the amount of abietic acid in a mixture, the ultra-violet absorption characteristics of the sample are compared with those of a pure reference sample.

Rosin, which contains 30%–40% of abietic acid, is composed of 90% of similarly constituted resin acids. It is one of the least expensive sources of organic acids available in large quantities and hence is used extensively to produce many commercial products of which the following are examples: the sodium soap of rosin and modified rosins find use in three large industries, in synthetic rubber production as an emulsifying agent, in paper-making for sizing and in soap manufacture. The heavy metal salts, prepared from the sodium salts, are used as driers for paints and varnishes, as hardening agents for rosin and as antifouling agents in paints. Monohydric and polyhydric alcohol esters of rosin are used extensively in the paint and varnish industry. Valuable resins with outstanding properties of light resistance and compatibility have been prepared by the addition of maleic anhydride to rosin followed by esterification with monohydric or polyhydric alcohols. Decarboxylated rosin, known as rosin oil, is used extensively in greases, rubber reclaiming, foundry core compounds, linoleums and shoe polishes.

(G. C. HA.)

ABIGAIL (Heb. *Abigail*, perhaps "father is joy"), or **ABIGAL** (II Sam. iii, 3), in the Bible, the wife of Nabal the Carmelite of southern Judah, on whose death she became one of the earlier wives of David (I Sam. xxv). By her David had a son, whose name appears in the Hebrew of II Sam. iii, 3 as Chileab, in the Septuagint as Daluyah and in I Chron. iii, 1 as Daniel. The name Abigail was also borne by a sister of David's (II Sam. xvii, 25; I Chron. ii, 16 f.). From the former (self-styled "handmaid" I Sam. xxv, 25 f.) is derived the 16th and 17th century colloquial use of the term for a waiting woman (cf. Abigail, the "waiting gentlewoman," in Francis Beaumont and John Fletcher's *The Scornful Lady*).

ABIJAH (Heb. *Abiyyah* and *Abiyyahu*, "Yah is father"), a name borne by nine different persons mentioned in the Old Testament, of whom the most noteworthy are the following. (1) The son and successor of Rehoboam, king of Judah (II Chron. xii, 16; xiii), reigned about two years (918–915 B.C.). The accounts of him in the books of Kings and Chronicles are very conflicting (compare I Kings xv, 2 and II Chron. xi, 20 with II Chron. xiii, 2). The Chronicler tells us that he has drawn his facts from the Midrash (commentary) of the prophet Iddo. This is perhaps sufficient to explain the character of the narrative. (2) The second son of Samuel (I Sam. viii, 2; I Chron. vi, 28 [13]). He and his brother Joel judged at Beersheba. Their misconduct was made by the elders of Israel a pretext for demanding a king (I Sam. viii, 4). (3) A son of Jeroboam I, king of Israel; he died young (I Kings xiv, 1 ff., 17). (4) Head of the eighth order of priests (I Chron. xxiv, 10), the order to which Zacharias, the father of John the Baptist, belonged (Luke i, 5).

The alternative form **ABIJAM** is probably a mistake, though it was upheld by M. Jastrow.

ABILA, (1) generally called Abila of Pausanias to distinguish it from (2) below. It was the capital of the tetrarchy of

Abilene in ancient Syria and an important town on the road between Damascus and Baalbek (Heliopolis). Ruins and inscriptions at the modern village of Sûq Wādî Baradâ mark its site, which, though the names have no connection, is one of the traditional burial places of Abel. Early Arab geographers called it Abil Al Sûq. According to Josephus, Abilene was a separate Iturean kingdom till A.D. 37, when Caligula granted it to Agrippa I; in 52 Claudius granted it to Agrippa II. (See also *LYSANIAS*.) (2) A city of Perea (modern north Jordan) represented by ruins of Abil Al Zait.

ABILDGAARD, NIKOLAJ ABRAHAM (1744–1809), Danish painter, was born at Copenhagen, the son of Sören Abildgaard, an antiquarian draughtsman of repute. He formed his style on that of Claude Lorrain and of Nicolas Poussin, and was a cold theorist, inspired not by nature but by art. As a technical painter he attained remarkable success, his tone being very harmonious and even, but the effect, to a foreigner's eye, was rarely considered to be interesting.

His works were scarcely known outside of Copenhagen, where he won an immense fame in his own generation. He was the founder of the Danish school of painting, and the master of Bertel Thorvaldsen and Kristoffer Eckersberg.

ABILENE, a city of Kansas, U.S., on the Smoky Hill river, about 95 mi. W. of Topeka; the county seat of Dickinson county. It is on federal highway 40, and is served by the Union Pacific, the Rock Island and the Santa Fe railways. The population was 5,580 in 1950, and 5,671 in 1940 by the federal census. In the 1860s Abilene, at the end of the trail from the southwest, was one of the important centres for shipping cattle. It has a large trade in cattle, grain and poultry, and is headquarters of the store company serving variety stores in Kansas and Colorado. Its creamery has an annual output valued at \$2,000,000. Flour mills and bottling works for medicinal mineral water are also important. Abilene was settled about 1860; incorporated in 1869; and adopted the commission-manager form of government in 1939. The boyhood home of Gen. Dwight D. Eisenhower is open to the public.

ABILENE, a city of Texas, U.S., about 150 mi. W. by S. of Fort Worth, at an altitude of 1,738 ft., almost at the geographical centre of the state; the county seat of Taylor county. It is on federal highways 80 and 83, and is served by the Texas and Pacific, the Abilene and Southern and the Wichita Valley railways and by seven motor-stage lines and Pioneer Air Lines. Between 1900 and 1920 the population increased threefold, from 3,411 to 10,274; in 1940 it was 26,612; in 1950, 47,102.

Abilene is the distributing centre for a fine farming and stock-raising district. Around it are many producing petroleum pools. It has numerous wholesale concerns, and is headquarters for many oil companies and oil-well supply firms.

Natural gas is abundant. Cottonseed and peanut products, feeds, pressed brick, dairy products, clothing, oil-field equipment, candy and watches are manufactured. The assessed valuation of property in 1950 was \$56,000,000. The West Texas fair is held there. Abilene is the seat of Hendrick Memorial hospital and St. Ann hospital. There are three denominational institutions of higher learning: McMurry college (Methodist), Abilene Christian college (Church of Christ) and Hardin-Simmons university (Baptist). The city has a council-manager form of government. Its site was determined by the route of the Texas and Pacific railway. When it was extended through that region, new towns sprang up as sections were completed; and at milepost 407, on March 16, 1881, the first sale of building lots was held for the city of Abilene.

ABILITIES, GENERAL AND SPECIAL. These (together with personality traits, attitudes and interests) constitute the principal subject matter of "differential psychology," which deals with individual differences in these mental functions, their nature, origin, determining conditions, development, measurement, interrelations and distribution. C. Spearman wrote in earlier editions of the *Encyclopædia Britannica*, "The now common term 'general ability' in its current signification is of recent origin. Previously it appears to have had only occasional usage in ordinary writing and conversation, being there taken to characterize excellence in performances of several different kinds; especially when

these were not all readily subsumable under the name of 'intelligence.' Recognition by psychologists and educators of different kinds and degrees of generality and specificity among abilities has gone forward along with the multiplication and refinement of psychological tests and with attempts to define the nature of the tested abilities more accurately, by methods of factor analysis and validation studies. (See DIFFERENTIAL PSYCHOLOGY; INTELLIGENCE; PSYCHOLOGICAL TESTS.) (F. A. K.)

ABIMELECH (Hebrew for "father of [or is] the king"), the name of two well-known characters in the Old Testament. (1) A king of Gerar in South Palestine with whom Isaac had relations. The patriarch, during his sojourn there, alleged that his wife, Rebekah, was his sister; but the king, doubting this, remonstrated with him and pointed out how easily adultery might have been unintentionally committed (Gen. xxvi). Abimelech is called "king of the Philistines," but the title is clearly an anachronism. A very similar story is told of Abraham and Sarah (ch. xx), but here Abimelech takes Sarah to wife, although he is warned by a divine vision before the crime is actually committed. The incident is fuller and shows a great advance in ideas of morality. Of a more primitive character, however, is another parallel story of Abraham at the court of Pharaoh, king of Egypt (xii, 10-20), where Sarah, Abraham's wife, is taken into the royal household, and the plagues sent by Yahweh lead to the discovery of the truth.

Further incidents in Isaac's life at Gerar are narrated in Gen. xxvi (cf. xxi, 22-34, time of Abraham), notably a covenant with Abimelech at Beersheba (whence the name is explained "well of the oath"). By a pure error, or perhaps through a confusion in the traditions, Achish the Philistine (of Gath, I Samuel xxi; xxvii), to whom David fled, is called Abimelech in the superscription to Psalm xxiv.

(2) A son of Jerubbaal or Gideon (q.v.), by his Shechemite concubine (Judges viii, 31; ix.). On the death of Gideon, Abimelech set himself to assert the authority which his father had earned, and through the influence of his mother's clan won over the citizens of Shechem. Furnished with money from the treasury of the temple of Baal-berith, he hired a band of followers and slew 70 (cf. II Kings x, 7) of his brethren at Ophrah, his father's home. This is one of the earliest recorded instances of a practice common enough on the accession of oriental despots. Abimelech thus became king, and extended his authority over central Palestine. But his success was short-lived, and the subsequent discord between Abimelech and the Shechemites was regarded as a just reward for his atrocious massacre. Jotham, the only one who is said to have escaped, boldly appeared on Mount Gerizim and denounced the ingratitude of the townsmen toward the legitimate sons of the man who had saved them from Midian. "Jotham's fable" of the trees who desired a king may be foreign to the context; it is a piece of popular lore, and cannot be pressed too far: the nobler trees have no wish to rule over others, only the bramble is self-confident. The "fable" appears to be antagonistic to ideas of monarchy. The origin of the conflicts which subsequently arose is not clear. Gaal, a newcomer, took the opportunity at the time of the vintage, when there was a festival in the temple, to head a revolt and seized Shechem. Abimelech, warned by his deputy Zebul, left his residence at Arumah and approached the city. In a fine bit of realism we are told how Gaal observed the approaching foe and was told by Zebul, "Thou seest the shadow of the mountains as if they were men," and as they drew nearer Zebul's ironical remark became a taunt, "Where is now thy mouth wherewith thou saidst, who is Abimelech, that we should serve him? Is not this the people that thou hadst despised? Go out, I pray now, and fight with them." This revolt, which Abimelech successfully quelled, appears to be only an isolated episode. Another account tells of marauding bands of Shechemites which disturbed the district. The king disposed his men (the whole chapter is specially interesting for the full details it gives of the nature of ancient military operations), and after totally destroying Shechem, proceeded against Thebez, which had also revolted. There, while storming the citadel, he was struck on the head by a fragment of a millstone thrown from the wall by a woman. To avoid the disgrace of perishing by a woman's hand, he begged his armour-bearer

to run him through the body, but his memory was not saved from the ignominy he dreaded (II Sam. xi, 21). It is usual to regard Abimelech's reign as the first attempt to establish a monarchy in Israel, but the story is mainly that of the rivalries of a half-developed petty state, and of the ingratitude of a community toward the descendants of its deliverer.

ABINGDON, municipal borough, Berkshire, lying in the flat Thames valley on the Oxford border, where the small river Ock, draining the Vale of White Horse, joins the Thames. Pop. (1938) 7,989. Abingdon (Abbedun, Abendun) was famous for its abbey, which was of great wealth and importance, and is believed to have been founded in A.D. 675 by Cissa, one of the *subreguli* of Centwin. Abundant charters from early Saxon monarchs are extant confirming various laws and privileges to the abbey, and the earliest of these, from King Ceadwalla, was granted before A.D. 688. In the reign of Alfred the abbey was destroyed by the Danes, but it was restored by Edred, and an imposing list of possessions in the Domesday survey evidences recovered prosperity. William the Conqueror in 1084 celebrated Easter at Abingdon, and left his son, afterward Henry I, to be educated at the abbey. After the dissolution in 1538, the town sank into decay, and in 1555, on a representation of its pitiable condition, Queen Mary granted a charter establishing it as a free borough corporate with a common council. The council was empowered to elect one Burgess to parliament, and this right continued until the Redistribution of Seats act of 1885. The abbot seems to have held a market from very early times, and charters for the holding of markets and fairs were granted by various sovereigns from Edward I to George II. In the 13th and 14th centuries Abingdon was a flourishing agricultural centre with an extensive trade in wool, and a famous weaving and clothing manufacture. The latter industry declined before the reign of Queen Mary, but has since been revived.

Remains of the Benedictine abbey include a beautiful Perpendicular gateway, ruins of buildings called the prior's house, and the guest house. The narrow arched bridge over the Thames dates from 1416, and was doubtless an important feature in the town's growth. Near the bridge is St. Helen's church, the fine Early English tower and Perpendicular spire of which are the principal objects in the views of the town from the river. There may be mentioned further the old buildings of the grammar school (1563) and of the charity called Christ's Hospital (1583) and the town hall, attributed to Inigo Jones.

A popular Thames-side holiday resort, Abingdon also has manufactures of clothing and carpets and a large agricultural trade. The borough is under a mayor, 4 aldermen and 12 councillors. Area 2.6 sq.mi.

For purposes of parliamentary representation Abingdon is included in the Abingdon county division.

ABINGER, JAMES SCARLETT, 1ST BARON (1769-1844), English judge, was born on Dec. 13, 1769, in Jamaica, where his father, Robert Scarlett, had property. In the summer of 1785 he was sent to England to complete his education, and went to Trinity college, Cambridge, taking his B.A. degree in 1789. Having entered the Inner Temple, he was called to the bar in 1791, and joined the northern circuit and the Lancashire sessions. Though he had no professional connections, by steady application he gradually obtained a large practice, ultimately confining himself to the Court of King's Bench and the northern circuit. He took silk in 1816, and from this time till the close of 1834 he was the most successful lawyer at the bar; he was particularly effective before a jury, and his income reached the high-water mark of £18,500, a large sum for that period. He began life as a Whig, and first entered parliament in 1819 as member for Peterborough, representing that constituency with a short break (1822-23) until 1830, when he was elected for the borough of Malton. He became attorney general, and was knighted when George Canning formed his ministry in 1827; and though he resigned when the duke of Wellington came into power in 1828, he resumed office in 1829 and went out with the duke of Wellington in 1830. His opposition to the Reform bill caused his severance from the Whig leaders and, having joined the Tories, he was elected, first for Colchester and

then in 1832 for Norwich, for which borough he sat until the dissolution of parliament. Appointed lord chief baron of the exchequer in 1834, he presided in that court for more than nine years.

While attending the Norfolk circuit on April 2, he was suddenly seized with apoplexy, and died in his lodgings at Bury St. Edmunds on April 7, 1844. He had been raised to the peerage as Baron Abinger in 1835, taking his title from the Surrey estate he had bought in 1813.

The qualities which brought him success at the bar were not equally in place on the bench; he was partial, dictatorial and vain; and complaint was made of his domineering attitude toward juries. But his acuteness of mind and clearness of expression remained to the end. Lord Abinger was twice married (the second time only six months before his death), and by his first wife (d. 1829) had three sons and two daughters, the title passing to his eldest son, Robert (1794–1861). His second son was Gen. Sir James Yorke Scarlett (*q.v.*), leader of the heavy cavalry charge at Balaclava; his elder daughter, Mary, married John, Baron Campbell, and was herself created Baroness Stratheden (Lady Stratheden and Campbell) (d. 1860). Sir Philip Anglin Scarlett (d. 1831), Lord Abinger's younger brother, was chief justice of Jamaica.

See P. Q. Scarlett, *Memoir of James, 1st Lord Abinger* (1877); Foss, *Lives of the Judges*; E. Manson, *Builders of our Law* (1904).

ABINGTON, FRANCES (1737–1815), English actress, was the daughter of a private soldier named Barton, and was, at first, a flower girl and a street singer. She then became servant to a French milliner, obtaining a taste in dress and a knowledge of French which afterward stood her in good stead. Her first appearance on the stage was at the Haymarket in 1755 as Miranda in Susanna Centlivre's *The Busy Body*. In 1756, on the recommendation of Samuel Foote, she became a member of the Drury Lane company, where she was overshadowed by Hannah Pritchard and Kitty Clive. In 1759, after an unhappy marriage with her music-master, one of the royal trumpeters, she is mentioned in the bills as Mrs. Abington.

Her first remarkable success was in Ireland as Lady Townley, and it was only after five years, on the pressing invitation of David Garrick, that she returned to Drury Lane. There she remained for 18 years, and created more than 30 important characters, notably Lady Teazle (1777). Her Beatrice, Portia, Desdemona and Ophelia were no less liked than her Miss Hoyden, Biddy Tipkin, Lucy Lockit and Miss Prue.

It was in the last character in *Love for Love* that Sir Joshua Reynolds painted his best portrait of her.

In 1782 she left Drury Lane for Covent Garden. After an absence from the stage from 1790 until 1797, she reappeared, quitting it finally in 1799. Her ambition, personal wit and cleverness won her a distinguished position in society, in spite of her humble origin. Women of fashion copied her frocks, and a head-dress she wore was widely adopted and known as the "Abington cap." She died on March 4, 1815.

ABINGTON, a town of Plymouth county, Mass., U.S.A., 19 mi. S. by E. of Boston. It is served by the New York, New Haven and Hartford railroad. The population was 7,133 in 1950 and 5,708 in 1940 by the federal census. Farming, fruit growing (especially strawberries), and dairying are carried on. The principal manufactures are boots and shoes, lasts, cement blocks, window-shades and machinery. The town was settled about 1680 and incorporated in 1712.

ABINGTON, a township of Montgomery county in eastern Pennsylvania, with an altitude of 300 ft. It is about 5 mi. N. of Philadelphia, of which it is a suburb, and is on U.S. highway 611. Population was 28,738 in 1950, and 20,857 by the census of 1940.

It was founded in 1714, the same year in which the Abington Presbyterian church was founded. It is ruled by a mayor-council form of government, with councilmen chosen in partisan elections and the mayor selected by the governing body. The town's sewage treatment plant is publicly owned. Abington is a banking town and has its own post office and hospital. The Abington Memorial hospital was established in 1914 and is a general, short-term hospital operated as a nonprofit corporation and accredited by the American College of Surgeons.

ABIOGENESIS, in biology, the term, equivalent to the older terms "spontaneous generation," *Generatio aequivoca*, *Generatio primaria*, and more recent terms such as archeogenesis and archeobiosis, for the theory according to which fully formed living organisms sometimes arise from non-living matter. Aristotle explicitly taught abiogenesis, and laid it down as an observed fact that some animals spring from putrid matter, that plant-lice arise from the dew falling on plants, etc., and most of the earlier biologists accepted his views. The first step in the scientific refutation of the theory of abiogenesis was taken by the Italian Redi, who, in 1668, proved that no maggots were "bred" in meat on which flies were prevented by wire screens from laying their eggs. From the 17th century onwards it was gradually shown that, at least in the case of all the higher and readily visible organisms, abiogenesis did not occur, but that *omne vivum e vivo*, every living thing came from a pre-existing living thing.

The discovery of the microscope carried the refutation further. In 1683 A. van Leeuwenhoek discovered bacteria, and it was soon found that however carefully organic matter might be protected by screens, or by being placed in stoppered receptacles, putrefaction set in, and was invariably accompanied by the appearance of myriads of bacteria and other low organisms. As knowledge of microscopic forms of life increased, so the apparent possibilities of abiogenesis increased, and it became a tempting hypothesis that whilst the higher forms of life arose only by generation from their kind, there was a perpetual abiogenetic fount by which the first steps in the evolution of living organisms continued to arise, under suitable conditions, from inorganic matter. It was due chiefly to L. Pasteur that the occurrence of abiogenesis in the microscopic world was disproved. If organic matter were first sterilized and then prevented from contamination from without, putrefaction did not occur, and the matter remained free from microbes. The nature of sterilization, and the difficulties in securing it, as well as the extreme delicacy of the manipulations necessary, made it possible for a very long time to be doubtful as to the application of the phrase *omne vivum e vivo* to the microscopic world, and there still remain a few belated supporters of abiogenesis. It may now be stated definitely that all known living organisms arise only from pre-existing living organisms. It must be noted, however, that this statement relates only to known existing organisms. It may be that in the progress of science it may yet become possible to construct living protoplasm from non-living material. The refutation of abiogenesis has no further bearing on this possibility than to make it probable that if protoplasm ultimately be formed in the laboratory, it will be by a series of stages, the earlier steps being the formation of some substance, or substances, now unknown, which are not protoplasm. Such intermediate stages may have existed in the past, and the modern refutation of abiogenesis has no application to the possibility of these having been formed from inorganic matters at some past time. Perhaps the words archeobiosis, or archeogenesis, should be reserved for the theory that protoplasm in the remote past has developed from non-living matter by a series of steps, and many of those, notably T. H. Huxley, who took a large share in the process of refuting contemporary abiogenesis, have stated their belief in a primordial archeobiosis. (See BIOGENESIS; BIOLOGY.)

ABIPONES, a tribe of South American Indians belonging to the Guaycuruan (*q.v.*) linguistic stock. The Abipones were a warlike, nomad hunting people, living in the Argentine Chaco, between the Vermejo and Salado rivers. Although once numerous, they are now believed to be quite extinct. Both men and women wore mantles of coarse textiles, belted at the waist; the women were abundantly tattooed, the men but slightly. The latter wore long, pendant labrets. Their dwellings were tents of mats. Spears, bows, clubs, slings and bolas were their weapons. They had no shield, but used a poncho of heavy hide for protection. They made no use of canoes, having only "bull-boats" of hide stretched over a bowl-shaped frame, for crossing broad streams. Pottery was made. The people were divided into local social units, over which a semi-hereditary chief presided, although he had little power. The bodies of the dead were buried, unless death occurred far from home, when the flesh was stripped from the bones, and

these placed in a leather sack. This was carried with the roving group, until they reached their home, where it was buried. The property and tent of the deceased were burned. Little is known of their religious beliefs and ceremonial. They possessed, however, some sort of secret societies, membership in which was attained by valour, and which celebrated ceremonials of importance.

The Abipones became widely known from the account of them written by the missionary Dobrizhoffer, at the end of the 18th century, after they had become horse Indians.

See M. Dobrizhoffer, *An Account of the Abipones*, etc. (1822).

ABITIBI, lake and river, Ontario, Canada. The lake, 49° N. 80° W., 60 mi. long, is shallow and studded with islands; the shores are covered with small timber. The Hudson's Bay Co. used it on a canoe route to the northern fur lands. The Grand Trunk Pacific (now the Canadian National) railway passes through this district. Its outlet is the rapid Abitibi river, which after 200 mi. joins the Moose river.

ABJURATION, a solemn repudiation or renunciation on oath. At common law, it signified the oath of a person who had taken sanctuary to leave the realm forever; this was abolished in the reign of James I. The *Oath of Abjuration*, in English history, was a solemn disclaimer, taken by members of parliament, clergy and laymen against the right of the Stuarts to the crown, imposed by laws of William III, George I and George III; but its place has since been taken by the Oath of Allegiance.

ABKHAZIA (ABKHASIA) (Georgian *Apkhazeti*, Abkhaz *Ap̄sne*) A.S.S.R. under protection of Georgian S.S.R. comprising six districts of the former Sukhum province. Area 3,155 sq.mi. Pop. (1939) 259,100. Its boundaries are, on the N., the North Caucasian area and Karachay autonomous area; on the S. and E., the Georgian S.S.R.; on the W., the Black sea. It is divided into the following districts for administrative purposes, population in parentheses: Gagrinsk (9,950; urban 3,659, rural 6,291), Galsk (50,071, entirely rural), Gydatsk (30,740; urban 3,536, rural 27,204), Kodorsk (33,043; urban 3,390, rural 29,653) and Sukhum (75,371; urban 20,032, rural 55,339). The area is mainly mountainous and densely forested (especially oak and walnut). The Black sea coastal belt from Sukhum-Kaleh southwards is an evergreen vegetation area with citrus fruits (oranges, mandarins, lemons), camellias and even palms. It has hot, sunny summers and winter rains of the western coast Mediterranean type, but in winter low-pressure systems form on the Black sea, with south and southeast winds bringing rain. Average temperature at Sukhum-Kaleh is in January 48.8° F., August 76.1° F. Oranges ripen in December and spring begins in February. The area is never frozen, and snow rarely falls and never lies; malaria is a perpetual scourge. The chief products are tobacco and maize, with wheat, grapes, figs, pomegranates, citrus fruits and wine (vines hang from walnut trees). Tea and mulberries (for silk) are produced. On higher land, cattle and horses are bred and bees kept. The chief town is Sukhum-Kaleh on the Black sea coast (site of ancient Greek Dioskuriass). Pop. 28,136. The town is noted for manufacture of saddlery. Other coastal towns are Pitsunda and Ochenchiri. There is a coastal railway. There are extensive coal deposits, practically unworked. Abkhazia, a former Georgian principality, was the home of the Abkhaz (Aphkaz) tribe (in Abkhaz *Ap̄sua*, in Greek *Abasgoi*). A part of the Roman empire, it became Christian under Justinian (c. 550). In the 8th century, Leo, duke (*Eristavi*) of the Abasgi conquered western Georgia or Lazica and set up the mediaeval kingdom of Abasgia, independent of the Byzantine empire and later a part of the Georgian state (see GEORGIA). The duchy of Abkhazia itself became by 1184 a fief of the house of Sharvashidze, under which it acquired, after 1463, its independence from the Georgian crown. Ottoman suzerainty was imposed on Abkhazia in the 16th century and Mohammedanism supplanted Christianity. In 1810, George I Sharvashidze, prince of Abkhazia signed a treaty of protectorate with Russia. In 1840 the principality of Samurzaqano, under a branch of the Sharvashidzes, was annexed by Russia; and in 1864 Russia annexed Abkhazia itself. The country proclaimed its autonomy in 1919, and became an A.S.S.R. in 1921. The people are of Circassian stock, whose language belongs to the Abkhazo-Adigean group of the North Caucasian branch of the Japhetite languages. There are both tall and fair groups, and short, dark groups, with Tatar intermixture.

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ABLATION, the process of removing anything; a term used technically in geology of the wearing away of a rock or glacier by weathering agents, and in surgery for operative removal.

ABLATIVE, in grammar, a case of the noun, the fundamental sense of which is direction from; in Latin extended to the instrument or agent of an act, and the place or time at, and manner in, which a thing is done; also found in Sanskrit, Zend,

Oscan, Umbrian and other languages. (Lat. *ablativus*, sc. *casus*, from *ablatus*, taken away.) The "ablative absolute," in Latin, consists of a noun in the ablative case, with a participle or qualifying word agreeing with it, not depending on any other part of the sentence, to express the time, occasion or circumstance of a fact.

ABLUTION, a ritual washing destined to secure that ceremonial purity which must not be confused with the physical cleanliness obtained by the use of soap and water. (Lat. *ablutio*, from *abluere*, "to wash off.") Indeed the two states may conflict, as with the 4th century pilgrim who boasted that she had not washed her face for 18 years for fear of removing the baptismal chrism. In the Catholic Church the *ablution* is the ritual washing of the chalice and of the priest's fingers after celebrating mass; or the wine and water used for this purpose. The purport of ablutions is to remove the supposed stains contracted by contact with the dead, with childbirth, menstuous women, murder, almost any form of bloodshed, persons of inferior caste, dead animal refuse, leprosy, madness and disease. In general, water, cows' urine and blood of swine are the materials used in ablutions. Of these water is the commonest, and its efficacy is enhanced if it be running, and still more if a magical or sacramental virtue has been imparted to it by ritual blessing or consecration. In the *Atharva-Veda*, vii. 116, a remedy for fever is to tie to the foot of the bed a frog, bound with red and black thread, and wash down the patient so that the water of ablution falls on the frog, the magician praying that the fever may pass into the frog, which is forthwith released. In the old Athenian Anthesteria the blood of victims was poured over the unclean. A bath of bulls' blood was used as a baptism in the mysteries of Attis. The water must in ritual washings run off in order to carry away the miasma or unseen demon of disease; so the early Christians used living or running water, which the baptizer must pour over the head of the baptized person so that it runs down his body. Similarly the Brahman takes care to wipe the cathartic water off from head to feet downwards, that the malign influence may pass out through the feet. The same care is shown in ritual ablutions in the Bukovina and elsewhere.

Water, fire, spices and sulphur are used in ritual cleansings (Iamblichus on Mysteries, v. 23), as being specially full of the divine nature. But in all religions the cathartic virtue of water is enhanced by means of suitable prayers and incantations. Ablutions are usually cathartic, that is, intended to purge away evil influences (*καθαίρειν*, to make *καθαρός*, pure). But things and persons may become taboo, that is, so holy as to be dangerous and useless for daily life, through the mere infection of holiness. Thus in Syria one who touched a dove became taboo for one whole day, and if a drop of blood of the Hebrew sin-offering fell on a garment it had to be ritually washed off. It was as necessary for the Hebrew priest to wash his hands *after* handling the sacred volume as before. Christians might not enter a church to pray without first washing their hands. Tertullian (c. 200) condemned this as a heathen custom; but it was insisted on in later ages (Sozomen, vi. 6) and is a survival of the pagan lustrations or *περιπαρήρεια*. The same custom prevails among Mohammedans. Porphyry (*de Abst.* ii. 44) relates that one who touched a sacrifice meant to avert divine anger must bathe and wash his clothes in running water before returning to his city and home, and similar scruples in regard to holy objects and persons have been observed among the natives of Polynesia, New Zealand and ancient Egypt.

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ABNAKI, a group of closely related and confederate Algonkin Indian tribes originally centring in Maine, now mainly in Quebec and New Brunswick. The name means "east land." They included the Etchimin, Malecite, Passamaquoddy and Penobscot, often reckoned as distinct tribes. They fought the English colo-

nists, were friendly with the French, and in the 18th century most of the bands withdrew to French Canadian soil. They grew maize, hunted and fished, lived in conical houses of bark or mats, palisaded their villages, were divided into patrilineal totemic clans and were typical northern woodland tribes. Their speech is close to the Algonkin dialects of the Great Lakes. About 2,000 survive.

ABNER. In the Old Testament, Saul's cousin and commander in chief, comes into prominence only after the crushing defeat of Israel at Mt. Gilboa. This battle placed the Philistines in control of the whole of central Palestine, and the weakness of Israel was enhanced by the division into two parties, that of the south, which followed David, and that of Trans-Jordan, which remained faithful to Ishbaal, the son who succeeded Saul. The king himself, however, was a weak character, and the whole strength of the party was concentrated in Abner. The struggle between the two parties was continuous, and in the battle of Gibeon Abner killed Asahel, brother of Joab, thus exposing himself to the blood-vengeance of the dead man's whole family. It seems that Abner aspired to become the sole leader of his party and, as a step in the achievement of his aim, married Rizpah, one of the concubines of Saul. For this he was reproved by Ishbaal, and thereupon deserted to the opposite party. An agreement was made between David and Abner, by which David had restored to him Michal, daughter of Saul, thus establishing a claim on Saul's throne, and Abner was received into favour. Joab, however, in obedience to the binding law of blood-revenge, took an opportunity of putting Abner to death, and his disappearance practically brought to an end the resistance of the eastern party. David, of course, was not implicated in Abner's death, though he had no right to punish the assassin, and his short dirge over the body, like that over Saul and Jonathan, is an exquisite specimen of the early poetry of Israel. (See II Sam., ii, 8; iii, 39.)

ABNEY, SIR WILLIAM DE WIVELESIE (1843-1920), English chemist, was born at Derby, July 24, 1843, and died at Folkestone on Dec. 3, 1920. Abney held high appointments at the board of education and was president at different times of the Royal Astronomical society and the Physical society. His contribution to science was mainly in the furtherance of photographic chemistry and especially of colour photography and colour printing. His publications on these subjects include *Instruction in Photography* (1870), *Colour Vision, Colour Measurement and Mixture* (1893) and *Trichromatic Theory of Colour* (1914). He also wrote *Thebes and Its Five Great Temples* (1876) and, with C. D. Cunningham, *The Pioneers of the Alps* (1888).

ABNORMALITIES AND DEFORMITIES: see MONSTERS.

ABNORMAL PSYCHOLOGY. Psychology is the study of behaviour, and abnormal psychology is the study of deviations from normal behaviour. This definition at once raises the fundamental question: what do we mean by normal, and how are we to recognize deviations from it? The average naïve person tends to consider himself as the measure of normality, and to regard as signs of abnormality all attitudes and responses in other persons that differ markedly from his own. Such a criterion, however reasonable it may seem to the individual employing it, has actually no value as a general principle. For one thing, it begins by assuming that each person is the sole judge of his own conduct, and for another, it implies that everyone is at all times normal.

An alternative to the naïve, individualistic approach is obviously that of judging each person's conduct in relation to the conduct of others in his culture who are of the same sex and belong to a similar age group. To carry out this procedure we should have, ideally, a system of well-defined, established norms with which any given behaviour sample might then be compared, and its conformity with or deviation from them determined. There are, however, formidable obstacles to the construction and use of rigidly specified behaviour norms. The most serious of these are: (1) the heterogeneous composition of our contemporary industrial society, (2) the greatly increased mobility of individuals and groups, which inevitably increases the incidence

of cultural conflict and (3) the relatively rapid changes in accepted standards of behaviour which have appeared within the past few generations.

These difficulties, and the existing limitations in available data and techniques in abnormal psychology, compel us for the time being to work with rough approximations, and to let the evolution of stricter definition wait upon the outcome of further exact investigation and controlled experiment. From this standpoint, the most useful criterion of normality we have is that of the relative adequacy of an individual's performance, in comparison with the behaviour to be expected of other persons sharing his status in his society. Such a criterion begins, not with the fiction of the perfect or ideal personality, but with the fact of a relatively wide range of culturally acceptable behaviour. It permits us to include as normal the many trivial oddities and irregularities, the little unexpected and unpredicted developments that can be found in the everyday reactions of ordinary persons.

Relationship between Normal and Abnormal.—From ancient times down to the present there have been two diametrically opposed views with regard to this important problem. According to one, there is a clean break, a chasm, between normal and abnormal. The normal person, it is contended, cannot possibly put himself in the place of abnormal persons and see things from their perspectives. According to the other view, there is unbroken continuity between normal and abnormal (principle of continuity). That is, the normal shades imperceptibly into the abnormal, and both share a borderland in which normality and abnormality cannot with certainty be distinguished.

The absolutist tradition, which sharply divides abnormal from normal behaviour, finds popular expression in such statements as that a person is out of his head, has lost his reason or his mind, and therefore needs an alienist; i.e., a specialist who deals with the mentally estranged. Most 19th-century alienists and nerve specialists, the predecessors of modern psychiatrists, accepted this hypothesis of discontinuity as fact. They tried to give substance to their speculations by postulating hypothetical brain and nerve changes in their patients to parallel the behaviour deviations which they observed. Early in the 20th century it was demonstrated conclusively that general paresis is the result of a specific brain infection. This raised the hope among absolutists that some day all neuroses and psychoses might prove to be no more than diseases of the brain. Their hope during the intervening four decades failed to materialize. Indeed, as data have accumulated concerning general paresis itself, the conclusion has been reached in recent years that whatever behaviour disorder develops in general paresis depends for its character, not upon the specific infection, but upon the preparatory personality traits of the individual patient.

The relativist tradition, which maintains that there is continuity between normal and abnormal behaviour, did not become dominant in behaviour pathology until the 20th century. The position of the relativists was greatly strengthened by the growing realization, late in the 18th century and throughout the 19th, that abnormal phenomena could be deliberately induced for a short time in normal persons. Credit for arousing widespread interest in this fact belongs to Friedrich Anton Mesmer, the great hypnotist, who reached the height of his fame toward the end of the 18th century. It was his work that stimulated later investigators to make use of hypnosis therapeutically; and it was this therapeutic use which, in the latter half of the 19th century, led to the historically crucial feud between Parisian physicians, led by Jean Charcot, and Nancy physicians, led by Hippolyte Bernheim and Ambroise-Auguste Liébaux.

Rise of Modern Behaviour Pathology.—The Paris-Nancy feud arose over differences concerning the relationship between hypnosis and hysteria. The Parisian group maintained that only the potentially hysterical could be hypnotized successfully; the Nancy group insisted that anyone could be. Each side was partly right, since we now know that nearly every adult

can be hypnotized and that most hysterical symptoms can be hypnotically induced in normal persons. However, by far the most important outcome of the celebrated quarrel was a greatly increased interest in the origins and characteristics of psychopathology, or behaviour pathology. Two of the men who came directly under Charcot's influence during the last quarter of the 19th century became themselves internationally famous as behaviour pathologists. Pierre Janet, who ultimately succeeded Charcot at Paris, began his long series of contributions to abnormal psychology with the publication of *L'Automatisme psychologique* in 1889 and *L'Etat mental des hystériques* in 1893. Sigmund Freud was a contemporary of Janet in Charcot's clinic during 1885; but he also visited Bernheim in Nancy for a few months in 1889. He translated the writings of both Charcot and Bernheim into German. Freud's first papers, on behaviour pathology, published in 1893 and 1895, were on the mechanisms of hysteria and show the effects of these early contacts.

No one else in recent times has influenced the development of abnormal psychology as profoundly as has Sigmund Freud. Those who attack him on methodological grounds are likely to find themselves corroborating, through the use of their more sophisticated procedures, some of the fundamental tenets which Freud succeeded in deriving from simple observation. Those who reject his hypotheses because they are phrased in the language of 19th-century psychosomatic dualism, discover that his most important constructs can be reformulated in modern biosocial terms without losing in usefulness. Indeed, one of the principal tasks confronting abnormal psychology in the mid-20th century was that of following up the leads indicated by the pioneer work of Freud and the psychoanalysts, with the aid of modern techniques and modern hypotheses.

NEED AND SATISFACTION

The deviations with which abnormal psychology deals are often referred to as personality disorders. They are primarily disturbances in an individual's acquired systems of behaviour which define his social personality, and upon which his interpersonal relationships depend. Consequently, in all discussions of behaviour pathology the social and cultural aspects of human living receive strong emphasis. This does not mean, however, that we can neglect the biological aspects. Personality and its abnormal developments must always be studied as the products of a lifetime of interaction between a human organism and the environment by means of which it lives. It is through this interaction that each person learns to satisfy biological needs within the framework supplied by the social organization around him; and it is through the same interaction that each of us acquires innumerable new biosocial needs and satisfactions.

By need we mean a condition of unstable or disturbed equilibrium in an organism's behaviour. This appears typically in the form of increased or protracted activity and tension. Need is characteristic of all ongoing activity sequences, whether these are overt or covert. It may result directly from some alteration in the relationship between organism and environment, as in sharp changes of temperature, or as the direct outcome of metabolic processes within the organism itself, as in hunger and thirst. In human beings, need commonly arises also as the more indirect result of symbolic behaviour, such as talking, reading or thinking.

The termination of need we call satisfaction. When this results directly from the increased activity incident to a need, as when eating or drinking restores the hungry organism's equilibrium, we speak of direct satisfaction. When a specific need is terminated through a mere shift in activity, through the distraction furnished by new stimulation, or by means of some learned substitution, we speak of indirect or substitute satisfaction. Under the conditions of human group living, with its compromises, its arbitrary rules and its cultural traditions, the indirect or substitute satisfactions take on great significance, and particularly so in the development and persistence of abnormal reactions.

Unsatisfied need is an important factor in behaviour from

the moment of birth. To be born is to be separated from the automatic machinery of satisfaction which life in the mother's uterus provides, and to be left for the first time dependent upon the convenience and good will of someone else. The newborn infant is thus introduced to his first frustrations in the form of delay between the appearance of need and its satisfaction. It is largely through his dependence upon older persons that the human infant and child is gradually inducted into the customs of the society into which he is born. His parents or parent-substitutes originally control all the means of a small child's satisfactions; and they relinquish control only as the child shows the ability to conform to social regulations in his patterns of need and satisfaction. In other words, the human being's inability early in life to satisfy his needs unaided constitutes one of the most important conditions for his progressive socialization.

The child receives his earliest lessons in distinguishing right from wrong when he learns the simple regulations which his society has set up in relation to eating, drinking and elimination, to body care and cleanliness and the taboos against erotic interest. These early acquired distinctions between that which his elders reward, as right, and that which they punish, as wrong, have been called visceral ethics; *i.e.*, ethical attitudes derived from learning the social control of visceral functions. Chiefly through the influence of psychoanalytic schools of thought, modern behaviour pathology has come to place considerable emphasis upon the importance of visceral ethics. This emphasis, in turn, has thrown much light upon the striking confusions that one encounters clinically between goodness or badness and questions of food or fluid intake, elimination, sex functions, cleanliness and body care. Some of the more common confusions of this kind are to be found in compulsive handwashing, in hypochondriacal attitudes toward gastrointestinal functions, in complaints of impotence and frigidity based upon guilt and aversion, in hysterical loss of appetite and in delusions of body change.

Hunger and Thirst.—As simple biological needs, which require no more than food and fluid intake for their satisfaction, hunger and thirst are seldom significant in abnormal psychology. However, in western society the normal satisfaction of hunger and thirst takes place under conditions that inevitably lead to important interpersonal relationships. Infant and child feeding, for example, involves intimate contact and personal interaction between mother and offspring. In this relationship are laid down some of the most fundamental patterns of social acceptance, approval and affection. Throughout childhood and adolescence, feeding continues to be an effective means of socialization. Banishment from the family table and the withholding of food are common types of punishment for nonconformity. Extra helpings and special foods are frequently used as rewards for pleasing behaviour or as consolation for other losses and for sacrifices. Moreover, the relationship of eating to health, strength, growth, good looks and biological maturing is repeatedly pointed out to child and adolescent at the family table.

If we are to understand some of the remarkable confusions met with in behaviour pathology, it is essential to realize that eating and drinking are by no means confined to the satisfaction of hunger and thirst, or even to social acceptance and approval within the family circle. We normally eat and drink in celebrating success, in sealing agreements, in mourning our sins or our losses through death, in solemnizing our hopes and in signifying unity with the divine. It must also be remembered that the mouth is used for many activities other than feeding. Infants and young children employ it as an organ of examination, manipulation and attack, just as subhuman mammals do. Older children and adults use it for kissing and, in an infinite variety of situations, as an organ of speech, grimace and oral gesture.

To all these potential sources of confusion must be added the influence upon a person of common metaphors, of fairy tales, folklore and superstition. Eating and drinking are related in stories, for example, to sudden body growth and shrinkage, to

miraculous changes in strength and beauty, to magical powers and magical helplessness, to fertility and impregnation and to the transformation of men into animals or gods. Thus, when a person becomes acutely anxious, insecure or disoriented, it should not surprise observers if he shows a disorganized intermingling of these different meanings, and tries to translate abstract symbols inappropriately into concrete action.

Sex Need and Satisfaction.—Early in the 20th century, Freud and his followers attached the greatest significance to sex in relation to behaviour pathology. The work of subsequent investigators, both psychoanalytic and nonpsychoanalytic, has in large measure verified this judgment. Certain peculiarities of sex functions help to account for their pre-eminence. The direct satisfaction of sex need, for example, unlike the situation in hunger and thirst, can be delayed for long periods and even permanently denied without resulting in death. Accordingly, sex activities can be regulated and restrained to a degree that is not possible in the case of hunger and thirst. Furthermore, although from infancy onward direct and indirect erotic stimulation can occur, full heterosexual satisfaction is biologically impossible for several years, while for several years more it is socially prohibited.

It is under precisely such conditions of intermittently occurring delay, thwarting and conflict that substitutive tension-reducing patterns of behaviour are acquired (*see DEFENSE MECHANISMS*). To the extent that these learned substitutive reactions lead to maladaptive results, they are likely to become implicated in the development of neuroses and psychoses. Of course, there are more cogent reasons for the social control of sexual satisfaction than the mere fact that control is biologically feasible. Mature sex behaviour involves two persons in a reciprocal relationship; and the one upon whom the biological burdens of pregnancy and childbirth fall is also the weaker of the two. Moreover, sex satisfaction is unique in leading to the production of new members of the social community, and the community therefore assumes the right to regulate the preliminaries of procreation and parenthood. Man shares with other mammals a further tendency to develop aggressive, jealous and vengeful attitudes with respect to courtship and mating. Such a tendency demands that, for the sake of peace and security in the community, both rights and responsibilities be assigned to persons entering into these relationships.

In contemporary western society the taboo against sexual activities in childhood is usually extended to include taboo against their discussion. This is undoubtedly an important source of the sex confusions so commonly encountered in behaviour pathology. We know that attitudes become socially mature either through shared activities or through the interchange of perspectives that can develop in free discussion, particularly discussion with a socially mature person. Unfortunately, in matters of sex the average person has not himself enjoyed in childhood the benefit of frank discussions with a judicious, informed adult. Consequently, he is seldom equipped to help his own child acquire social maturity in this important area of human interest. He is easily embarrassed and made anxious by his child's sex curiosity and is therefore more likely to silence or reprimand his questioner than to meet each situation as it arises with mature effectiveness. The result is that the next generation grows up as little matured in sex attitudes as the last one.

During pubescence and adolescence there occurs a marked acceleration of biosocial maturing. This is in part the direct result of biological changes, in part the more indirect consequence of concomitant increases in social pressure. Sex problems, which in childhood were controlled by simple permissive and inhibitory training, now reappear with new vigour in a new social context. Instead of merely showing sex curiosity, the adolescent begins attempting seriously to interpret and play the role of his sex in terms of his peer culture. Adolescence thus becomes the phase of development during which ease and skill may be acquired in social behaviour with contemporaries of the opposite sex, an acquisition which aids in the general

process of emancipation from filial dependence and prepares one for adult love relationships.

Under the influence of the social environment, sex needs and satisfactions undergo many significant modifications by the time adulthood is reached. It is expected that sex attitudes will be oriented toward marriage and family formation; and they cannot receive social recognition unless they conform to civil or religious codes. Marriage, the family and the home are in turn made the basis of socioeconomic organization. In this way, sex attitudes and responses are brought into direct behavioural relationship with social and economic problems, with ethical standards of all kinds, with religious beliefs and practices, as well as with questions of hunger, thirst, warmth, shelter, security, approval and personal significance. Here we see how the groundwork is laid, in the domestic organization of life, for the unification of otherwise unrelated needs and satisfactions. The same domestic organization leads also to the intricate confusions we find in behaviour pathology between sex conflicts and economic, social, religious and ethical questions.

Primary and Derived Needs.—The needs discussed above constitute only a fraction of those which are pertinent to abnormal psychology; they are, however, representative and they are unquestionably important. In relation to these and other needs, the attempt is sometimes made to distinguish between those which are primary and those which are derived. The primary needs are usually defined as the purely biological ones, while the secondary or derived needs are defined as the ones modified by the social environment or developed out of some nonbiological relationship. In practice, however, this distinction cannot be maintained. None of the so-called biological needs fails to undergo far-reaching socialization, beginning early in life, and none of the so-called secondary or derived needs can ever be completely divorced from the human organism's physiological activities. Actually, all needs of significance to abnormal psychology are in this sense derived: they represent the disequilibrium of a biological organism which operates always in terms of its social environment.

FRUSTRATION AND CONFLICT

Frustration.—By frustration we mean a situation in which ongoing motivated behaviour, or some organized plan of action, is permanently or temporarily prevented from reaching consummation. During all phases of the development, maturity and involution of personality, everyone must inevitably meet with repeated frustration. Need arises and there is delay, thwarting or conflict before it can be terminated and satisfaction reached. Each of us in his childhood acquires special adjustive techniques which enable him to circumvent, overcome, evade, nullify or disown the innumerable difficulties which can be solved neither by direct aggression nor by headlong flight (*see DEFENSE MECHANISMS*). Individuals show marked differences in the degree to which they develop these adjustive techniques, or defense mechanisms, in their preference for one defense over another, and in the degree of frustration they can withstand (*frustration tolerance*) before their preferred techniques prove inadequate, or operate to their own detriment.

During early infancy, of course, the commonest form of frustration is delay. The infant's inadequate biological equipment does not permit him to satisfy his needs without an older person's help. Delay continues to be an effective condition of frustration throughout life. As the growing child acquires greater strength and more aggressive techniques, he gains increasing familiarity with thwarting, a second form of frustration. His small size, his relative weakness and incompetence, and the obstacles which are intentionally or unintentionally placed between him and his goals, all contribute to his thwarting. When he acquires speech and his thinking undergoes progressive socialization his needs multiply; and to the more direct obstacles that thwart him are now added symbolic obstructions, such as verbal warnings, signs, rules and his own self-reactions. As he grows into adolescence and adulthood, his level of aspiration is raised in a great many relations, so that he never succeeds in reaching all his goals, no matter what his ability.

Conflict.—The third important form of frustration is conflict, by which we mean the mutual interference between competing reactions. This interference prevents ongoing motivated behaviour from developing adequately and reaching a consummatory phase. The competing reactions may be overt or covert, they may be confined to antagonistic changes in muscular tension, or they may be conceived of as mere shifts in action potential.

Conflicts have been grouped into three classes: adient-avoidant, double-adient and double-avoidant. The adient-avoidant conflict involves two incompatible reactions, one directed toward and one away from an object, activity or goal. What we call guilt is an adient-avoidant conflict in which temptation is the adient reaction, while the avoidant reaction is the partial inhibition which prevents consummation of the act but does not terminate it. The sustained anxiety that develops in such conflict may eventually lead over into an anxiety disorder, phobia, compulsive or hysterical disorder. It is also responsible for many delusional and hallucinatory reactions in paranoid disorders, mania, depressions, schizophrenia and deliria.

Double-adient conflicts are of two kinds. In convergent adience only one object, activity or goal is involved, but the person gives two incompatible reactions toward it. Sibling rivalry, for example, typically includes simultaneously present hostile aggressive and affectionate accepting attitudes. In divergent adience there are two objects, activities or goals, and competing reactions toward both develop. This conflict is characteristic of situations which promise a person a reward he wants on condition that he abandon something else he also wants. Attempted solutions of divergent adience sometimes take the form of the enjoyment of one satisfaction in the public shared field of overt activity, and of the other satisfaction in private asocial fantasy. This is a common source of behaviour pathology.

The double-avoidant conflict involves two incompatible reactions, each directed away from some object, activity or goal. This is characteristic of situations which threaten to harm a person if he remains and to punish him if he leaves, as for example in military combat situations. It also appears where there is intense boredom, aversion or humiliation in the situation but the expectations of other persons, or the prospect of starvation, prevent one from abandoning it. Hysterical and depressive disorders are common pathological solutions of the double-avoidant conflict.

Although a great many conflicts disappear with time and distraction, or in the course of simple training, a great many more are not so easily resolved as this. Some of the latter are settled through compromise or substitution. In sibling rivalry, for example, the older child may substitute taunts, belittling comments and nonco-operation for the direct blows he would give his baby brother if he could. He may, on the other hand, overcompensate in denying his hostility and react instead with exaggerated solicitude toward his rival. He may attempt to escape his predicament by the radical expedient of running away from home, thus leaving the conflict field entirely. This last solution occurs among adults in hysterical fugues; the individual in conflict runs away from it and develops amnesia which hides his identity even from himself.

To settle a conflict does not guarantee that it will never return. If situations similar to the ones originally arousing it appear, the old conflict like an old remembrance may be reinstated. However, it is the incompletely resolved conflict that is most likely to keep recurring, and therefore to form a starting point for neurosis or psychosis. The recurrent conflict means recurrent tension, difficulty in relaxing or sleeping adequately, unreadiness for diversion and entertainment and an inability to achieve satisfaction for personally important needs. It may lead directly into chronic anxiety reactions, phobias or depressive disorders. Some persons with perpetually recurring conflict develop compulsive rituals, hysterical disabilities or manic attacks as a defense against their anxiety. Others escape it by developing body overconcern, fatigue syndromes or schizophrenic withdrawal, which provides relief from anxiety but seriously impairs the individual's social usefulness.

Conscious and Unconscious Conflicts.—A conscious conflict is one that can be correctly identified or inferred by the person in conflict. An unconscious conflict is one that someone

else can correctly identify or infer, but the person having it cannot. There are, of course, all gradations in accessibility between these two extremes. Theorists in abnormal psychology have in the past gone beyond this simple distinction to assert that unconscious conflicts are radically different entities from conscious ones, and have located them in a hypothetical psychic region which they designate the unconscious. Actually there is no need to introduce the hypothesis of a special, unconscious reality to account for the differences that we find in the relative accessibility of conflicts.

We may begin with the observed fact that conflicts do vary in the degree to which they are accessible to the reactions of the individual having them. Conscious conflicts are those which are fully accessible to a person's self-reactions; *i.e.*, to his reactions toward his own behaviour. A person may share the fact of his conscious conflict with someone else or he may keep it to himself as a secret; but in either case the important thing is that he is able to formulate it to someone, to himself or to another individual. If he keeps the conscious conflict to himself, of course, he can still debate it aloud in solitude, like Hamlet, or go over it silently in his socially organized thinking. The conscious or fully accessible conflict is frequently a source of behaviour pathology. To identify or infer one's difficulties correctly is not to guarantee that they will miraculously disappear; if compromise, renunciation or escape cannot be carried through successfully, the situation may become just as intolerable as in the case of unconscious conflict.

However, in abnormal psychology it is the conflict which remains relatively inaccessible to a person's self-reactions, the unconscious conflict, that is by far the more important. To understand its origins, its consequences and the therapeutic techniques that have been developed to cope with it, is to understand the greater part of modern behaviour pathology. There are innumerable reasons for the inaccessibility of conflicts. Five of the simpler and more general factors will be listed here.

1. Conflicts become and remain inaccessible to a person (unconscious) because of previous threat or punishment. Early in life the threat or punishment comes from other persons, but as time goes on, a person learns to threaten, criticize, reject and punish himself. Moreover, the anxiety which threat and the prospect of punishment arouse is likely to generalize to situations not originally involved and not necessarily related in terms of strict verbal logic. Simple juxtaposition and concomitance, for example, are sufficient conditions for the development of new anxieties out of an old conflict.

2. Conflicts remain inaccessible (unconscious) if a person has never succeeded in formulating them. Language and socially organized thinking are of the utmost importance in the recall of any complex behaviour and in its analysis. Therefore, as long as a conflict remains unformulated in these terms it can rarely be adequately recalled and correctly identified as an effective factor.

3. Conflicts remain inaccessible (unconscious) because of strong emotional participation. When emotional components of behaviour are dominant in a conflict situation they may disorganize behaviour, at the time, or later on when recall is attempted. The recall of strongly emotional situations is also made difficult by the fact that it is seldom possible to reinstate the emotional components in their original intensity, or even with their original characteristics. The therapeutic methods of recumbent free verbalization ("free association") are designed to facilitate the recall and the reliving of past incidents with something approaching their original intensity and character.

4. Conflicts remain inaccessible (unconscious) because a person cannot recall his fantasies. This difficulty is in part a result of the relatively loose organization of fantasy as contrasted, for example, with communicative speech. It is also frequently a result of repression (*see* DEFENSE MECHANISMS). Thus, anyone who is suddenly interrupted by someone in the midst of his fantasizing may find himself incapable of remembering anything he has been thinking. We see this repeatedly in treatment situations where a neurotic patient, for example, will likewise show an inability to recall his own fantasy, and this inaccessibility frequently resists therapeutic attack for a long time.

5. Conflicts remain inaccessible (unconscious) because a person fails to recognize and accept the significant factors involved. The average individual, no matter how intelligent or well-educated he may be, has neither the detachment nor the special training required for the successful analysis of his behaviour when he is in trouble. Sometimes, in relatively uncomplicated conflicts, it is possible for an expert to identify and explain significant factors in such a way that the patient can recognize and accept a correct interpretation with lasting benefit. Usually, however, the person in serious conflict cannot assimilate a ready-made interpretation, but must instead work out the significant factors himself with an expert's impartial help, even though this takes much longer and leads ultimately to essentially the same conclusions which the expert had come to early in the process.

Conscious and Unconscious Motivation.—One of the basic assumptions in abnormal psychology is that all organized reactions are motivated. This simply means that the analysis of behaviour, if carried far enough, would always yield identifiable factors of special significance in the instigation, determination and sustaining of all organized acts. Such factors we call motives. The motive is thus not some form of hidden energy, a force, a drive or a first cause, as sometimes implied in popular writings. It is merely a verbal designation which is itself the product of our own operations in the motivational analysis of human behaviour.

The unconscious motive is not to be thought of as something which lurks dangerously in a psychic underworld. The distinction between conscious and unconscious motivation, like that between conscious and unconscious conflict, rests upon the question of whether or not the motive is accessible to the individual concerned. If a person can correctly identify or infer his motivation, we speak of it as conscious; if he cannot, but someone else can, we call it unconscious. Some of the special characteristics ascribed to unconscious motivation undoubtedly result from the fact that what is inaccessible to a person's self-reactions escapes a great many of the socializing influences by which other behaviour is modified.

INDIVIDUAL SUSCEPTIBILITY TO BEHAVIOUR DISORDERS

Sex differences, physiological age and relative biological competence may all enter into the determination of behaviour pathology in any given individual. However, when it comes to individual differences in susceptibility to behaviour disorders, the most important factors seem to be the differences in frustration tolerance, and in the development and use of special adjustive techniques, or defense mechanisms. The wide variations in frustration tolerance, mentioned earlier, are to be found not only in comparisons of one individual with others, but also in comparisons of the same person's tolerance level at different times and under varying conditions of stress. Moreover, one person may exhibit low general frustration tolerance (*i.e.*, he reacts maladaptively to any ordinary frustration) while another may exhibit low specific frustration tolerance (*i.e.*, he reacts maladaptively to some particular group of frustrating circumstances but not to others). This multiple variability in resistance to frustration helps to account for the great range we find in both the intensity and the variety of precipitating factors in neuroses and psychoses.

Similar observations may be made concerning the development and use of special adjustive techniques or defense mechanisms. The failure to develop adequate defense reactions, for example, leaves one vulnerable in a crisis to mounting anxiety; and this may culminate in frank anxiety attacks, phobia or agitated depression. The overdevelopment and unskilled or injudicious use of defense reactions, such as rationalization and projection, often lead in the direction of delusional and hallucinatory behaviour. Likewise, regressive techniques may render an individual susceptible to hysterical disorders, fatigue syndromes or hypochondriacal invalidism. Excessive fantasy favours a gradual withdrawal from participative activities; and this may in turn permit de-socialization to develop and progress to a point at which the social disorganization of a person's behaviour justifies our calling it schizophrenia. Thus, we have also multiple variability in the maldevelopment and misuse of defense mechanisms to help ex-

plain the variation in degree and kind of susceptibility to behaviour pathology.

Childhood Influences.—Individual differences in frustration tolerance and in the adequacy of adjustive techniques can be ascribed chiefly to differences in what is acquired in the course of childhood personality development. One of the most important factors influencing this development is that of the prevailing domestic pattern. If the otherwise healthy child of a chronically fatigued or overanxious parent begins to exhibit habitual fatigue or exaggerated anxiety, the public is apt to blame biological inheritance. The child is said to be "delicate, like his mother," or "nervous, like his father." Actually, of course, these are examples of contact transmission, not biological inheritance, since teachers, playmates or neighbourhood invalids can have the same influence. In short, children learn to adopt the attitudes and techniques prevalent among their elders or associates, whether these include abnormal reactions or not. If abnormal behaviour is acquired in childhood, and subsequently abandoned for something better, it may still leave an individual more susceptible than the average person to its reappearance, later in life, when new difficulties arise.

Differences in the prevailing patterns in different homes help also to account for many of the variations we find, from person to person, in the kinds of behaviour pathology which develop under comparable conditions of stress—the so-called "choice of neurosis." If a chronically insecure parent meets his anxieties habitually by the use of compulsive ritual, this preferred technique may be adopted by the child. If the home environment is dominated by elders with chronic body overconcern, a child may grow up in it with hypochondriacal reaction-sensitivity to normal physiological functions. If a child is reared among adults or older siblings who show pathological fear of lightning, high places, sin, darkness, animals or contamination, he will be likely to acquire phobias himself, and to react later in life with these patterns of behaviour pathology rather than with others.

Children who are not given a maladaptive pattern of behaviour to adopt can, instead, be trained in one by their elders. An over-solicitous parent, with no serious doubts concerning his own body functions, may by worrying aloud over his child's minor discomforts, transient sickness or normal fatigue, unintentionally school the child in worrying over himself. Such a child learns to react to himself as his elder reacts to him, to interpret normal physiological events as signs of danger, and to develop a lack of confidence in his own health and strength. If he is given the privileged status of a sickly or delicate person because of his complaints, he may learn to utilize them to gain rewards, to avoid unpleasant tasks and to excuse failure. Likewise, the child whose parents are more overprotective than anxious, may nevertheless be trained in anxiety through the incessant warning, guarding, restraint and taboo with which he is surrounded. By learning to look always for danger before attempting anything, he develops a habitual expectation of danger and is thus rendered chronically insecure because of his selectively trained imagination.

Domineering parents sometimes control a child by keeping him continually dependent upon their emotional support and always uncertain of it. They give affection only as a reward for complete submission, and they withhold it the moment filial rebellion threatens to appear. The child trained in submission is an emotionally dependent child who is unlikely to develop adequate emotional independence in adolescence and become a socially mature adult. In business, professional, domestic and friendship relations, the adult with such a childhood is apt to expect special consideration and privilege from others, in return for dependent behaviour, and to misinterpret ordinary adult competition and detachment as hostility and rejection. The outcome may then be an abandonment of adult goals, with the substitution of less mature ones, or the elaboration of misinterpretations into delusional structures.

The child made oversensitive to guilt becomes especially vulnerable to behaviour disorder in adolescence and adulthood. Every child learns anxiety in relation to anticipated punishment, and when he is tempted to do something for which he has been previously punished or threatened, his anticipatory anxiety tends

to reappear. As they grow older, children learn also to use the words and attitudes of condemnation or threat toward their own behaviour (self-reactions) through which older persons had earlier controlled them. These self-reactions are capable of arousing severe anxiety over one's own thinking, intending or doing forbidden things, and they are much more difficult to escape than the criticisms of other persons. Under sufficient stress such conflict situations, for the individual overtrained in guilt reactions, may lead to the development of anxiety disorders, compulsive penitential or protective rituals, agitated depression, manic attacks or schizophrenic disorganization.

Illness, Injury and Defeat.—At any period of life, behaviour pathology may develop out of the circumstances incident to illness or injury. The sick and the injured are relatively helpless and dependent. They commonly suffer pain, weakness, discomfort and disability which may form a basis for body overconcern, easy fatigability, chronic anxiety reactions or hysterical disorder. If patients are overtrained in watching over their physiological functions during convalescence, they may be unable to abandon this acquired solicitude when it becomes unnecessary and inappropriate. Moreover, the sick and disabled are granted special rights and exemptions which they lose as soon as they are well again. This leads sometimes to an indefinite prolongation of convalescence which, of course, is usually unplanned and unrecognized by the patient. Thus, chronic invalidism may follow upon illness or injury and lead to permanent hypochondriacal, fatigue or hysterical disorders.

Severe disappointment, disillusionment and defeat may also increase an individual's susceptibility to behaviour pathology at any age. The biosocial conditions of middle and late life, however, are especially apt to provide these factors. The middle-aged or elderly person finds his general energy level diminishing, begins to realize the impossibility of ever reaching his hoped-for goals and sees himself gradually overtaken and then outdistanced or displaced by a younger generation. Like-aged relatives and friends in increasing number sicken and die, while the opportunities for acquiring new friends steadily decrease.

Many of the reactions to aging, for which explanations were once sought exclusively in brain pathology, are now recognized as the maladaptive behaviour of a person whose security and satisfactions have been undermined by biological waning and social restriction. In other words, the difference between normal and pathological senility cannot be completely expressed in terms of relative brain degeneration. It is also determined by the degree of stress or frustration to which the individual is subjected, his habitual reactions to it, his adaptability to change, and the consequences to him of the reduced social status that comes with increasing age.

BEHAVIOUR DISORDERS

The behaviour disorders are relatively fixed, crystallized patterns of maladaptation. They have been divided traditionally into neuroses and psychoses. This division was originally based upon an erroneous hypothesis which attributed neuroses to nerve damage and psychoses to impairment of the psyche or the brain. The distinction is still preserved as a convenience in differentiating between disorders which justify legal commitment to a psychiatric hospital and those which do not. Freud attempted to divide neuroses further into those resulting from actual nerve disorder (actual neuroses) and those which he believed to be psychic (psychoneuroses). Although the concept of actual neuroses has proved to be unfounded, Freud's term psychoneurosis is used today to mean the same as neurosis.

Behaviour disorders are exceedingly difficult to classify. They cannot be grouped in accordance with aetiological agents, as infectious diseases can, because different individuals react to similar stresses in radically different ways. They cannot be grouped according to structural defects or lesions, since in the behaviour disorders none can be consistently demonstrated. Consequently, they are classified in terms of behaviour pathology which means, of course, that all the difficulties inherent in classifying behaviour are carried over into abnormal psychology.

There were several official classifications in use at mid-20th century, each of which disagreed in some particulars with the others and possessed certain advantages in the eyes of its users. The three most widely employed in English-speaking countries were those sponsored, respectively, by the Royal Medico-Psychological association, the American Psychiatric association and the United States army. The classification adopted, in the discussion which follows, is derived from these sources. It recognizes eight major disorders, of which the first five are customarily designated as neuroses (hypochondriacal disorders, fatigue syndromes, anxiety disorders, compulsive disorders and hysterical disorders), while the remaining three are the psychoses (paranoid, schizophrenic and manic-depressive disorders). In accordance with the United States army procedure, the organic psychoses are not included as a separate group. They will be discussed under *Cerebral Incompetence* at the end of this article.

Hypochondriacal Disorders.—The hypochondriacal person is habitually preoccupied with a supposed disease or defect in some part of his body which is functioning within normal limits; or he is exaggeratedly concerned over an actual disease or defect. Most hypochondriacs diagnose their own ills, and prescribe for and treat themselves; a great many consult physicians at least once or twice, and a minority do so chronically. In the United States, Great Britain and the dominions, millions are spent annually on patent medicines, tonics, laxatives, liver and kidney pills, antacids and the like, by persons whose illness lies not in the part they are treating but in their adaptation to the life they live. Since body overconcern is by no means confined to the well-to-do, the financial drain from this huge, unnecessary expenditure creates a serious socioeconomic problem. Even more serious, however, is the loss in a person's social effectiveness which constant preoccupation with body complaints inevitably entails.

It is not difficult to understand the origins of hypochondriacal disorders. Everyone is taught in childhood to observe his body functions, to comment upon them, to take pride in healthy performance and share his elders' concern over anything that goes wrong. If this training is too thorough, a child will become reaction-sensitive to some of the many normal activities of his body, and learn to watch and worry over them. Such an individual, when exposed later in life to prolonged anxiety or unsatisfied need, is likely to react with his already established patterns of body overconcern. As one might expect, gastrointestinal complaints head the list in hypochondria, even though fatal disease is actually much commoner in the cardiovascular system. Food intake, digestion and elimination are, after all, readily accessible to observation, discussion and control; and the vast amount of information and folklore available to the public focuses the attention of anxious and dissatisfied persons upon them.

Fatigue Syndromes.—In this group the patient speaks of continual fatigue and easy fatigability, in the absence of systemic disease or defect sufficient to account for them. A person with these complaints tends to avoid activities, situations and responsibilities that seem to induce or increase fatigue, and in consequence suffers a severe reduction in social effectiveness and in the opportunities left him for enjoyment. Some patients eventually lead a hermit's existence, shut away from all but a handful of friends whom they seldom see, and restricted to a routine which provides minimal disturbing stimulation.

Factors predisposing a person to develop pathological fatigue include childhood training in regarding oneself as weak or delicate, the example set in childhood by chronically fatigued adults and personal experience at any time of life with prolonged illness and convalescence. Under such conditions the individual may learn to react selectively to normal physiological events as if they were danger signals that he is overtaxing his strength. Fatigue in this sense is not an energy concept, but rather an attitude of aversion or unreadiness with respect to new or continued activity. It may result from overwork and inadequate rest, but it may equally well come from prolonged anxiety, frustration, disappointment or discouragement. This helps to explain the failure of rest and recreation to bring about a lasting improvement in persons suffering from pathological fatigue.

Fatigue syndromes, under the name of neurasthenia and nervous exhaustion were once called the American disease, and attributed to the strain of protracted conflict. The conflict was supposed to be that between the demands made by a ruthless, competitive mode of life and the ethical standards carried over from the more stable European culture. It was further believed that this situation depleted the supply of essential biochemical substances in the patient's nerves with consequent weakening of the nervous system. These hypotheses gave rise to the rest cure, the goal of which was to restore the nerves to their normal condition by overfeeding and complete inactivity. With the rise of modern behaviour pathology, both the rest cure and the hypotheses that gave it birth have been discarded.

Anxiety Disorders.—The prevalence of anxiety disorders is an expression of the fact that, although human beings are continually exposed to emotional stimulation, under the conditions of group living, they have relatively few opportunities for complete emotional reaction. They are frightened but cannot flee or hide, they are angered but cannot attack, they are sexually stimulated but cannot directly respond. Anxiety is the incomplete or amputated emotional response which appears under circumstances such as these.

If anxiety becomes persistent, and disturbs the pattern of a person's life, we speak of chronic anxiety disorder. The pathologically anxious person cannot relax, he sleeps poorly, has uneasy or frightening dreams and responds exaggeratedly or inappropriately on slight provocation. Because of his tension, he grows fatigued, irritable and dissatisfied, he cannot concentrate or remember as he once could and he usually develops visceral symptoms which reflect his emotional disturbance. He may have acute anxiety attacks, at irregular intervals, in which his heart palpitates, he sweats, his breathing grows laboured and he may think he is about to die; these attacks are frequently mistaken for signs of heart disease. Anxiety attacks in some persons take the form of acute gastrointestinal dysfunction, and in others resemble asthma.

Regardless of the precise symptomatology in anxiety disorders, the striking thing is that the patient rarely attributes his symptoms to their origin in the biosocial stresses and strains arising out of his personal and social problems. If he fails to get competent help, his next step is to avoid the situations which seem to arouse or increase anxiety, and to blame these situations for his predicament. Like the hypochondriacal and fatigued patients, he progressively limits his activities and his pleasures, and like them he decreases his general adequacy without gaining permanent relief. For no matter how many situations he avoids, he cannot escape the tensions of his own unrecognized needs and conflicts.

Phobia, or pathological fear, is an anxiety disorder in which the patient is able to identify the anxiety excitant, but cannot explain it. The commonest excitants of phobias are small, enclosed places, large wide-open spaces, public gatherings in or out of doors, high places, the dark, animals, germs and poisons. Actually, the situation or object which the patient accuses is as a rule some fragment, substitute or symbol of something which he has forgotten, repressed or never identified. It may have been part of a conflict which the patient has succeeded in partially repressing, without getting rid of his anxiety reaction to the partial rearousal. Treatment in phobias, as in other anxiety disorders, is directed not at the symptom but at its origins and what it represents.

Compulsive Disorders.—These are ritualistic attempts at dealing with anxiety. The compulsive reaction consists of an irrepressible tendency to think, say or do some particular thing which is opposed by a simultaneous tendency to resist thinking, saying or doing it. In this situation, tension gradually rises until the patient gives in and gains temporary relief. The variety of compulsive behaviour is great, and its seriousness ranges from the harmless repetition of rituals, such as checking several times each night to see that lights are out and doors are locked, to seriously antisocial activities such as stealing, arson, exhibitionism and assault.

Compulsive behaviour has interesting normal homologues in the attitudes of children toward familiar tales and organized play, where the same tense insistence upon ritual and meticulous repetition can be found. The same is true of the reactions of normal adults in relation to etiquette, rules of procedure in civil and military organizations, in institutionalized games, theatre performances and patriotic or religious ceremonies. Discussion of pathological compulsions will be limited to one well-known syndrome.

Repeated handwashing, the classical example in this group, illustrates the salient features of compulsive disorders. As a reaction to the self-accusation of guilt, it performs the function of symbolically cleansing and disowning responsibility. After it has been performed a number of times, because of sinful deeds or fantasies, it is likely to grow into a more general reaction to any tension, whether guilt is involved or not. The annoyance and inconvenience of having to wash repeatedly also constitutes punishment, and this aspect is increased when the application of cleansing agents eventually brings about a painful chemical dermatitis. The penitential meaning becomes clear when the patient complains then that he takes pleasure in hurting himself. One sees here the division of behaviour into the role of the punitive parent and the sinful penitent child, a dual role which the patient has usually acquired in childhood, through learning to be over-conscientious at the hands of a hypercritical, perfectionistic parent.

Hysterical Disorders.—These are characterized by persistent inactivation or autonomy which superficially resembles the product of neurological damage and disease. Actually, no neurological lesion is present, and the disorder arises in relation to need or anxiety. Hysteria, or "conversion hysteria" as it is commonly called, differs from hypochondria in one important respect. The hypochondriacal patient shows marked overconcern in relation to an organ or part which is actually performing reasonably well. The hysterical patient shows relative unconcern with respect to an organ or part which is obviously disabled. This is because the hysterical patient, in accepting his symptom as a sign of disability, frees himself from the tensions of frustrated need and conflict. Hysteria can be distinguished from malingering, with which it is usually confused, by the fact that the patient is himself convinced of the verity of his symptom as a sign of damage or disease.

The commonest examples of hysterical inactivation are those of hysterical aphonia, paralysis, anaesthesia, blindness and amnesia. In hysterical aphonia, or loss of voice, the organs of speech are usually normal and their participation in activities other than talking may be unimpaired. Aphonia appears under circumstances similar to those inducing normal loss of voice—acute anxiety, fright, sudden surprise, extreme disappointment or conflict. It may also follow tonsillectomy, some minor injury or an infection, which interferes temporarily with speech. The disability persists if it disposes of the tensions of intolerable need or anxiety; and it may disappear with dramatic abruptness when it no longer performs this function.

Hysterical paralysis and anaesthesia are not nearly so common as they were early in the 20th century. The reduction in incidence seems to be the result of public education and the great care now exercised by medical examiners in avoiding suggestion. However, when they do occur they are both striking and instructive. A person finds, for example, that following a fright, accident or operation, he cannot walk or cannot move an arm. Examination of the inactivated part fails to reveal evidence of tissue pathology adequate to account for the symptom; but the outcome of psychotherapy demonstrates that it represents the patient's attempt at adjustment in relation to deep personal need or anxiety. The skin of a hysterically disabled arm or leg may also be found insensitive to ordinarily painful stimulation. Sometimes such anaesthesia occurs alone. Its origin and meaning are the same as in the case of hysterical paralysis. Hysterical blindness has similar roots, but its significance may also include symbolic implications such as unwillingness to recognize, and self-punishment for the sinful use of seeing.

Hysterical amnesia, the loss of recall, is usually selective for

certain kinds of past events, but sometimes it is global and covers a complete episode. Nothing illustrates the extreme operation of repression better than global amnesia. A person, caught in an intolerable conflict situation, may escape from it by repressing all remembrance of it. He may go further and exclude also the responses by which, he establishes his own identity. When this happens, we have the patient who cannot remember his own name or his status in society. This is the man whom the newspapers call "victim of amnesia." He is in fact the victim of over-complete repression; he has carried to an extreme an adjustive technique which all of us use in getting rid of anxiety and frustrated need.

The commonest examples of autonomy are the hysterical tremor, cramp and tic. The tremor is a rapid oscillatory movement, the cramp is a severe sustained muscular contraction and the tic is a relatively complex, co-ordinated movement. All three occur in normal behaviour. We call them hysterical when they are persistent or recurrent, and arise from need or anxiety, not from physiological impairment, intoxication or tissue damage. The so-called "occupational" tremor, cramp or tic illustrates such a relationship. For example, a machinist who is otherwise well finds that his hand shakes whenever he tries to work but not in other situations. A typist suffers a painful cramp each time she tries to type but finds no difficulty in writing longhand. A taxicab driver develops head jerking on the job which makes driving impossible, but the jerking does not occur when someone else does the driving. The symptom in each instance is the expression of an incompletely repressed conflict; and if the conflict is resolved, the symptom will usually clear up quickly.

Three other varieties of hysterical autonomy are relatively rare but psychologically important. These are the seizure, the fugue and multiple personality. The hysterical seizure is usually a dramatic re-enactment of some personally important role in the patient's life. During the attack phase, which may last from a minute or two up to several hours, the patient excludes the biosocial environment almost completely. When not in an attack, he usually cannot recall the events re-enacted in the seizure. In hysterical fugue, the patient runs away from his conflict situation and becomes amnesic for his past, often to the point of losing his identity. Fugues seem to be related to ordinary sleepwalking.

Multiple personality is an extreme form of hysterical autonomy to which both fugue and amnesia may contribute. In one form, alternating personality, two organized systems of biosocial behaviour develop and alternate in dominating a person's activities. Each system is amnesic for events in the other. The fictional representative of this form is Robert Louis Stevenson's Dr. Jekyll and Mr. Hyde. It is estimated that not more than 150 authenticated cases of multiple personality have been reported.

Paranoid Disorders.—This term is reserved for more or less systematized delusional reactions in patients who show neither serious disorganization nor deterioration. They develop as a rule under conditions of unusual anxiety, emotional arousal, strong personal need or physiological incompetence. They frequently lead to behaviour that is socially detrimental, inappropriate or inept. Paranoid disorders are relatively common and in most cases curable. The relatively rare paranoia is an extreme, rigid form in which elaborate, highly systematized delusions prevail; it is seldom curable.

Emotional factors are of great importance in the origin and persistence of delusions. The insecure, tense individual who is for any reason unskilled in the social techniques of give-and-take, upon which adequate interpersonal relationships depend, is particularly vulnerable. In his anxiety or frustrated need, the patient becomes reaction-sensitive to the activities of persons around him which seem to confirm his suspicions or hopes. If this development goes on unchecked, he begins to feel that he is the focus, or an important part, of some concerted action on the part of other persons, some of whom are actual individuals and some imagined. This organization of the human environment in terms of delusion is called a paranoid pseudocommunity. It may be conceived of as malignant or benign by the patient.

When it seems to him that he is about to be attacked or exalted, he is likely to take action which brings him confinement and, in fortunate cases, psychiatric treatment.

Schizophrenic Disorders.—Delusional reactions also develop along less well-organized lines, show fantastic characteristics, self-contradictory attitudes and hallucination, such as one finds in normal dreams and in delirium. The patient, however, is neither asleep nor delirious but, on the contrary, may be well oriented and able to carry on complex biosocial activities impossible for a sleeping or delirious person. Some of these activities, in severe cases all of them, will inevitably show the influence of the fantastic, ambivalent, hallucinatory disorganization which is present. This is what we call schizophrenia or, more accurately, the schizophrenic disorders, since there are many clinical varieties. It is customary to distinguish four general types of schizophrenic disorder. However, these are no longer regarded as mutually exclusive forms but only as descriptive statements of the dominant behaviour the patient shows at the time. Thus, if he postures, gestures, shows great excitement or grows mute and stuporous, he is called catatonic. If poorly organized delusions dominate the clinical picture, the patient is called paranoid schizophrenic. If the patient hallucinates freely and behaves in a silly, giggling manner, he is called hebephrenic; and if he seems to fit into none of these categories, he is labelled simple schizophrenic. The United States army classification of 1945 advises against forcing all diagnoses into these arbitrary types.

The most impressive characteristics of the schizophrenic person are his disorganization and desocialization. The biosocial behaviour systems that constitute personality are to a considerable extent replaced by behaviour determined and dominated by private fantasy. The patient includes his fantasy products in the reactions he gives to his environment (overinclusion), with the result that his social behaviour becomes disorganized. This disorganization, in turn, interferes with normal communication and participative activities and so promotes the desocialization and further isolates the patient. If this process continues, the patient's behaviour may pass from the organization of a poorly systematized pseudocommunity to that of an autistic community, made up of the imagined activities of fictitious persons in a fantasied context.

The severity of schizophrenic disorganization led long ago to the conclusion that it must result from cerebral damage or metabolic disease. Research over a period of 50 years failed to support this hypothesis; and the complete or partial recovery of about half the adequately treated cases, including many severe ones, tends to contradict it. There is good evidence to indicate that personality traits acquired in childhood and adolescence are determinative factors.

Manic-Depressive Disorders.—Manic excitements are circumscribed episodes of elation or marked aggression, usually with grandiose delusions. Depressions are either agitated, in which case sustained tension, restless overactivity, despair and apprehensive delusions predominate, or else retarded, in which case the patient shows marked slowing and restriction of activity, with sadness, self-depreciatory delusions and dejection. Suicidal attempts are extremely common in depression. The close relationship of manic excitement to depression was widely accepted by the ancients. The old name, manic-depressive insanity, seems first to have been used in a medical essay of the 17th century which described both types of attack in the same patient. Contrary to popular opinion, it is actually unusual for mania and depression to occur in succession, as a cyclic reaction. Even those patients who have both types in widely separated attacks constitute only about one-fourth of the total in this group. Agitated depressions occurring in middle life are commonly called involuntional melancholias. There is no general agreement as to whether or not they are of endocrine origin, and whether or not they are essentially different from agitated depressions at other periods of life.

Within recent years there has been growing recognition of the evolution of mania and depression from severe, prolonged anxiety.

As Karl Abraham and Freud pointed out, there is often strong emotional ambivalence toward loved persons in the premorbid situation; and at some point in the development the original hostility is turned, from the loved person, against the patient himself. This change, the crucial shift, marks the onset of agitated depression in which self-condemnatory accusations are typical. The same change, in another person, leads to the profound self-depreciation and hopelessness of retarded depressions. If the patient, on the other hand, rejects and disowns self-condemnation or self-depreciation, he may overcompensate by developing elated grandiosity or aggressive self-assertion; and this constitutes manic excitement. The arrogance and clowning of manic patients are frequently mistaken for signs of mere overconfidence and happiness by relatives and friends, whereas they are actually the symptoms of a serious illness which may involve an individual in grave difficulties, and sometimes leads to his death.

Cerebral Incompetence.—The brain as an organ, particularly its cerebrum, cannot function efficiently unless a physiological equilibrium is maintained within a rather narrow range. This equilibrium may be disturbed by marked changes in body temperature, blood pressure and blood volume, by alterations in the composition of tissue fluids, cerebrospinal fluid and blood and by intoxication, brain disease and brain degeneration. Sudden changes often precipitate acute cerebral incompetence, and we have delirium, stupor or coma. More gradual changes may be compensated physiologically for a long time; but if this compensation ends abruptly, the result will again be acute cerebral incompetence. If, instead, there is a gradual reduction in the adequacy of compensation, we have progressive cerebral incompetence.

The United States army classification excludes cerebral incompetence as nonpsychiatric, unless behaviour disorder can be demonstrated, in which case the cerebral incompetence is regarded simply as one aetiological factor.

Behaviour disorders develop in patients with acute or progressive cerebral incompetence if their reduced biosocial adequacy makes them unable to deal effectively with their anxieties and frustrations. Suppose that a person has acquired adjustive techniques earlier in life which take care of serious personal conflicts through repression, identification and rationalization (see DEFENSE MECHANISMS). If his brain, the organ upon whose integrity such complex learned behaviour depends, becomes physiologically incompetent through intoxication, infection, injury or degeneration, the patient may suffer a rearousal of these conflicts because his adjustive techniques have been impaired. The result will then be a neurotic or psychotic reaction, the character of which will depend less upon present conditions than upon the conflicts and the patient's premorbid personality. This relationship has been demonstrated for alcoholic intoxication, general paresis and pathological senility, each of which may set the stage for the development of any of the behaviour disorders described above.

By the mid-20th century, it had become generally recognized that psychoses, in the cerebrally incompetent as well as in the cerebrally competent, could no longer be dismissed as mere reflections of brain pathology, nor could their treatment be limited to custodial care. This change was paralleled by a growing realization that neurotic patients were neither weaklings nor malingerers, but persons with legitimate claims to the privileges accorded the sick. It was chiefly to the credit of Freud that behaviour disorders had finally achieved a status of equality with other illnesses.

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ABO; see TURKU.

ABO-BJORNEBORG; see TURKU-PORI.

ABODE. In English law this term has a more restricted meaning than domicile, being used to indicate the place of a man's residence or business, whether that be either temporary or permanent. The law may regard for certain purposes, as a man's abode, the place where he carries on business, though he may reside elsewhere; so that the term has come to have a looser significance than residence, which has been defined as "where a man lives with his family and sleeps at night" (*R. v. Hammond*, 1852, 17 Q.B. 772). In serving a notice of action, a solicitor's place of business may be given as his abode (*Roberts v. Williams*, 1835, 5 L. J.M.C. 23), and in more recent decisions it has been similarly held that where a notice was required to be served under the Public Health Act 1875, either personally or to some inmate of the owner's or occupier's "place of abode," a place of business was sufficient. (See DOMICILE.)

ABOLITIONIST, an advocate of the abolition of slavery. The term as used in the United States referred specifically to those persons who, during the years 1830–61, made it their mission to advocate the immediate abolition of Negro slavery. In spite of riots, assaults and persecutions of every kind, they carried on their task by means of the press, tracts, lectures and petitions to congress. Among the outstanding leaders of the abolitionist movement were William Lloyd Garrison, Wendell Phillips, Lucretia Mott and John Brown. (See SLAVERY.)

ABOMASUM, the fourth or rennet stomach of ruminants. It is that part of the digestive apparatus in which chemical digestion takes place. (See PECORA.)

ABOMEY, capital of the ancient kingdom of Dahomey, West Africa, now included in the French colony of the same name. Pop. (1936), 11,300, of whom 15 were Europeans. It is 70 mi. north by rail of the seaport of Kotonu. Abomey is built on a plain, 800 ft. above sea level. The town was surrounded by a mud wall, 6 mi. in circumference, with a ditch 5 ft. deep, filled with a dense growth of prickly acacia, the usual defense of West African strongholds. There were six gates. Within the walls were villages separated by fields, several royal palaces, a marketplace and a large square containing the barracks. In Nov. 1892, Behanzin, the king of Dahomey, being defeated by the French, set fire to Abomey and fled northward. Under French administration the town has been rebuilt, placed (1905) in railway communication with the coast, and given an ample water supply. It is an important centre of fetish worship.

ABOMINATION, anything regarded with aversion as were things contrary to omen (Lat. *ab*, from, and *ominor*, forbode). Evil doctrines and impure ceremonial practices are so-called in the Bible. Hebrew authorities hold that the expression "abomination of desolation" (Matt. xxiv, 15; Mark xiii, 14) refers to the desecration of the sacred temple of Jerusalem by the erection of heathen statues (see *s.v.* *Jewish Encyclopedia*).

ABOR (*A-bari*-untamed), an Assam tribe inhabiting hills north of the Brahmaputra, subdivided into Minyong, Galong, Padam and other groups. They fall into patrilineal exogamous sects with traces of dual organization. A cross division exists into Mishing and Mipak—pure and impure, the latter condition being hereditary, and contagious as a result of sexual intercourse, though exogamy is not affected by it. The dead are buried; monogamy prevails, but the Galongs practise the levirate and polyandry within the family circle; slavery, tattooing and segregation of the unmarried obtain, but there is no headhunting. Public affairs are managed by elders and offenders are fined by the random confiscation of property; the property owner must execute the order of the court in order to recover from the culprit in his turn. Weapons used include long swords, crossbows, bows, poisoned arrows and spears. Men wear bark loincloths with tails, women a string of small circular metal plates—often the only garment.

See Duff-Sutherland-Dunbar, *Abors and Galongs* (1916); Cumming, *The Abors*, Assam Census Report, I, Appendix B, iii (1921).

ABOR HILLS, a tract of country on the northeast frontier of India, occupied by an independent tribe—the Abors, who are divided into clans. They live north of Lakhimpur, between the

Miri and Mishmi hills in the extreme north of Assam, where the Brahmaputra (Dihang) debouches on to the plain. The country is exceedingly difficult and entirely mountainous and forest clad, with great rivers running for miles in rocky gorges, and unnavigable beyond Pasighat. Communication is only by the roughest tracks from village to village. The rainfall is very heavy. The term Abor is Assamese signifying "barbarous" and is applied by the Assamese to many frontier tribes; but is restricted especially to the above tract. The Abors frequently raided the plains of Assam. They were first visited by the English in 1826. From 1848 they carried out numerous raids and outrages on the neighbouring territory and several expeditions were sent against them, while a blockade was instituted from 1894-1900. From 1911 onward parties under military escort surveyed the border.

ABORIGINAL LANGUAGES, languages spoken by the native inhabitants of certain countries. The term is generally applied to tongues called nonliterary languages, jargons, broken dialects, etc., but is more correctly used of languages which, whatever their state of development, have left their individuality unimpaired upon the territory where they originated. Aboriginal languages of Africa, for example, are the Bushman (*q.v.*), dialects; of China, the Lolo (*q.v.*), Man-tse, No-su, Mo-so, etc.

ABORIGINES, a mythical people of central Italy, supposed to have descended from near Reate (an ancient Sabine town) upon Latium, whence they expelled the Siceli and settled down as Latini under a King Latinus (Dion Halic. i, 9, 60). The etymology of the name (*ab origine*), makes them the original inhabitants (=Gr. *αὐτόχθονες*) of the country, but is inconsistent with the fact that the oldest authorities (*e.g.*, Cato in his *Origines*) regarded them as Hellenic immigrants, not as a native Italian people. Other explanations suggested are *arborigines*, "tree-born," and *aberrigines*, "nomads."

The term "Aborigines" indicates the inhabitants found in a country at its first discovery. The Aborigines' Protection society was founded in 1838 in England as the result of a royal commission appointed at the instance of Sir T. Fowell Buxton to enquire into the treatment of the indigenous populations of the various British colonies.

ABORTION means the termination of pregnancy before independent viability of the foetus has been attained. In humans, when modern facilities and expert care of the premature infant are available, such viability is at about the 26th week after the 1st day of the last normal menstruation. Miscarriage is the folk term for spontaneous abortion. When this occurs before the 16th week of gestation, as it does in fully 75% of the cases, the foetus, if it were present at all, almost always has died two to five weeks before expulsion of the abortus. In about 50% of abortuses, no foetus is found; only an abnormal placenta (after-birth) is present. If expulsion does not follow separation of the placenta or death of the foetus, the condition is called missed abortion and usually requires surgical removal of the abortus. It is estimated that about 12% of recognized pregnancies are aborted spontaneously. Meagre embryologic studies indicate that possibly 20% of fertilized ova are expelled before pregnancy can be diagnosed and that in about one-third of them no foetus, only placental tissue, is formed. Almost all the occult and most diagnosable miscarriages are caused by abnormal development of the embryo or the placenta. This is caused by intrinsic defects in the particular combining sperm or egg (the latter more frequent in women over 40 years of age), or occasionally to inadequacies of the lining of the womb where the ovum imbeds. In general, only an extreme dietary deficiency, a marked endocrine disorder or a gross toxic, anatomically defective or locally traumatized condition of the mother effectively impairs development of the normal conceptus. The injurious role of the emotions is as yet entirely theoretic.

Adequate diet and good hygiene during childhood and adolescence will favour normality of male and female germ cells. The same treatment for the adult female with avoidance, correction or relief of disabilities mentioned as harmful to the conceptus will tend to supply its needs. When miscarriage is threatened by a showing of blood or by intermittent mild cramps, moderate

sedation supplemented by inhibition of uterine contractions will help if the conceptus is still normal. Contractions can usually be stopped by repeated intramuscular injection of at least ten milligrams of progesterone, the *corpus luteum* hormone, given at intervals no greater, and preferably less, than 48 hr. Inevitable abortion is associated with more or less haemorrhage, somewhat proportional to the duration of pregnancy, or with severe cramps, usually both. If evacuation of the uterus does not follow promptly, expert surgical removal of the abortus is indicated to prevent serious loss of blood. Similarly, in cases where only part of the products of conception is extruded, the rest should soon be removed surgically to avoid haemorrhage and infection.

In most civilized countries, medical ethics and the law permit the deliberate termination of pregnancy, called therapeutic abortion, when the mother's health, life or reason is clearly jeopardized by continuance of the pregnancy and in the rare cases when grossly defective offspring can surely be expected. British law in 1938 recognized rape as justification. Even severely oppressive socioeconomic conditions alone are not valid reasons. He who wilfully causes abortion, as well as anyone who contributes to the act, in the absence of the indications mentioned, is liable to conviction of crime. As of 1947, no medical abortifacient is known that is effective without seriously endangering the mother's life. Surgical destruction and preferably prompt removal of the conceptus is the only effective therapeutic measure. In spite of the legal hazard and maternal risk, induced abortion destroys probably about 16% of diagnosable pregnancies in the United States, and doubtless many more in some European countries. The over-all mortality rate of legitimate therapeutic abortion is about 1%, lowest during the first weeks of pregnancy, increasing with age of gestation. The undiscoverable death rate of criminal abortion must be high, for in the United States in 1943, abortion contributed to 16% of maternal deaths.

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ABORTION, CONTAGIOUS: see BRUCELLOSIS.

ABOUKIR, a village on the Mediterranean coast of Egypt, 14½ mi. northeast of Alexandria by rail. The meaning of the name is "Father Cyrus," who was a Coptic saint. Stretching eastward as far as the Rosetta mouth of the Nile is the spacious bay of Aboukir, where on Aug. 1, 1798, Nelson fought the battle of the Nile. Near Aboukir, on March 8, 1801, the British army, commanded by Sir R. Abercromby, landed from its transports in the face of strenuous opposition from a French force entrenched on the beach.

ABOUT, EDMOND FRANÇOIS VALENTIN (1828-1885), French novelist, publicist and journalist, was born Feb. 14, 1828, at Dieuze, in Lorraine. Among his college contemporaries at the École Normale were Taine, Francisque, Sarcey, Challengel-Lacour and Prévost-Paradol. Of them all About was, according to Sarcey, the most highly vitalized, exuberant, brilliant and "undisciplined." After a brief period spent at the French school in Athens he returned to Paris, and became an industrious and lively journalist. About's attitude toward the empire was that of a candid friend. He greeted the liberal ministry of Émile Olivier at the beginning of 1870 with delight, and welcomed the Franco-German War.

With the fall of the empire he became a republican, and, always an inveterate anticlerical, he fought against the conservative reaction which made progress during the first years of the republic. From 1872 onward for some five or six years his paper, the *XIX^e Siècle*, of which he was the heart and soul, became a power in the land. On Jan. 23, 1884, he was elected a member of the French academy, but died Jan. 16, 1885, before taking his seat. About's best work is to be found, not in the once famous *Roman d'un brave homme* (1880), but in the books that are almost wholly farcical, *Le nez d'un notaire* (1862); *Le roi des*

montagnes (1856); *L'homme à l'oreille cassée* (1862); *Trente et quarante* (1858); *Le cas de M. Guérin* (1862). Here his most genuine wit, his sprightliness, his vivacity and the fancy that was in him, have free play.

ABRABANEL, ISAAC, called also ABRAVANEL, ABRARBANEL (1437-1508), Jewish statesman, philosopher, theologian and commentator, was born at Lisbon of an ancient family which claimed descent from the royal house of David. Like many of the Spanish Jews he united scholarly tastes with political ability. He was a favourite of King Alphonso V, who entrusted him with important state business, but after his death in 1481 Abrabanel was compelled to flee to Spain, where he held for eight years (1484-92) the post of a minister of state under Ferdinand and Isabella. After the expulsion of the Jews from Spain in 1492 Abrabanel resided at Naples, Corfu and Monopoli, and in 1503 removed to Venice, where he was a minister of state till his death in 1508. Abrabanel was one of the first to see that for biblical exegesis it was necessary to reconstruct the social environment of olden times, and he skilfully applied his practical knowledge of statecraft to the elucidation of the books of Samuel and Kings.

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ABRACADABRA, a word analogous to Abraxas (*q.v.*) used as a magical formula by the Gnostics of the sect of Basilides in invoking the aid of beneficent spirits against disease and misfortune. It is found on Abraxas stones, which were worn as amulets. The Gnostic physician Serenus Sammonicus gave precise instructions as to its mystical use in averting or curing agues and fevers generally. Subsequently its use spread beyond the Gnostics, and in modern times it is applied contemptuously to complicated, unscientific hypotheses.

ABRAHAM or (Genesis xi, 26-xvii, 5) **ABRAM** is the progenitor of the chosen people, the "seed" of the "promised land," Canaan (Gen. xii, 7; xiii, 15; xv, 18, etc.). He was the

other hand in the New Testament it is declared that God can raise up children unto Abraham from stones (Matt. iii, 9), possibly an allusion to the myth of Deucalion and Pyrrha or to an Aramaic play upon words (*b'vîn* "sons," *abnîn* "stones"). To rest in Abraham's bosom, the bosom of the progenitor of the race, was the summit of eternal peace (Luke xvi, 22 *et seq.*).

The Different Accounts.—The stories in Gen. xi, 27-xxv, 11 belong to a larger whole. The basic conception upon which they are chosen and brought together is a single one. Despite all human opposition and despite all apparent despair and hopelessness, God holds forth his promise and brings to realization his scheme of salvation. Abraham, the bearer of this promise, is the pattern of peaceful and childlike faith, who stands firm against all dangers and disappointments. From the first his difficulties were exceedingly great.

He had to leave his home and people and, following the course of the sun, go on into a foreign land, the very name of which has not been told to him by God (Gen. xii, 1). The mighty Canaanites prevent his peaceful establishment (Gen. xii, 6), so he tarries in Shechem (xii, 6), Bethel (xii, 8), Hebron (xiii, 18), Gerar (xx, 1) and Beersheba (xxi, 33). At the very beginning he is compelled by a famine to leave Canaan and to go into Egypt, where his wife Sarai (Sara) is in danger through his untruth (Gen. xii, 10-20, *cf.* xx, 1-18, where the scene is Gerar). Hardly has he again settled in Canaan when dissensions among the shepherds bring a new danger, and he has to part from his only kinsman Lot. In calm trust in God, Abraham leaves the choice of locality to Lot (xiii, 9), who chooses the fruitful land on the other side beyond the borders of the promised land. Further difficulties arise when Lot falls into captivity (xiv) and, finally, into extreme danger, at the destruction of Sodom (ch. xix). Nevertheless here also Abraham's trustful confidence prevails, and he receives the promise of God in the form of a covenant (xv and xvii). There was to be born a son to the aged and childless couple and Abraham *believed*: his calm, childlike trust represents the just relation between man and God. This is the real meaning of the famous verse (Gen. xv, 6) with which, in the New Testament, the profoundest thoughts of the Christian doctrine of justification are connected (Rom. iv, 3; Gal. iii, 6).

A new side-issue is Abraham's marriage with Hagar, for the offspring of that union, Ishmael, cannot be heir (Gen. xvi, *cf.* xxi, 8 *et seq.*). Finally Isaac, "the son of promise," is born (xxi, 1 *et seq.*), and Abraham by means of a covenant with the king of Gerar gets a footing near the borders of the promised land (xxi, 22 *et seq.*). Then comes the severest test of his faith: the son of the promise must be willingly sacrificed! Even this test Abraham stands and God renews the promise (xxii), and yet toward the end of his days all that he has acquired as his estate is a grave (xxiii). This tomb of the Patriarch near Hebron is the sign that one day the whole territory shall belong to his descendants. Isaac, it it true, is still without an heir when Abraham dies in a good old age; and the old man's last thoughts concern themselves with the marriage of his son with a woman from his far-off home (xxiv). For Isaac is the heir, not Ishmael, or the children of Keturah; and Abraham has gained nought in the land of Canaan but a grave and his belief in the Promise.

Analysis of Sources.—These stories do not form a unity. The isolated stories whose concrete perspicuousness and brevity are unsurpassed are woven into a garland of sagas. They were collected in three or four larger works and finally put together in their present form, from the above-mentioned point of view. (See BIBLE: *Old Testament* and GENESIS.) To the latest work, the so-called Priestly Codex (P.), are ascribed Gen. xi, 27, 31, 32; xii, 4b, 5; xiii, 6, 11b, 12; xvi, 1a, 3, 15, 16; xvii; xix, 29; xxi, 1b, 2b-5; xxii; xxv, 7-11a. As the work of the Elohist (E) are reckoned chapters xv and xxiv (?) in part, and nearly all of chapters xx, xxi and xxii. The rest belongs to the works of the two Jahwists (J, *i.e.*, the older "Lay-source" [so Eissfeldt] and J). The accuracy of this analysis is, however, in some details doubtful. More important is the fact that the stories, despite many noticeable duplications (*cf.* xii, 10 *et seq.* and xx; xv and xvii; xvi and xxi), agree in all essentials. The etymological



ABRAHAM, THE FIRST OF THE GREAT BIBLICAL PATRIARCHS, BEING PRESENTED BY AN ANGEL FROM OFFERING UP HIS SON, ISAAC, AS A SACRIFICE. AFTER A RELIEF OF THE LIFE OF ABRAHAM ON THE DOORS OF THE BAPTISTERY, FLORENCE, BY GIBERTI

first of the three Patriarchs. He was extolled as "the Friend of God" (Isa. xli, 8; II Chron. xx, 7; *cf.* James ii, 23, and also the Mohammedan tradition), and as the "Father of the Faithful" (*cf.* Rom. iv, 11). To the present day the Jews trace their descent from him and from his progeny; who in accordance with the promise were to be as numerous as "the stars in the sky" (Gen. xv, 5) and "the sand on the sea shore" (Gen. xxii, 17). On the

explanations of names and word-plays are of fundamental importance as stylistic criteria.

Historical Value.—The style and content of the stories deviate from strictly historical writing. The narrative does not concern itself with the political, social and economic events and conditions in the life of the peoples (with the sole exception of xiv, on which see below), but with family idylls, delineated with an artist's love, the details of which, however, are beyond the reach of the historian. The question, therefore, of the real historical worth of the details is difficult to decide. On the other hand, scepticism as to the historicity of the patriarch himself goes too far. Some would suppose that the figure of Abraham owes its origin merely to the imagination of the poet; or that Abraham is merely a personification of the people who derived themselves from him, and that the sagas and legends concerning him and other patriarchs are only a reflection of later tribal history. According to other scholars, the heroic figure of Abraham is based on a Canaanite god who was worshipped in the holy trees of Shechem and Hebron. In this case the Israelites are supposed to have taken over the cult-centres and the rites; although, judging from their hatred of the earlier peoples, it is not very likely that they humanized their gods and heroes and regarded them as the progenitors of their own people. All these explanations, however, have an air of unreality about them. From beginning to end all that Abraham does and suffers is peculiar to individuals. Mythical outlines are wholly wanting, even miracles are not ascribed to him (in contrast, for example, to Moses). Even his human failings are not disguised (his untruth, xii, 13; xx, 2; his frailty, xvi, 6; his doubts, xvii, 17). Were his shape devised with something of the idea of establishing Israel's right to Canaan, one would look for some other sort of figure. According to the later sagas—some of which have been preserved—the Patriarchs were mighty heroes who conquered the land with signs and miracles, and held firmly to the later sacrificial and food laws. It is just the unfavourable traits in the characters of the Patriarchs and the undesirable traits in their lives, and the consciousness of a difference between the patriarchal and the Mosaic period as regards the idea of God and the cults, that must rest on an historical foundation.

The Two Names: Abram and Abraham.—The double name is peculiar, *Ab-ram* means "the father is exalted" or "the exalted father"; the word "Patriarch" is really nothing more than a Greek translation of this name. Lesser known bearers of the name were called *Abiram* (Num. xvi, etc.). *Ab-rāhām* is the new name which the patriarch received from God from the moment of the solemn covenant (Gen. xvii, 5). A new name—mostly with a slight variation (cf. Sarai-Sara, Hosea-Joshua, Eliakim-Jehoiakim, Saul-Paul)—indicates a new period in the life of the bearer. This name is explained in Gen. xvii, 5 as "Father of a Multitude," which in Hebrew would be *Ab-hamon*; but the second part of the compound is preferably compared with an Arabic word for "crowd" (*rūhām*). This explanation is however probably a popular etymology; it is most probable that the two names Abram and Abraham mean precisely the same thing. *Abram* may be the Accadian (Babylonian) and *Abraham* the Amorite (Canaanite) form of the same name. It is among the Amorite peoples in Babylonia during the first dynasty that names are found like *Abaram*, *Abam-rama*, and probably even *Aba-raham* (cf. for the last form Lutz, *Early Babylonian Letters from Larsa* [1917], No. 15). Thus it seems that this name was in use in Abraham's old Babylonian home, the regions of Ur and Larsa.

Chronological Questions.—For determining the date of Abraham the 14th chapter of Genesis is the starting point. In this noteworthy chapter are given the names of kings and lands, and Abraham appears as a warlike hero. The identification of these kings with the great Babylonian king Hammurabi and those of his time would seem to be erroneous. It is probable that the chapter deals with a punitive expedition undertaken by two princes of the middle Euphrates (*Amraphel*; i.e., *Amur-apil* and *Arioch* or *Ariaka*) in the service of the allied kings of *Khatti* (*Tid'al*; i.e., *Tid'alia*, *Dudhalia*). They were beaten by the attack of a much smaller number of Hebrews under Abraham; it was

the unforgettable first military exploit of this people on Canaanite soil. Now, of these kings we know from the cuneiform inscriptions that *Tid'al I* was the founder of a dynasty of the kingdom of the Hittites (*Khatti*), and that he lived somewhere about 1550 B.C. (or at the latest 1450 B.C.). It is therefore probable that we must place the time of Abraham about this date. With this agrees the little that is known of the political life of the dark age after the downfall of the Hyksos kingdom. The biblical chronology does not actually contradict this late dating, for the dates in Gen. xxi, 5; xxv, 26; xlvii, 9; Exod. xii, 40 and 1 Kings vi, 1 belong to an artificial scheme, whereby precisely 12 centuries elapse from the birth of Abraham to the building of Solomon's temple. To make up these 12 centuries the length of a generation was reckoned first as 100 years, then as 40. But the older literary sources in the Old Testament give another picture; above all, the genealogical tables present good ancient evidence. On the basis of statements such as are found in Gen. xv, 16; xxxvi, 31–39 (cf. Num. xx, 14); Gen. i, 23; Exod. vi, 16–20, Ruth iv, 18–22, the period between Abraham and David must at the most be reckoned as 600 years, probably much shorter.

From the historical point of view Abraham's journey from Mesopotamia to Canaan is directly bound up with the wandering of the Moabites, Ammonites and Edomites to the southwest and southern Canaan, and with the wandering of the Aramaeans to Syria. An invasion by the non-Semitic tribes of the Mitanni and Kharri (about 1600 B.C.) expelled these Hebrews and Aramaeans from their old homes on the middle Euphrates, in a south-westerly direction. In the course of this migration individual Hebrew families (viz., Abraham and his kindred) came to Canaan; but there was no intention in the first instance of conquering this ancient land of culture.

The Religious Significance.—It has been shown that Abraham's journey from Ur (Gen. xi, 28) *via* Haran (xi, 31) to Canaan was merely a part of a greater movement of peoples. But, according to Biblical tradition, this journey had a precise objective and aim; God's direct command already contained a religious motive (Gen. xii, 1 *et seq.*). Abraham is no leader of a Bedouin tribe seeking plunder and conquest; his significance lies rather in the field of religion. He is not, in the first instance, the progenitor of the people but the founder and leader of a religious movement. Like Mohammed, some 2,000 years later, he stood at the head of a great movement among the Semitic peoples and tribes. Naturally, his adherents were bound to each other firmly by blood ties. Abraham's religion was characterized by abstraction and was yet personal. The *one* great God, throned in heaven, honoured without priests and temple, the Almighty and all-comprehending One, to whom the faithful have personal access—this is Abraham's God so far as we can gather from our sources. And that is more important for us than the question of the details of the tradition. While Abraham's forefathers in Mesopotamia served other gods (Josh. xxiv, 2), "The God who redeemed Abraham" was the same as the God of Moses (cf. Exod. iii, 6, 13 *et seq.*) and of Elijah (1 Kings, xviii, 36). According to the Old Testament, Abraham was the founder of the Israelite faith, and Moses the founder of the nation's thought and reformer of the cultus. See GENESIS.

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ABRAHAM, WILLIAM (1842–1922), British Labour politician of the old school, was born in the Afon valley and went to work in a coal mine at the age of nine. He was affectionately known by the name of Mabon, a name originally adopted by him in Eisteddfod competitions. President of the South Wales Miners' federation, he was a power in South Wales, and he remained a

respected figure to the end. He sat in the house of commons for Rhondda from 1885 to 1920 and died on May 14, 1922.

ABRAHAM, THE PLAINS OF, a plateau to the southwest of the city of Quebec, the scene of the historic battle between the French under Montcalm and the English under Wolfe on Sept. 13, 1759. (See QUEBEC.)

ABRAHAM A SANCTA CLARA (1644-1709), Austrian divine, was born at Kreenheinstetten, near Messkirch. His real name was Ulrich Megerle. In 1662 he joined the order of Barefooted Augustinians, became a popular preacher and assumed the name by which he is known. In this order he rose step by step until he became *prior provincialis* and *definitor* of his province. He died at Vienna on Dec. 1, 1709. In his published writings he displayed the same force and homeliness as in the pulpit.

BIBLIOGRAPHY.—His works have been several times reproduced in whole or in part, though with many spurious interpolations. The best edition is that published in 21 vol. at Passau and Lindau (1835-54). See Th. G. von Karajan, *Abraham a Sancta Clara* (Vienna, 1867); H. Maret, *Über Judas d. Erschehm* (Vienna, 1875); Schnell, *Pater A. a. S.C.* (Munich, 1895); Sexto, *Abraham a S.C.* (Sigmaringen, 1896); Blanckenburg, *Studien über die Sprache Abrahams a S.C.* (Halle, 1897).

ABRAHAM IBN DAUD (c. 1110-80), Jewish historiographer and philosopher of Toledo. His historical work was the *Book of Tradition* (*Sepher Haqabala*), a chronicle down to the year 1161. It was translated into Latin by Gênébrad (1519). His philosophy was expounded in an Arabic work better known under its Hebrew title *'Emunah Ramah* (*Sublime Faith*). This was translated into German by Weil (1882). Ibn Daud was one of the first Jewish scholastics to adopt the Aristotelian system. Maimonides owed a good deal to him.

ABRAHAMITES, a sect of deists in Bohemia in the 18th century, who professed to be followers of the precircumcised Abraham. Believing in one God, they contented themselves with the Decalogue and the Paternoster. Declining to be classed either as Christians or Jews, they were excluded from the edict of toleration promulgated by the emperor Joseph II in 1781, and were deported to various parts of the country, the men being drafted into frontier regiments. Some became Roman Catholics, and those who retained their "Abrahamite" views were not able to hand them on to the next generation. As a religious sect they disappeared by the end of the century.

ABRAHAM-MEN, the nickname for vagrants who infested England in Tudor times. The phrase is as old as 1561, and was due to these beggars pretending that they were patients discharged from the Abraham ward at Bedlam.

On his discharge the genuine Bedlamite, provided he wore a badge, was allowed to roam the country, soliciting alms. This humane privilege was grossly abused, and thus gave rise to the slang phrase "to sham Abraham."

ABRANTES, a town of central Portugal, in the district of Santarem, formerly included in the province of Estremadura. It is on the right bank of the river Tagus, at the junction of the Madrid-Badajoz-Lisbon railway with the Guarda-Abrantes line. Pop. (1940), 4,170. Abrantes, which occupies the crest of a hill covered with olive woods, gardens and vines, is a fortified town, with a thriving trade in fruit, olive oil and grain. As it commands the highway down the Tagus valley to Lisbon, it has usually been regarded as an important military position. Originally an Iberian settlement, founded about 300 B.C., it received the name Aurantes from the Romans; perhaps owing to the alluvial gold (*aurum*) found along the Tagus.

Roman mosaics, coins, the remains of an aqueduct, and other antiquities have been discovered in the neighbourhood. Abrantes was captured on Nov. 24, 1807, by the French under Gen. Andache Junot, who for this achievement was created duke of Abrantes. By the Convention of Cintra (Aug. 22, 1808) the town was restored to the British and Portuguese.

ABRASIVES. Abrasion is a scratching action and depends on the relative hardness of the two materials—the abrasive and the one abraded. The degree of hardness of a material, as determined by scratching, has long been used by mineralogists for distinguishing one mineral from another, and F. Mohs in 1820

devised a scale of hardness for minerals, which is still in use. Mohs's scale is:—

- | | | |
|-------------|-------------|-------------|
| 1. Talc | 5. Apatite | 8. Topaz |
| 2. Gypsum | 6. Feldspar | 9. Corundum |
| 3. Calcite | 7. Quartz | 10. Diamond |
| 4. Fluorite | | |

Diamond at No. 10 is the hardest of all minerals and indeed of all known substances. Steel (a knife-blade or file) will scratch feldspar but not quartz, and it is itself scratched by quartz; it can therefore be set at 6½ on the scale. Window-glass at 5½ can be abraded and polished by feldspar. The higher a material stands in the scale the more efficient is it as an abrasive, diamond being the most efficient of all.

Mohs's scale is arbitrary and merely comparative, and it gives no absolute measure of the degree of hardness of a material. Attempts have been made to arrive at this by various methods: such as by measuring under a microscope the depth of scratch produced by a diamond point under a certain load; or by determining the amount of work done in grinding away a certain weight or volume of material. From such experiments it is found that the gap between 10 and 9 on Mohs's scale is even greater than that between 9 and 1, emphasizing again the efficiency of diamond as an abrasive.

Brittleness or friability is another physical character to be considered in addition to hardness. Carborundum although exceeding corundum in hardness is much more brittle, and it soon crushes and rubs down to a fine flour. Diamond with rough usage breaks along the directions of perfect cleavage in the crystal. For this reason carbonado, a compact aggregate of minute diamond crystals, rather than a single crystal, is used in rock-drills.

The form in which abrasives are used varies for different purposes. The material may be crushed and sieved to different degrees of fineness. This may be used as a loose powder for grinding; or it may be glued on cloth or paper, or bonded with cements in the form of grinding wheels or hones. Other abrasives are used in block form cut to a suitable shape, as grindstones, millstones, scythestones, whetstones, pumice blocks, etc. Besides being used for grinding and polishing metal, stone, wood, leather, etc., abrasives are also employed for cutting, drilling and boring.

In addition to natural minerals, certain artificial products are also used for abrasive purposes. For example, powdered glass as glass paper, crushed steel for stone cutting, and the important carborundum. Corundum is also produced artificially on a large scale. Carbides of boron, tantalum and tungsten are extremely hard, and these may in the future find technical applications.

In the following list the various abrasive agents are arranged according to their degree of hardness, *i.e.*, in the order of their efficiency. Further information respecting each of these materials will be found in the separate articles (see DIAMOND, etc.).

Diamond (Hardness = 10). This is a crystallized form of carbon, and only the natural mineral is available. Cloudy, spotted and imperfectly crystallized stones, known as bort, and small fragments that cannot be cut as gems are crushed to powder for use as an abrasive. Diamond powder is the only material with which diamond itself can be ground and polished.

Carborundum (H.=9½). This artificial product is a crystallized carbide of silicon (CSi), and since its discovery in 1891 it has more and more replaced mineral abrasives. It is produced in large quantities by heating coke and sand in electric furnaces. It is used in the form of powder either loose or on cloth, or is made up with porcelain, shellac or other bonding material in the form of grinding wheels, hones, etc. This material is sold under a variety of trade names—crystolon, carbolon, samite, etc.

Corundum (H.=9) is the crystallized oxide of aluminum (Al₂O₃), a mineral which in its gem varieties is ruby and sapphire. Rough corundum is found as large crystals in certain kinds of igneous rock in Canada, North Carolina, Ural mountains, Madagascar, and South Africa, the last being now the principal producer of material for abrasive purposes. *Emery* is an impure granular variety of corundum mixed with magnetite and other minerals, and it is not quite so hard as the purer crystal or rock corundum. It is mined in Naxos, Asia Minor and the state of New

York. Much corundum is now produced artificially by fusing bauxite in electric furnaces, the product being sold under the names alundum, adamite, aloxite, lionite, etc.

Garnet ($H.=6\frac{1}{2}$ – $7\frac{1}{2}$) as mined in the eastern United States and in Spain for abrasives is mainly the almandine variety, a silicate of iron and aluminum. It is largely used for making garnet paper (often sold as emery paper).

Quartz ($H.=7$) is a crystallized form of silica (oxide of silicon, SiO_2) and is the commonest of all minerals, occurring in a bewildering variety of forms. It finds extensive applications as an abrasive. Millstones, grindstones and pulpstones (for grinding wood in the manufacture of paper) are made of quartzite, burrstone, grit or sandstone. Whetstones are made of hornstone, Lydian stone, Arkansas stone, and other compact varieties of quartz. In the form of sand, quartz is used as a sandblast, as sandpaper, in scouring soap, and for cutting and grinding marble. Pebbles and flints are used for grinding cement materials and clinker.

Steel ($H.=6\frac{1}{2}$). Crushed crucible steel, crushed cast iron and steel shot are used in stone cutting.

Feldspar ($H.=6$), the potash-feldspar, orthoclase or microcline ($KAlSi_3O_8$), is used for polishing plate glass and in scouring soaps.

Glass ($H.=5\frac{1}{2}$), powdered glass as glass paper or sandpaper.

Pumice ($H.=5\frac{1}{2}$), a natural volcanic glass blown by included steam into a cellular mass. The best block pumice is from the Lipari Islands, and enormous quantities of pumice-dust are available in the United States.

Opal ($H.=5$), a hydrated glassy form of silica, found in a powdery form as large deposits of tripoli, diatomaceous or infusorial earth, and largely used for polishing and in scouring soap.

Rottenstone, chalk, rouge, putty powder and other softer grinding and polishing materials might also be mentioned.

Abrasives, in the household, are substances of an erosive nature used for polishing or cleaning purposes. Those best suited for this use are fine sand, emery, crushed pumice and chert, which consists of siliceous skeletons of sponges and marine shells. These materials are often mixed with a solution of soap, so that there is a cleansing action as well. In the cleaning of aluminum, steel wool, in combination with an abrasive powder or soap, has a wide usage. Abrasives are in very general use and have done much to lighten the housewife's work. They may be purchased in paste, powder or cake form and used for cleaning and polishing all kinds of metals, as well as scouring paint and enamelware.

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ABRAUM SALTS (from the German *Abraum-salze*, salts to be removed), the name given to a mixed deposit of salts, including chlorides and sulphates of sodium, potassium and magnesium, found in association with rock salt at Stassfurt in Prussia.

ABRAXAS or **ABRASAX**, a word probably first used by the Basilidians and engraved on certain antique stones, called on that account "Abraxas stones." The letters of ἀβραξάς in the Greek notation make up the number 365, and the Basilidians gave the name to the 365 orders of spirits which emanated in succession from the supreme being. These orders were supposed to occupy 365 heavens, each fashioned like but inferior to that above it, the lowest being the abode of the spirits who formed the earth and its inhabitants, to whom was committed the administration of its affairs. In addition to the word Abraxas the stones often have cabalistic figures engraved on them.

ABROGATION, the annulling or repealing of a law by legislative action or by usage. Abrogation, which is the total annulling of a law, is to be distinguished from the term *derogation*, which is

used where a law is only partially abrogated. Abrogation may be either express or implied. It is express either when the new law pronounces the annulment in general terms, as when in a concluding section it announces that all laws contrary to the provisions of the new one are repealed, or when in particular terms it announces specifically the preceding laws which it repeals. It is implied when the new law contains provisions which are positively contrary to the former laws without expressly abrogating those laws. The abrogation of any statute revives the provisions of the common law which may have been abrogated by that statute. (See STATUTE; REPEAL.)

ABRON, a longheaded tribe, physically akin to the Fanti, living on the Ivory Coast (Bondoukou region) and between Kintampo and Salaga, Gold Coast. The natives are husbandmen and traders, and they practise Animism. There are small kingdoms made up of several provinces. The family is constituted by several subgroups which embrace a number of households. Marriage between cross-cousins is frequent. Descent is reckoned in the paternal lines. Inheritance passes to the maternal uncle, then to the nephew, the sister's son. Society consists of (1) nobles, (2) freemen, and (3) slaves and descendants of slaves. The judiciary organization is fairly well developed.

See Tauxier, *Le Noir de Bondoukou* (1921).

ABRUZZI, DUKE OF THE (1873–1933), Italian vice-admiral and explorer, son of Amadeo, duke of Aosta, was born at Madrid Jan. 29, 1873, and named Luigi Amadeo. Although he had a distinguished naval career he achieved fame also as a traveller and mountaineer. He was the first to ascend Mt. St. Elias in Alaska (1897) and in 1899 he organized a North Pole expedition, part of which reached lat. $86^{\circ} 3'$ N., at that time the record of northern exploration, he himself being forced to remain behind owing to frostbite. In 1906 he was the first to ascend the Ruwenzori in East Africa, reaching the twin summits (16,795 ft.) which he named Margherita and Alexandra. He also made the first detailed map of the Ruwenzori. In 1909 he ascended K 2 in the Himalayas to an altitude of over 20,000 ft. and on July 18 Bride peak to 24,600 ft. During World War I he commanded the naval forces in the Adriatic, but he resigned in 1917 owing to disagreements with Admiral Thaon di Revel, his chief of staff, and retired from the service. Afterward he undertook to carry out an important colonization scheme in Italian Somaliland.

English translations of his works are *The Ascent of Mount St. Elias* (1900); *Ruwenzori* (1909).

ABRUZZI E MOLISE, a group of provinces (*compartimento*) of south central Italy. The area is 5,954 sq.mi. and the population (1936) 1,600,631. The interior is mountainous including the central portion of the Apennines and their culmination, the *Gran Sasso d'Italia*. The coastal hills consist mainly of somewhat unstable clay and sand; the zone of level ground along the coast is quite inconsiderable. The 100 mi. of coast have not a single harbour of importance. Climate varies with altitude, the highest peaks being covered with snow for most of the year, while the valleys running northeast toward the sea are fertile and well watered by several small rivers, the chief of which are the Tronto, Vomano, Pescara, Sangro, Trigno and Biferno. These are fed by minor streams, such as the Aterno and Gizio, with valleys between the main chains of the Apennines. They may be suddenly swollen by rains, and floods and landslips often cause damage. This danger has been increased, as elsewhere in Italy, by indiscriminate timber-felling without provision for reforestation, though considerable oak, beech, elm and pine forests still exist and are the home of wolves, wild boars and even bears. The woods have large herds of swine, and the hams and sausages of the Abruzzi are famed. The rearing of cattle and sheep was at one time the chief occupation, and many flocks are still driven down to the Campagna di Roma for the winter and back again in the summer, but more cultivation is now done, especially in the valleys and in the now drained bed of Lago Fucino where beet sugar is produced. Industries are small but various: e.g., arms and cutlery at Campobasso and Agnone and majolica at Castelli and elsewhere. Liqueurs are also made in several places. The river Pescara and its tributary the Tirino form an important source of power for generating elec-



BY COURTESY OF THE BRITISH MUSEUM
OBVERSE AND REVERSE OF AN
ABRAXAS STONE ATTRIBUTED TO
THE BASILIDIANS

tricity. Communications are not easy. Railways are (1) the coast railway (a part of the Bologna-Brindisi line), with branches from Giulianova to Teramo and from Ternoli to Campobasso; (2) a line diverging S.E. from this at Pescara and running via Sulmona (whence there are branches via Aquila and Rieti to Terni, and via Carpinone to [a] Isernia and Caianello, on the line from Rome to Naples, and [b] Campobasso and Benevento), and Avezzano (whence there is a branch to Roccasecca) to Rome, (3) a connecting line between the coast (at Ortona and S. Vito Lanciano) and the line from Sulmona to Isernia (at Castel di Sangro). There are, consequently, no large towns. The district was, in Lombard times, part of the duchy of Spoleto and, under the Normans, a part of that of Apulia; it was first formed into a single province in 1240 by Frederick II who placed the *Justiciarius Aprutii* at Sulmona and founded the city of Aquila. After the Hohenstaufens lost their Italian dominions the Abruzzi became a province of the Angevin kingdom of Naples, to which it was of great strategic importance.

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ABSALOM, the third son of David, and his father's favourite. The picture presented in II Sam. xiii-xix (which deals mainly with his life) suggests that he was the Alcibiades of the Old Testament, alike in his personal attractiveness, his lawless insolence and his tragic fate. He is first mentioned as murdering his half-brother Amnon, David's eldest son, in revenge for the rape of his full sister Tamar. This deed drove him into banishment, but he was eventually restored to favour through the good offices of Joab. Later, when some uncertainty seems to have arisen as to the succession, Absalom organized a revolt. For a time he seemed to be completely successful; David with a few followers and his personal guard fled across the Jordan, leaving to Absalom Jerusalem and the main portion of the kingdom. The usurper pursued the fugitives with his forces but was completely defeated in "the wood of Ephraim" (apparently west of Jordan, if the text be right), and killed by Joab, who found him caught by the hair in an oak tree. To the affectionate chivalrous heart of David, the loss of his son, worthless and treacherous as he was, brought grief which more than outweighed his own safety and restoration.

ABSALON (c. 1128-1201), Danish archbishop and statesman, was born about 1128, the son of Asser Rig of Fjenneslev, at whose castle he and his brother Esbjorn were brought up with the young prince Valdemar, afterward Valdemar I. He was sent later to the University of Paris. Absalon first appeared in Saxo's chronicle as a fellow-guest at Roskilde, at the banquet given in 1157 by King Sweyn to his rivals, Canute and Valdemar. Both Absalon and Valdemar narrowly escaped assassination at the hands of their treacherous host on this occasion, but at length escaped to Jutland, where Sweyn followed them, to be defeated and slain at the battle of Grathe Heath.

In the same year (1158) in which Valdemar ascended the Danish throne, Absalon was elected bishop of Roskilde. Henceforth Absalon was the chief counsellor of Valdemar, and the promoter of that imperial policy which, for three generations, was to give Denmark the dominion of the Baltic. Briefly, it was Absalon's intention to clear the northern sea of the Wendish pirates, who inhabited that portion of the Baltic littoral which we now call Pomerania, and ravaged the Danish coast so unmercifully that at the accession of Valdemar one-third of the realm of Denmark lay waste and depopulated. The very existence of Denmark demanded the suppression and conversion of these stiff-necked pagan freebooters, and to this double task Absalon devoted the best part of his life.

The first expedition against the Wends, conducted by Absalon in person, set out in 1160, but it was not till 1168 that the chief Wendish fortress, at Arkona in Rügen, containing the sanctuary of their god Svantevit, was surrendered, the Wends agreeing to accept Danish suzerainty and the Christian religion at the same time. From Arkona Absalon proceeded by sea to Garz, in South

Rügen, the political capital of the Wends, and an all but impregnable stronghold. But the unexpected fall of Arkona had terrified the garrison, which surrendered unconditionally at the first appearance of the Danish ships. Absalon, with only Sweyn, bishop of Aarhus, and 12 "housecarls," thereupon disembarked, passed between a double row of Wendish warriors, 6,000 strong, along the narrow path winding among the morasses, to the gates of the fortress, and, proceeding to the temple of the seven-headed god Rügievit, caused the idol to be hewn down, dragged forth and burned. The whole population of Garz was then baptized, and Absalon laid the foundations of 12 churches in the isle of Rügen.

The destruction of this chief sally-port of the Wendish pirates enabled Absalon to reduce considerably the Danish fleet. But he continued to keep a watchful eye over the Baltic, and in 1170 destroyed another pirate stronghold, farther eastward, at Dievenow on the isle of Wollin. Absalon's last military exploit was the annihilation, off Strela (Stralsund), on Whitsunday 1184, of a Pomeranian fleet which had attacked Denmark's vassal, Jaromir of Rügen.

He was now only 57, but his strenuous life had aged him, and he was content to resign the command of fleets and armies to younger men, like Duke Valdemar, afterward Valdemar II, and to confine himself to the administration of the empire which his genius had created. The aim of his policy was to free Denmark from the German yoke. It was contrary to his advice and warnings that Valdemar I rendered fealty to the emperor Frederick Barbarossa at Dôle in 1162; and, when, on the accession of Canute V in 1182, an imperial ambassador arrived at Roskilde to receive the homage of the new king, Absalon resolutely withstood him.

"Return to the emperor," cried he, "and tell him that the king of Denmark will in no wise show him obedience or do him homage."

As the archpastor of Denmark, Absalon also rendered his country inestimable services, building churches and monasteries, introducing the religious orders, founding schools and doing his utmost to promote civilization and enlightenment. It was he who held the first Danish synod at Lund in 1167. In 1178 he became archbishop of Lund, but very unwillingly, only the threat of excommunication from the Holy See finally inducing him to accept the pallium. Absalon died on March 21, 1201, at the family monastery of Soro, which he himself had richly embellished and endowed.

Absalon remains one of the most striking and picturesque figures of the middle ages, and was equally great as churchman, statesman and warrior. There can be no doubt that he enjoyed warfare; and his splendid physique and early training had well fitted him for martial exercises. He was the best rider in the army and the best swimmer in the fleet. Yet he was not like the ordinary fighting bishops of the middle ages, whose sole concession to their sacred calling was to avoid the shedding of blood by using a mace in battle instead of a sword. Absalon never neglected his ecclesiastical duties, and even his wars were of the nature of crusades. Moreover, all his martial energy notwithstanding, his personality must have been singularly winning; for it is said of him that he left behind not a single enemy, all his opponents having long since been converted by him into friends.

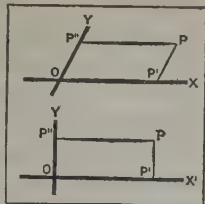
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(R. N. B.)

ABSCCESS, a localized collection of pus in tissue spaces, hollow viscera or body cavities. It is formed as the result of infection with pus-forming (pyogenic) organisms; there is local heat, redness, swelling and pain. The cells die and the centre of the inflammatory mass liquefies to form pus which may break through the wall of the abscess or be emptied by incision. Various names are applied according to the location and the causative organism. The term "cold abscess" designates a localized collection of pus, caused by the bacillus of tuberculosis.

(See BACTERIAL AND INFECTIOUS DISEASES; INFLAMMATION AND ITS SEQUELS.) (F. L. A.)

ABSCISSA. In Cartesian co-ordinates (*see* CO-ORDINATES) the abscissa of a point (P) is the part (OP') of the X axis lying between the origin (O) and the point (P') where a line (PP') parallel to the Y axis cuts the X axis. In each of the two figures, the line segment $P'P$ is also called the abscissa of P . The axis of X (OX) is called the axis of abscissas. The term was used in its technical sense by Pietro Mengoli in 1659.



ABSCISSION, a tearing away, or cutting off; a term used sometimes in prosody for the elision of a vowel before another, and in surgery, especially of the eye, for removal of projections of a diseased cornea; in botany, the separation of spores by elimination of the connection.

ABSCOND, to depart in a secret manner; in law, to remove from the jurisdiction of the courts or so to conceal oneself as to avoid their jurisdiction. A person may abscond either for the purpose of avoiding arrest for a crime (*see* ARREST) or for a fraudulent purpose, such as the defrauding of his creditors (*see* BANKRUPTCY).

ABSENCE, the fact of being away, either in body or mind. The special occasion roll call at Eton college which the boys attend in their tall hats is called absence. A soldier must get leave of absence before he can be away from his regiment. Seven years' absence with no sign of life either by letter or message is held, by English law, to be presumptive evidence of death.

ABSENTEE OWNERSHIP, a term to which specialized usage has given different meanings freighted with social and economic implications not inherent in a literal interpretation of the phrase. The earliest such usage identified absentee ownership with proprietors of land who did not reside on their estates, yet demanded and enjoyed incomes from them. This practice, exercised in greater or less degree, has probably always existed where there was private ownership of land. Classical writers mention it. It is present in the history of landholding in Hungary, Poland, Russia and other countries of central and eastern Europe, and in parts of the orient, notably India. But students of western thought and institutions know it best through the criticism levelled at the absentee owners among the court nobility of pre-Revolutionary France (though their significance is somewhat minimized by the increased importance given by modern writers to resident country nobles and peasant proprietors); and in connection with Irish lands in the 19th century.

In the main the practice has met popular disfavour, sometimes on economic, often on social and ethical grounds. The basic assumption was that absentee landlords lacked the personal interest and contact believed conducive to the well-being of a tenant population. But in 19th-century England where charges against absentee English landlords who exploited their Irish tenantry brought the subject into the field of economic theory and speculation, the arguments were not all on one side. Some economists defended the practice, not so much as protagonists, as in denial of its responsibility for many of the ills laid at its door. But it was probably the Land Purchase acts and other remedial measures that led to a lessening of interest in the subject by the end of the century.

The first quarter of the 20th century saw the term carried over into the field of business enterprise and industry. A theory developed chiefly among certain U.S. economists held that "captains of industry" who, by means of investments managed through corporate organization and financial combines, kept a controlling influence over industrial prices and output while not themselves participating in industry, were the most powerful absentee owners of modern times. Thorstein Veblen, social and economic philosopher who pointed up the possible social ills likely to accrue from this practice, did much to enhance the usage of the term though he was not alone in its propagation.

It was the belief of the Veblen school that the cleavage which had grown up between industrial work and business enterprise was responsible for the absentee feature of this type of ownership. And it was in this division that Veblen saw the possibility of all

manner of social ills. These would, if and when production should outrun markets, lead to action that would in time bear heavily on the underlying population and others engaged in the working processes of industry. Another practice also described as absentee ownership, though of different origin, was that involving the private ownership of public resources. The U.S. exploitation of public lands was a flagrant example. These ideas were strongly challenged, and they also had stout defense.

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ABSENTEE VOTING, U.S. was first provided for by state legislation during the Civil War, when 11 Union states permitted men on leave for military duty to vote in the federal election by absentee ballot or by proxy. There were then about 2,000,000 men under arms, of whom about 150,000 voted. But although more than three-fourths of the soldiers voted for the re-election of their commander in chief, Pres. Abraham Lincoln, their total vote scarcely affected the general outcome.

In 1896 a law was passed in Vermont inaugurating the use of the absentee ballot by civilians and five years later a similar measure was passed in Kansas. By 1917 citizens of 28 states had acquired the privilege and in 1942 all states except Delaware, Kentucky and New Mexico had absentee voting laws of one kind or another. Legal bases for absentee voting included such duties, businesses or occupations as those of commercial travellers, railroad and marine employees, federal employees and their wives, college and university students and faculties, actors, inmates of veterans' homes and hospitals and members of the regular army. Not all laws, however, were equally comprehensive nor did all apply to military personnel.

There was relatively little interest in the soldier vote during the Spanish-American War or World War I. During the latter, some legislation was discussed, but no action was taken and the war department announced that there would be no voting overseas. It did, however, co-operate with those states which provided machinery for absentee voting within the U.S.

Less than a year after the U.S. entry into World War II, the nation approached the congressional elections of 1942 with an armed force of about 5,500,000 at home and abroad. In an effort to simplify matters for absent soldiers, congress passed a Soldiers Vote law on Sept. 16. Mailing of request cards for state ballots was undertaken by the war department and personal registration as well as the poll tax requirements of eight states (Ala., Ark., Ga., Miss., S.C., Tenn., Tex. and Va.) were waived. Nevertheless, the law proved inadequate and of the more than 100,000 who requested ballots, only 28,051 received them and returned them in accordance with their various state law requirements. Efforts to secure more effective legislation were renewed in 1943.

By 1944 there were an estimated 9,225,000 service men and women of voting age scattered throughout the world and a method of ensuring them the vote became a point of controversy between the president and congress. The constitution leaves the qualifications of voters and the machinery for voting (except as modified by the 14th, 15th and 19th amendments) to the various states. Pres. Franklin D. Roosevelt advocated a short federal ballot to which objections were raised on both political and constitutional grounds. First, the Roosevelt-Dewey election promised to be a close contest and the Republicans feared that the great majority of soldiers would vote for their commander in chief, throwing the margin of victory to the Democrats. Second, in spite of the 1942 law, many of the states (especially in the south) protested anew against the encroachment on their traditional rights, since a federal ballot would enfranchise thousands who could not qualify under state laws and requirements such as the poll tax.

Many bills were debated and at last a compromise was arrived at (though not signed by the president who protested its limited character) which became law on March 31. It provided for a short federal ballot for citizens of such states as approved its use, and then, only if the soldier had applied for a state ballot by Sept. 1 and had not received it by Oct. 1. Those eligible in-

cluded members of the army, the navy, the merchant marine and civilian personnel overseas who were in the service of the government or attached to service units, such as members of the Red Cross, the U.S.O., etc. The law called for the creation of a War Ballot commission composed of the secretary of war, the secretary of the navy and the administrator of the War Shipping administration. This body was charged with the printing, distribution and collection of absentee ballots and the mailing of post-card requests for ballots.

Twenty states approved the federal ballot, namely: Calif., Conn., Fla., Ga., Me., Md., Mass., Mich., Neb., N.H., N.J., N.M., N.C., Okla., Ore., R.I., Tex., Utah, Vt. and Wash. Use of the federal ballot within the U.S. was limited by the law to voters of such states as provided no machinery for absentee soldier voting, but as all 48 states had made such provision by Nov. 1944, the short federal ballot was in effect available only to overseas personnel. Blank ballots were distributed by the War Ballot commission with space for writing in the name or party of candidates for president, vice-president and members of congress. About 4,400,000 absentee ballots, state and federal, were cast by military personnel at home and abroad. In the seven states where data was tabulated separately for civilian and soldier vote the results showed that, despite earlier forecasts, the vote was approximately as close in one category as in the other.

ABSINTHE, a highly toxic liqueur or aromatized spirit, the characteristic flavouring matter of which is derived from various species of wormwood (*Artemisia absinthium*). Among the other substances generally employed in its manufacture are angelica root, sweet flag, dittany leaves, star-anise fruit, fennel and hyssop. The Swiss variety has a higher alcoholic strength than the French. The best absinthe contains 70% to 80% of alcohol. It quickly intoxicates, and its deleterious effects are more serious than those of other forms of alcohol. The wormwood acts powerfully upon the nerve centres, and causes delirium and hallucinations, followed in some cases by idiocy. (See LIQUEURS.)

ABSOLUTE. The term absolute is frequently used in contrast with the terms relative, comparative, conditioned, etc.

Absolute and Relative, Etc.—(1) Sometimes the contrast intended is that between what expresses a relationship and what does not. In logic, for instance, a term is described as relative when its function is to indicate some definite relationship in which the object named stands to some other object denoted by the correlative term. Thus teacher is called a relative term because it indicates the relationship in which somebody, say Socrates, stands or stood to somebody else, for instance, Plato, who is consequently designated by the correlative term disciple, or pupil. But a term that indicates no relationship is called absolute. Thus the names Socrates and Plato are called absolute terms because they do not indicate any definite relationship in which Socrates and Plato stood to each other. (2) More commonly the contrast intended is that between what a thing is relatively to something else (or in comparison with certain other things) and what it is in itself (that is, apart from such comparisons), or absolutely. In this sense one sometimes contrasts what is relatively or approximately true with what is absolutely true, or what is comparatively beautiful, or large, or old, etc., with what is absolutely so. (3) Intimately connected with the preceding distinction between absolute and relative, etc., is yet another distinction, which is perhaps the commonest of all. This is the contrast between what is subject to certain reservations or conditions and what is not subject to conditions or reservations. Thus, for example, relative success may mean success under certain difficult circumstances, while absolute success would mean complete success, without any reservations. In this way absolute monarchy means monarchical government not subject to any conditions or reservations, whereas constitutional monarchy means monarchical government subject to certain reservations or restrictions formulated in the constitution of the country. Similarly a system of ethics conceived to be valid for all times under all conditions would be described (by H. Spencer, for instance) as absolute, whereas a system of ethics conceived to be valid only under certain conditions of time, place or circumstance, would be called

relative, or local, or temporary, etc. (4) The foregoing distinction naturally leads to yet another distinction; namely, that between that which is conditioned by, or dependent on, something else and that which is independent of, or unconditioned by, anything else. In philosophy, absolute frequently means independent or unconditioned. When certain philosophers speak of absolute truth, or of absolute value, they mean that there are truths, or values, as the case may be, that are objective, independent or self-dependent, and not relative to, or dependent upon, individual thinkers or seekers.

The Absolute.—This term owes its great vogue in recent times mainly to the German Idealists (Immanuel von Fichte, Friedrich von Schelling, Georg Hegel, etc.) and their followers. But the main idea which it expresses is already found in Plato; and both the idea and the term were familiar to Thomas Aquinas, Giordano Bruno, Benedictus de Spinoza, and many others, long before the period of German Idealism. The use of the term is intimately connected with the last of the above-mentioned applications of the term absolute (4). Spinoza describes substance (that is, nature, God or the universe) as absolutely infinite, in contrast with its ultimate attributes, which are infinite each in its kind only; and absolutely infinite substance is conceived by Spinoza as the self-existing, independent, unconditional ground of all that is. It is the ultimate ground of all reality that is always, or nearly always, meant by the Absolute. But different systems of philosophy hold out different views as regards both the reality and the nature of the Absolute. In Vaihinger's *Philosophy of "As If,"* the Absolute is a fiction. For Hamilton, Henry Mansel and Herbert Spencer the Absolute is the unknown; for Immanuel Kant the Absolute (or Noumenon) is even unknowable. Theists identify the Absolute with God; pantheists, with the universe; Arthur Schopenhauer and Wilhelm Wundt, with will; Henri Bergson, with a life force characterized by creative evolution; Gustav Fechner and Lipsius, with consciousness; Francis Bradley, with experience; Joel, with the potentiality of all that is real; Rudolf Lotze and Josiah Royce, with self-conscious personality; Alexander, presumably with the space-time matrix of all reality. Hegel, whose philosophy is most intimately connected with the conception of the Absolute, identified it with the universal spirit, which by a process of logical or dialectical development takes on one predicate after another until it manifests itself as an objective world in perfect harmony with reason.

BIBLIOGRAPHY.—Histories of philosophy by Benno Erdmann, Wilhelm Windelband, etc.; the works of Hegel, Bradley and the other philosophers referred to in the text.

(A. Wo.)

ABSOLUTE DIFFERENTIAL CALCULUS: see TEN-SOR ANALYSIS.

ABSOLUTE MUSIC, a term applied to music of a purely abstract type, devoid of any nonmusical or extra-musical significance, as distinguished from that of the pictorial or descriptive kind known as "programme music" (*q.v.*).

ABSOLUTE PITCH, in the language of the physicist, is the position of a tone as determined by its rate of vibration. Among musicians, it signifies that sense, or form of memory, which enables a person to recognize or reproduce any musical tone, as an A or C#. In this sense, the term is used in contradistinction to relative pitch which concerns itself, for example, with the tonic or the dominant within a given key. The possession of absolute pitch is not considered essential for fine musicianship; notable among composers who were without absolute pitch were Robert Schumann and Richard Wagner. (See also PITCH, MUSICAL.)

ABSOLUTE TEMPERATURE SCALE, the scale of temperature based on thermodynamics (*q.v.*), also called the Kelvin scale after Lord Kelvin (*q.v.*). The temperature scale derived from the law of expansion of a perfect gas, is identical with this thermodynamical scale. The usual abbreviations for absolute scale are abs., or K. Comparing it (approximately) with the centigrade scale, $0^{\circ}\text{C.} = 273^{\circ}\text{A.}$, $100^{\circ}\text{C.} = 373^{\circ}\text{A.}$, thus absolute zero is equivalent to -273°C. (See THERMODYNAMICS and THERMOMETRY.)

ABSOLUTE UNITS, units of measurement of a physical quantity in terms of the fundamental units of length, mass and

time; the British association selected, as their fundamental units, the centimetre, the gram and the second of mean solar time, and thus formed the C.G.S. system of units. (See PHYSICAL UNITS.)

ABSOLUTION (religious) denotes the setting of the penitent sinner free from the guilt of his sin, or from the ecclesiastical penalty (excommunication), or from both. The authority of the church or its minister to pronounce or refuse forgiveness is implied in II Cor. ii, 5-11, and Acts v, 1-9 (cf. James v, 15, 16), and was derived from the tradition of our Lord's teaching; see John xx, 23 (in Matt. xviii, 18, binding and loosing probably mean forbidding and allowing). In primitive times, when confession of sins was made before the congregation, the absolution was deferred till the penance was completed; and there is no record of the use of any special formula. The penitent was reconciled by imposition of hands by the bishop, with or without the clergy. Later the office was usually discharged by priests, and the outward action more and more disused. It became the custom to give the absolution to penitents immediately after their confession and before the penance was performed. Until the middle ages the form of absolution after private confession was of the nature of a prayer, such as "May the Lord absolve thee"; and this is still the practice of the Greek church. But about the 13th century the Roman formula was altered, and the Council of Trent (1551) declared that the form and power of the absolution lay in the words *Ego te absolvo*, etc., and that the accompanying prayers are not essential to it. Of the three forms of absolution in the Anglican Prayer Book, that in the Visitation of the Sick (disused in the church of Ireland and in the United States) runs "I absolve thee," tracing the authority so to act through the church up to Christ; the form in the Communion Service is precativ, while that in Morning and Evening Prayer is indicative indeed, but so general as not to imply a decree of absolution.

(W. O. B.)

In civil law absolution signifies the acquittal of an accused person on the ground that the evidence has either disproved or failed to prove the charge against him. The term is now little used, except in Scottish law in the forms *assolzie* and *absolvitor*.

ABSOLUTISM. The term absolutism is generally applied to any view or theory that the object under consideration (whatever it may be) is not merely conventional, or subjective, or dependent, or limited in any way, but absolute, that it is real or valid in itself, or objective, or independent, or unrestricted. (See ABSOLUTE.) (1) In ethics, absolutism is the view that moral distinctions are not the result of mere arbitrary commands of God, or of human conventions variable according to circumstances, but that they are intrinsically valid, and the same for all human beings, at all times, and in all places. (2) In aesthetics, absolutism is the view that distinctions of beauty and ugliness are not entirely dependent on the subjective feelings of the percipient mind, but that they are objective differences in things themselves, such as the primary qualities of material objects. (See QUALITIES.) Absolutism maintains accordingly that aesthetic appreciation should not be regarded as merely a matter of taste about which people must agree to differ (*de gustibus non disputandum*), but that there is an objective or absolute standard of beauty by which aesthetic judgment ought to be guided. The fact that even art specialists are frequently at variance is accounted for by absolutists by the suggestion that individuals vary in their powers of apprehending aesthetic qualities just as they vary in other capacities. (3) In political theory, absolutism denotes a form of government in which the sovereign exercises almost complete power unrestrained by such laws and reservations as characterize what is commonly called constitutional government. (See ABSOLUTISM, POLITICAL.)

ABSOLUTISM, POLITICAL. In political theory, the term "absolutism" designates a form of government in which the whole power of the state is concentrated in one single individual, the ruler, whose will is the law of the state. All other individuals, members of the community, are subjected to the ruler without participating in his power which for this reason is unlimited and

in this sense absolute. For the ruled it means complete lack of individual freedom in the sense of self-determination. It is incompatible with the idea of equality, since justifiable only by the essential difference which is supposed to exist between the ruler and the ruled. Political absolutism is synonymous with despotism, dictatorship or autocracy.

Its opposite is democracy. Here the political power of everybody is necessarily limited by the fact that it must be shared with others and is in this sense relative only. In participating in the power of the state, and especially in the creation and application of the law, the individuals are politically free and equal.

In historic reality there is or was no state conforming completely with the type of political absolutism. There are only more or less fargoing approximations to this form of government. In the past the most pronounced form of autocracy was the absolute monarchy such as existed in Europe in the 18th century, especially in France under Louis XIV, whose saying, *L'état, c'est moi* (I am the State), is the best-known formulation of its basic idea. In the orient, despoties were, during the most diverse periods and among the most diverse peoples, the prevailing political system. In recent times a new form of political absolutism has arisen in the party dictatorship of bolshevism and fascism. In Russia the new form is a product of the socialist revolution that was released by World War I. Its intellectual basis is the Marxist theory of class struggle and the dictatorship of the proletariat. In reality this dictatorship has become that of a party representing the interests of the proletariat, excluding all other parties, even socialistic ones. The word "bolshevism" was originally applied only to the political creed of the party, which later on exercised dictatorship in Russia; but it has come to designate a type of government. In Italy the fascists were a middle-class party that rose to dictatorship in struggle against socialist parties. The word "fascism," like bolshevism, has come to be used as the name for a type of government: the dictatorship of a middle-class party. The national socialist state of Germany belonged to this type.

The ruling party in a party dictatorship has itself an autocratic character. Its members are under the absolute rule of the party leader who at the same time is the head of the state. Since bolshevism originally maintained the fiction of a separation of party and state, and further did not have an ideology of "leadership," the leader was for a long time officially the secretary-general of the party only. But in reality there is in this point no essential difference between the two forms of party dictatorship, nor is there an essential difference between so-called party dictatorship and personal dictatorship of an absolute monarch.

Political absolutism corresponds perfectly to philosophical absolutism, meaning by this term the view that there exist absolute values and consequently also absolute truths. The validity of judgments referring to these values is absolute, not relative; objective, not subjective; that is to say, the value judgments are valid, not only relative to, and dependent upon, the judging subject, but for everybody, always and everywhere. Their personal, temporal and territorial spheres of validity are unlimited.

Such a view is possible only under the conscious or unconscious presupposition that there exists an absolute being, unlimited in every respect and, hence, unique. Since value is the function of will, absolute values are conceivable only as emanations of the will of an absolute being. Consequently, the latter must be realized as a supreme normative authority, as the unique and, hence, absolute ruler of the universe. Philosophical absolutism has an immanent tendency toward monotheism.

There is not only perfect parallelism between political and philosophical absolutism; the former has the outspoken inclination to use the latter as an ideological instrument. To justify his unlimited power, the ruler must present himself as directly or indirectly authorized by the only true absolute, the superhuman being, as his descendant or deputy or as inspired by him in a mystical way. Where the political ideology of an autocratic government does not permit recourse to the absolute of an historical religion, as in the case of bolshevism, it assumes itself a more or less religious character by absolutizing its basic value,

the idea of socialism.

Less obvious, but nevertheless not less true, is the parallelism which exists between the opposite of political absolutism—democracy, and the opposite of philosophical absolutism—relativism. To determine the contents of a social order, not according to what is really best for the individuals subject to this order, but according to what these individuals, or their majority, rightly or wrongly believe to be best for them—this consequence of the democratic principle of liberty and equality is justifiable only if there is no absolute answer to the question as to what is the best. It is justifiable only if there is no such thing as an absolute Good (to use a term of Plato, the classical representative of philosophical absolutism and passionate opponent of democracy), or if God, and not (as the democratic sophists said) man, is the measure of all things. To let the ignorant majority decide, instead of the only one who by virtue of his divine origin or inspiration has the exclusive knowledge of the absolute Good, is not the most absurd method when it is believed that such knowledge is impossible and that, consequently, no single individual has the exclusive right to enforce his will upon the others. In claiming that judgments of value have only relative validity, the basic principle of philosophical relativism implies that opposite value judgments are neither logically nor morally impossible. It is one of the fundamental principles of democracy that everybody has to respect the political opinion of everybody else, since all are equal and free. Tolerance, minority rights, freedom of opinion, freedom of thought, so characteristic of democracy, have no place within a political system based on the belief in absolute values. This belief irresistibly leads, and always has led, to a situation in which the one who is supposed to possess the secret of the absolute Good claims to have the right to impose his opinion as well as his will upon the others who are in error; and to be in error is, according to this view, to be wrong. If, however, it is recognized that only relative values are accessible to human knowledge and human will, then it is justifiable to enforce a social order against reluctant individuals only if this order is in harmony with the will of the greatest possible number of equal individuals; that is to say, with the will of the majority. However, it may be that the minority and not the majority is right. Solely because of this possibility (which only philosophical relativism can admit) that what is right today may be wrong tomorrow, the minority must have the chance of expressing freely its opinion and have full opportunity of becoming the majority.

This is the true meaning of that political system which is called democracy, and which may be opposed to political absolutism only because it is political relativism. (H. KN.)

ABSORPTION OF LIGHT IN SPACE. This term is used to designate any interference with the propagation of light while it travels through interstellar space.

The possibility that the light of distant stars might be dimmed by absorption on its long path to the earth was mentioned as early as 1720 by Edmund Halley and was discussed by Heinrich Wilhelm Matthias Olbers, Friedrich Georg Wilhelm Struve, Hugo von Seeliger and others during the 19th century. No real evidence of its existence was obtained before the second quarter of the 20th century; after 1930, however, information on this subject accumulated with surprising rapidity.

The earlier studies took it for granted that such absorption, if it existed, would be universal or uniform, and this erroneous expectation has undoubtedly retarded the discovery. The actual observational data show that absorption of light in space is caused by interstellar matter, highly rarefied nebulous matter, irregularly spread between the stars through certain parts of our stellar system while in other parts of the universe the transparency of space is practically perfect. The problem of space absorption is thus intimately related to that of nebulae and interstellar matter; it forms the main avenue of approach to the investigation of the latter.

The observed phenomena of interstellar absorption and the knowledge of interstellar matter gained therefrom will be presented under the following headings: (1) general absorption, (2)

change of colour by absorption, (3) interstellar spectral lines, (4) nature and distribution of interstellar matter.

General Absorption.—The light radiated by a star spreads in all directions, and in a perfectly transparent space the star's apparent brightness must be inversely proportional to the square of its distance from the observer; but if the light suffers an absorption in space the apparent brightness decreases more rapidly with distance than by the inverse square law. A loss of light by interstellar absorption may thus be detected if, in addition to the apparent brightness of a star, we can also determine its distance and its true luminosity (brightness when seen at unit distance). The last two data, however, are difficult to obtain for stars sufficiently far away to show an appreciable absorption effect.

The first successful test of this kind was made by R. J. Trumpler in 1930 in a study of galactic star clusters. The angular diameter of each of these star groups furnished an estimate of its distance, while the luminosities of its stars could be inferred from their spectra. In the more distant clusters (5,000 to 15,000 light years) the observed brightness of the cluster stars was found considerably less than that calculated by the inverse square law. Over a distance of 10,000 light years the loss of light (photographic) by space absorption was on the average about 2 magnitudes or 84%. A similar result was later obtained by A. Joy and R. E. Wilson from a study of faint Cepheid variables.

The existence of local absorption effects in the Milky Way had already been recognized by E. E. Barnard and M. Wolf at the end of the last century. Their excellent Milky Way photographs revealed numerous dark, nearly starless patches in the midst of densely crowded star fields. They interpreted these formations as dark nebulae—local clouds of absorbing matter which obscure the stars behind them. When the numbers of stars of different magnitudes are counted in the obscured region and in the surrounding normal star field, the distance and absorption of the cloud can be found by statistical analysis. Several of the most conspicuous dark clouds have been investigated by this method and all evidence seems to indicate that they are merely local concentrations in the general stratum of interstellar matter.

Change of Colour by Absorption.—The sun appears red when it is near the horizon before sunset because its blue light of short wave lengths has been mostly lost by scattering in the earth's atmosphere, while the longer waves of red light have been more readily transmitted. In a similar way, if absorption of light in space affects some colours or wave lengths more than others, the colour (or mixture of colours) of distant stars will be changed.

Since a star radiates very nearly like a perfect radiator (black body), its true colour is determined by the temperature of its luminous surface. The latter can be estimated rather closely from the spectral class, that is from the intensities of the various dark absorption lines in its spectrum. The difference between the observed colour of a star and its true colour as inferred from its spectral class is called the colour excess. Extensive studies of colour excess in galactic star clusters and of high temperature stars show conclusively that distant stars in the Milky Way are considerably reddened by interstellar absorption, and that the latter is nearly inversely proportional to the wave length. According to physical theory a loss of light of this kind is produced when light is scattered by small solid particles. Interstellar space seems to be permeated by a thin haze of fine cosmic dust.

Interstellar Spectral Lines.—When the light of a star is spread by the spectroscope into a continuous band of rainbow colours, this band is found to be interrupted by numerous dark lines. Such spectral lines are due to absorption of certain wave lengths by the atoms or molecules of any gases through which the light emitted by the star's luminous surface passes before reaching the observer.

Most of the lines observed in stellar spectra originate in the atmosphere of the star (star lines), a few in the earth's atmosphere (telluric lines), and some, according to recent evidence, are absorbed on the passage of the light through space between the star and the earth (interstellar lines). The existence of these latter lines proves that interstellar matter also contains free atoms and molecules, and these may be said to form an extremely rare-

fied interstellar gas.

The main difficulty is that of distinguishing interstellar lines from star lines. This is possible, for instance, in the case of binary systems where two stars are rapidly revolving around their centre of gravity. The star lines in the spectrum of one of these stars will be alternately shifted toward the violet and the red end of the spectrum (Doppler shift) as the star approaches or recedes from the observer. Interstellar matter, of course, takes no part in such orbital motion and its lines remain stationary.

In general, interstellar lines may also be recognized by the fact that they are stronger in the spectra of distant Milky Way stars than in the spectra of relatively near stars of the same spectral class.

The most important interstellar lines identified are those due to atoms of calcium, sodium, potassium, titanium, iron and to the molecules CH and CN. It is, however, probable that most of the common elements as well as free electrons are contained in the interstellar gas although some of the constituents do not reveal their presence as readily as others.

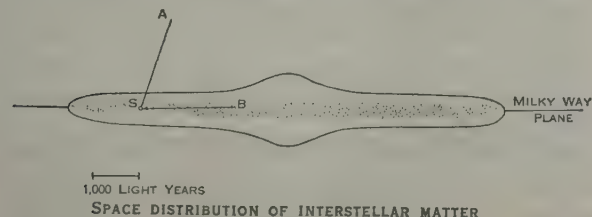
Nature and Distribution of Interstellar Matter.—The observed effects of space absorption lead to the conclusion that the space between the stars is not completely empty but contains some matter consisting of small solid particles as well as atoms and molecules.

The solid particles may be of various sizes, but those which produce most of the scattering must be very small with diameters of 0.1 to 10 microns (25,000 microns = 1 in.). Nothing is known about their chemical composition except that they are probably nonmetallic.

It is difficult to give an adequate idea of the extremely rarefied state of interstellar matter. On the average, one cubic mile of such matter would weigh less than $\frac{1}{100,000,000}$ gr.; it would contain a few hundred microscopic dust particles and about as many molecules and atoms as are found in $\frac{1}{100,000}$ cu.cm. of air. The space between the stars, however, is so large that the total mass of interstellar matter is probably not much less than the mass contained in the stars. Perhaps these interstellar particles are debris lost by the stars; perhaps they constitute the primordial matter from which stars are born. In any case they form an important feature of our stellar system and in many of the external galaxies the presence of such dark matter is also quite noticeable.

The general distribution of interstellar matter in relation to our stellar system is illustrated in the figure. This system is of a highly flattened shape somewhat like a circular disk or lens, and the plane of this disk is outlined on the celestial sphere by the circle of the Milky Way. Interstellar matter seems to be confined to a relatively thin layer stretching along the central plane of the system. Outside of this layer we find practically no absorbing matter and the vast spaces between our system and other galaxies appear to be of perfect transparency.

When observing from the solar system S (fig.) in the direction A, at a considerable angle from the Milky Way, the line of sight has only a short path through the absorbing layer, and we can see very distant objects such as external galaxies with little interference. In the direction of the Milky Way (direction B), the light from distant stars is obstructed all along its way and shows heavy absorption effects. This peculiar arrangement of the absorb-



The full line shows a cross out through the lens-shaped system containing the stars; the position of our sun is marked by S. The dotted area indicates the region where highly rarefied cosmic dust and interstellar gas are irregularly spread between the stars. Outside of this layer, space is of practically perfect transparency

ing medium has the consequence that we can see external galaxies millions of light years away while large parts of our own stellar system are obscured from our view and we have so far not even been able to penetrate to the centre of our galaxy.

The distribution of interstellar matter through this general layer, however, is extremely irregular. The cosmic dust seems to have the tendency to accumulate in numerous local clouds large or small with concentrations sometimes exceeding ten times the average. How closely the distribution of the interstellar gas follows the irregularities of the cosmic dust is as yet uncertain.

While on the one hand absorption of light in space is an important source of information concerning interstellar matter, it is on the other hand a serious obstacle in any attempt to map the structural features of our stellar system by statistical studies of star distribution. The technique of taking photographs by red or infra-red light, less subject to scattering by cosmic dust, may, however, offer a means for penetrating to the more distant parts of our galaxy.

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ABSORPTION SPECTRUM: see BAND SPECTRUM; LIGHT; QUANTUM MECHANICS; SPECTROSCOPY.

ABSTEMIL, a name formerly given to such persons as could not partake of the cup of the Eucharist on account of their aversion to wine (Lat. *abs*, "away from"; *temetum*, "intoxicants"). In modern times many total abstainers, holding that the use of intoxicants is to be condemned absolutely, communicate in the unfermented "juice of the grape," sometimes also alleging that the wine used by Christ and his disciples at the Last Supper was unfermented.

ABSTINENCE, the fact or habit of refraining from anything, usually from indulgence of the appetite. A "total abstainer" is one who takes the pledge to abstain from alcoholic liquor (see TEMPERANCE). Abstinence in the Christian Church is a moderate form of fasting (*q.v.*).

"Abstinence" was also a term in economics, now fallen into disuse, applied to the postponement or sacrifice of present satisfaction for the sake of future gain.

It remains true that no person will save except for the purpose of securing some future advantage for himself or for others. As Frank Taussig puts it, "present resources will not be cancelled for future resources unless some inducement be offered." This is true equally of individual or of communal saving; thus, a Collectivist or Socialist government could only provide capital for the prosecution of industry or for future social satisfactions by drafts upon current income, *i.e.*, by performing an act of national abstinence. (See ECONOMICS.)

ABSTRACT and ABSTRACTION. The term abstract is sometimes used as a noun to denote a summary or digest of a document. Such an abstract is usually obtained by selecting what is essential and omitting the rest. Speaking generally, the process of abstraction is usually a process of selection of some part or aspect of a complex whole, and of consequent neglect of the rest. The result of such a process of "withdrawal" (in the twofold sense of selecting a part and neglecting the rest) is commonly described as abstract.

In logic, *e.g.*, abstract terms are distinguished from concrete terms, the latter denote objects consisting of a whole complex of attributes and standing in various relations, whereas the former designate some quality or relation isolated or abstracted from its concrete context. For instance, "motor" and "relative" are concrete terms, whereas "motion" and "relationship" are abstract terms. But there are degrees of abstraction—the selection may be less or more restricted, and the consequent neglect more or less extensive. This may be readily seen if one passes in review such a series of terms as, say, "the horse that won the Derby in 1927," "race horse," "horse," "quadruped," "animal," "life." Of these terms only the last would be called abstract, but really all the

terms in the series except the first are obtained by abstraction. In fact all general terms, or common nouns, are the result of abstraction. That is why some of the earlier logicians and psychologists applied the epithet *abstract* to what are now usually called general concrete terms. It is just a matter of convenience and convention that only the more abstract terms are now called *abstract*, the less abstract terms being called *general*.

In the past too much stress used to be laid on the negative side of abstraction; that is, on the mere neglect of certain parts or aspects of the concrete whole. It is now realized, more fully that the process is mainly positive in character. It is a process of positive selection, not merely one of omission, though of course it involves omission.

The relative stress on the positive and the negative sides of the process of abstraction really varies considerably. When the process is merely spontaneous, or not deliberate, the negative character of abstraction is probably more prominent; when it is deliberate (that is, a process of voluntary attention), the positive phase is the more marked.

Abstraction is of great importance for all real knowledge, especially for science and philosophy. The aim of all scientific knowledge is the discovery of laws expressing the relation or correlation between various aspects of reality, such as mass and gravitation, volume and pressure or temperature and volume; and it is by processes of abstraction that these phases of reality are isolated and followed up. (A. Wo.)

ABSTRACT OF TITLE, in law, a digest or epitome of the various instruments and events under, and in consequence of, which the vendor or mortgagor of an estate derives his title thereto. The system of registration has much affected the necessity for this abstract's being prepared or used. (See also LAWS RELATING TO REAL PROPERTY AND CONVEYANCING.)

ABT, FRANZ (1819-1885), German composer, was born at Eilenburg, Saxony, and died at Wiesbaden. His songs and part-songs enjoyed an extraordinary vogue throughout the world in the middle of the 19th century, and are still popular.

Abt was kapellmeister at Bernburg in 1841, at Zurich in the same year and at Brunswick from 1852 to 1882, when he retired to Wiesbaden.

ABU, a mountain of central India, situated within the Rajputana state of Sirohi. It is an isolated peak of the Aravalli range, being completely detached from that chain by a narrow valley 7 mi. across, in which flows the western Banas. It rises from the surrounding plains of Marwar like a precipitous granite island, its various points ranging from 4,000 to 5,646 ft. The elevations and platforms of the mountain are covered with elaborately sculptured shrines, temples and tombs. On the top of the hill is a small round platform containing a cavern, with a block of granite, bearing the impression of the feet of Data-Bhrigu, an incarnation of Vishnu.

The two principal temples, at Dilwarra, about the middle of the mountain, are built of white marble, and are pre-eminent alike for their beauty and as typical specimens of Jain architecture in India.

The more modern of the two was built by two brothers, rich merchants, between the years 1197 and 1247, and for delicacy of carving and minute beauty of detail stands almost unrivalled, even in that land of patient and lavish labour.

The other was built by Vimala, a local governor, apparently about A.D. 1032; simpler and bolder in style, it is one of the oldest, as well as one of the most complete, examples of Jain architecture known. The principal object within the temple is a cell lighted only from the door, containing a cross-legged seated figure of the god Parswanath. The portico is composed of 48 pillars, the whole enclosed in an oblong courtyard about 140 ft. by 90 ft., surrounded by a double colonnade of smaller pillars, forming porticos to a range of 52 cells, each of which is occupied by an image of Parswanath.

The whole interior is magnificently ornamented.

Abu was the summer residence of the governor-general's agent for Rajputana, and is a place of resort for Europeans in hot weather. The annual mean temperature is about 70°, rising

to 90° in April; but the heat is never oppressive. The annual rainfall is about 68 in.

ABU BEKR, properly ABU BAKR (c. 573-634), the first of the Mohammedan caliphs (see CALIPHATE), the son of Abu Kohāfa, of the Taim clan of the tribe of Quraish at Mecca. His original name is unknown, since on conversion to Islam he took the name of 'Abdullah. *Abu Bekr* ("father of the camel-foal") is an epithet, also of unknown origin and sometimes mistakenly rendered "father of the virgin" (*bikr*), in reference to his daughter Ayesha (A'isha), the young wife of the prophet Mohammed. He was one of the earliest of Mohammed's converts and spent the considerable wealth which he had acquired by trade in the service of the new religion and in ransoming slaves. His firm belief in Mohammed and his teachings won for him the appellation of al-Siddik ("the faithful"). In his personal relationship to the prophet he showed the deepest veneration and unswerving devotion. When Mohammed fled from Mecca to Medina (622), Abu Bekr was his sole companion; and Abu Bekr remained constantly with him till his death. During his last illness the prophet indicated Abu Bekr as his successor by appointing the latter to lead the congregation in public prayers.

The choice was ratified by the chief companions of the prophet at Medina and ultimately confirmed, although it was disputed by Ali, Mohammed's son-in-law. After a time Ali submitted, but the difference gave rise to the controversy which divides Moslems into Sunnites and Shi'ites, the latter supporting the claims of Ali.

Abu Bekr had scarcely assumed his new position (632), under the title of *khalīfat rasūl-illāh* ("successor of the apostle of God") when he was called to suppress a rising of the tribesmen of Hejaz and Nejd against the political control of Medina and the payment of *zakat* ("almstax," or tribute). The troops of Medina encountered strong opposition from several quarters but defeated the rebels in a series of engagements, the severest struggle being that with the "false prophet" Mosailima in Nejd, who was finally overcome by Khālid in the battle of Akraha. The reconverted tribesmen were called up to join the expeditions into Iraq under Khālid and toward Palestine and Syria under different commanders. After the hard-won victory over Mosailima, Omar, fearing that Mohammed's revelations might be forgotten when those who had heard them were removed by death, induced Abu Bekr to put them into a written form. The completed record was deposited with Omar's daughter Hafsa (one of the wives of Mohammed) and furnished most of the materials out of which the Koran was prepared. Abu Bekr died on Aug. 23, 634, probably from natural causes although one tradition speaks of poison. He is said to have indicated Omar as his successor.

See Sir W. Muir, *The Caliphate*, rev. ed. (Edinburgh, 1924); L. Caetani, duke of Sermoneta, *Annali dell' Islam*, vol. ii and iii (Milan, 1907-10). (H. A. R. G.)

ABU HAMED, a town of the Anglo-Egyptian Sudan on the right bank of the Nile, 345 mi. by rail N. of Khartum, and near the head of the fourth cataract. It stands at the centre of the great S-shaped bend of the Nile, and from it the railway to Wadi Halfa strikes straight across the Nubian desert, a little west of the old caravan route to Korosko. A branch railway, 138 mi. long from Abu Hamed, goes down the right bank of the Nile to Kareima in the Dongola district.

The town is named after a celebrated sheikh buried there, by whose tomb travellers crossing the desert formerly used to deposit all superfluous goods, the sanctity of the saint's tomb ensuring their safety.

During the advance on Khartum in 1897, a sharp action was fought there, the troops under Gen. George Hunter routing the Dervishes (Aug. 7, 1897).

ABŪ HANĪFA AN-NU'MAN IBN THABIT, Mohammedan canon lawyer, was born at Kufa in A.H. 80 (A.D. 699) of non-Arab, and probably Persian, parentage. Few events of his life are known to us with any certainty. He was a rich silk-dealer, lectured at Kufa upon canon law (*fiqh*) and was a consulting lawyer (*mufti*), but refused steadily to take any public post. When al-Mansūr, however, was building Baghdad (145-149) Abū Hanīfa was one of the four overseers whom he appointed over the crafts-

men. In A.H. 150 (A.D. 767) he died there. A persistent but apparently later tradition asserts that he died in prison after a severe beating, because he refused to obey al-Mansūr's command to act as a judge (*cadi, qādi*). This was to avoid a responsibility for which he felt unfit—a frequent attitude of more pious Muslims.

For many personal anecdotes see de Slane's transl. of Ibn Khalikan iii. 555 ff., iv. 272 ff. He was buried in eastern Baghdad, where his tomb still exists, one of the few surviving sites from the time of al-Mansūr, the founder.

See C. Brockelmann, *Geschichte*, i, 169 ff.; Nawawi's *Biogr. Dict.* pp. 698–770; Ibn Hajar al-Haitami's *Biography*, publ. Cairo, A.H. 1304; legal bibliography under ISLAMIC LAW.

ABU KLEA, a halting-place for caravans in the Bayuda desert, Anglo-Egyptian Sudan. It is on the road from Merawi to Metemma and 20m. north of the Nile at the last-mentioned place. Near this spot, on Jan. 17, 1885, a British force marching to the relief of Gen. Gordon at Khartum was attacked by a greatly superior force of Mahdists, who were repulsed. On the 19th, when the British force was nearer Metemma, the Mahdists renewed the attack, again unsuccessfully. Sir Herbert Stewart, the commander of the British force, was mortally wounded on the 19th, and among the killed on the 17th was Col. F. G. Burnaby.

ABU-L-ĀLA UL-MA'ARRI (973–1057), Arabian poet and letter-writer, belonged to the South Arabian tribe Tanukh, a part of which had migrated to Syria before the time of Islam. He was born in 973 at Ma'arrat un-Nu'mān in Syria. In 1007 he visited Baghdad, where he was admitted to literary circles, recited in the academies and mosques, and made the acquaintance of men to whom he addressed some of his letters later. In 1009 he returned to Ma'arra, where he spent the rest of his life in teaching and writing.

Of his works the chief are two collections of his poetry and two of his letters. The earlier poems up to 1029 have been published in Bulaq (1869), Beirut (1884) and Cairo (1886), under the title of *Saqt uz-Zand*. The poems of the second collection, known as the *Luzūm ma lam yalzam*, or the *Luzūmiyyāt*, are written with the difficult rhyme in two consonants instead of one, and contain the more original, mature, and somewhat pessimistic thoughts of the author on mutability, virtue, death, etc. They have been published in Bombay (1886) and Cairo (1889).

BIBLIOGRAPHY.—The letters on various literary and social subjects were published with commentary by Shain Effendi in Beirut (1894), and with English translation, etc., by Prof. D. S. Margoliouth in Oxford (1898). A second collection of letters, known as the *Risālat-ul-Ghufrān*, was summarized and partially translated by R. A. Nicholson in the *Journal of the Royal Asiatic Society* (1900, pp. 637 ff.; 1902, pp. 75 ff., 337 ff., 813 ff.). C. Rieu, *De Abu-l-'Alae Poetae Arabici vita et carminibus* (Bonn, 1843); A. von Kremer, *Über die philosophischen Gedichte des Abu-l-'Ala* (Vienna, 1888); cf. also the same writer's articles in the *Zeitschrift der deutschen morgenländischen Gesellschaft* (vols. xxix., xxx., xxxi. and xxxviii.). Some of his poems are translated by H. Baerlein in the *Diwan of Abu-l-'Ala* ("The Wisdom of the East" Series, 1908). For his life see the introduction to D. S. Margoliouth's edition of the letters, supplemented by the same writer's articles "Abu-l-'Ala al-Ma'arri's Correspondence on Vegetarianism" in the *Journal of the Royal Asiatic Society* (1902, pp. 289 ff.).

ABU-L-ĀTAHIYA (Abū Ishāq Ismā'īl ibn Qāsim al-'Anazī) (748–828), Arabian poet, was born at 'Ain ut-Tamar in the Hejāz near Medina. His ancestors were of the tribe of 'Anaza. His life was spent in Kufa and in Baghdad, where he died in 828 in the reign of al-Ma'mūn. The poetry of Abū-l-'Ātāhiya is notable for its avoidance of the artificiality almost universal in his days. The older poetry of the desert had been constantly imitated up to this time, although it was not natural to town life. Abū-l-'Ātāhiya was one of the first to drop the old *qasida* (elegy) form. He is one of the earliest philosophic poets of the Arabs. Much of his poetry is concerned with the observation of common life and morality, and at times is pessimistic. Naturally, in the circumstances, he was strongly suspected of heresy.

His poems (*Diwān*) with life from Arabian sources have been published at the Jesuit Press in Beirut (1887, 2d ed. 1888). On his position in Arabic literature see W. Ahlwardt, *Diwān des Abu Nawas* pp. 21 et seq. (Greifswald, 1861); A. von Kremer, *Culturgeschichte des Orients*, vol. ii. pp. 372 ff. (Wien, 1877).

ABULFARAJ (Abū-l-Faraj 'Alī ibn ul-Husain ul-Isfahani) (897–967), Arabian scholar, was a member of the tribe of the Quraish (Koreish) and a direct descendant of Marwān, the last of the Omayyad caliphs. He was thus connected with the Omayyad rulers in Spain, and seems to have kept up a correspondence with them and to have sent them some of his works. He was born in Isfahān, but spent his youth and made his early studies in Baghdad. He became famous for his knowledge of early Arabian antiquities. His later life was spent in various parts of the Muslim world, in Aleppo with Saif-ud-Daula (to whom he dedicated the *Book of Songs*), in Rai with the Buyid vizier ibn 'Abbād and elsewhere. In his last years he lost his reason. In religion he was a Shiite. Although he wrote poetry, also an anthology of verses on the monasteries of Mesopotamia and Egypt, and a genealogical work, his fame rests upon his *Book of Songs* (*Kitāb-ul-Aghāni*), which gives an account of the chief Arabian songs, ancient and modern, with the stories of the composers and singers. It contains a mass of information as to the life and customs of the early Arabs, and is the most valuable authority we have for their pre-Islamic and early Muslim days. A part of the *Book of Songs* was published by J. G. L. Kosegarten with Latin translation (Greifswald, 1840). The text was published in 20 vols. at Bulaq in 1868. Vol. xxi. was edited by R. E. Brünnow (Leyden, 1888). A volume of elaborate indices was edited by I. Guidi (Leyden, 1900), and a missing fragment of the text was published by J. Wellhausen in the *Zeitschrift der deutschen morgenländischen Gesellschaft*, vol. 50, pp. 146 ff. For his life see M'G. de Slane's translation of Ibn Khalikan's *Biographical Dictionary*, vol. ii. pp. 249 ff. (G. W. T.)

ABULFARAJ (13th century): see BAR-HEBRAEUS.

ABUL FAZL (āb-ūl fahzl) (1551–1602), vizier and historiographer of the Mogul emperor, Akbar, wrote the *Akbar Nameh* or "Book of Akbar" in Persian. It consists of two parts, and is a history of Akbar's reign and the *Ain-i-Akbari*, or "Institutes" of Akbar, giving an account of the constitution, religion and administration of the empire. Akbar was murdered at the instigation of Prince Selim, afterwards Jahangir, who was jealous of the vizier's influence.

A translation of the *Ain-i-Akbari* (Calcutta, 1783–86), by Francis Gladwin, is now exceedingly rare. There is a modern translation (Calcutta, 1873, 1891, 1894): vol. i. by H. Blockmann, vols. ii. and iii. by H. S. Jarrett.

ABULFEDA (Abū-l-Fidā' Ismā'īl ibn 'Alī 'Imād-ud-Dnī) (1273–1331), Arabian historian and geographer, was born at Damascus, whither his father Malik ul-Afdal, brother of the prince of Hamah, had fled from the Mongols. He was a descendant of Ayyūb, the father of Saladin. In 1285 he was present at the assault of a stronghold of the knights of St. John, and he took part in the sieges of Tripoli, Acre and Qal'at ar-Rūm. In 1298 he entered the service of the Mameluke Sultan Malik al-Nāsir and in 1310 became governor of Hamah. In 1312 he became prince with the title Malik us-Sālih, and in 1320 received the hereditary rank of sultan with the title Malik ul-Mu'ayyad. For more than twenty years altogether he reigned in tranquillity and splendour, devoting himself to the duties of government and to the composition of the works to which he is chiefly indebted for his fame. He was a munificent patron of men of letters, who came in large numbers to his court. He died in 1331.

BIBLIOGRAPHY.—His chief historical work is *An Abridgment of the History of the Human Race*, annals extending from the creation to the year 1329 (Constantinople, 1869). Various translations of parts of it exist. His *Geography* is founded on the works of his predecessors, and so ultimately on the work of Ptolemy. Parts of the work were published and translated as early as 1650 (cf. Carl Brockelmann's *Geschichte der Arabischen Literatur*, Berlin, 1902, vol. ii. pp. 44–46). The text of the whole was published by M'G. de Slane and M. Reinaud (Paris, 1840), and a French translation with introduction by M. Reinaud and Stanislas Guyard (Paris, 1848–83).

ABU'L KASIM MANSUR: see FIRDOUSI.

ABŪ-L-QĀSIM [Khalaf ibn 'Abbās uz-Zahrāwī], Arabian physician and surgeon, generally known in Europe as **ABULCASIS**, flourished in the tenth century at Cordova as physician to the caliph 'Abdur-Rahmān III. (912–961).

A part of his compendium of medicine was published in Latin as *Liber theoricæ nec non practicæ Alsaharavii* (Augsburg, 1519). His manual of surgery was published at Venice in 1497, at Basle in 1541, and at Oxford *Abulcasis de Chirurgia arabice et latine cura Johannis Channing* (2 vols. 1778).

For his other works see Carl Brockelmann, *Geschichte der arabischen Literatur* (Weimar, 1898), vol. i. pp. 239-240; M. Neuberger, *History of Medicine*, vol. I (1910).

ABŪ 'L WAFĀ or **ALBUZDSCHANI** (940-998), Arab astronomer and mathematician, was born at Buzdschan in Khurāsān, and was one of the most learned men of his day. A passage in his *Almagest* is held by some to indicate that he had noted inequalities in the moon's motion, later described as variation. He translated and commented on the works of the Greek mathematicians, and made an exhaustive commentary on Diophantus, but these writings are lost. The existing book in 12 chapters of geometrical constructions in a Persian translation is not his, but appears to be derived from an account of his lectures drawn up by one of his pupils. Abū 'l Wafā introduced the trigonometrical functions and constructed tables of tangents and co-tangents.

See Woepcke in *Journal Asiatique*, Feb. and March, 1855.

ABUNDANTIA, Roman goddess, the personification of prosperity and good fortune. On the coins of the later Roman emperors she is frequently represented holding a horn of plenty and distributing grain and money. She may be compared with Domina Abundia (O. Fr. *Dame Habonde, Notre Dame d'Abondance*), a beneficent fairy, who brought plenty to those whom she visited (Grimm, *Teutonic Mythology*, i. 286-7).

ABU NUWAS (Abū 'Alī Hal-asan ibn Hānī'al-Hakāmī) (c. 756-810), Arabian poet, was born in al-Ahwāz, probably about 756. His mother was a Persian, his father a soldier, a native of Damascus. He is said to have spent a year with the Arabs in the desert to gain purity of language. Settling in Baghdad he enjoyed the favour of Harūn al-Rashid and al-Amin, and died there, probably about 810. Abū Nuwās is recognized as the greatest Arab poet of his time. Genial, cynical, immoral, he drew on all the varied life of his time for the material of his poems. In his wine-songs especially the manners of the upper classes of Baghdad are revealed. He was one of the first to ridicule the set form of the *qasida* (elegy) as unnatural, and has satirized this form in several poems.

See I. Goldziher, *Abhandlungen zur Arabischen Philologie* (Leyden, 1896), i. pp. 145 ff. His poems were collected by several Arabian editors. One such collection (the MS. of which is now in Vienna) contains nearly 5,000 verses. His collected poems (*Diwān*) have been published in Cairo (1860), in Beirut (1884) and an edition by Isma'il al-Nabhanī (Cairo, 1904). The wine-songs were edited by W. Alwardt under the title *Diwān des Abu Nowas*. i. *Die Weinlieder* (Greifswald, 1861).

ABU SIMBEL or **IPSAMBUL**, the name of a group of temples of Rameses II. (c. 1250 B.C.) in Nubia, on the left bank of the Nile, 56m. by river south of Korosko. They are hewn in the sandstone cliffs at the riverside, and are three in number. The principal temple, begun by Seti and completed by his son, is probably the greatest and most imposing of all rock-hewn monuments. It was discovered by Burckhardt in 1812 and opened by Belzoni in 1817; the front has been cleared several times, but the sand is always pressing forward from the north end. The hillside was recessed to form the façade, backed against which four immense seated colossi of the king, in pairs on either side of the entrance, rise from a platform or forecourt reached from the river by a flight of steps. The colossi are 65ft. in height, of nobly placid design, and are accompanied by smaller figures of Rameses' queen and their sons and daughters; behind and over them is the cornice, with the dedication below a long row of apes, standing in adoration of the rising sun. The temple is dedicated primarily to the solar gods Amenra of Thebes and Raharakht of Heliopolis, the true sun god; it is oriented to the east so that the rays of the sun in the early morning penetrate the whole length of two great halls to the innermost sanctuary and fall upon the central figures of Amenra and Rameses, which are there enthroned with Ptah of Memphis and Raharakht on either side. The interior of the temple consists of a series of halls, penetrating for 185ft. into the

solid rock and decorated with coloured sculpture of fine workmanship and in good preservation; some of the scenes are of religious import (amongst them Rameses as king making offerings to himself as god), others illustrate war in Syria, Libya and Ethiopia: another series depicts the events of the famous battle with the Hittites and their allies at Kadesh, in which Rameses saved the Egyptian camp and army by his personal valour. Not the least important feature of the temple belongs to a later age when some



THE COLOSSAL STATUES OF RAMESES II. AT ABU SIMBEL ARE 65FT. HIGH AND ARE ACCOMPANIED BY SMALLER STATUES OF THE MEMBERS OF HIS FAMILY

Greek, Carian and Phoenician soldiers of one of the kings named Psammetichus (apparently Psammetichus II., 594-589 B.C.) inscribed their names upon the two southern colossi, doubtless the only ones then clear of sand. These graffiti are of the highest value for the early history of the alphabet, and as proving the presence of Greek mercenaries in the Egyptian armies of the period. The upper part of the second colossus (from the south) has fallen; the third was repaired by Sethos II. not many years after the completion of the temple. A small temple, immediately to the south of the first, is believed to have had a built antechamber: it is the earliest known example of a "birth chapel," such as was usually attached to Ptolemaic temples for the accommodation of the divine mother-consort and her son. The third and northernmost temple, separated from the others by a ravine, is on a large scale; the colossi of the façade are six in number and 33ft. high, representing Rameses and his queen Neferêre, who dedicated the temple to the goddess Hathôr.

ABŪ TAMMĀM (Habib ibn Aus) (807-846), Arabian poet, was born in Jāsim (Josem), a place to the north-east of the Sea of Tiberias or near Manbij (Hierapolis). He died in Mosul. Abū Tammām is best known as the compiler of the collection of early poems known as the *Hamāsa* (q.v.). Two other collections of a similar nature are ascribed to him. His own poems have been somewhat neglected owing to the success of his compilations. His poems (*Diwān*) were published in Cairo (A.D. 1875).

See Life in Ibn Khallikan's *Biographical Dictionary*, trans. by M'G. de Slane (Paris and London, 1842), vol. i. pp. 348 ff.; and in the *Kitāb ul-Aghānī* (Book of Songs) of Abulfaraj (Bulaq, 1869), vol. xv. pp. 100-108, also D. S. Margoliouth, "Indices to the *Diwān* of Abū Tammām" in the *Journal of the Royal Asiatic Society* (1905).

ABUTILON (from the Arabic *aubūtīlīn*, a name given by Avicenna to this or an allied genus), a genus of tropical shrubs of the family Malvaceae (mallows), having about 100 widely distributed species, often called flowering maple and Chinese bell-flower. They are free-growing, with showy bell-shaped flowers, and are favourite greenhouse plants.

They are grown as summer bedding plants but will stand no frost and are readily propagated from spring- or autumn-rooted cuttings.

Many hybrids have variegated foliage.

ABUTMENT, a construction in masonry designed to receive and resist the lateral pressure of an arch, vault or strut. When part of a wall it is termed a buttress (q.v.).

ABU ŪBAIDA (Ma'mar ibn ul-Muthannal) (728-825), Arabian scholar, was born a slave of Jewish-Persian parents in Basra. In 803 he was called to Baghdad by Harūn al-Rashid. He died in Basra. He was one of the most learned and authoritative scholars of his time in the Arabic language, antiquities and stories. The titles of 105 of his works are mentioned in the *Fihrist*, and his *Book of Days* is the basis of parts of the history of ibn al-Athīr, and of the *Book of Songs*, but nothing of his (except a song) seems to exist now in an independent form.

BIBLIOGRAPHY.—See *Life in ibn Khallikān's Biographical Dictionary*, trans. by M'G. de Slane (1842), vol. iii., pp. 388–398; also I. Goldziher's *Muhammedanische Studien* (Halle, 1888), vol. i., pp. 194–206.

ABYDOS, ancient town of Mysia, Asia Minor, on the Hellespont, here scarcely a mile broad. Probably originally a Thracian town, it was afterwards colonized by Milesians. Here Xerxes crossed the strait on his bridge of boats when he invaded Greece. Abydos is celebrated for its vigorous resistance to Philip V. of Macedon (200 B.C.), and is famed in story for the loves of Hero and Leander. Until late Byzantine times the toll station of the Hellespont, its importance was transferred to the Dardanelles (*q.v.*), after the building of the “Old Castles” by Sultan Mohammed II. (c. 1456).

ABYDOS, one of the most ancient cities of Upper Egypt, about 7m. west of the Nile in lat. 26° 10' N. (railway station Al-Baliana). The Egyptian name was *Abdu*, “the hill of the symbol or reliquary” in which the sacred head of Osiris was preserved. Thence the Greeks named it Abydos, like the city on the Hellespont; the modern Arabic name is *Arabet el Madfuneh*. The history of the city begins in the late prehistoric age, it having been founded by the pre-Menite kings whose town, temple and tombs have been found there. The kings of the 1st dynasty, and some of the 2nd dynasty, were also buried here, and the temple was renewed and enlarged by them. Great forts were built on the desert behind the town by three kings of the 2nd dynasty. The temple and town continued to be rebuilt at intervals down to the times of the 30th dynasty, and the cemetery was used continuously. In the 12th dynasty a gigantic tomb was cut in the rock by Senwosri (or Senusert) III. Seti I. in the 19th dynasty founded a great new temple to the south of the town in honour of the ancestral kings of the early dynasties; this was finished by Rameses II., who also built a lesser temple of his own. Mineptah added a great Hypogeum of Osiris to the temple of Seti. The latest building was a new temple of Nekhtnef in the 30th dynasty.

The worship here was of the jackal god Upuaut (Ophois, Wepwoi), who “opened the way” to the realm of the dead, increasing from the 1st dynasty to the time of the 12th dynasty and then disappearing after the 18th. Anher appears in the 11th dynasty; and Khentamenti, the god of the western Hades, rises to importance in the middle kingdom and then vanishes in the 18th. The worship here of Osiris in his various forms begins in the 12th dynasty and becomes more important in later times, so that at last the whole place was considered as sacred to him.

The temples successively built here on one site were nine or ten in number, from the 1st dynasty, to the 26th dynasty (500 B.C.). The first was an enclosure, about 30 x 50ft., surrounded by a thin wall of unbaked bricks. Covering one wall of this came the second temple of about 40ft. square in a wall about 10ft. thick. An outer *temenos* (enclosure) wall surrounded the ground. This outer wall was thickened about the 2nd or 3rd dynasty. The old temple entirely vanished in the 4th dynasty, and a smaller building was erected behind it, enclosing a wide hearth of black ashes. Pottery models of offerings are found in the ashes, and these were probably the substitutes for sacrifices decreed by Cheops (Khufu) in his temple reforms. A great clearance of temple offerings was made now, or earlier, and a chamber full of them has yielded the fine ivory carvings and the glazed figures and tiles which show the splendid work of the 1st dynasty. A vase of Menes with purple inlaid hieroglyphs in green glaze and the tiles with relief figures are the most important pieces. The noble statuette of Cheops in ivory, found in the stone chamber of the temple, gives the only portrait of this ruler. The temple was rebuilt entirely on a larger scale by Pepi I. in the 6th dynasty. He placed a great stone gateway to the *temenos*, an outer *temenos* wall and gateway, with a colonnade between the gates. His temple was about 40 x 50ft. inside, with stone gateways front and back, showing that it was of the processional type. In the 11th dynasty Menthotp (Mentuhotep) III. added a colonnade and altars. Soon after, Sankherē entirely rebuilt the temple, laying a stone pavement over the area, about 45ft. square, besides subsidiary chambers. Soon after Senwosri (Senusert) I. in the 12th dynasty laid massive foundations of stone over the pavement of his predecessor.

A great *temenos* was laid out enclosing a much larger area, and the temple itself was about three times the earlier size.

The 18th dynasty began with a large chapel of Amasis I., and then Thothmes III. built a far larger temple, about 130 x 200ft. He made also a processional way past the side of the temple to the cemetery beyond, with a great gateway of granite. Rameses III. added a large building; and Amasis II. in the 26th dynasty rebuilt the temple again, and placed in it a large monolith shrine of red granite, finely wrought. The foundations of the successive temples were comprised within about 18ft. depth of ruins.

The temple of Seti I. was built on entirely new ground half a mile to the south of the long series of temples just described. This is the building best known as the Great Temple of Abydos, being nearly complete and an impressive sight. The long list of the kings of the principal dynasties carved on a wall is known as the “Table of Abydos.” There were also seven chapels for the worship of the king and principal gods. The temple was originally 550ft. long, but the forecourts are scarcely recognizable, and the part in good state is about 250ft. long and 350ft. wide, including the wing at the side. Excepting the list of kings and a panegyric on Rameses II., the subjects are not historical but mythological. The adjacent temple of Rameses II. was much smaller and simpler in plan; but it had a fine historical series of scenes around the outside, of which the lower parts remain. A list of kings, similar to that of Seti, formerly stood here; but the fragments were sold by the French consul to the British Museum.

The royal tombs of the earliest dynasties were placed about a mile back on the great desert plain. The earliest is about 10 x 20ft. inside, a pit lined with brick walls, and originally roofed with timber and matting. Others also before Menes are 15 x 25ft. The tomb probably of Menes is of the latter size. After this the tombs increase in size and complexity. The tomb-pit is surrounded by chambers to hold the offerings, the actual sepulchre being a great wooden chamber in the midst of the brick-lined pit. Rows of small tomb-pits for the servants of the king surround the royal chamber, many dozens of such burials being usual. By the end of the 2nd dynasty the type changed to a long passage bordered with chambers on either hand, the royal burial being in the middle of the length. The greatest of these tombs with its dependencies covered a space of over 3,000sq. yards. The contents of the tombs have been nearly destroyed by successive plunderers; enough remained to show that rich jewellery was placed on the mummies, a profusion of vases of hard and valuable stones from the royal table service stood about the body, the store-rooms were filled with great jars of wine, perfumed ointment and other supplies, and tablets of ivory and ebony were engraved with a record of the yearly annals of the reigns.

The cemetery of private persons begins in the 1st dynasty with some pit tombs in the town. It was extensive in the 12th and 13th dynasties and contained many rich tombs. In the 18th–20th dynasties a large number of fine tombs were made, and later ages continued to bury here till Roman times.

The forts lay behind the town. That known as Shunet ez Zebib is about 450 x 250ft. over all, and still stands 30ft. high. It was built by Khasekhemui, the last king of the 2nd dynasty. Another fort nearly as large adjoined it, and is probably rather older. A third fort of a squarer form is now occupied by the Coptic convent; its age cannot be ascertained.

Jean Capart, *Abydos: Le Temple de Seti I.* (Bruxelles, 1912); *The Cemeteries of Abydos*, 3 vols. (Egypt Exploration Fund, 1913–14).

ABYSS, any deep place (Gr. *â-*, privative, *βυσσός*, bottom), a bottomless depth. From the late popular *abyssimus* (superlative of Low Latin *abyssus*) through the French *abisme* (i.e., *abîme*) is derived the poetic form *abysm*, pronounced as late as 1616 to rhyme with *time*. The adjective “abyssal” or “abysmal” has been used by zoologists to describe deep regions of the sea. In heraldry the abyss is the middle of an escutcheon. In the Greek version of the Old Testament the word represents (1) the original chaos (Gen. i. 2), (2) the Hebrew *tehom*, which is used also in apocalyptic literature and in the New Testament for hell. In the Septuagint cosmography the word is applied (a) to the waters under the earth, and (b) to the waters of the firmament

which were regarded as closely connected with those below. Derivatively it acquired the meaning of the place of the dead. In *Revelation* it is the prison of evil spirits whence they may occasionally be let loose, and where Satan is doomed to spend 1,000 years. In rabbinical cosmography the abyss is a region of Gehenna situated below the ocean bed and divided into three or seven parts imposed one above the other. In the Kabbalah the abyss as the opening into the lower world is the abode of evil spirits, and corresponds to the opening of the abyss to the world above. In general, the abyss is regarded vaguely as a place of indefinite extent, the abode of mystery and sorrow.

ABYSSINIA (officially Ethiopia), an inland country and empire of North-east Africa lying, chiefly, between 5° and 15° N. and 35° and 42° E. It is bounded on the north by Eritrea (Italian), on the west by the Anglo-Egyptian Sudan, on the south-west and south by Uganda and Kenya, on the south-east and east by British, Italian and French Somaliland. The coast lands in European hands, which cut off Abyssinia from access to the sea, vary in width from 40 to 250 miles and are narrowest on the north-east border near the Red Sea. Abyssinia in the north is 230m. east to west, but is 900m. wide along latitude 9° N., and resembles a triangle with apex north. It is divided into Abyssinia proper (*i.e.*, the old Ethiopian empire consisting of Tigré, Amhara, Gojam and part of Shoa) with the south-west Galla highlands and the remainder of Shoa all forming a geographical unit—and cut off from it by the great Rift valley—and the Somaliland plateau with Harar: nearly all this country being surrounded by tracts of low-lying desert. The area of the whole State is 305,731 sq.mi., of which Abyssinian Somaliland covers about a third. Pop. (1939) estimated at about 9,450,000.

PHYSICAL FEATURES

Between the Upper Nile and the low south-west shores of the Red Sea and the Gulf of Aden lie elevated plateaux with mountain ranges. The plateaux rise abruptly from the plains, constituting outer mountain chains. The Abyssinian highlands are thus a clearly marked orographic division. From Ras Kasar (18°N.) to Annesley Bay (15°N.) the eastern wall of the plateau runs parallel to the Red Sea. It then turns due south and follows closely the line of 40°E. for some 400m. About 9°N. the River Hawash flows east through the opening of the Rift valley. The main range at this point trends south-west, while south of the Hawash valley, which is some 3,000ft. below the level of the mountains, another massif rises in a direct line south. The second range sends a chain (the Harar Hills) east to the Gulf of Aden. The two chief eastern ranges run parallel south by west on either side of the Rift valley—in which are a series of lakes—to about 3°N., the outer (eastern) spurs of the plateau still keeping along the line of 40°E. The southern escarpment of the plateau is highly irregular, but has a general direction north-west and south-east from 6°N. to 3°N. The western wall of the plateau, from 6°N. to 11°N., is precipitous. North of 11°N. the hills turn more to the east, and fall more gradually to the plains at their base. On its northern face also the plateau falls in terraces to the level of the eastern Sudan. The eastern escarpment has a mean height of 7,000 to 8,000ft., and is often precipitous. Torrents descend narrow deep clefts to lose themselves in the sandy coast land; they afford means of reaching the plateau, as alternatives to the easier route through the Hawash valley. On surmounting this rocky barrier the traveller finds that the encircling rampart rises little above the normal level of the plateau. The northern highlands, mainly 10° to 15°N., consist of Archaean rocks of mean height 7,000 to 7,500ft., and a deep central depression contains Lake Tana. Above the plateau mountain ranges rise to 12,000 and over 15,000ft., with fantastic forms, and cut by enormous fissures due to erosion; some are wider, others have the opposite walls but 200 or 300yd. apart, and fall almost vertically thousands of feet. Numerous isolated flat-topped hills or small plateaux known as *ambas*, are left. The highest peaks are in the Simen (or Semien) ranges, north-east of Lake Tana, which culminate in a snow-covered peak, Dajan (15,160ft.). Parallel with the eastern escarpment the heights rise to Mt. Kollo (14,100ft.)

south-west of Magdala. The valley between these hills and the eastern escarpment is one of the largest and most profound chasms in Abyssinia. Between Lake Tana and the eastern hills are Mounts Guna (13,800ft.) and Uara Sahia (13,000ft.). The highlands south of latitude 10°N. have more open tableland than the northern portion and fewer lofty peaks, but the general character is still that of a much broken hilly plateau.

The uplands usually slope north-west and nearly all the large rivers flow to the Nile; the Takkaze in the north, the Abbai in the centre, and the Sobat in the south make up four-fifths of the entire drainage. The rest is carried off almost due north by the Khor Baraka, which occasionally reaches the Red Sea south of Suakin, by the Hawash, which runs out in the salt lake area near the head of Tajura Bay; by the Webi Shibeli and Juba, which flow south-east through Somaliland, though the Shibeli fails to reach the Indian ocean; and by the Omo, the main feeder of the closed basin of Lake Rudolf. The Takkaze, the true upper course of the Atbara, falls from about 7,000ft. in the central tableland to 2,500ft. in the tremendous crevasse through which it sweeps west, north, and west again, to the western terraces and the Sudan. During the rains the Takkaze (*i.e.*, the "Terrible") rises some 18ft. above its normal level, and at this time forms an impassable barrier between the northern and central provinces. Lower down, the river has the Arab name Setit. The Setit is joined (14° 10'N., 36°E.) by the Atbara, formed by several streams of the mountains west and north-west of Lake Tana. The Gash or Mareb is the most northerly Abyssinian river flowing towards the Nile. It rises on the landward side of the eastern escarpment within 50 miles of Annesley Bay on the Red Sea, and reaches the Sudan near Kassala to lose itself in the sandy plain. The Mareb is dry for a great part of the year, but like the Takkaze has sudden freshets during rains. Only the left bank of the upper course of the river is in Abyssinian territory, the Mareb here forming the boundary between Eritrea and Abyssinia.

The Abbai or Blue Nile has its source near Mt. Denguiza in the Gojam highlands (about 11°N. and 37°E.) and first flows for 70m. nearly due north to the south side of Lake Tana (*q.v.*), through which it runs for some 20 miles and, escaping by a deep crevasse, bends in a great semicircle, east, south and north-west, the reverse of that of the Takkaze, down to the plains of Sennar. The Abbai has many perennial tributaries, of which the principal are the Bashilo, the Jamma, the Muger, the Gudiv, the Didessa, largest of all, and the Yabus. The right-hand tributaries, rising mostly on the western sides of the plateau, have steep slopes and are generally torrential; the Bolassa is perennial, and the Rahad and the Dinder are important in flood-time.

In the mountains and plateaux of Kafia and Galla in south-west Abyssinia rise the chief affluents of the Sobat tributary of the Nile. The Akobo joins the Pibor, which unites with the Baro to form the Sobat. These rivers (which form for 250m. the west or south-west frontiers of Abyssinia) descend in great falls, and like other Abyssinian streams are unnavigable in their upper courses. The Baro on reaching the plain affords, however, an open waterway to the Nile (*see* NILE; SOBAT and SUDAN).

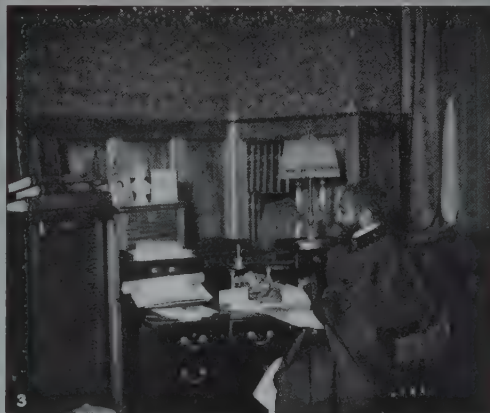
The chief eastward river is the Hawash, rising in the Shoa uplands and bending first south-east and then north-east. It reaches the Afar (Danakil) lowlands through a broad breach in the eastern escarpment of the plateau, where it is nearly 200ft. wide and 4ft. deep, even in the dry season, and during the floods rises 50 or 60ft. above low-water mark, thus inundating the plains for many miles along both its banks. Yet it fails to reach the coast and after a winding course of about 500m. is lost near Lake Aussa, some 60 or 70m. from the head of Tajura Bay. From Shoa south-west to Lake Rudolf extends a chain of lovely upland lakes, some fresh, some brackish, some completely closed, others connected by short channels, the chief links in their order from north to south being:—Zwai, communicating southwards with Hora Abyata, which connects with Langanza, all in the Arusi Galla territory; then Shala and Awusa; farther south Abaya (Margherita) with an outlet to a smaller tarn, Chamo, in the romantic Baroda and Gamo districts, skirted on the west by grassy slopes and wooded ranges (6,000 to nearly 9,000ft.);



PHOTOGRAPHS, (1, 4, 5) E. A. SALISBURY FROM EWING GALLOWAY, (3) INTERNATIONAL NEWSREEL, (2, 6) EWING GALLOWAY

VILLAGE AND COUNTRY LIFE IN ABYSSINIA

1. A weaver at his loom in a village of Abyssinia, where practically all the manufacturing is primitive
2. Typical Abyssinian landscape showing farms on the level lands and mountains in the distance
3. General view of Djibouti, a French possession which is the principal port of French Somaliland
4. Crushing grain for bread in front of a country home in the hills of Abyssinia
5. View over the stables of one of the numerous local kings
6. A peaceful family scene taken in the evening in front of one of the huts on the plains



PHOTOGRAPHS, (1, 2) SALISBURY FROM EWING GALLOWAY, (4) INTERNATIONAL NEWSREEL, (5) EWING GALLOWAY

LIFE AND CUSTOMS OF THE PEOPLE OF ABYSSINIA

1. Haile Selassie I (Ras Tafari Makonnen), who was appointed regent at the coronation of the Empress Zauditu, Feb. 11, 1917
2. Reproduction of a picture in an Abyssinian church in which the native artist has replaced the original face of the rider by that of the regent at that time
3. Haile Selassie signing the slavery decree in 1923. This decree made slave-trading punishable by death in Abyssinia
4. Wood-sellers at Addis Ababa, the capital of Abyssinia
5. Picture of the officers of the Abyssinian army on the parade grounds at Addis Ababa. They were commanded by Ras Tafari
6. An ancient Galla stone in the Arussi country, where archaeologists discovered numbers of dolmens
7. An Abyssinian and a Shankalla woman (negroids) grinding grain on stones
8. The queen, wife of Haile Selassie, posing for her picture in front of the palace in Addis Ababa before his exile



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ABYSSINIA COVERS 305,731 SQ. MI., OF WHICH ABYSSINIAN SOMALILAND MAKES NEARLY A THIRD. MOST OF THE COUNTRY WEST OF 40° IS A PLATEAU FROM WHICH RISE VARIOUS MOUNTAIN RANGES. ON EVERY SIDE EXCEPT THE SOUTH THE WALLS OF THE PLATEAU RISE ABRUPTLY FROM THE PLAINS. IN A DAY'S JOURNEY THE TRAVELLER MAY PASS FROM TROPICAL TO ALMOST ALPINE CONDITIONS OF CLIMATE. EQUALLY GREAT IS THE RANGE OF THE FLORA AND FAUNA. THERE ARE FEW LARGE TOWNS

lastly, in the Asille country, Lake Stefanie, the Chuwaha of the natives, completely closed and about 1,800ft. above sea. To the same system obviously belongs the neighbouring Lake Rudolf (*q.v.*), larger than all the rest together. This lake receives at its northern end (1,800ft. above sea level) the waters of the Omo, a rapid and unnavigable perennial stream with many affluents, rising in the Shoa highlands and falling 6,000ft. in its course of 370m. The chief rivers of Somaliland (*q.v.*), Webi Shibeli and Juba (*q.v.*), rise on the south-eastern slopes of the Abyssinian escarpment and most of their course is through Abyssinian territory.

GEOLOGY

The East African tableland is continued into Abyssinia, the following formations being represented:—

Archæan.—Metamorphic rocks, the main mass of the tableland, are exposed in every deep valley in Tigré and along the Blue Nile. Mica schists are most prevalent. Hornblende schists also occur and a compact felspathic rock in the Suris defile. The foliæ of the schists strike north and south.

Triassic (?).—In the region of Adigrat the metamorphic rocks are invariably overlain by white and brown sandstones, unfossiliferous, and attaining a maximum thickness of 1,000ft. They are overlain by the fossiliferous limestones of the Antalo group. Around Chilga and Adigrat coal-bearing beds occur, which Blanford suggests may be of the same age as the coal-bearing strata of India. The Adigrat sandstone possibly represents some portion of the Karroo formation of South Africa.

Jurassic.—The fossiliferous limestones of Antalo are generally horizontal, but much disturbed when interstratified with trap rocks. The fossils are all characteristic Oolite forms and include a species of *Hemicidar*, *Pholadomya*, *Ceromya*, *Trigonia* and *Alaria*.

Igneous Rocks.—Above a height of 8,000ft. the country consists of bedded traps belonging to two distinct and unconformable groups. The lower (Ashangi group) consists of basalts and dolerites often amygdaloidal. Their relation to the Antalo limestones is uncertain, but Blanford considers them to be not later in age than the Oolite. The upper (Magdala group) contains

much thick trachytic rock lying perfectly horizontally, and giving rise to a series of terraced ridges characteristic of central Abyssinia. They are interbedded with unfossiliferous sandstones and shales. Of more recent date (probably Tertiary) are some igneous rocks, rich in alkalis, in parts of southern Abyssinia. Still more recent are the basalts and ashes west of Massawa and around Annesley Bay, and known as the Aden volcanic series. The older igneous rocks have suffered severe denudation, giving deep and narrow ravines, sometimes to a depth of 3,000 to 4,000ft.

Climate.—Somaliland and the Danakil lowlands are hot and dry with semi-desert conditions; the lower basin of the Sobat is hot, swampy and malarious. But over most of Abyssinia, as well as the Galla highlands, the climate is very healthy and temperate. The country lies wholly within the tropics, but its nearness to the equator is counterbalanced by the elevation of the land. In the deep valley of the Takazze and Abbai, and generally below 4,000ft., conditions are torrid and fevers prevalent. On the uplands, however, the air is bracing and the nights very bleak. The mean range of temperature is between 60° and 80°. On the higher mountains the climate is Alpine. The atmosphere on the plateaus is exceedingly clear. In addition to variation in climate with elevation, the year may be divided into two main seasons, the dry (*baga*) from Oct. to mid-June, and the rainy (*karamt*), caused by the south-west monsoon, from mid-June to the end of September. There is also a period of so-called "little rains," generally about March.

The incidence of the rains varies slightly in different parts of the country, the rain moving from north to south; the average annual rainfall at Addis Ababa over a period of 25 years amounted to 1,200mm.; it is on the whole rather lighter in the north. The rainy season is of great importance not only to Abyssinia but to the countries of the Nile valley, as the prosperity of the eastern Sudan and Egypt is largely dependent upon the Abyssinian rainfall.

Flora and Fauna.—As in a day's journey the traveller may pass from torrid to almost Alpine conditions of climate, so great also is the range of flora and fauna. In the valleys and lowlands vegetation is dense, but the plateaus are comparatively bare, with thinly scattered trees and bushes. The glens and ravines are often thickly wooded, and offer a delightful contrast to the open downs. These conditions are particularly characteristic in the north; in the south the upland vegetation is more luxuriant. The date palm, mimosa, wild olive, giant sycamores, junipers and laurels, the myrrh and other gum trees (gnarled and stunted, these flourish most on the eastern foothills), a magnificent pine (the Natal yellow pine, which resists the attacks of the white ant), the fig, orange, lime, pomegranate, peach, apricot, banana and other fruit trees; the grape vine (rare), blackberry and raspberry; the cotton and indigo plants, and occasionally the sugar cane, are all found. There are in the south large forests of valuable timber; and the coffee plant is indigenous in the Kaffa country, whence it takes its name. Many grasses and flowers abound. Large areas in the highlands are covered by the Kosso tree, which grows from 30 to 40ft. high and has abundant pendant red blossoms; the flowers and the leaves are prized for medicinal purposes. The fruit of the kurarina, found almost exclusively in Shoa, yields a black grain highly esteemed as a spice. On the tableland a great variety of grains and vegetables are cultivated. A fibrous plant, the sansevieria, grows wild in the semi-desert regions of the north and south-east.

Elephant and rhinoceros are found in low-lying districts, especially in the Sobat valley. The hippopotamus and crocodile inhabit many of the rivers and lakes, in some of which otters of large size are plentiful. Lions abound in the low countries and in Somaliland. Leopards, spotted and black, are numerous and often large; hyaenas are found everywhere and are hardy and fierce; lynx, wolf, wild dog and jackal are also common. Boars and badgers are more rarely seen. The giraffe is found in the west; the zebra and wild ass frequent the lower plateaux and the rocky hills of the north. Antelopes and gazelles of many varieties are numerous in most parts and include greater and lesser kudu (both rather rare), oryx, duiker, gemsbuck, hartebeest, gerenuk

(the most common—it has long thin legs and a camel-like neck), klip-springer, found on the high plateaus as well as in the lower districts, and the dik-dik, the smallest of the antelopes, rarely over 10 lb., common in the low countries and the foothills. The rarest of all these is the nyala. The civet is found in many parts but chiefly in the Galla regions. Squirrels and hares, monkeys, notably the guereza, gelada, guenon and dog-faced baboon, range abundantly from the warm lowlands to heights of 10,000ft. Eagles, vultures, hawks, bustards and other birds of prey, partridges, duck, teal, guinea-fowl, sand-grouse, curlews, woodcock, snipe, pigeons, thrushes and swallows are very plentiful. A fine variety of ostrich is common. Among birds prized for plumage are the marabout, crane, heron, blackbird, parrot, jay, and many sun-birds of extraordinary brilliance. Serpents are not numerous but several are poisonous. The bee's honey is an important part of the people's food. The locust is a pest. There are thousands of varieties of butterflies and other insects.

ADMINISTRATION AND INDUSTRY

Provinces and Towns.—The ancient provincial divisions of Abyssinia (Amhara, Tigré, Gojam, Shoa, etc.) are for the most part now mere geographical expressions, having been broken up into smaller governorships with the exception of the ancient kingdom of Gojjam, enclosed by the great bend of the Abbai, which is still a single governorship. The more important provinces number about 20, of which may be mentioned: Gojam, North and South Tigré, Bagemdir, Harar, Salale, Waag and Lasta and Jimma. Each is divided into sub-districts and further subdivided into groups of villages. With the exception of the capital, Addis Ababa (*q.v.*), Harar, and Direddawa, there are no towns of any size in Abyssinia. Centuries of almost continual warfare between the provinces help to account for the absence of large towns; also royal residences have changed frequently on exhaustion of fuel supplies. The earliest capital appears to have been Aksum (*q.v.*), in Tigré, where there are extensive ruins. Gondar in Amhara was the capital from the middle ages to the middle of the 19th century. Addis Ababa in Shoa, the capital since 1892, has about 150,000 inhabitants, Direddawa 30,000 and Harar 25,000.

None of the other towns has a permanent population exceeding 6,000 to 10,000, but several have large periodic markets. In Tigré are Aduwa (17m. E. by N. of Aksum), Aksum, Adigrat, Makale and Antalo. The three last are near the eastern escarpment of the high plateau on the direct road South from Massawa to Shoa. West of Adigrat is the monastery of Debra-Damo, a most celebrated sanctuary.

In Amhara are Magdala (*q.v.*), formerly the residence of King Theodore, and the place of imprisonment of the British captives in 1866; Debra-Tabor ("Mount Tabor"), the chief royal residence under King John in a strong strategic position, overlooks the fertile plain east of Lake Tana about 8,620ft. above sea. Amba-Mariam, a fortified station midway between Gondar and Debra-Tabor near the north-east side of Lake Tana, with a population of 3,000, has the famous shrine and church dedicated to St. Mary, whence the name Mahdera-Mariam ("Mary's Rest"). It was a royal residence, and is an important market and place of pilgrimage, a few miles south-west of Debra-Tabor; Sokota, a great central market, capital of Waag, is at the convergence of several main routes. In Shoa are: Ankober, formerly the capital of the kingdom, Debra-Birhan ("Mountain of Light"), once a royal residence; Liché (Litché), one of the largest market towns in the south. Lfeka, the largest market in Gallaland, communicates direct with Gojam, Shoa and other parts of the empire. Anderacha, the commercial centre of Kaffa, and Jiren, capital of the neighbouring province of Jimma, attract traders from surrounding provinces.

Communications.—There is a single line of railway from Jibuti to Addis Ababa (486m.) but, outside the capital, there are no roads for wheeled traffic. Transport is by mules, donkeys, pack-horses and (in the lower regions) camels. Telegraph lines connect Addis Ababa and several important towns of the North with Massawa, Harar and Jibuti. There is also a telephonic

service, but outside Addis Ababa, the capital, it is subject to frequent interruption.

Agriculture.—The soil is exceedingly fertile and agriculture is extensively followed; in the lower regions maize, durra, wheat, barley, rye, *teff*, pease, cotton and sugar-cane are grown. *Teff*, a kind of millet with pinhead grains, is the common bread grain. The low grounds also produce a grain, *tocussa*, from which black bread is made. Certain oleaginous plants, the *suf*, *nuc* and *selite* (no European equivalents for the native names), and the groundnut, are largely grown. The castor bean grows wild, the green castor in the low, damp regions, the red castor at medium altitudes. The kat plant, a medicinal tonic, is largely grown in Harar province. On the higher plateaus the chief crops are wheat, barley, *teff*, peppers, vegetables of all kinds and coffee. Above 10,000ft. one finds barley, oats, beans and occasionally wheat. Of all cereals *teff* and barley are the most widely and generally grown. In the high plateaus sowing begins in May, in the lower plateaus and the plains in June, but where the summer is long and rain abundant sowing and reaping are going on at the same time. Most regions yield two, many three, crops a year.

Stock.—The land is admirably adapted for stock raising; enormous herds of cattle estimated at from 10 to 15 million head are found in Abyssinia, of which the most remarkable are the immensely long horned Sanga or Galla oxen. Most cattle are of the zebu or hump-backed variety, but there are also two breeds—one large, the other resembling the Jersey cattle—which are straight-backed. Sheep, of which there are also immense flocks, belong to the short and fat-tailed variety. The majority are not wool-bearing, but in one district a very small black sheep is raised for wool. The small mountain breed of sheep weigh no more than 20 to 30lb. apiece. Goats are of both the long and short-haired varieties, those from the Arusi Galla country having fine silky hair sometimes 16in. long. Large quantities of butter, generally rancid, are made from the milk of cows and sheep. In the Leka province small black pigs are bred in considerable numbers. The horses (very numerous) are strong and only about 14 hands high. The best breeds come from the Shoa uplands. The ass is also small and strong; and the mule, bred in large numbers, is of excellent quality, and, both as a transport animal and as a mount, is preferred to the horse. The mule, which averages 12 hands, thrives in every condition of climate, is fever-proof, travels over the most difficult mountain passes with absolute security and carries a load of from 150 to 200lb.

Minerals.—In the south and west provinces placer gold mines along the water-courses are worked by Gallas as an industry subsidiary to tending their flocks and fields. In the Wallega district veins of gold-bearing quartz and finds of platinum have been reported. Iron, coal, potash and other minerals are found. Rock-salt is obtained from the province of Tigre.

Trade and Currency.—The small progress in the economic and commercial development may be attributed to disturbed political conditions (until quite recently), the lack of communications, bad methods of taxation, suspicion of foreign enterprise and currency difficulties. Some European commercial enterprises have been started and there are indications that the Government will be able to give more sympathetic attention in the future to this. A Belgian company has acquired the alcohol monopoly, but is meeting with great difficulties; a Franco-Belgian company has been formed for cotton cultivation, two Belgian companies are developing large coffee plantations in addition to a few smaller undertakings. Banking is a monopoly of the Bank of Abyssinia (a branch of the National Bank of Egypt) under charter of Emperor Menelek.

The total trade approximates £2,500,000 annually. The chief exports are coffee and hides, and the principal imports, salt, cotton fabrics and hardware. The main channel of trade is the Franco-Ethiopian railway, from Addis Ababa to the port of Jibuti in French Somaliland. The principal trade routes with the Sudan are via Gambela, Gallabat and Roseires. Other trade routes are through the Italian colony of Eritrea to Massawa, and through Harar to Berbera in British Somaliland. The currency is the Maria Theresa and Menelek dollars of a nominal

value of about 2s., but in parts of the country bars of salt or even cartridges are used.

Government.—The political institutions are of a feudal character, and within their provinces the *rases* and other chiefs exercise large powers. The empress and regent have a number of ministers and a council of elders of the Crown. The legal system (*Feta Negast*) is a strange combination of various origins based on the Mosaic Code; the chief judicial officer is the *Afa Negus* (breath of the king). From all decisions there is an appeal to the throne. The powerful Abyssinian Church (*q.v.*) is presided over by the *Abuna*, always a Copt nominated from Egypt. The priests, an ignorant body, teach the scriptures in Gize, a tongue understood by very few. Apart from this and two schools in Addis Ababa, for which a few European teachers have been



BY COURTESY OF BARNUM BROWN
ABYSSINIAN NATIONAL COSTUME: A CHIEF IN GALA DRESS WITH LION'S MANE COLLAR AND HEADRESS AND AN INDIVIDUAL IN EVERY-DAY DRESS WITH WOOLLEN BURNOUS

introduced, education is practically non-existent. The Abyssinian calendar divides the year into 12 months of 30 days each, followed by one month of five days (six in leap year). The year begins on 1st Maskaram, our Sept. 11 (12 in the European year preceding our leap year) and is then seven years behind the European year; from Jan. 1 to Sept. 10 it is eight years behind. The land is not held in fee simple but is subject to the control of the throne or the church. Revenue is derived from a 10% customs duty on imports, and from a levy on all forms of productions; but as the provincial governors receive no salaries the receipts of the central Government are subject consequently to fluctuations. (C. F. R.)

Defence.—The early history of Abyssinia was marked by the struggles of an early Christian community against pagan and Mohammedan invaders. Early Portuguese records (1520-27) contain some entries of military interest. King Theodore (b. 1818) first conceived the idea of organizing an Abyssinian army on European lines. His power was broken in 1868 by an expedition under Lord Napier of Magdala, sent to the succour of Europeans whom he had made prisoner. (See also EGYPT: *Egypt and Sudan Campaigns, 1882-1900*.)

In March 1896 Theodore's successor Menelek successfully defended the country against an Italian invading force, 200,000 men responding to his call to arms.

In time of war every able-bodied Abyssinian is expected to serve. According to estimates, about 250,000-300,000 Abyssinians (including a small standing army) could be equipped with modern rifles; but lack of commissariat would prevent a large force from keeping the field long.

From 1890 onwards various expedients had been adopted ineffectively by the European Powers to limit the import of arms.

Under the terms of a treaty concluded in May 1902 an area near Itang (Baro river) bordering the Sudan cannot be used for any military purpose (State Papers, vol. 95, p. 467). (G. G. A.)

HISTORY

Early Records.—Abyssinia, or at least the northern portion of it, was included in the tract of country known to the ancients as Ethiopia, the northern limits of which reached at one time to about Syene. The connection between Egypt and Ethiopia was in early times very intimate, and occasionally the two countries were under the same ruler, so that the arts and civilization of the one naturally found their way into the other. In early times, too, the Hebrews had commercial intercourse with the Ethiopians; and according to Abyssinian tradition the queen of

Sheba who visited Solomon was a monarch of their country, and from their son Menelek the kings of Abyssinia claim descent. During the Captivity many of the Jews settled here and brought with them a knowledge of the Jewish religion. Under the Ptolemies, the arts as well as the enterprise of the Greeks entered Ethiopia, and led to the establishment of Greek colonies. Out of these Greek colonies appears to have arisen the kingdom of Auxume which flourished from the 1st to the 7th century A.D. and was at one time nearly coextensive with Abyssinia proper. The capital Auxume and the seaport Adulis were then the chief centres of the trade with the interior of Africa in gold dust, ivory, leather, aromatics, etc. At Axum, the site of the ancient capital, many vestiges of its former greatness still exist; and the ruins of Adulis, which was once a seaport on the bay of Annesley, are now about 4 miles from the shore (see the article, ETHIOPIA).

Introduction of Christianity.—Christianity was introduced into the country by Frumentius (*q.v.*), who was consecrated first bishop of Ethiopia by St. Athanasius of Alexandria about A.D. 330. From the scanty evidence available it would appear that the new religion at first made little progress, and the Axumite kings seem to have been among the latest converts. Towards the close of the 5th century a great company of monks established themselves in the country, and since that time monachism has been a power among the people and not without its influence on the course of events. In the early part of the 6th century the king of the Homerites, on the opposite coast of the Red Sea, having persecuted the Christians, the emperor Justinian I. requested the king of Auxume, Caleb or El-Esbaha, to avenge their cause. He accordingly collected an army, crossed over into Arabia, and conquered Yemen (*c.* 525), which remained subject to Ethiopia for over 50 years. This was the most flourishing period in the annals of the country. The Ethiopians possessed the richest part of Arabia, carried on a large trade, which extended as far as India and Ceylon, and were in constant communication with the Greek empire. Their expulsion from Arabia, followed by the conquest of Egypt by the Mohammedans in the middle of the 7th century, changed this state of affairs, and the continued advances of the followers of the Prophet at length cut them off from almost every means of communication with the civilized world; so that, as Gibbon says, "encompassed by the enemies of their religion, the Ethiopians slept for near a thousand years, forgetful of the world by whom they were forgotten." About A.D. 960, a Jewish princess, Judith, conceived the design of murdering all the members of the royal family, and of establishing herself in their stead. During the execution of this project, the infant king was carried off by some faithful adherents, and conveyed to Shoa, where his authority was acknowledged and the Solomonean dynasty ruled for about 300 years; while Judith reigned for 40 years over the rest of the kingdom after which a usurping dynasty of Lasta held the reins of power (except in Shoa) until in 1268 the kingdom was restored to the royal house in the person of Yekünö Amläk.

Advent of the Portuguese.—Towards the close of the 15th century the Portuguese missions into Abyssinia began. A belief had long prevailed in Europe of the existence of a Christian kingdom in the far east, whose monarch was known as Prester John, and various expeditions had been sent in quest of it. Among others who had engaged in this search was Pedro de Covilham, who arrived in Abyssinia in 1490, and, believing that he had at length reached the far-famed kingdom, presented to the negüs, or emperor of the country, a letter from his master the king of Portugal, addressed to Prester John. Covilham remained in the country, but in 1507 an Armenian named Matthew was sent by the negüs to the king of Portugal to request his aid against the



BY COURTESY OF D. BROWN.
ABYSSINIAN LADY WEARING WHITE SHAMMA (THE NATIONAL TOGA) WITH COLOURED STRIPES

Mohammedans. In 1520 a Portuguese fleet, with Matthew on board, entered the Red Sea in compliance with this request, and an embassy from the fleet visited the negüs, Lebna Dengel or Dawit (David) II., and remained in Abyssinia for about six years. One of this embassy was Father Francisco Alvarez, from whom we have the earliest and not the least interesting account of the country. Between 1528 and 1540 armies of Mohammedans, under the renowned general Mohammed Grañ (probably a Somali), entered Abyssinia from the low country to the south-east, and overran the kingdom, obliging the emperor to take refuge in the mountain fastnesses. In this extremity recourse was again had to the Portuguese, who sent a fleet, under the command of Stephen da Gama, from India, which arrived at Massawa in Feb. 1541. In the July following a force of 450 musqueteers, under the command of Christopher da Gama, younger brother of the admiral, left the fleet and marched into the interior, and being joined by native troops were at first successful against the enemy; but they were subsequently defeated, and their commander taken prisoner and put to death (Aug. 1542). On Feb. 21, 1543, however, Mohammed Grañ was shot in an engagement and his forces totally routed. After this, quarrels arose between the negüs and the Portuguese, who now wished the emperor publicly to profess himself a convert to Rome, which the negüs refused to do. The Jesuits who had accompanied or followed the da Gama expedition into Abyssinia, and fixed their headquarters at Fremona (near Adowa), were oppressed and neglected, but not actually expelled. In the beginning of the 17th century Father Pedro Paez arrived at Fremona, a man of great tact and judgment, who soon rose into high favour at court, and gained over the emperor to his faith. He directed the erection of churches, palaces and bridges in different parts of the country, and carried out many useful works. His successor Mendez was a man of much less conciliatory manners, and the feelings of the people became strongly excited against the intruders, till at length, on the death of the negüs, Socinius or Seged I., and the accession of his son Fasildas in 1633, they were all sent out of the country, after having had a footing there for nearly a century and a half.

Penetration of European Travellers.—The French physician C. J. Poncet, who went there in 1698, via Sennar and the Blue Nile, was the only European that afterwards visited the country before Bruce in 1769. James Bruce's main object was to discover the sources of the Nile, which he was convinced lay in Abyssinia. Accordingly, leaving Massawa in Sept. 1769, he travelled via Axum (Aksum) to Gondar, and was well received by King Tekla Haimanot II. He accompanied the king on a warlike expedition round Lake Tana, crossing the genuine Blue Nile (Abbai) close to its point of issue from the lake. On a second expedition of his own he proved to his own satisfaction that the river originated some 40m. S.W. of the lake at a place called Geesh (Nov. 4, 1770). He showed that this river flowed into the lake, and left it by its now well-known outlet. In 1805 the first British mission under Lord Valentia and Mr. Henry Salt was sent to conclude an alliance with Abyssinia and obtain a port on the Red Sea in case France secured Egypt by dividing up the Turkish Empire with Russia. This mission was succeeded by many travellers, missionaries and merchants of all countries. Prominent amongst them were Dr. C. T. Beke (*q.v.*) who did much to extend geographical knowledge of the country from 1840 to 1843, and Mr. Mansfield Parkyns (1843-46) who wrote the most interesting book on the country since Bruce.

In 1830 Protestant missionary enterprise was begun by Samuel Gobat and Christian Kugler, who were sent out by the Church Missionary Society and were well received by the Ras of Tigré, but in 1838 most of the missionaries were obliged to leave the country owing to the opposition of the native priests. Later on, however (1856), Bishop Gobat conceived the idea of sending lay missionaries who would engage in secular occupations as well as missionary work. Their secular work appears to have been the more appreciated, and King Theodore employed them as workmen and established them at Gaffat, near his capital.

Position of the Negusa Nagast.—In order to obtain a clear view of native Abyssinian history, as distinct from the visits and

influence of Europeans, it must be borne in mind that during the last 300 years, and indeed for a longer period, for the old chroniclers may be trusted to have given a somewhat distorted view of the importance of the particular chieftains with whom they came in contact, the country has been merely a conglomeration of provinces and districts, ill defined, loosely connected and generally at war with each other. Of these the chief provinces have been Tigré (northern), Amhara (central), Gojam (north western) and Shoa (southern). The seat of government, or rather of overlordship, has usually been in Amhara, the ruler of which, calling himself *negusa nagast* (king of kings, or emperor), has exacted tribute, when he could, from the other provinces. The title of *negusa nagast* has been to a considerable extent based on the blood in the veins of the claimant. All the emperors have based their claims on their direct descent from Solomon and the queen of Sheba; but it is needless to say that in many, if not in most, cases their success has been due more to the force of their arms than to the purity of their lineage. Some of the rulers of the larger provinces have at times been given or have given themselves, the title of *negūs* or king, so that on occasion as many as three, or even more, *negūses* have been reigning at the same time; and this must be borne in mind by the student of Abyssinian history in order to avoid confusion of rulers. The whole history of the country is, in fact, with a few bright intervals due to the efforts of some of the more enlightened monarchs, one gloomy record of internecine wars, barbaric deeds and unstable governments, of adventurers usurping thrones, only to be themselves unseated, and of raids, rapine and pillage.

Thus, for example, though the Empire had been re-united under Yekūnō Amlāk of the Solomonean dynasty in 1268, the overlordship of the *Negūs* or *Negusa Nagast* (king of kings) had become purely nominal by the 18th century, and the rulers of Tigré and Amhara alternately held the real power. Between these two quasi-kingdoms there was perpetual hostility and much fighting, but without definite results until Kassa (later King Theodore of Magdala fame) appeared on the scene.

KING THEODORE

Origin and Rise.—Lij Kassa was born in Kwara, a small district of Western Amhara, in 1818. His father was a small local chief, and his uncle was governor of the districts of Dembea, Kwara and Chelga between Lake Tana and the undefined N.W. frontier. He was educated in a monastery, but preferred a more active life, and by his talents and energy came rapidly to the front. On the death of his uncle he was made chief of Kwara, but in consequence of the arrest of his brother Bilawa by Ras Ali, he raised the standard of revolt against the latter, and, collecting a large force, repeatedly beat the troops that were sent against him by the *ras* (1841-47). On one occasion peace was restored by his receiving Tavavich, daughter of Ras Ali, in marriage; and this lady is said to have been a good and wise counsellor during her lifetime. He next turned his arms against the Turks, in the direction of Massawa, but was defeated; and the mother of Ras Ali having insulted him in his fallen condition, he proclaimed his independence. As his power was increasing, to the detriment of both Ras Ali and Ubié, these two princes combined against him, but were heavily defeated by him at Gorgora (on the southern shore of Lake Tana) in 1853. Ubié retreated to Tigré, and Ras Ali fled to Begemeder, where he eventually died. Kassa now ruled in Amhara, but his ambition was to attain to supreme power, and after conquering Gojam and Tigré, he proclaimed himself *negusa nagast* of Ethiopia under the name of Theodore III. He now turned his attention to Shoa which still remained unsubdued.

Struggle with Shoa.—Retracing our steps for a moment in that direction, we find that in 1813 Sahale (or Sella) Selassie, younger son of the preceding ruler of Shoa, Wassen Seged, had proclaimed himself king of Ifat, Shoa and the Galla. His reign was long and beneficent, and by his wise measures and personal generosity, and by extending his hospitality to Europeans, he brought his country within the closer ken of civilized European powers. During his reign he received the missions of Major W. Cornwallis Harris, sent by the governor-general of India (1841),

and M. Rochet d'Héricourt, sent by Louis Philippe (1843), with both of whom he concluded friendly treaties on behalf of their respective governments. He was succeeded in 1847 by his eldest son, Haile Melikot, who, by increasing his dominions at the expense of the Galla, and by concluding a treaty with Ras Ali against Kassa in 1850 determined the latter to crush him at the earliest opportunity.

Thus it was that in 1855 Kassa, under the name of the emperor Theodore, advanced against Shoa with a large army. Dissensions broke out among the Shoans, and after a desperate and futile attack on Theodore at Debra-Berhan, Haile Melikot died of exhaustion and fever, nominating with his last breath his 11-year-old son Menelek as successor (Nov. 1855). After a hard fight, Menelek was defeated and handed over to the *negūs*, taken to Gondar and there trained in Theodore's service.

Decline of Power.—Theodore had by then reached the zenith of his career. He is described as being generous to excess, free from cupidity, merciful to his vanquished enemies, and strictly continent, but subject to violent bursts of anger and possessed of unyielding pride and fanatical religious zeal. He was also a man of intelligence, superior to those among whom he lived, with natural talents for governing and gaining the esteem of others. He had, further, a noble bearing and majestic walk, a frame capable of enduring any amount of fatigue, and is said to have been "the best shot, the best spearman, the best runner, and the best horseman in Abyssinia." Unfortunately, success turned his head, and he lost certain good influences around him by the death of his good queen Tavavich, and the murder by rebels of his two English friends and advisers, W. C. Plowden and J. T. Bell, whose deaths he avenged by the slaughter of 2,000 of the rebels.

His union with his second wife, Terunish, the proud daughter of the late Ras of Tigré, was a most unhappy one, and he seems to have given himself over to intoxication and lust, and to have exercised the most terrible cruelty in his campaigns against the Galla and the various districts in which rebellions broke out against him. This exhausted his strength and resources, and such of the country as he still dominated groaned under his heavy exactions.

Quarrel with Great Britain.—In Oct. 1862, Captain Cameron, who had been appointed in Feb. of that year to succeed Mr. Plowden as British consul, was sent home by Theodore, with a letter to the queen of Great Britain, which reached the Foreign Office on Feb. 12, 1863. This letter was put aside and no answer returned, and to this in no small degree are to be attributed the difficulties that subsequently arose with that country. In Nov. despatches were received from England, but no answer to the emperor's letter, and this, together with a visit paid by Captain Cameron to the Egyptian frontier town of Kassala, greatly offended him. Accordingly in Jan. 1864 Captain Cameron and his suite, with Messrs. Stern and Rosenthal, were cast into prison. When the news of this reached England, the government resolved, when too late, to send an answer to the emperor's letter, and selected Mr. Hormuzd Rassam to be its bearer. The British party on arrival at the king's camp in Damot, on Jan. 25, 1866, were received with all honour, and were afterwards sent to Kwarata, on Lake Tana, there to await the arrival of the captives. The latter reached Kwarata on March 12 and everything appeared to proceed favourably. A month later they started for the coast, but had not proceeded far when they were all brought back and put into confinement. The Europeans, although detained as prisoners, were not at first unkindly treated; but in the end of June they were sent to Magdala, where they were soon afterwards put in chains, suffered hunger, cold and misery, and were in constant fear of death. Meanwhile one of them, Mr. Flad, had been sent by Theodore with a letter to Queen Victoria, asking for European workmen and machinery, and with a view if possible to effect the release of the prisoners by conciliatory measures. Mr. Flad was sent back, with some artisans and machinery, and a letter from the queen, stating that these would be handed over to his majesty on the release of the prisoners and their return to Massawa. This, however, failed to influence the emperor, and the British Government at length saw that they must have recourse to arms.

Sir Robert Napier's Expedition.—In July 1867 it was resolved to send an army into Abyssinia to enforce the release of the captives, under Sir Robert Napier (1st Baron Napier of Magdala). The landing-place selected was Mulkutto (Zula), on Annesley Bay, the point of the coast nearest to the site of the ancient Adulis, and we are told that "the pioneers of the English expedition followed to some extent in the footsteps of the adventurous soldiers of Ptolemy, and met with a few faint traces of this old-world enterprise" (C. R. Markham). The force amounted to upwards of 16,000 men, besides 12,640 belonging to the transport service, and followers, making in all upwards of 32,000 men. The task necessitated a march over 400 miles of a mountainous and little-known country, inhabited by savage tribes, to the camp or fortress of Theodore. The commander-in-chief landed on Jan. 7, 1868, and soon after the troops began to move forward through the pass of Senafé, and southward through the districts of Agamé, Tera, Endarta, Wojerat, Lasta and Wadela.

In the meantime the power of Theodore in the country was rapidly waning. Shoa had already shaken off his yoke; Gofjam was virtually independent; Walkeit and Simen were under a rebel chief; and Lasta, Waag and the country about Lake Ashangi had submitted to Wagshum Gobassié, who had also overrun Tigré and appointed Dejaz Kassai his governor. The latter, however, in 1867 rebelled against his master and assumed the supreme power of that province. At the time when the British troops made their appearance in the country Theodore had thus been reduced to great straits. His army, which at one time numbered over 100,000 men, was rapidly deserting him, and he could hardly obtain food for his followers. He resolved to quit his capital Debra-Tabor, which he burned, and set out with the remains of his army for Magdala. During this march he displayed an amount of engineering skill in the construction of roads, of military talent and fertility of resource, that excited the admiration and astonishment of his enemies. But after a heavy defeat near Magdala on April 10, Theodore sent Lieut. Prideaux, one of the captives, and Mr. Flad, accompanied by a native chief, to the British camp to sue for peace. Answer was returned, that if he would deliver up all the Europeans in his hands, and submit to the queen of Great Britain, he would receive honourable treatment. The captives were liberated and sent away, and accompanying a letter to the British general was a present of 1,000 cows and 500 sheep, the acceptance of which would, according to Eastern custom, imply that peace was granted. Through some misunderstanding, word was sent to Theodore that the present would be accepted, and he felt that he was now safe; but in the evening he learned that it had not been received, and despair again seized him. The next day, April 13, Magdala was stormed and taken, practically without loss, and within they found the dead body of the emperor, who had fallen by his own hand. The inhabitants and troops were subsequently sent away, the fortifications destroyed, and the town burned. The queen Terunish having expressed her wish to go back to her own country, accompanied the British army, but died during the march, and her son Alamayahu, the only legitimate son of the emperor, was brought to England, as this was the desire of his father.¹ The success of the expedition was in no small degree owing to the aid afforded by the several native chiefs through whose country it passed, and no one did more in this way than Dejaz Kassa or Kassai of Tigré. In acknowledgment of this, several pieces of ordnance, small arms and ammunition, with much of the surplus stores, were handed over to him, and the British troops left the country in May 1868.

THE EMPEROR MENELEK II.

Early Struggles as King of Shoa.—It is now time to return to the story of the young prince Menelek, who, as we have seen, had been nominated by his late father as ruler of Shoa, but was in Theodore's power in Tigré. In 1865, he took advantage of Theodore's difficulties with the British government and escaped to Workitu, queen of the Wollo Galla country. The emperor,

¹He was subsequently sent to school at Rugby, but died in his 19th year, on Nov. 14, 1879. He was buried at St. George's Chapel, Windsor.

who held as hostage a son of Workitu, threatened to kill the boy unless Menelek were given up; but the gallant queen refused, and lost both her son and her throne. The fugitive meanwhile arrived safely in Shoa, and was there acclaimed as négus. For the next three years Menelek devoted himself to strengthening and disciplining his army, to legislation, to building towns, such as Liché (near Debra-Berhan), Worra Hallu (Wollo Galla country), etc., and to repelling the incursions of the Galla. On the death of Theodore (April 13, 1868) many Shoans, including Ras Dargé, were released, and Menelek began to feel himself strong enough to undertake offensive operations against the northern princes. But these projects were of little avail, for Kassai of Tigré, had by this time (1872) risen to supreme power in the north. With the help of the rifles and guns presented to him by the British, he had beaten Ras Bareya of Tigré, Wagshum Gobassié of Amhara and Tekla Giorgis of Gondar, and after proclaiming himself négusa nagast under the name of Johannes or John, was now preparing to march on Shoa. Here, however, Menelek was saved from probable destruction through the action of Egypt. This power had, by the advice of Werner Munzinger, then the Swiss governor of Massawa, seized and occupied in 1872 the northern province of Bogos; and, later on, insisted on occupying Hamasen also, for fear Bogos should be attacked. John, after futile protests, collected an army, and with the assistance of Ras Walad Michael, hereditary chief of Bogos, advanced against the Egyptian forces, who were under the command of one Arendrup, a Dane. Meeting near the Mareb, the Egyptians were beaten in detail, and almost annihilated at Gundet (Nov. 13, 1875). An avenging expedition was prepared in the spring of the following year, and, numbering 14,000 men under Ratib Pasha, Loring (American), and Prince Hassan, advanced to Gura² and fortified a position in the neighbourhood. Although reinforced by Walad Michael, who had now quarrelled with John, the Egyptians were a second time (March 25, 1876) heavily beaten by the Abyssinians, and retired, losing an enormous quantity of both men and rifles. Colonel C. G. Gordon, governor-general of the Sudan, was now ordered to go and make peace with John, but the king had moved south with his army, intending to punish Menelek for having raided Gondar whilst he, John, was engaged with the Egyptians. Menelek's kingdom was meanwhile torn in twain by serious dissensions on the subject of the succession, but on the approach of John, the Shoans united for a time against their common enemy. After a few skirmishes, however, they melted away, and Menelek was obliged to submit and do obeisance to John. The latter behaved with much generosity, but at the same time imposed terms which effectually deprived Shoa of her independence (March 1878). In 1879 Gordon was sent on a fresh mission to John on behalf of Egypt; but he was treated with scant courtesy, and was obliged to leave the country without achieving anything permanent.

Advent of the Italians.—The Italians now come on the scene. Assab, a port near the southern entrance of the Red Sea, had been bought from the local sultan in March 1870 by an Italian company, which, after acquiring more land in 1879 and 1880, was bought out by the Italian Government in 1882. In this year Count Pietro Antonelli was despatched to Shoa in order to improve the prospects of the colony by treaties with Menelek and the sultan of Aussa; but both John and Menelek became uneasy when Beilul, a port to the north of Assab Bay, was occupied by the Italians in Jan. 1885, and Massawa taken over by them from Egypt in the following month. This latter act was greatly resented by the Abyssinians, for by a treaty concluded with a British and Egyptian mission under Admiral Hewett and Mason Pasha in the previous year, free transit of goods was to be allowed through this port. In Jan. 1887, the Abyssinians, in consequence of a refusal from General Gené to withdraw his troops, surrounded and attacked a detachment of 500 Italian troops at Dogali, killing more than 400 of them. Reinforcements were sent from Italy, whilst in the autumn the British Government stepped in and tried to mediate by means of a mission under Mr. (afterwards Sir Gerald) Portal. His mission, however, proved abortive, and after many difficulties and dangers he returned to Egypt at

the end of the year. John was killed in battle against the dervishes in March 1889, when Menelek immediately claimed the Empire of Abyssinia. The new emperor brought Abyssinia for the first time under a single rule, doubled the size of the Empire by extensive conquests, and began development on European lines.

The Italian envoy Count Antonelli was with Menelek when he claimed the throne, and promptly concluded with him (May 2, 1889) on behalf of Italy a friendly treaty, to be known hereafter as the famous Ucciali treaty. In consequence of this the Italians occupied Asmara, made friends with Mangasha, reputed son and heir of King John, and received Ras Makonnen (Ras of Harar, which province had been conquered by Menelek in Jan. 1887), Menelek's nephew, as his plenipotentiary in Italy; thus it seemed as though hostilities between the two countries had come to a definite end. As, however, the Italians became more and more friendly with Mangasha and Tigré the apprehensions of Menelek increased, till at last, in Feb. 1893, he wrote denouncing the Ucciali treaty, which differed in the Italian and Amharic versions. According to the former, the *negüs* was bound to make use of Italy as a channel for communicating with other powers, whereas the Amharic version left it optional. Meanwhile the dervishes were threatening Eritrea. A fine action by Colonel Arimondi gained Agordat for Italy (Dec. 21, 1893), and a brilliant march by Colonel Baratieri resulted in the acquisition of Kassala (July 17, 1894).

War with Italy.—On his return Baratieri found that Mangasha was intriguing with the dervishes, and had actually crossed the frontier with a large army. At Koatit and Senafé (Jan. 13–15, 1895) Mangasha was met and heavily defeated by Baratieri, who occupied Adigrat in March. But as the year wore on the Italian commander pushed his forces unsupported too far to the south. Menelek was advancing with a large army in national support of Mangasha, and the subsequent reverses at Amba-Alagi (Dec. 7, 1895) and Makale (Jan. 21, 1896) forced the Italians to fall back.

Reinforcements of many thousands were meanwhile arriving at Massawa, and in Feb. 1896 Baratieri took the field at the head of over 13,000 men. Menelek's army, amounting to about 90,000, had during this time advanced, and was occupying a strong position at Abba Garima, near Aduwa (or Adowa). Here Baratieri attacked him on March 1, but the difficulties of the country were great, and one of the four Italian brigades had pushed too far forward. This brigade was attacked by overwhelming numbers, and on the remaining brigades advancing in support, they were successively cut to pieces by the encircling masses of the enemy. The Italians lost 4,600 white and nearly 3,000 native troops killed and wounded; the number of prisoners was estimated at between 2,500 and 3,000. The Abyssinians' casualties were far greater. General Baldassera advanced with a large body of reinforcements to avenge this defeat, but, beyond the peaceful relief of Adigrat no further operations took place. On Oct. 26 following, a provisional treaty of peace was concluded at Addis Ababa, annulling the treaty of Ucciali and recognizing the absolute independence of Abyssinia. (See ITALY: *History* and SOMALILAND.)

Consolidation and Extension of the Empire.—The war, so disastrous to Italy, attracted the attention of all Europe to Abyssinia and its monarch, and numerous missions, two Russian, three French, and one British, were despatched to the country, and hospitably received by Menelek. The British one, under Mr. Rennell Rodd (later Lord Rennell), concluded a friendly treaty with Abyssinia (May 15, 1897).

In 1898 Menelek subdued Mangasha and later conducted a number of expeditions in different parts of the country, notably against the Galla, and added immense provinces to the empire. An important treaty was concluded on May 15, 1902, between England and Abyssinia for the delimitation of the Sudan-Abyssinian frontier. Menelek, in addition, agreed not to obstruct the waters of Lake Tana, the Blue Nile or the Sobat, so as not to interfere with Nile irrigation. A combined British-Abyssinian expedition (Mr. A. E. Butter's) was dispatched in 1901 to propose and survey a boundary between Abyssinia on the one side and British East Africa and Uganda on the other; and the report of the expedition was made public by the British Government in Nov. 1904. It was followed in 1908 by an agreement defining the frontiers concerned.

It is also an interesting fact that between 1899 and 1904 the Abyssinians co-operated with the British in their campaigns against the "Mad Mullah" of Somaliland by sending joint expeditions on no less than four occasions.

Growth of European Influence.—The first concession for a railway was the one from the coast at Jibuti (French Somaliland) to the interior, granted by Menelek to a French company in 1894. Difficulties arose over the continuation of the railway to Addis Ababa and beyond, and the proposed internationalization of the line. These difficulties, which hindered the work of construction for years, were composed (so far as the European Powers interested were concerned) in 1906 by the terms of an Anglo-French-Italian agreement, signed in London on Dec. 13 of that year.

Meanwhile the country slowly developed in parts and opened out cautiously to European influences and most of the Powers appointed representatives at Menelek's capital, the British minister-plenipotentiary and consul-general, Lieut.-Colonel Sir J. L. Harrington, having been appointed shortly after the British mission in 1897. But Ras Makonnen, the most capable and civilized of Menelek's probable successors, died in March 1906, and Mangasha died later in the same year; the question of the succession therefore opened up the possibility that, in spite of recent civilizing influences, Abyssinia might still relapse in the future into its old state of conflict. The Anglo-French-Italian agreement of Dec. 1906, referred to above, contained provisions in view of this contingency. The preamble of the document declared that it was the common interest of the three Powers "to maintain intact the integrity of Ethiopia," and Article I. provided for their co-operation in maintaining "the political and territorial *status quo* in Ethiopia." Should, however, the *status quo* be disturbed, the Powers were to concert to safeguard their special interests. The terms of the agreement were settled in July 1906, and its text forthwith communicated to the *negüs*. (E. GL.; C. F. R.)

From 1908 to the War with Italy.—For the first 8 of these years (1908–1916) chaos reigned, *i. e.*, during the regency of Menelek's widow Taitu and Ras Tessama, and the rule of the Emperor Lej Yasu; during the next 12 years, 1916–1928—the period of combined rule of Menelek's daughter Zauditu as Empress with Ras Tafari (later the Emperor Haile Selassie) as Regent—matters improved to some extent in spite of constant intrigue between the progressive party, supporting the Regent, and the reactionary elements led by the Empress; during the last 8 years Tafari, first of all as King (1928–1930), later as Emperor (1930–1936), had begun to introduce a measure of reform and progress into his backward and unruly empire.

First Period—1908–1916.—Menelek had in 1908 nominated as his successor Lej Yasu (born 1896) under the regency of one of the more enlightened Abyssinian chieftains, Ras Tessama. But the constant strife between Menelek's wife Taitu, the Regent, and the boy Emperor, made ordered government impossible. The enforced retirement of Taitu in 1910, the death of Tessama in 1911, and the complete assumption of power in that year by Yasu, merely drove matters from bad to worse.

By his misgovernment, his tyrannical and dissolute conduct, and particularly by his inclination to Islam, Lej Yasu mortally affronted his own subjects, intensely proud as they were and are of their 15 centuries of Christian tradition. His support of the "Mad Mullah" of Somaliland, who claimed him as a cousin, and his efforts to build up a federation of Muslim states, anti-ally in its sentiments, also estranged the sympathies of the three great Powers with possessions bordering on Abyssinia. In September, 1916, he was excommunicated by the Abuna, the head of the Abyssinian Church. The great Rases, thus relieved of their oath of fealty, formally deposed him, and proclaimed Zauditu, a daughter of the Emperor Menelek, born in 1876, as Empress, and Dajazmach Tafari, born July 17, 1891, son of Menelek's nephew, Ras Makonnen, as Regent of the empire, heir to the throne and Ras of Rases. Heavy fighting followed. Lej Yasu's father, Ras Mikael of Wollo Galla, raised large Galla forces to aid his son, but the troops of the deposed ruler were defeated with great slaughter at Sagalle on October 27, 1916. Ras Mikael was taken prisoner, and

Lej Yasu became a wanderer, first of all in the Danakil country and later in the province of Tigré. He was taken prisoner by Tafari in 1921, and kept in chains until his death in 1935.

Second Period—1916-1928.—The dual nature of the administration of Empress and Regent stimulated intrigue among the powerful Rasés and provincial governors, who had fallen back into a state of semi-independence during the preceding years of misrule, and made effective control difficult to exercise. In spite of this, however, and of sporadic fighting with Lej Yasu's followers, Ras Tafari made substantial progress in administrative improvement; he was, however, hampered by a thoroughly bad and ineffective, though onerous, financial system, and an entire absence of men of integrity and ability to support and execute his ideas.

His distrust of the intentions of the great European littimptrope powers—England, France, and Italy—made him slow to grant concessions to or to accept financial or advisory assistance from nationals of these powers, and this further hindered development. It was largely on account of this distrust of his neighbours that Ras Tafari strove for the admission of Abyssinia to the League of Nations, which he achieved in 1923. This step was criticized as being premature in view of the backward state of development of the country, and was, in fact, opposed at first by the British representatives but ultimately approved, largely owing to the strong support accorded by the French.

Feeling more secure both internally and externally, as a result of the League membership, Ras Tafari felt able to leave Abyssinia and visit the principal European countries in 1924. Shortly afterwards he appealed to the League against the Anglo-Italian agreement regarding spheres of influence in Abyssinia, concluded in December 1925, which he regarded as a violation of Abyssinian rights. A visit of the Duke of Abruzzi to Addis Ababa in 1927 was followed by the signature during the following year of an Italo-Abyssinian arbitration treaty of "perpetual friendship," and of a further agreement between the two countries providing for the cession to Abyssinia of the port of Assab, and for the construction of a road thence to the capital. This instrument, however, was neither published nor implemented.

Meanwhile, on October 7, 1928, Tafari caused himself to be proclaimed King with all power in his hands, leaving Zauditu to retain a nominal position as Empress. On April 3, 1930, Zauditu died, and on November 2 of that year Tafari was crowned Emperor.

Third Period—1928-1936.—From the moment when Ras Tafari assumed full power in 1928 he worked unceasingly and with a greater measure of success than before for the development of Abyssinia. Progress was, however, slow in view of the factors already described, which still existed albeit to a lesser extent. Such administrative reforms as were introduced, *e.g.*, the establishment of ministries, and the creation of a "Parliament," were more theoretical than real, and had little actual effect, all power remaining, in fact, in the hands of the Emperor, who however, added to his effective control of the country by removing the last of the hereditary provincial governors, Ras Hailu of Gojam, who led a rebellion against him in 1932 in favour of the deposed Emperor Lej Yasu. Minor reforms in the way of educational institutions, road construction, *etc.*, were carried out; but the financial system remained practically untouched.

Strengthened in his belief that the external position of Abyssinia was safeguarded by membership in the League of Nations, the Emperor manifested little inclination to meet the views of Italy, which country was pressing for development on the lines of the Anglo-Italian Agreement of 1925 and otherwise, and was engaged in ever increasing activity in Eritrea, Italian Somaliland and along the Red Sea generally.

The Outbreak of the War with Italy.—Wal Wal, an obscure village near the ill-defined Abyssinian Italian Somaliland frontier, although placed in Abyssinia by most maps, had been occupied by Italian troops for several years without protest from Abyssinia. An Anglo-Abyssinian frontier delimitation commission, escorted by a force of Abyssinian troops, arrived there on November 23, 1934, and came into touch with the Italians, owing to whose attitude the British mission withdrew. Italian and Abyssinian

troops remained facing each other at Wal Wal until on December 5, 1934, firing took place; nine months later, in Sept. 1935, the arbitrators appointed by the League of Nations, agreed unanimously that neither side was guilty of aggression.

As the gravity of the issues likely to be raised by this incident became apparent, strenuous efforts to maintain peace were made by various countries, notably by England, both directly and through the machinery of the League of Nations. In Dec. 1934, Abyssinia had notified the League of Nations of the Wal Wal incident, and had appealed for League intervention under Article XI. of the Covenant in Jan. 1935. In that month the two countries ostensibly agreed to seek a settlement; but, no agreement having been reached by March, Abyssinia invoked Article XV., and later demanded arbitration under the Treaty with Italy of 1928.

A conference between England, France and Italy was held in Paris on August 15 to 18 but they failed to find any basis of agreement. A Committee of five, appointed by the League of Nations on Sept. 6 to formulate proposals, reported on the 18th; Abyssinia agreed to open negotiations on the basis of these proposals but Italy refused them. Then, when war broke out on October 3, the League condemned Italy as the aggressor, and proceeded to elaborate in October, and put in force on November 18, 1935, a scheme of financial and economic "sanctions" against Italy.

Bitter feeling was aroused in Italy by these measures, and the international aspect of the situation was rendered more delicate owing to the despatch by Italy in September of large reinforcements to Libya; which was followed by the sending to Egypt by England of considerable numbers of troops and much war material, and the strengthening of the British fleet in the Mediterranean.

On November 6, the League committee of eighteen had adopted a resolution in favour of oil, steel and coal sanctions, and on November 25 this was supported by Rumania and Russia. But on December 13, the committee adjourned further consideration of the proposed oil sanction, which in fact was never imposed. No country appeared to be willing to consider the imposition of military sanctions.

Proposals for a peace settlement on the basis of certain territorial cessions by Abyssinia to Italy were formulated between Sir Samuel Hoare, British foreign secretary, and M. Laval, representing France, on December 8; submitted to Abyssinia on the 10th; and published on December 13. These had been approved by the British government, which, however, abandoned them on December 18 in view of the strong adverse public opinion in England.

On March 3, 1936 the League committee of thirteen issued an appeal to both belligerents to cease hostilities. This, however, was unavailing, and on April 20 the League Council adjourned until May 11, by which time the War was over. At the session held during the week commencing June 29 (which was addressed by the Emperor Haile Selassie in person) the League decided to recommend the raising of the sanctions which had been imposed on Italy as these had failed to achieve their purpose, but refused to recognize the Italian occupation of Abyssinia. Sanctions were raised in July. After that, several of the Powers previously represented in Abyssinia by legations replaced them by consulates, tacitly admitting the change in status, although no general or specific recognition of Italy's possession had been given. (C. F. R.)

FROM ITALIAN AGGRESSION TO THE NEW INDEPENDENCE

Military Operations.—During the period of negotiations, Italy utilized the first nine months of 1935 in equipping and assembling a large army in Eritrea and Somaliland, so that she started the campaign well prepared and with an immense superiority in every form of modern armament. The Abyssinians, to avoid any appearance of provocation, ordered mobilization only after Italian troops had crossed the frontier, without any official declaration of war, on Oct. 3. The Abyssinians were completely inferior in equipment especially because the democratic powers had again and again refused the demands of the emperor to be allowed to buy modern armaments. Thus the Italians, moving from Eritrea in the north and from Somaliland in the south, under General de Bono, who had been appointed commander-in-chief in Jan. 1935, had an easy task. Nevertheless it took them, in spite of their technical superiority and the general backwardness of Ethiopian organization, seven months to defeat the Ethiopian forces. As a result of slow progress General de Bono, an old time fascist, was replaced on Nov. 28 by General Badoglio. Nor was General Graziani, commanding the southern army, more successful. He could take the principal town of that part, Harar, only on May 8, while the northern army entered the capital, Addis Ababa, on May 5, 1936. The emperor

had flown on the night of May 1, and sailed via Palestine to Europe where he settled in England.

Abyssinia under Italian Domination.—Italy annexed Abyssinia on May 9, 1936, and the king of Italy was proclaimed emperor of Abyssinia. On June 1, 1936, the colony of Italian East Africa (Africa Orientale Italiana) was created comprising Abyssinia, Eritrea and Italian Somaliland under one viceroy and divided into five provinces: Eritrea with the capital of Asmara; Amhara with the capital of Gondar; Galla with the capital of Jimma; Harar with the capital of the same name; Somaliland with the capital of Mogadiscio. A sixth province, Shoa, was later added. Each province was under a governor. The whole area was 665,977 sq.mi. with 12,100,000 inhabitants in 1939. The capital, Addis Ababa, with about 150,000 inhabitants, formed a district of its own.

The Italian occupation of the country was placed first under Marshal Badoglio as viceroy, who, however, was succeeded after a few weeks by Marshal Graziani. On Nov. 20, 1937, Prince Amedeo of Savoy, duke of Aosta, became viceroy. The Italian administration tried to improve the economic production of the country and built a number of good motor roads. Yet in spite of very large Italian forces maintained in the country, the Abyssinians continued to fight for their independence. Unrest did not subside in some of the less accessible parts of the country, and it was kept alive by the cruel methods which the fascists applied. In March 1937 bombs were thrown at Addis Ababa which wounded the viceroy. As a result the Italians established a reign of terror and thousands of natives were massacred and executed. Though a number of Italian settlers were brought to Ethiopia, the country in no way fulfilled the great economic expectations which the fascists had heralded to the world in 1935. By the beginning of 1939 the Italian fascists raised the demand for the annexation of French Somaliland with the port of Djibouti, to Italian East Africa.

Abyssinia in World War II.—With the outbreak of World War II in 1939 the importance of Abyssinia for Italian strategy increased considerably, because it was generally supposed, as the fascists had often given to understand, that, in case of Italy's entrance into the conflict, Italian armies from Libya and Abyssinia would take the British position in Egypt and the Sudan into a great pincer movement and thus definitely establish the longed-for great Italian empire. On May 9, 1940, the anniversary of the proclamation of the new empire, bellicose and boastful speeches were made by the fascists in Rome and Count Grandi declared that the Italian people "powerful in its arms, strong in its right, conscious of its mission, formed from the Alps to the Indian ocean a compact army of 45,000,000 soldiers." When on June 10 Italy declared war against "the plutocratic and reactionary democracies of the west," it became however, quickly clear how unfounded the fascist boasts had been and on how weak feet of clay the proud Italian empire in Abyssinia was built.

The complete inefficiency of the numerically superior Italian naval forces in the Mediterranean, which for the first year of the war left the control of the sea in British hands, was responsible for the cutting off of the Italian army in Abyssinia from home supply. Nevertheless there was a very considerable Italian army in Abyssinia, magnificently equipped, at least on paper. (See World War II.)

The Liberation of Abyssinia.—On July 12, 1940, the British government officially recognized Ethiopia as an ally and promised its liberation in case of victory. Emperor Haile Selassie left Great Britain in the same month and began to organize Ethiopian resistance from the Sudan. It is true that the Italians, as a result of their great numerical superiority, were able to occupy, in Aug. 1940, British Somaliland. But soon the tide was to turn. The Italians had to abandon Kassala, the only town in the Sudan near the frontier, which they succeeded in occupying in 1940. On Jan. 15, 1941 Emperor Haile Selassie crossed the border into Ethiopia; patriot forces began to gather around him and played an important role in the liberation of their country. A British army under General Sir Alan Gordon Cunningham moved from the south into Italian Somaliland. The operations started by the end of January and by the end of March not only had the whole of Italian Somaliland been captured, but also British Somaliland reconquered.

Meanwhile British forces from the Sudan, who under General Platt had entered Eritrea, had made their victory secure by the capture of Cheren on March 27, and of Asmara on March 31. The patriot armies under the emperor had approached from Debra Markos the centre of the country which was threatened simultaneously from the south by General Cunningham's quick advance. On April 6 the capital, Addis Ababa, was in British hands. The Italian troops under the duke of Aosta withdrew to the north and resisted for a few weeks longer before they surrendered at Amba Alagi on May 19. Two major pockets of resistance remained, at Jimma in the south under General Pietro Gazzera and at Gondar in the north under General Guglielmo Nasi. The last to surrender was that at Gondar. This fortified position was taken by storm by patriot troops on Nov. 27. Thus the war ended in a complete disaster for fascist Italy, the dream of empire had gone, the hated Italian domination of Abyssinia was over and the liberty of the ancient empire could be restored. More than 100,000 Italians were taken prisoners, among them the duke of Aosta. The British victory made the Suez canal safe from attack from the south, and opened the Red sea to American shipments for Egypt and the middle east. In Dec. 1941 the American government began to build a great supply base in Eritrea.

On May 5, 1941 Emperor Haile Selassie re-entered Addis Ababa, exactly five years after the Italians had occupied the city. He had been the first of the heads of state expelled by fascist conquerors and forced to go into exile. He was also the first to return. As a legacy from the time of the Italian occupation he found a modernized capital and much improvement in road communications which with British help will facilitate the modernization of Abyssinia's administration, the great task set before the emperor. For a transitory period a dual British and Abyssinian control was instituted. There were about 40,000 Italian civilians in the country. It should be pointed out that in spite of the easily understandable feelings of the Ethiopians against their fascist oppressors, no serious disorders occurred and the Italian civilians continued their occupations peacefully until circumstances made their evacuation possible.

On Feb. 3, 1942 the British foreign secretary announced the conclusion of a two-year agreement between Britain and Abyssinia which provided for a British military mission and British advisers to the emperor, a loan of \$10,000,000 and the presence of British judges in Ethiopian courts. R. G. Howe was appointed British minister to Abyssinia, and at the end of Aug. 1942 the Abyssinian minister, Ayalla Gabre, arrived in London. At the same time all British troops left Abyssinia, as the pacification of the country had been completed and the new native administration firmly established. (H. Ko.)

See James Bruce, *Travels to Discover the Source of the Nile* (1790); A. B. Wylde, *Modern Abyssinia* (1901), a valuable volume; Powell-Cotton, *A Sporting Trip through Abyssinia* (1902); Duchesne-Fournet, *Mission en Ethiopie* (1909), which contains a useful bibliography; G. Montandon, *Au pays Gimmirra* (Neuchâtel, 1913); C. Annatarone, *In Abissinia* (1914); L. de Castro, *Nella Terra dei Negus* (1915), a good general description; Major Maydon, *Simen, its Heights and Abysses* (1925), describing the mountainous northern country; C. F. Rey, *Unconquered Abyssinia as it is Today* (1923) and *In the Country of the Blue Nile* (1927), two books embodying a comprehensive study of the country as the result of four journeys therein. Arnold Hodson, *Seven Years in Southern Abyssinia* (1927), a valuable record of borderland difficulties; C. F. Rey, *The Real Abyssinia* (1935), a comprehensive description up to war with Italy.

For later geographical information, see the *Geographical Journal* (London)—H. Weld Blundell, "A Journey through Abyssinia" (vol. xv, 1900) and "Exploration in the Abbai Basin" (vol. xxvii, 1906); Arnold Hodson, "Southern Abyssinia" (Feb. 1919) and "Notes on Abyssinian Lakes" (July 1922); Major Athill, "Through S.W. Abyssinia to the Nile" (Nov. 1920); C. F. Rey, "Abyssinia of To-day" (Sept. 1922) and "A Visit to Gudrn and Gojam" (June 1926).

For history, see the Hakluyt Society's translation of *The Portuguese Expedition to Abyssinia* (1902); Handbook No. 29 prepared by the historical section of the foreign office (1920); Sir E. Hertslage, *A History of Ethiopia* (1928); Sir E. W. Budge, *A History of Ethiopia* (1928); C. F. Rey, *The Romance of the Portuguese in Abyssinia* (1929).

Political questions are referred to by H. Le Roux, *Menelik et nous* (1901); Charles Michel, *La Question d'Ethiopie* (1905); T. Lennox Gilmour, *The Ethiopian Railway and the Powers* (1906); Pierre Aylpe, *L'Ethiopie et les convoitises allemandes* (1917) and *L'Empire des Negus* (1924); G. E. Underhill, in the *Quarterly Review* (Jan. 1922); C. F. Rey, *Edinburgh Review* (Oct. 1926).

ABYSSINIAN CHURCH. As the chronicle of Axum relates, Christianity was adopted in Abyssinia in the 4th century. About A.D. 330 Frumentius was made first bishop of Ethiopia by Athanasius, patriarch of Alexandria. Little is known of church history down to the period of Jesuit rule, which broke the connection with Egypt from about 1500 to 1633.

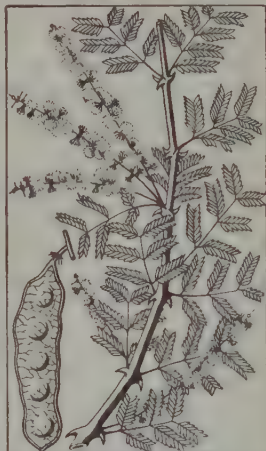
Early in the 16th century the church was brought under the influence of a Portuguese mission. The initiative in the Roman Catholic missions to Abyssinia was taken by Portugal, as an incident in the struggle with the Muslims for the command of the trade route to India by the Red sea. In 1507 Matthew, or Matheus, an Armenian, had been sent as Abyssinian envoy to Portugal to ask aid against the Muslims, and in 1520 an embassy under Dom Rodrigo de Lima landed in Abyssinia.

Generally the Abyssinians agree with the Copts in ritual and practice (see Copts). The Septuagint was translated into the literary language, which is used for all services, though hardly understood. Saints and angels are highly revered, if not adored, but graven images are forbidden. Fasts are long and rigid. Confession and absolution, strictly enforced, give great power to the priesthood. Pilgrimage to Jerusalem is a religious duty and covers many sins.

For an account written shortly before World War I see Dowling, *The Abyssinian Church* (1909). The account of Alvarez was translated and edited for the Hakluyt Society by Lord Stanley of Alderley under the title *Narrative of the Portuguese Embassy to Abyssinia* (1881).

With reference to present social and political conditions, see *ABYSSINIA*. On the architecture, see J. C. Hotten, *Abyssinia Described* (1868), and (especially with reference to monuments of heathen origin) Bent, *The Sacred City of the Ethiopians* (1896).

ACACIA, a genus of trees and shrubs belonging to the pulse or pea family (Leguminosae, sub-family Mimosoideae), comprises a group of about 550 species widely distributed over the warmer regions of the world, but particularly abundant in Australia and Africa. The leaves are usually twice compounded (bipinnate, see fig.); in some instances, notably with Australian species indigenous to arid localities, the leaflets are suppressed, their stalks (petioles) then becoming flattened and acquiring the physiological functions of leaves. These stalks are commonly vertically disposed, an orientation which precludes the inception of intense sunlight, thus apparently preventing injury through the retardation of excessive surface evaporation. The small, frequently fragrant flowers are arranged in rounded or elongated clusters. The several seeded pod-like fruits are either flattened or cylindrical, often with constrictions between the seeds. Sharp spines arm the branchlets of many forms.



FLOWERING BRANCH AND POD OF *ACACIA SENEGAL*, ONE OF 550 SPECIES OF *ACACIA* WIDELY DISTRIBUTED IN WARM REGIONS: *A. SENEGAL* PRODUCES GUM ARABIC

True gum arabic is the product of *Acacia senegal*, a native of both east and west tropical Africa. The Indian *A. arabica* yields a similar gum, but of inferior quality. Catechu (*q.v.*) or cutch is procured from *A. catechu* and several other species. Extractions from finely divided wood of this tree are employed in dyeing khaki cloth.

The barks of most acacias are rich in tannin. *Babul* or *babool*, derived from *A. arabica*, is used in northern India for tanning. The Australian wattle barks, but especially golden wattle (*A. pycnantha*), silver wattle (*A. dealbata*), and tan wattle (*A. decurrens*), are important sources of tannin and collectively form an important article of export. The fruit pods of *nebebe* (*A. nilotica*) and other African species are other sources of this astringent. Seeds of the South American *A. niopo* are processed and used as snuff.

A few acacias are productive of valuable timber. Australian blackwood (*A. melanoxylon*) is a highly figured wood of cabinet rank. Myall (*A. homalophylla*, also Australian) yields a fragrant, decorative wood. Koa (*A. koa*), a native of the Sandwich Islands, produces a handsomely figured wood known to many through its use in the manufacture of ukuleles. *A. heterophylla* from Mauritius and Bourbon is another excellent timber tree. The biblical shittah tree (*A. seyal*) is also a member of this group. Species noted for their heavily developed spines include the Australian kangaroo-thorn (*A. armata*), the African camel-thorn (*A. giraffae*), and the Central American bull-thorn acacia (*A. sphaerocephala*). The large thorn-like stipules of *A. spadicigera* (Central America) are hollow and provide shelter for ants which feed on leaf-stalk secretions and curious food-bodies at the tips of leaflets. Sweet acacia (*A. farsiana*) of the southwestern United States has been introduced into India and southern Europe. Its fragrant, yellow flowers are used in making perfume.

The term acacia has been applied to species of the genus *Robinia* (*q.v.*), also a member of the Leguminosae. The American black locust (*Robinia pseudoacacia*) is the false acacia so widely cultivated in milder parts of Britain. (E. S. HR.)

ACADEMIE NATIONALE DE MUSIQUE, the official title of the Paris Opéra, also known as the Théâtre National de l'Opéra, founded by Louis XIV. in 1669 and the most famous institution of its kind in the world. Lully, an Italian by birth but

naturalized as a Frenchman, was the first composer of note associated with the Académie, of which he obtained control in 1672. Later Rameau became director and produced there nearly all of his many operas, and he was succeeded by Gluck as ruling spirit with Piccinni as his rival. Other eminent composers prominently identified with the Paris Opéra subsequently included Spontini, Cherubini, Rossini, Meyerbeer, Auber, Gounod, Saint-Saëns and Massenet. The present building of the Paris Opéra, opened in 1875 and one of the most magnificent of its kind in existence, succeeded two others, both of which were destroyed by fire. Closely associated with the Paris Opéra is the Conservatoire de Musique, founded in 1784 under the name École royale de chant et de déclamation for the purpose of training opera singers and later widened in scope to include musical teaching and training of every kind.

ACADEMIES. The word "academy" is derived from "the olive grove of Academe, Plato's retirement" (see under *ACADEMY, GREEK*). The schools of Athens after the model of the Academy continued to flourish almost without a break for nine centuries till they were abolished by a decree of Justinian. "Academy," in its modern acceptation, may be defined as a society or corporate body having for its object the cultivation and promotion of literature, of science and of art, either severally or in combination, undertaken for the pure love of these pursuits, with no interested motive. Modern academies, moreover, have, almost without exception, some form of public recognition; they are either founded, endowed or subsidized, or at least patronized, by the supreme head of the State. The term "academy" has been loosely used in modern times. In the 18th century it was frequently adopted by schools run by dissenters, and the name is often found attached to the public schools in Scotland and Northern Ireland. We are only concerned here, however, with those institutions which are of historical importance in their various spheres.



BY COURTESY OF THE METROPOLITAN MUSEUM OF ART

A RENAISSANCE CONCEPTION OF A GREEK ACADEMY. FROM A 16TH CENTURY WOODCUT BY FRANCESCO MARCOLINI AFTER THE PAINTING, "THE ACADEMY OF KNOWLEDGE," BY GIUSEPPE PORTA

The first academy, as thus defined, though it might with equal justice claim to be the first of universities, was the museum of Alexandria founded at the beginning of the 3rd century B.C. by the first of the Ptolemies. There all the sciences then known were pur-

sued, and the most learned men of Greece and of the East gathered. Here, too, was the nucleus of the famous library of Alexandria. Modern literary academies may be said to trace their lineage in direct descent from the troubadours of the early 14th century. The first floral games were held at Toulouse in May, 1324, at the summons of a gild of troubadours, who invited "honourable lords, friends and companions who possess the science whence spring joy, pleasure, good sense, merit and politeness" to assemble in their garden of the "gay science" and recite their works. These floral games survived till about the year 1500. In 1694 the *Académie des Jeux Floraux* was constituted an academy by letters patent of Louis XIV. Suppressed during the Revolution it was revived in 1806, and still continues to award amaranths of gold and silver lilies, for which there is keen competition.

Provence led the way, but Italy of the Renaissance is the soil in which academies most grew and flourished. The *Accademia Pontaniana*, to give it its subsequent title, was founded at Florence in 1433 by Antonio Beccadelli of Palermo and fostered by Laurentius Valla. Far more famous was the *Accademia Platonica*, founded c. 1442 by Cosimo de' Medici, which numbered among its members Marsilio Ficino, Pico della Mirandola, Machiavelli and Angelo Poliziano. It was, as the name implies, chiefly occupied with Plato, but it added to its objects the study of Dante and the purification of the Italian language, and though it lived for barely half a century yet its influence as a model for similar learned societies was great and lasting.

I. SCIENTIFIC ACADEMIES

Austria.—The *Akademie der Wissenschaften* at Vienna, originally projected by Leibnitz, was founded by the emperor Ferdinand I. in 1846, and has two classes—mathematics and natural science, and history and philology.

Belgium and the Netherlands.—A literary society founded at Brussels in 1769 by Count Charles de Cobenzl, minister plenipotentiary of Maria Theresa, became in 1816 the *Académie royale des sciences et des Beaux-Arts de Belgique*, under the patronage of William I of the Netherlands. In 1834 it became *Académie Royale de Belgique*, while the Dutch portion took the name of the *Koninklijke Nederlander Institut*. The Royal Institute of the Low Countries was founded in 1808 by King Louis Bonaparte. It was replaced in 1851 by the *Koninklijke Akademie van Wetenschappen* at Amsterdam, to which in 1856 a literary section was added.

Denmark.—The *Kongelige danske videnskabernes selskab* (Royal Academy of Sciences) at Copenhagen owes its origin to Christian VI. (1742). It developed into a sort of learned club. The king took it under his protection, enlarged its scope by the addition of natural history, physics and mathematics, and in 1743 constituted it a royal academy with an endowment fund.

France.—The old *Académie des sciences* had the same origin as the more celebrated *Académie française*. A number of men of science had for some 30 years met together. They included Descartes, Gassendi, Blaise and Etienne Pascal. Hobbes, the author of *Leviathan*, was presented to it during his first visit to Paris in 1640. Colbert conceived the idea of giving an official status to this learned club. A number of chemists, physicians, anatomists and eminent mathematicians—among whom were Christian Huyghens and Bernard Frenicle de Bessy (1605–75), the author of a famous treatise on magic squares—were chosen to form the nucleus of the new society. Pensions were granted by Louis XIV. to each of the members, and a fund for instruments and experiment was placed at their disposal. They began their session on Dec. 22, 1666, in the royal library. At first the academy was rather a laboratory and observatory than an academy proper. Several foreign *savants*, in particular the Danish astronomer Roemer, joined the society; and the German physician and geometer, Tschirnhausen, and Sir Isaac Newton were made foreign associates. After the death of Colbert the labours of the academicians were diverted from the pursuit of pure science to such works as the construction of fountains and cascades at Versailles, and the mathematicians were employed to calculate the odds of the games of lansquet and basset. In 1699 the academy was reconstituted. By its new constitution it consisted of 25 members, ten honorary,

men of high rank interested in science, and 15 pensionaries, who were the working members. Of these three were geometers, three astronomers, three mechanicians, three anatomists and three chemists. Each of these three had two associates, and, besides, each pensionary had the privilege of naming a pupil. There were eight foreign and four free associates. The constitution was purely aristocratical, differing in that respect from that of the French Academy, in which the principle of equality among the members was never violated. The leading spirits of the academy at this period were Clairault, Réaumur and Fontenelle, the popularizer of science. In the 18th century other prominent members were Laplace, Buffon, Lagrange, D'Alembert, Lavoisier and Jussieu, the father of modern botany. It was suppressed on April 8, 1793.

In 1795 the Convention decided on founding an *Institut National* which was to replace all the academies. In 1816 the *Académie des sciences* was reconstituted as a branch of the Institute. The new academy has reckoned among its members, besides many other brilliant men, Carnot the engineer, the physicists Fresnel, Ampère, Arago, Biot, the chemists Gay-Lussac and Thénard, the zoologists G. Cuvier and the two Geoffroy Saint-Hilaires. In France there were also academies in most of the large towns. Montpellier, for example, had a royal academy of sciences, founded in 1706 by Louis XIV., reconstituted in 1847, and organized under three sections—medicine, science and letters. There were analogous institutions at Toulouse, Nîmes, Arles, Lyons, Dijon, Bordeaux and elsewhere.

Germany.—The *Collegium Curiosum* was a scientific society, founded by J. C. Sturm, professor in the University of Altorf, in Franconia, in 1672, on the plan of the *Accademia del Cimento*. It originally consisted of 20 members, and continued to flourish long after the death of its founder. Two volumes (1676–85) of proceedings were published by Sturm. The former, *Collegium Experimentale sive Curiosum*, begins with an account of the diving-bell, "a new invention"; next follow chapters on the camera obscura, the Torricellian experiment, the air-pump, microscope, telescope, etc. It is now extinct.

The *Preussische Akademie der Wissenschaften* in Berlin holds the first place in Germany. Its origin was the *Societas Regia Scientiarum* constituted in 1700 by Frederick I. on the comprehensive plan of its first president, Leibnitz. It was reorganized under Frederick II. on the French model furnished by Maupertuis, and received its present constitution in 1812. It is divided into two classes and four sections—physical and mathematical, philosophical and historical. Among the contributors to its transactions (first volume published in 1710), to name only the dead, we find Immanuel Bekker, Böckling, Bernoulli, F. Bopp, P. Buttmann, Encke (of comet fame), L. Euler, the brothers Grimm, the two Humboldts, Lachmann, Lagrange, Leibnitz, T. Mommsen, J. Müller, G. Niebuhr, C. Ritter (the geographer), Savigny and Zumpt. To the *Berlin Academy* we owe the *Corpus Inscriptionum Graecarum*, the *Corpus Inscriptionum Latinarum*, and the *Monumenta Germaniae Historica*.

The *Bayerische Akademie der Wissenschaften*, at Munich, founded in 1759, is distinguished by the part it has played in national education. Maximilian Joseph, the enlightened elector (afterwards king) of Bavaria, induced the Government to hand over to it the organization and superintendence of public instruction, and this work was carried out by Privy-councillor Jacobi, the president of the academy. In recent years the academy has specially occupied itself with natural history.

The *Preussische Akademie gemeinnütziger Wissenschaften*, at Erfurt, which dates from 1754 and devotes itself to applied science, and the Hessian academy of sciences at Giessen, which publishes medical transactions, also deserve mention.

Great Britain and Ireland.—In 1616 a scheme for founding a royal academy was started by Edmund Bolton, an eminent scholar and antiquary, who in his petition to King James I. proposed that the title of the academy should be "King James, his Academe or College of honour." A list of the proposed original members is still extant, and includes the names of George Chapman, Michael Drayton, Ben Jonson, John Selden, Sir Kenelm Digby and Sir Henry Wotton. The death of King James put an

end to the undertaking. About 1645 the more ardent followers of Bacon used to meet, some in London, some at Oxford, for the discussion of subjects connected with experimental science. This was the original of the Royal Society (*g.v.*) which received its charter in 1662.

A society was formed in Dublin similar to the Royal Society in London, as early as 1683; but it was short-lived. The Royal Irish Academy grew from a society established in Dublin about 1782 by a number of gentlemen, most of whom belonged to the university. The first volume of transactions appeared in 1788.

Hungary.—The *Magyar Tudományos Társaság* (Hungarian Academy of Sciences) was founded in 1825 by Count Stephen Széchenyi for the encouragement of the study of the Hungarian language and the various sciences. It has a fine building in Budapest containing a picture gallery and housing various national collections.

Italy.—The *Accademia Secretorum Naturae* was founded at Naples in 1560 by Giambattista della Porta. The condition of membership was to have made some discovery in natural science. Della Porta was suspected of practising the black arts and summoned to Rome to justify himself before the papal court. He was acquitted on those charges by Paul V., but commanded to close his academy.

The *Accademia dei Lincei* was founded in 1603 by Federigo Cesi, the marchese di Monticelli. Galileo and Colonna were among its earliest members. As a monument the Lincei have left the magnificent edition of Fernandez de Oviedo's *Natural History of Mexico* (Rome, 1651, fol.), printed at the expense of the founder and elaborately annotated by the members. This academy was resuscitated in 1870 under the title of *Reale Accademia Nazionale dei Lincei*, with a literary as well as a scientific side, endowed in 1878 by King Humbert, and in 1883 it received official recognition from the Italian Government, being thereafter lodged in the Corsini palace, whose owner made over to it his valuable library and collections.

The *Accademia del Cimento* was founded at Florence in 1657 by Leopold de' Medici, brother of the grand duke Ferdinand II., at the instigation of Vincenzo Viviani, the geometrician. It was an academy of experiment, a deliberate protest against the deductive science of the quadrivium. It lasted only ten years, but the grand folio published in Italian (afterwards translated into Latin) in 1667 is a landmark in the history of science. It contains experiments on the pressure of the air (Torricelli and Borelli were among its members), on the incompressibility of water and on universal gravity.

Other pre-eminent Italian Academies are the new *Reale Accademia d'Italia*, and the *Reale Accademia delle Scienze di Torino*. The latter was founded in 1757 as a private society by a group of learned men (among whom was Joseph Louis la Grange), and incorporated by royal warrant in 1783. It consists of 60 *Soci Nazionali*, 20 *Soci Stranieri*, and 160 *Soci Corrispondenti*. It publishes volumes of *Memorie* and a yearly volume of proceedings, and awards prizes for learned works. There are, besides, royal academies of science at Naples, Lucca and Palermo.

Portugal.—The *Academia Real das Sciencias* (now *Acad. das Sciencias de Lisboa*) dates from 1779. It was reorganized in 1851 and since then has been chiefly occupied in the publication of *Portugaliae Monumenta Historica*.

Russia.—The *Académie Impériale des sciences de Saint-Petersbourg* (*Imperatorskaya Akademiyá naúk*), was established on Dec. 21, 1725, by Catherine I. Shortly afterwards the empress settled a fund of £4,982 per annum for the support of the academy; and 15 eminent members were admitted and pensioned, under the title of professors in the various branches of science and literature. The most distinguished of these were Nicholas and Daniel Bernoulli, the two Delisles, Biflenger and Wolff. At the accession of Elizabeth the original plan was enlarged and improved; learned foreigners were drawn to St. Petersburg (Leningrad); and, what was considered a good omen for the literature of Russia, two natives, Lomonosov and Rumovsky, men of genius who had prosecuted their studies in foreign universities, were enrolled among its members. The annual income was increased to £10,659. Cath-

erine II. utilized the academy for the advancement of national culture. By her recommendation the most intelligent professors visited all the provinces of her vast dominions, with most minute and ample instructions to investigate the natural resources, conditions and requirements, and report on the real state of the empire. The result was that no country at that time could boast, within so few years, such a number of excellent official publications on its internal state, its natural productions, its topography, geography and history, and on the manners, customs and languages of the different tribes that inhabited it, as came from the press of this academy. In its researches in Asiatic languages, oriental customs and religions, it proved itself the worthy rival of the Royal Asiatic Society in England. The first transactions, *Commentarii Academiae Scientiarum Imperialis Petropolitanae ad annum 1726*, with a dedication to Peter II., were published in 1728. In 1747 the transactions were called *Novi Commentarii Academiae*, etc.; and in 1777, *Acta Academiae Scientiarum Imperialis Petropolitanae*. The papers, hitherto in Latin only, were now written indifferently in Latin or in French. Of the *Commentaries*, 14 volumes were published; of the *New Commentaries* (1750–76) twenty. Of the *Acta Academiae* two volumes are printed every year. In 1872 there was published at St. Petersburg, in 2 vols., the valuable *Tableau général des matières contenues dans les publications de l'Académie Impériale des Sciences de St. Petersburg*. The academy of to-day has three divisions: (1) physical and mathematical sciences; (2) Russian language and literature; (3) historical science and philology. A large number of laboratories and museums are affiliated to it, as well as a physico-mathematical and an Indo-European Institute. The Asiatic museum and the mineralogical museum are housed in this building, and also the academical botanical museum. The vast library of the Academy of Sciences is situated in a separate building, erected 1718–25. Its scientific publications are exempt from censorship and include transactions of its various sections, a monthly and a yearly journal. These are edited by the scientific staff of the academy, but published by the Soviet Government Publishing Department.

Spain.—The *Real Academia Española* at Madrid (*see below*) had a predecessor in the *Academia Naturae curiosorum* (dating from 1657) modelled on that of Naples. It was reconstituted in 1847 after the model of the French Academy.

Sweden.—The *Kongliga Svenska Vetenskaps-academien* owes its institution to six persons of distinguished learning, among whom was Linnaeus. In 1739 they formed a private society, the *Collegium Curiosorum*. In March 1741 it was incorporated as the Royal Swedish Academy. Though under royal patronage and largely endowed, it is, like the Royal Society in England, entirely self-governed. The dissertations read at each meeting are published in the Swedish language, quarterly, and make an annual volume. The first 40 volumes, octavo, completed in 1779, are called the *Old Transactions*.

Norway has an active Academy of Sciences at Oslo; Japan has an Imperial Academy at Tokyo; Yugoslavia has two academies, one Serbian at Belgrade and one Yugoslav at Zagreb. Czechoslovakia has the Czech Academy of Sciences and Arts at Prague.

II. ACADEMIES OF BELLES LETTRES

Belgium.—Belgium has always been famous for its literary societies. The little town of Diest boasts that it possessed a society of poets in 1302, and the Catherinists of Alost date from 1107. It is at least certain that numerous chambers of rhetoric (so academies were then called) existed in the first years of the rule of the house of Burgundy.

France.—The French Academy (*l'Académie française*) was established by order of the king in the year 1635, but in its original form existed four or five years earlier. About the year 1629 certain literary friends in Paris agreed to meet informally each week. The conversation turned mostly on literary topics; and when one of the number had finished some literary work he read it to the rest, and they gave their opinions upon it. The fame of these meetings, though the members were bound to secrecy, reached the ears of Cardinal Richelieu, who promised his protec-

tion and offered to incorporate the society by letters patent. These were granted by the king on Jan. 29, 1635. The officers consisted of a director and a chancellor, chosen by lot, and a permanent secretary, chosen by vote. The director presided at the meetings, being considered as *primus inter pares*. The chancellor kept the seals and sealed all the official documents of the academy. The cardinal was *ex officio* protector.

The number of members was fixed at 40, but it was not till 1639 that the full number was completed. Their first undertaking consisted of essays written by the members in rotation. Next, at the instance of Cardinal Richelieu, they undertook a criticism of Corneille's *Cid*, the most popular work of the day. It was a rule of the academy that no work could be criticized except at the author's request, but fear of incurring the cardinal's displeasure wrung from Corneille an unwilling consent. The critique of the academy was re-written several times before it met with the cardinal's approbation. After six months of elaboration it was published under the title, *Sentiments de l'académie française sur le Cid*. This judgment did not satisfy Corneille, as a saying attributed to him on the occasion shows. "*Horatius*," he said, referring to his last play, "was condemned by the Duumviri, but he was absolved by the people." But the crowning labour of the academy, begun in 1639, was a dictionary of the French language. By the 26th article of their statutes they were pledged to compose a dictionary, a grammar, a treatise on rhetoric and one on poetry. Jean Chapelain, one of the original members, drew up a plan for compiling the dictionary, which was to a great extent carried out. C. F. de Vaugelas was appointed editor-in-chief. The first edition of this dictionary appeared in 1694, the sixth and last in 1835, since when *compléments* have been added.

Reconstruction.—The old *Académie* perished with other pre-revolutionary academies in 1793, and it has little but the name in common with the present academy, a section of the institute. The object of the Convention in 1795 was, as already stated, to rebuild all the institutions that the Revolution had shattered and to combine them in an organic whole. The institute was at first composed of 184 members resident in Paris and an equal number living in other parts of France, with 24 foreign members, divided into three classes: (1) physical and mathematical science, (2) moral and political science, (3) literature and the fine arts. It held its first sitting on April 4, 1796. Napoleon as first consul suppressed the second class, as subversive of government, and reconstituted the other classes as follows: (1) as before, (2) French language and literature, (3) ancient history and literature, (4) fine arts. The class of moral and political science was restored on the proposal of M. Guizot in 1832, and the present institute consists of the five classes named above. Each class or academy has its own special jurisdiction and work, with special funds; but there is a general fund and a common library, which, with other common affairs, are managed by a committee of the institute—two chosen from each academy, with the secretaries.

The class of the institute which deals with the language and literature takes precedence, and is known as the *Académie française*. There was at first no perpetual secretary, each secretary of sections presiding in turn. Shortly afterwards J. B. Suard was elected to the post, and ever since the history of the academy has been determined by the reigns of its successive perpetual secretaries. The secretary, to borrow an epigram of Sainte-Beuve, both reigns and governs. Among the best known in the 19th century were Suard, François Juste Raynouard, François Andrieux and Villemain. Under Raynouard the academy ran a tilt against the abbé Delille and his followers. Under Auger it did battle with romanticism, "a new literary schism." Auger did not live to see the election of Lamartine in 1829, and it needed ten more years for Victor Hugo after many vain assaults to enter by the breach. The academy is professedly non-political. It accepted and even welcomed in succession the empire, the restoration and the reign of Louis Philippe, and it tolerated the republic of 1848; but to the Second Empire it offered a passive resistance, and no politician of the Second Empire, whatever his gifts as an orator or a writer, obtained an armchair. The one seeming exception, Emile Ollivier, confirms the rule. He was elected on the eve of the Franco-Ger-

man War, but his *discours de réception*, a eulogy of the emperor, was deferred and never delivered. The institute has large vested funds in property, including the magnificent estate and library of Chantilly bequeathed to it by the duc d'Aumale. It awards various prizes, of which the most considerable are the Montyon prizes, each of 20,000frs., one for the poor Frenchman who has performed the most virtuous action during the year, and one for the French author who has published the book calculated to prove of most service to morality.

A point of considerable interest is the degree in which, since its foundation, the French Academy has or has not represented the best literary life of France. It appears from an examination of the lists of members that a surprising number of authors of the highest excellence have, from one cause or another, escaped the honour of academic "immortality." When the academy was founded in 1634, the moment was not a very brilliant one in French letters. Among the 40 original members we find only ten who are remembered in literary history; of these four may reasonably be considered famous still—Balzac, Chapelain, Racan and Voiture. In that generation Scarron was never one of the 40, nor do the names of Descartes, Malebranche or Pascal occur. The one astounding omission of the 17th century, however, is the name of Molière, who was excluded by his profession as an actor; but the academy has made the *amende honorable* by placing in the *Salle des séances* a bust of Molière, with the inscription "*Rien ne manque à sa gloire, il manquait à la nôtre*." On the other hand, the French Academy was never more thoroughly representative of letters than when Boileau, Corneille, La Fontaine, Racine and Quinault were all members. Of the great theologians of that and the subsequent age, the academy included Bossuet, Fléchier, Fénelon and Massillon, but not Bourdaloue. La Bruyère and Fontenelle were among the 40, but not Saint-Simon, whose claims as a man of letters were unknown to his contemporaries. Early in the 18th century almost every literary personage of eminence found his place naturally in the academy. The only exceptions of importance were Vauvenargues, who died too early for the honour, and two men of genius but of dubious social position, Le Sage and the abbé Prévost d'Exiles. The approach of the Revolution affected gravely the *personnel* of the academy. Montesquieu and Voltaire belonged to it, but not Rousseau or Beaumarchais. Of the Encyclopaedists, the French Academy opened its doors to D'Alembert, Condorcet, Volney, Marmontel and La Harpe, but not to Diderot, Rollin, Condillac, Helvétius or the Baron d'Holbach. Apparently the claims of Turgot and of Quesnay did not appear to the academy sufficient, since neither was elected. In the transitional period, when the social life of Paris was distracted and the French Academy provisionally closed, neither André Chénier nor Benjamin Constant nor Joseph de Maistre became a member. In the early years of the 19th century considerations of various kinds excluded from the ranks of the 40 the dissimilar names of Lamennais, Prud'hon, Comte and Béranger. Critics of the French Academy are fond of pointing out that neither Stendhal, nor Balzac, nor Théophile Gautier, nor Flaubert, nor Zola penetrated into the Mazarine palace. It is not so often remembered that writers so academic as Thierry and Michelet and Quinet suffered the same exclusion. In later times neither Alphonse Daudet nor the brothers de Goncourt, nor Guy de Maupassant were members. Verlaine, although a poet of genius, was of the kind that no academy can ever be expected to recognize.

Concerning the influence of the French Academy on the language and literature, the most opposite opinions have been advanced. Thus Matthew Arnold, in his *Essay on the Literary Influence of Academies*, has pronounced a glowing panegyric on the French Academy as a high court of letters, and a rallying-point for educated opinion, as asserting the authority of a master in matters of tone and taste. To it he attributes in a great measure that thoroughness, that openness of mind, that absence of vulgarity which he finds everywhere in French literature; and to the want of a similar institution in England he traces that eccentricity, that provincial spirit, that coarseness which, as he thinks, are barely compensated by English genius. Thus, too, Renan, one of its most distinguished members, says that owing to the academy "one

can say everything in the language of well-bred persons without being pedantic. Do not say they have done nothing, these obscure devotees of culture who spend their lives in investigating the credentials of words and weighing up syllables. They have produced a masterpiece—the French language.” On the other hand, its inherent defects have been vigorously summed up by P. Lanfrey in his *Histoire de Napoléon*. The truth probably lies midway between the two extremes. Like all national institutions, the French Academy is a rather conservative body to which only people of a certain age and with well established reputations are elected. As a protest against such a state of things, the *Académie Goncourt* was founded by E. de Goncourt in 1896. It contains ten academicians whose principal function is to award an annual prize of 5,000 francs, preferably to a young novelist. None the less, since 1890, the *Académie française* may be said to have been fairly representative of the nation's culture. Among the critics may be cited, Brunetière, Lemaître, Faguet; among the poets, Sully Prudhomme, Richepin, de Regnier, Valéry; among the novelists, Bourget, Anatole France, Loti, Prevost; among the dramatists, Hervey, Curel, Rostand, Brieux; among the historians, Masson, Vandal, Hanotaux, etc.; among the philosophers, Boutroux, and Bergson. Of the writers best known abroad who have not been elected members of the academy are Maeterlinck, Romain Rolland, Proust and Gide.

Germany.—Of the German literary academies the most celebrated was *Die Fruchtbringende Gesellschaft* (the Fruitful Society), established at Weimar in 1617. Five princes were among the original members. The object was to purify the mother tongue. The German academies copied those of Italy in their quaint titles and petty ceremonials, and exercised little permanent influence on the language or literature of the country. Other noteworthy modern societies are the *Berlinsche Gesellschaft für Deutsche Sprache*, the *Deutsche Shakespeare Gesellschaft*, and the *Goethe Gesellschaft*.

Italy.—Italy in the 16th century was remarkable for the number of its literary academies. Tiraboschi, in his *History of Italian Literature*, has given a list of 171; and Jarkius, in his *Specimen Historiæ Academicarum Conditarum*, enumerates nearly 700. Many of these, with a sort of Socratic irony, gave themselves ludicrous names, or names expressive of ignorance. Such were the *Lunatics* of Naples, the *Estravaganti*, the *Fulminales*, the *Trapesati*, the *Drowsy*, the *Sleepers*, the *Anxious*, the *Confused*, the *Unstable*, the *Fantastic*, the *Transformed*, the *Ethereal*. “The first academies of Italy chiefly directed their attention to classical literature. . . . It was not till the writings of Bembo furnished a new code of criticism in the Italian language that they began to study it with the same minuteness as modern Latin” (Hallam, *Int. to Lit. of Europe*). The Italian nobility, excluded as they mostly were from politics, and living in cities, found in literature a consolation and a career. Such academies were oligarchical in their constitution; they encouraged culture, but tended to hamper genius and extinguish originality. Far the most celebrated was the *Accademia della Crusca* or *Fururatorum*; that is, of bran, or of the sifted, founded in 1582. The title was borrowed from a previous society at Perugia, the *Accademia degli Scossi*, of the well-shaken. Its device was a sieve; its principal object the purification of the language. Its great work was the *Vocabolario della Crusca*, printed at Venice in 1612. It was composed avowedly on Tuscan principles, and regarded the 14th century as the Augustan period of the language. Paul Benf assailed it in his *Anti-Crusca*, and this exclusive Tuscan purism has disappeared in subsequent editions. The *Accademia della Crusca* is now incorporated with two older societies—the *Accademia degli Apatici* (the Impartials) and the *Accademia Fiorentina*.

Among the numerous other literary academies of Italy we may mention the Academy of Naples, founded about 1440 by Alphonso, the king; the Academy of Florence, founded 1540, to illustrate and perfect the Tuscan tongue, especially by the close study of Petrarch; the *Intronati* of Siena, 1525; the *Infiammati* of Padua, 1534; the *Rozzi* of Siena, suppressed by Cosimo, 1568. In 1690 the *Accademia degli Arcadi* was founded at Rome, for the purpose of reviving the study of poetry, by Crescimbeni, the author of a

history of Italian poetry. Its members came to its meetings masked and dressed like Arcadian shepherds. Within ten years from its establishment the number of academicians was 600. The Royal Academy of Savoy was founded in 1719, and made a royal academy by Charles Albert in 1848. Its emblem was a gold orange-tree full of flowers and fruit; its motto “*Flores fructusque perennes*,” the same as that of the famous Florimontane Academy, founded at Annecy by St. Francis de Sales. It published valuable memoirs on the history and antiquities of Savoy. Mention should also be made of the *Società Dantesca Italiana*.

Spain.—The *Real Academia Española* at Madrid held its first meeting in July 1713, in the palace of its founder, the duke d'Escalona. In 1714 the king granted them the royal confirmation and protection. The number of its members was limited to 24; the duke d'Escalona was chosen director for life, but his successors were elected yearly, and the secretary for life. Their object, as marked out by the royal declaration, was to cultivate and improve the national language. They were to begin with choosing carefully such words and phrases as have been used by the best Spanish writers; noting the low, barbarous or obsolete ones; and composing a dictionary wherein these might be distinguished from the former. Another important Spanish Academy is the *Real Academia de la Historia* at Madrid.

III. ACADEMIES OF ARCHAEOLOGY AND HISTORY

France.—The old *Académie des inscriptions et belles-lettres* (or “*Petite Académie*,” founded in 1663) was an offshoot of the French Academy, which then at least contained the *élite* of French learning. Louis XIV. was of all French kings the one most occupied with his own aggrandisement. Literature, and even science, he encouraged only so far as they redounded to his own glory. Thus it was that the Academy of Inscriptions arose. At the suggestion of Colbert a company (a committee we should now call it) had been appointed by the king, chosen from the French Academy, charged with the office of furnishing inscriptions, devices and legends for medals. It consisted of four academicians: Chapelain, then considered the poet laureate of France; the abbé Amable de Bourzeis (1606–71); François Charpentier (1620–1702), an antiquary of high repute, and the abbé Jacques de Casagnes (1636–79). Their meetings were principally occupied with discussing the inscriptions, statues and pictures intended for the decoration of Versailles; and their first published work was a collection of engravings, accompanied by descriptions, designed for some of the tapestries at Versailles. Later Félibien, the learned architect, and the two great poets Racine and Boileau, were added to their number. A series of medals was commenced, entitled *Médailles de la Grande Histoire*, or, in other words, the history of *Le Grand Monarque*.

But it was to M. de Pontchartrain, comptroller-general of finance and secretary of State, that the academy owed its institution. By a new regulation, dated July 16, 1701, the *Académie royale des inscriptions et médailles* was instituted, being composed of ten honorary members, ten pensioners, ten associates, and ten pupils. In 1716 the regent changed its title to that of the *Académie des inscriptions et belles-lettres*, a title which better suited its new character.

In the great battle between the ancients and the moderns which divided the learned world in the first half of the 18th century, the Academy of Inscriptions naturally espoused the cause of the ancients, as the Academy of Sciences did that of the moderns. During the earlier years of the French Revolution the academy continued its labours uninterruptedly; and on Jan. 22, 1793, the day after the death of Louis XVI., we find in the *Proceedings* that M. Bréquigny read a paper on the projects of marriage between Queen Elizabeth and the dukes of Anjou and Alençon. On Aug. 2 of the same year the last séance of the old academy was held.

In the first draft of the new institute, Oct. 25, 1795, no class corresponded exactly to the old Academy of Inscriptions; but most of the members who survived found themselves re-elected either in the class of moral and political science, under which history and geography were included as sections, or more generally under the class of literature and fine arts, which embraced an-

cient languages, antiquities and monuments. In 1816 the academy received again its old name. Perhaps the subjects on which it has shown most originality are comparative mythology, the history of science among the ancients, and the geography and antiquities of France. The old academy has reckoned among its members De Sacy the orientalist, Dansse de Vilvoison (1750-1805) the philologist, Anquetil du Perron the traveller, Guillaume J. de C. L. Sainte-Croix and du Theil the antiquaries, and Le Beau, who has been named the last of the Romans. The new academy included the names of Champollion, A. Rémusat, Raynouard, Burnouf and Augustin Thierry.

In consequence of the attention of several literary men in Paris having been directed to Celtic antiquities, a *Celtic Academy* was established in that city in 1805. It still exists as *La société nationale des antiquaires de France*.

Great Britain.—The British Academy was the outcome of a meeting of the principal European and American academies, held at Wiesbaden in Oct. 1899. A scheme was drawn up for an international association of the academies of the world under the two sections of natural science and literary science, but while the Royal Society adequately represented England in science there was then no existing institution that could claim to represent England in literature. A separate society was therefore formed entitled "The British Academy for the promotion of historical, philosophical and philological studies," which on Aug. 8, 1902, was incorporated by royal charter. The objects of the academy are therein defined: "the promotion of the study of the moral and political sciences, including history, philosophy, law, politics and economics, archaeology and philology." The number of fellows (so all members are entitled) is restricted to 150 and the academy is governed by a president and a council of 15 elected annually by the fellows.

The published *Proceedings of the British Academy* amount already to 12 volumes. Other publications are *Supplemental Papers* (1911, etc.) and the annual *Schweich Lectures* on biblical archaeology, inaugurated in 1908. The Fund has also enabled the academy to forward the work of excavation in Bible lands. The series of *Social and Economic Records* under the direction of Sir Paul Vinogradoff was started in 1908, with the support of a Government grant. The publication, by the Clarendon Press, of the facsimile *Old Testament of the Codex Sinaiticus* (1911-22) was made possible by an anonymous gift. The academy has also published a facsimile of the Caedman ms.

In 1908 the academy organized the commemoration of the tercentenary of Milton's birth. It is helped by the foundation of the annual Master Mind lecture (one of a number of endowments, under the will of the late Henriette Hertz). In 1927 it celebrated its 25th anniversary, the hon. secretary, Sir Israel Gollancz, having held uninterrupted office since the beginning. Among other endowments may be mentioned the annual Shakespeare lecture, the annual Raleigh lectures on history, the Warton lecture on English poetry; the Philosophical lecture; the Italian lecture; the lecture on aspects of art; the lecture on English philology and literary history; the Cromer prize for Greek essay; the biennial prize for English studies. The academy administrators also the Rose Mary Crawshay prize fund for English literature, an annual prize of £100 awarded to a woman of any nationality for work on English literature.

The school of oriental studies, now an integral part of the University of London, was largely the outcome of a scheme submitted to the academy in 1904 by the late Prof. Rhys Davids. The organization of imperial studies, now recognized in London and in other British universities, was directly due to proposals made by Sir Sidney Low to the academy in 1912. The English Place-Name Society, founded in 1921 to carry out the survey of English place-names, was inaugurated under the auspices of the British academy in 1923, as the result of a statement submitted by Prof. A. Mawer, now director of the society. The foundation of the British School of Archaeology in Jerusalem in 1919 was brought about by the academy, in conjunction with the Palestine exploration fund. The establishment of the British school at Jerusalem must take an important place among the more recent

efforts of the academy. Among its recent excavations are those on the Hill of Ophel at Jerusalem, the results of which confirm the view as to the site of the city of David. Meanwhile remarkable discoveries have been made in the Near East. Among the enterprises promoted by the academy is the *Encyclopaedia of Islam* (1908, etc.).

The academy is closely associated with the newly established Union Académique Internationale. The principal proposals of the Union in which the academy is concerned are the following: (a) *Corpus vasorum* (1922, etc.); (b) *Catalogue of Alchemical mss.* (1926, etc.); (c) *Dictionary of Mediaeval Latin*; (d) *Forma Orbis Romani*; and (e) supplements to the *Corpora Inscriptionum graecarum et latinarum*.

Italy.—The *Accademia Ercolanese* (*Academy of Herculaneum*) was established at Naples about 1755, at which period a museum was formed of the antiquities found at Herculaneum, Pompeii and other places, by the marquis Tanucci. Its object was to explain the paintings, etc., discovered at those places, and for this purpose the members met every fortnight. The first volume of their labours appeared in 1775, and they have been continued under the title of *Antichità di Ercolano*. They contain engravings of the principal paintings, statues, bronzes, marble figures, medals, utensils, etc., with explanations. In the year 1807 an academy of history and antiquities, on a new plan, was established at Naples by Joseph Bonaparte, but the subsequent changes in the political state of Naples prevented the full and permanent establishment of this institution. In the same year an academy was established at Florence for the illustration of Tuscan antiquities, which published some volumes of memoirs.

IV. ACADEMIES OF MEDICINE AND SURGERY

Austria.—The Academy of Surgery at Vienna was instituted in 1784 by the emperor Joseph II. under the direction of the distinguished surgeon, Giovanni Alessandro Brambilla (1728-1800). In 1874 it ceased to exist; its functions had become mainly military and were transferred to newer schools.

France.—Charlemagne is said to have established a school of medicine in the Louvre, and various societies have been founded and privileges granted to the faculty by his successors. The *Académie de médecine* succeeded to the old *Académie royale de chirurgie et société royale de médecine* in 1820. The new academy was divided into three sections—medicine, surgery and pharmacy. In its constitution it closely resembled the *Académie des sciences*.

Germany.—The *Academia Naturae Curiosae*, afterwards called the *Academia Caesaraea Leopoldina*, was founded in 1662 by J. L. Bausch, a physician of Leipzig. The works of the *Naturae Curiosae* were at first published separately; but from 1784 this appeared annually under the title of *Ephemerides*. In 1687 the emperor Leopold took the society under his protection, and its name was changed in his honour. This academy has no fixed abode, but follows the home of its president. Its library remains at Dresden.

V. ACADEMIES OF THE FINE ARTS

France.—The *Académie royale de peinture et de sculpture* at Paris was founded by Louis XIV. in 1648, under the title of *Académie royale des beaux arts*, to which was afterwards united the *Académie d'architecture*, founded 1671. It is composed of painters, sculptors, architects, engravers and musical composers. From among the members of the society who are painters, is chosen the director of the French *Académie des beaux arts* at Rome, also instituted by Louis XIV. in 1677. The director's province is to superintend the studies of the painters, sculptors, etc., who, chosen by competition, are sent to Italy at the expense of the Government, to complete their studies in that country. The *Académie nationale de musique* (q.v.) is the official and administrative name given in France to the grand opera.

Great Britain.—The Royal Academy of Arts in London, founded in 1768, is described in a separate article. (See *ACADEMY, ROYAL*.)

The *Academy of Ancient Music* was established in London in 1710, with the view of promoting the study and practice of vocal and instrumental harmony. About 1734 the academy became a

seminary for the instruction of youth in the principles of music and the laws of harmony. The *Royal Academy of Music* was formed for the performance of operas, composed by Handel and conducted by him at the theatre in the Haymarket. A contest between Handel and Senesino, one of the performers, in which the directors took the part of the latter, occasioned the dissolution of the academy after it had existed with honour for more than nine years. The present *Royal Academy of Music* dates from 1822, and was incorporated in 1830. It instructs pupils of both sexes in music. (See also the article *CONSERVATOIRE* for colleges of music.)

The *Royal Academy of Dramatic Art* (incorporated in 1920), was originally founded by Beerbohm Tree in 1904. It provides a thorough training for the stage. Like the Royal Academy and the Royal College of Music it receives a grant of £500 a year from the Government. It awards annually certain scholarships, and also prepares for the diploma in dramatic art of London university. A somewhat similar institution is the School of Speech Training and Dramatic Art (incorporated), founded by Miss E. Fogerty, which also prepares for the stage.

Italy.—In 1778 an academy of painting and sculpture was established at Turin. In Milan an academy of architecture was established so early as 1380, by Gian Galeazzo Visconti. About the middle of the 18th century an academy of the arts was established there, after the example of those at Paris and Rome. Before the effects of the French Revolution reached Italy this was one of the best establishments of the kind in that kingdom. The academy of the arts, which had been long established at Florence, fell into decay, but was restored at the end of the 18th century. But the treasures of this and the other institutions for the fine arts were greatly diminished during the occupation of Italy by the French. There are also academies of the fine arts in Mantua, Venice and Naples.

Russia.—The academy of St. Petersburg was established in 1757 by the empress Elizabeth, at the suggestion of Count Shuvalov, and annexed to the academy of sciences. It is now known as the *Akademiya Nauk Soyuzha Sovetskikh Socialisticheskikh Respublik*.

South America.—There are several small academies in the various towns of South America, the most important being that of Rio de Janeiro, founded by John VI. of Portugal in 1816 and now known as the *Escola Nacional de Bellas Artes*.

Spain.—In Madrid an academy for painting, sculpture and architecture, the *Academia de Bellas Artes de San Fernando*, was founded by Philip V. The minister for foreign affairs is president. Prizes are distributed every three years. In Cadiz a few students are supplied by the Government with the means of drawing and modelling from figures; and such as are not able to purchase the requisite instruments are provided with them.

Sweden.—An academy of fine arts was founded at Stockholm in the year 1733 by Count Tessin. Such students as display distinguished ability obtain pensions from the Government, to enable them to reside in Italy for some years for the purposes of investigation and improvement. In this academy there are nine professors and generally about 400 students.

Austria.—In the year 1705 an academy of painting, sculpture and architecture was established at Vienna, with the view of encouraging and promoting the fine arts.

See also *SOCIETIES, LEARNED*.

The volume of excerpts from the general catalogue of books in the British Museum, "Academies," five parts and index, furnishes a complete bibliography. See also *Minerva* published in Berlin and Leipzig and *Index Generalis* published in Paris. (C. Br.)

United States.—The early organization of scholars in America took a form frankly imitative of that prevalent in Europe. Academies were organized in Philadelphia and Boston in the 18th century, which, like their European prototypes, were divided into different classes. Election to membership in them was in recognition of scholarly or scientific attainment, and they still closely resemble their European counterparts.

American scientists and scholars, however, have found their most effective organization in societies and associations of open

membership, described in the article on *Learned Societies*. These frequently maintain a national headquarters at either Washington, D.C., or New York city, co-ordinate the work of the affiliated societies throughout the United States and even Canada and often issue an annual or quarterly publication, sometimes in addition to a more popular monthly magazine. There are, for example, the Archaeological Institute of America, organized in 1879, and the American Federation of Arts, which was organized in 1909 to further art in the United States by means of lectures, exhibitions and publications. There are, too, many so-called academies, clubs, societies, guilds, leagues and associations devoted to the



BY COURTESY OF AMERICAN PHILOSOPHICAL SOCIETY

ORIGINAL BUILDING AT PHILADELPHIA OF THE AMERICAN PHILOSOPHICAL SOCIETY FOR THE PROMOTION OF USEFUL KNOWLEDGE FOUNDED IN 1727 BY BENJAMIN FRANKLIN

preservation, study and furtherance of the fine arts, the physical and natural sciences, natural scenery and historic landmarks and to the improvement of cities (see *American Art Annual*, v. XXIV., 1927). Finally, there are various Federal, State and municipal art commissions that generally supervise the embellishment of public works.

Of the American organizations the following most nearly approximate the European *academy* as it has been considered here: The American Academy of Arts and Letters was organized in 1904 from within the membership of the National Institute of Arts and Letters. Founded in 1893 by members of the American Social Science Association, the National Institute of Arts and Letters now has a membership limited to 250 and divided into three sections: literature, art and music. To be elected to the Institute a candidate must be proposed by a member of his own group and receive a vote of the majority of his section and later a majority vote of those present at the annual meeting. Its executive office is in the Academy building at 633 West 155th street, New York city. The American Academy of Arts and Letters operates under a Federal charter. It is limited to 50 members, chosen from the membership of the Institute only. Unlike the Institute, it functions as a whole and a literary man is not necessarily elected to fill the chair formerly occupied by a literary man. Apart from the honour conferred by membership, the actual work of the Academy is to promote American literature and art by giving the stamp of its approval of the best that both the past and the present have to offer, by means of public addresses, by bringing to the United States representatives of other Academies and, through conferences and discussion, thereby helping to establish a literary and artistic entente between nations, and through its exhibitions, publications, collections and awards.

The American Academy of Arts and Sciences, Boston, the second oldest scientific society in the United States, was chartered in 1780 by a group of distinguished citizens of Massachusetts, including John and Samuel Adams and John Hancock. The membership is divided into three classes, covering the physical and mathematical, the natural and physiological, and the moral and political sciences. It includes fellows (limited to 600), associates and foreign honorary members, elected on the basis of recognition of scholarship or professional eminence. The academy publishes *Proceedings* and *Memoirs*. It administers various trust funds in aid of physical and chemical research, and awards the Rumford medal to the authors of "any important discovery or useful improvement in light or heat which shall have been made in any part of America." It has a commodious building but no considerable endowment. The library is rich in the fields of physics, chemistry, mathematics and in the publications of learned societies of other countries.

The American Philosophical Society Held at Philadelphia for Promoting Useful Knowledge is the oldest scientific association in the United States. The society is the outgrowth of the Junto founded by Franklin in 1727. In 1743 Franklin published *A Proposal for Promoting Useful Knowledge among the British Plantations in America*, which was so favourably received that in the same year the society was organized, with Thomas Hopkinson (1709-51) as president and Franklin as secretary. In 1769 it united with another scientific society founded by Franklin, called the American Society Held at Philadelphia for Promoting Useful Knowledge, and adopted its present name, adding the descriptive phrase from the title of the American Society, and elected Franklin president, an office which he held until his death (1790). The American Philosophical Society is national in scope and comprehends all departments of learning; its *Transactions* date from 1771, and its *Proceedings* from 1838. It has a hall in Philadelphia with meeting-rooms and a valuable library and collection of interesting portraits and relics. David Rittenhouse was its second and Thomas Jefferson its third president. In 1786 John Hyacinth de Magellan, of London, presented a fund, the income of which was to supply a gold medal for the author of the most important discovery "relating to navigation, astronomy or natural philosophy (mere natural history excepted)."

The National Academy of Sciences (1863) was incorporated by Congress with the object that it "shall, whenever called upon by any department of the Government, investigate, examine, experiment and report upon any subject of science or art." Its membership was first limited to 50; after the amendment of the act of incorporation in 1870 the limit was placed at 100; and in 1907 it was prescribed that the resident membership should not exceed 150 in number, no more than ten members to be elected in any one year, and that the number of foreign associated be restricted to 50. The constitution was later amended to provide that the membership shall not exceed 250 and that not more than 15 members shall be elected at one annual meeting. The academy is divided into ten sections: mathematics, astronomy, engineering, chemistry, geology and palaeontology, botany, zoology and anatomy, physiology and pathology, anthropology and psychology. It gives several gold medals for meritorious researches and discoveries, and holds also a number of small trust funds, from the income of which grants are made for scientific research. It publishes scientific and biographical memoirs, an annual report and monthly proceedings.

The National Academy of Design was founded in 1826 and incorporated in 1828. The first president was Samuel Finley Breese Morse, a portrait painter who subsequently invented the telegraph. The number of "associates" is unlimited but the number of "academicians" is limited to 125 painters, 25 sculptors and 25 architects or engravers. Two exhibitions are given annually and each member is entitled to exhibit one work without approval by the jury of selection.

The American Institute of Architects was chartered in 1857 with Richard Upjohn as president and Richard M. Hunt as secretary. It merged with the Western Association of Architects (founded 1884) in 1889 and has since been national in scope.

Since 1902 admission to membership has required an accredited diploma, or scholarship, or passing an examination either technical or on the candidate's work and standing. An annual convention is held and an annuary and monthly journal are issued.

ACADEMY, GREEK, or ACADEME, the name given to the philosophic school founded by Plato. The name is derived from a pleasure garden or gymnasium situated in the suburb of the Ceramicus on the river Cephissus about a mile to the north-west of Athens from the gate called Dipylum. It was said to have belonged to the ancient Attic hero Academus, who, when the Dioscuri invaded Attica to recover their sister Helen, carried off by Theseus, revealed the place where she was hidden. Out of gratitude the Lacedaemonians, who revered the Dioscuri, always spared the Academy during their invasions of the country. It was walled in by Hipparchus and was adorned with walks, groves, and fountains by Cimon (Plut. *Cim.* 13), who bequeathed it as a public pleasure ground to his fellow citizens. Subsequently the garden became the resort of Plato (*q.v.*) who had a small estate in the neighbourhood. Here he taught for nearly 50 years till his death in 348 B.C., and his followers continued to make it their headquarters. It was closed for teaching by Justinian in A.D. 529 along with the other pagan schools. Cicero borrowed the name for his villa near Puteoli, where he composed his dialogue, *The Academic Questions*.

The Platonic Academy (proper) lasted from the days of Plato to those of Cicero, and during its whole course there is traceable a distinct continuity of thought which justifies its examination as a real intellectual unit. On the other hand, this continuity of thought is by no means an identity. The Platonic doctrine was so far modified in the hands of successive scholars that the Academy has been divided into either two, three or five main sections (Sext. Empir. *Pyrroh. Hyp.* i. 220). Finally, in the days of Philo, Antiochus and Cicero, the metaphysical dogmatism of Plato had been changed into an ethical syncretism which combined elements from the Scepticism of Carneades and the doctrines of the Stoics; it was a change from a dogmatism which men found impossible to defend, to a probabilism which afforded a retreat from Scepticism and intellectual anarchy. Cicero represents at once the doctrine of the later Academy and the general attitude of Roman society when he says, "My words do not proclaim the truth, like a Pythian priestess; but I conjecture what is probable, like a plain man; and where, I ask, am I to search for anything more than verisimilitude?" And again: "The characteristic of the Academy is never to interpose one's judgment, to approve what seems most probable, to compare together different opinions, to see what may be advanced on either side and to leave one's listeners free to judge without pretending to dogmatize."

The passage from Sextus Empiricus, cited above, gives the general view that there were three academies: the first, or Old, academy under Speusippus and Xenocrates; the second, or Middle, academy under Arcesilaus and Polemon; the third, or New, academy under Carneades and Clitomachus. Sextus notices also the theory that there was a fourth, that of Philo of Larissa and Charmidas, and a fifth, that of Antiochus. Diogenes Laertius says that Lacydes was the founder of the New Academy (i. 19, iv. 59). Cicero (*de Orat.* iii. 18, etc.) and Varro insist that there were only two academies, the Old and the New. Those who maintain that there is no justification for the five-fold division hold that the agnosticism of Carneades was really latent in Plato, and became prominent owing to the necessity of refuting the Stoic criterion.

The general tendency of the Academic thinkers was towards practical simplicity, a tendency due in large measure to the inferior intellectual capacity of Plato's immediate successors. Cicero (*de Fin.* v. 3) says generally of the Old Academy: "Their writings and method contain all liberal learning, all history, all polite discourse; and besides they embrace such a variety of arts that no one can undertake any noble career without their aid . . . In a word the Academy is, as it were, the workshop of every artist." It is true that these men turned to scientific investigation, but in so doing they escaped from high altitudes in which Plato thought, and tended to lay emphasis on the mundane side of philosophy.

Of Plato's originality and speculative power, of his poetry and enthusiasm they inherited nothing, "nor amid all the learning which has been profusely lavished upon investigating their tenets is there a single deduction calculated to elucidate distinctly the character of their progress or regression" (Archer Butler, *Lect. on Anc. Phil.* ii, 315)

The modification of Academic doctrine from Plato to Cicero may be indicated briefly under four heads.

(1) Plato's own theory of Ideas was not accepted even by Speusippus and Xenocrates. They argued that the Good cannot be the origin of things, inasmuch as Goodness is only found as an attribute of things. Therefore, the idea of Good must be secondary to some other more fundamental principle of existence. This unit Speusippus attempted to find in the Pythagorean number theory. From it he deduced three principles, one for numbers, one for magnitude, one for the soul. The Deity he conceived as that living force which rules all and resides everywhere. Xenocrates, though like Speusippus infected with Pythagoreanism, was the most faithful of Plato's successors. He distinguished three spheres, the sensible, the intelligible, and a third compounded of the two, to which correspond respectively, sense, intellect and opinion (*δῶξα*). Cicero notes, however, that both Speusippus and Xenocrates abandon the Socratic principle of hesitancy.

(2) Up to Arcesilaus, the Academy accepted the principle of finding a general unity in all things, by the aid of which a principle of certainty might be found. Arcesilaus, however, broke new ground by attacking the very possibility of certainty. Socrates had said, "This alone I know, that I know nothing." But Arcesilaus went farther and denied the possibility of even the Socratic minimum of certainty: "I cannot know even whether I know or not." Thus from the dogmatism of the master the Academy plunged into the extremes of agnostic criticism.

(3) The next stage in the Academic succession was the moderate scepticism of Carneades, which owed its existence to his opposition to Chrysippus, the Stoic. To the Stoical theory of *apprehensible* (or *knowable*) *presentation*, by which they expressed a conviction of certainty arising from impressions so strong as to amount to real knowledge, he opposed the doctrine of *inapprehensible* (or *unknowable*) *presentation*, which denied any necessary correspondence between perceptions and the objects perceived. He saved himself, however, from absolute scepticism by the doctrine of probability or verisimilitude, which may serve as a practical guide in life. Thus his criterion of imagination is that it must be credible, irrefutable, and attested by comparison with other impressions; it may be wrong, but for the person concerned it is valid. In ethics he was an avowed sceptic. During his official visit to Rome he gave public lectures, in which he successively proved and disproved with equal ease the existence of justice.

(4) In the last period we find a tendency not only to reconcile the internal divergences of the Academy itself, but also to connect it with parallel growths of thought. Philo of Larissa endeavours to show that Carneades was not opposed to Plato, and further that the apparent antagonism between Plato and Zeno was due to the fact that they were arguing from different points of view. From this syncretism emerged the prudent noncommittal eclecticism of Cicero, the last product of Academic development.

For detailed accounts of the Academicians see ARISTOTLE, XENOCRATES, OF CHALCEDON, etc., also STOICS and NEOPLATONISM. Histories of philosophy by Erdmann, Zeller, and Windelband, and Th. Gomperz, *Greek Thinkers*, ii, 270 (Eng. trans. 1905).

ACADEMY, ROYAL. The Royal Academy of Arts in London, to give it the original title in full, was founded in 1768, "for the purpose of cultivating and improving the arts of painting, sculpture and architecture." It was the outcome of many attempts which had previously been made in England to form a society which should have for its object the advancement of the fine arts. No time was lost in establishing the schools, and on Jan. 2, 1768, they were opened at some rooms in Pall Mall, a little eastward of the site now occupied by the Junior United Service club, the president, Sir Joshua Reynolds, delivering on that occasion the first of his famous "Discourses." The opening of the first exhibition at the same place followed on April 26.

The government of the academy was by the "Instrument" vested in "a president and eight other persons, who shall form a council." Four of these were to retire every year, and the seats were to go by rotation to every academican. The number was increased in 1870 to 12, and reduced to ten in 1875. The rules as to retirement and rotation are still in force. Newly elected academicians begin their two years' service as soon as they have received their diploma. The council has, to quote the "Instrument," "the entire direction and management of the business" of the academy in all its branches, and also the framing of new laws and regulations; but the latter, before coming into force, must be sanctioned by the general assembly of academicians and approved by the sovereign. The original number of academicians was fixed in the "Instrument" at 40, and has so remained. Each academican on his election has to present an approved specimen of his work—called his diploma work—before his diploma is submitted to the sovereign for signature. On receiving his diploma he signs the Roll of Institution as an academican, and takes his seat in the general assembly. The class of associates, out of whom alone the academicians can be elected, was founded in 1769.

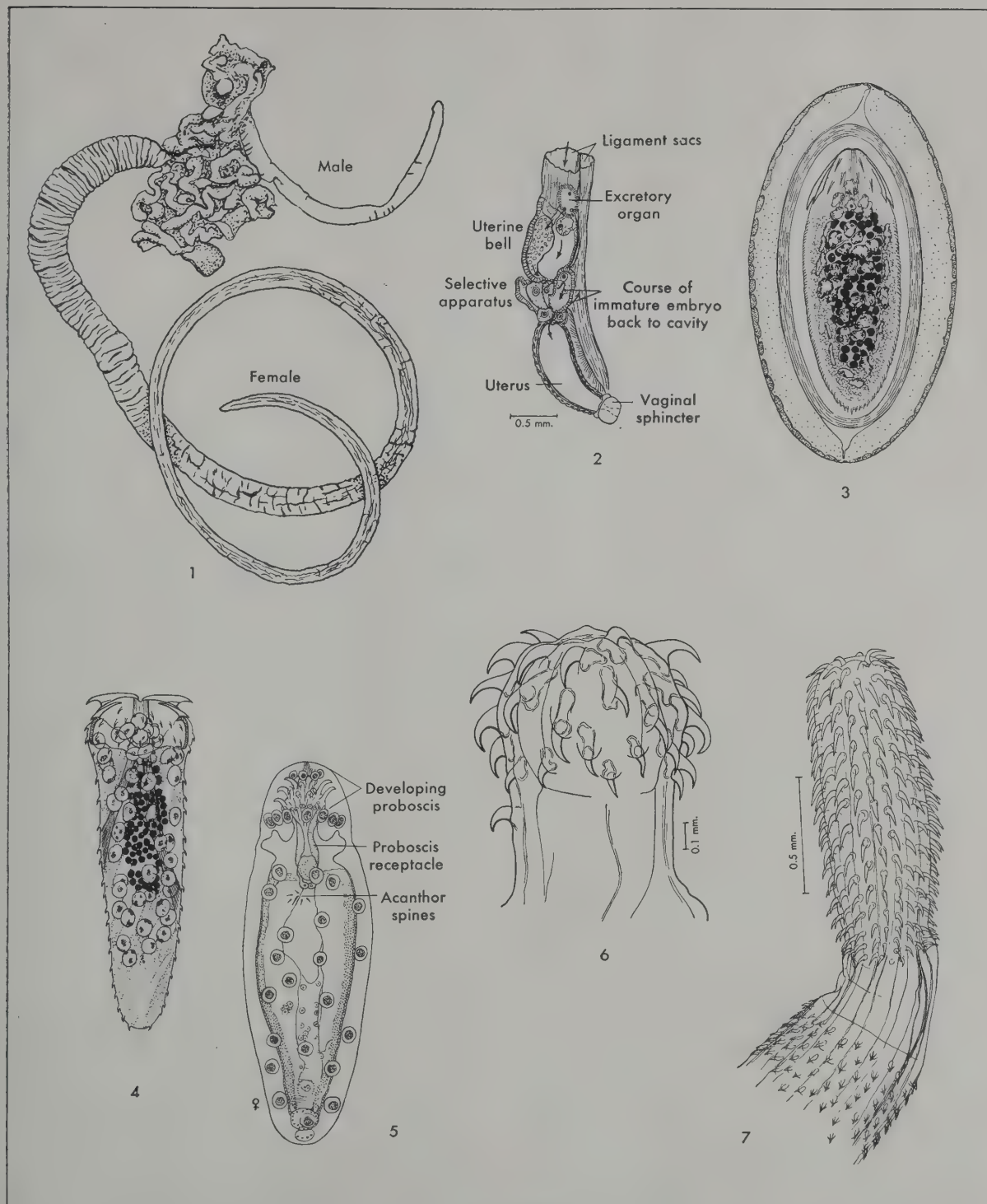
One of the most important functions of the Royal academy, and one which for nearly a century it discharged alone was the instruction of students in art. The first act, as has been shown, of the newly founded academy was to establish schools—"an Antique Academy," and a "School for the Living Model" for painters, sculptors and architects. A school of painting was added in 1815, and special schools of sculpture and architecture in 1871. The schools consist of an antique school, a school of painting, a school of drawing from the life, a school of modelling from the life and an architectural school. Admission is gained by submitting specimens of drawing or modelling, and the successful candidates, called probationers, have then to undergo a further test in the schools, on passing which they are admitted as students for five years. Female students were first admitted in 1860. There are permanent curators and teachers in all the schools, but the principal teaching is done by the keeper and visitors—academicians and associates—elected to serve in each school.

Another of the principal objects to which the profits of the Royal academy have been devoted has been the relief of distressed artists and their families. The source from which have been derived the funds for carrying on the varied work of the Royal academy, its schools, its charities and general cost of administration, and which has enabled it to spend large sums on building, and provided it with the means of maintaining the buildings, has been the annual exhibitions. There is an annual winter exhibition of works by old masters and deceased British artists, and a summer exhibition of works by living artists.

Presidents of the Royal Academy.—Sir Joshua Reynolds, 1768–92; Benjamin West (resigned), 1792–1805; James Wyatt, 1805; Benjamin West (re-elected), 1806–20; Sir Thomas Lawrence, 1820–30; Sir Martin Archer Shee, 1830–50; Sir Charles Lock Eastlake, 1850–65; Sir Francis Grant, 1866–78; Frederic, Lord Leighton of Stretton, 1878–96; Sir John Everett Millais, 1896; Sir Edward John Poynter, Bt., 1896–1918; Sir Aston Webb, 1919–24; Sir Frank Dicksee, 1924–28; Sir W. Llewellyn, 1928–38; Sir E. Lutyens, 1938–44; Sir Alfred Munnings, 1944–.

The library of about 11,000 volumes, some of them of great rarity and value, is open daily to the students and members, and to others on introduction. The trust funds administered by the Royal academy include the following: The Turner fund, the Creswick fund, the Landseer fund, the Armitage fund, the Leighton bequest and the Edward Stott fund.

BIBLIOGRAPHY.—The literature concerning the Royal academy consists chiefly of pamphlets and articles of more or less ephemeral value. More serious works are: William Sandby, *The History of the Royal Academy of Arts* (1862) (withdrawn from circulation on a question of copyright); *Report from the Select Committee on Arts and their Connection with Manufactures, with the Minutes of Evidence and Appendix* (1836); *Report of the Royal Commission on the Royal Academy, with Minutes of Evidence and Appendix* (1863); Martin Archer Shee, *The Life of Sir M. A. Shee, P.R.A.* (1860); C. R. Leslie, R.A., and Tom Taylor, *Life and Times of Sir Joshua Reynolds, P.R.A.* (1865); J. E. Hodgson, R.A., and F. A. Eaton, Sec. R.A., *The Royal Academy and its Members, 1768–1830* (1905). But the chief sources



(1, 2, 4, 5) REDRAWN FROM BRONN'S "TIERREICHS," MODIFIED FROM MEYER; (3) REDRAWN WITH MODIFICATIONS FROM MEYER

1. Male and female of the thorny-headed worm attached to the inner lining of a portion of the intestine of a hog (natural size)
2. Female genital and excretory organs of thorny-headed worm of hog. Arrows indicate path of eggs through the selective apparatus
3. Egg of the thorny-headed worm of the hog, showing developing acanthor within its membranes
4. Acanthor after hatching within the digestive tract of a beetle larva
5. Acanthella or infective larval stage removed from tissues of a beetle larva
6. Surface view of proboscis of adult thorny-headed worm from the intestine of a hog
7. Proboscis and spine-clad portion of body proper of an acanthocephalan (*Gorgorhynchus*) from a marine fish

of information on the subject are the minute-books of the council and of the general assembly, and the annual reports, which, however, only date from 1859. (F. A. E.; W. R. M. L.)

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, THE, founded in 1812, possesses a library of 120,000 volumes and 7,000,000 natural history specimens. Its free museum contains 19 habitat groups of animals, as well as a Hall of Earth History and exhibits of birds, minerals and insects. The academy's scientific staff is comprised of 48 research scientists. It has published the *Proceedings* continuously since 1841, in addition to *The Manual of Conchology* and *Frontiers*. From 1929 to 1939, 200 expeditions sought new specimens in all parts of the world for its collections. Since 1876 The American Entomological society has been affiliated with it.

ACADIA or **ACADIE**, a district in what is now Nova Scotia and eastern New Brunswick, so named either because Verazano called a part of the coast *Arcadia* in 1524, or from the Micmac *acadie*, fertile land, found in several place names. Visited by Champlain in 1603 and by De Monts in 1604, and colonized by France, Acadia was a bone of contention in the wars between France and England. It became English under the treaty of Utrecht in 1713. In 1755 the imminence of war with France, the vexed question of the neutrality of the Acadians and their possible revolt, led to the forcible deportation of the majority of the Nova Scotia Acadians (about 6,500). Their settlements were destroyed and those not deported driven into the wilderness. This deportation is the theme of Longfellow's *Evangeline*. The Acadians were distributed among the English colonies. One party made its way to Bayou Teche, Louisiana, where Cable has described their modern life. After the peace of 1763, about 800 returned to New Brunswick, where the name Acadian is still current. See G. P. Bible, *An Historical sketch of the Acadians* (1892); A. Doughty, *The Canadian Exiles* (1914).

ACAJUTLA, a Pacific port of El Salvador, Central America, terminus of the British-owned Salvador railroad, and coffee-shipping centre for the republic. The population is (1940) 1,448, and the port an open roadstead, passengers and freight being handled by lighters. The town is 65 mi. distant from San Salvador and 12 mi. from Sonsonate.

ACANTHACEAE, a large family of dicotyledonous plants, chiefly tropical and subtropical with bilabiate irregular flowers and for the most part with dehiscent capsules, the seeds borne on characteristic more or less elastic jacularia or retinacula, an aid in seed dispersal. In this family, considerable use of pollen grain characters has been made in differentiating genera. The species, all herbs, shrubs or vines, in excess of 2,500, are arranged in about 180 genera. Some of these genera are very large, such as *Justicia*, with in excess of 250 species. Many species are cultivated for ornamental purposes, especially in such genera as *Thunbergia*, *Graptophyllum*, *Aphelandra*, *Barleria*, *Ruellia*, *Justicia*, *Jacobinia*, *Beloperone*, *Strobilanthes*, *Eranthemum*, *Phlogacanthus*, and others. The leaf characters of certain species of *Acanthus* (q.v.) form an important part of the design on the capitals of classical Grecian and Roman columns.

ACANTHOCEPHALA. These thorny-headed worms are obligatory parasites, perfectly adapted to parasitic existence, since no stage in the life history possesses any specialized organs for digestion. The mature worms, invariably of separate sexes, live in the intestines of vertebrate hosts, where food is obtained exclusively by absorption through the body wall. While in some species fully mature females are less than 2 mm. (.08 in.) long, in other species they have been reported to exceed 500 mm. (20 in.). Males are usually smaller than females of the same species.

All groups of vertebrates may serve as hosts for Acanthocephala, although for each vertebrate class there are some distinctive genera and species. Introduction into the host intestine is always along with food. So far as known, an arthropod is invariably the first host, although animals which feed upon arthropods may serve as intermediate hosts to carry the worms to the vertebrate.

A typical life cycle is that of *Macracanthorhynchus hirudinaeus* (Pallas, 1781), a species which dwells in the intestine of the hog and undergoes larval development in soil-inhabiting beetle

larvae. Developing eggs are given off by the female worm and reach the ground with the intestinal wastes of the pig. In the soil they may be eaten by grubs of the June beetle, cockchafer or other beetle larvae. Within the digestive tract of the grub the egg hatches to a stage called an acanthor. By growth and metamorphosis the acanthella or infective larval stage is reached while still within the body of the grub. The parasite never reaches maturity unless its sheltering beetle larva is devoured by a pig or other suitable host in whose intestine the life cycle is completed.

One of the most distinctive features of all Acanthocephala is the hook-covered proboscis which may be of extremely diverse size and shape. By the use of special muscles this organ is capable of being inverted and withdrawn into a muscular proboscis receptacle within the front end of the body. If in contact with the host intestine when everted, the proboscis hooks tear their way into the intestinal wall to anchor the worm securely.

The wall of the body-proper is composed mainly of a syncytial subcuticula permeated by a series of fluid-filled canals termed the lacunar system. Two continuations of this tissue into the body cavity at its front end constitute organs of problematical function known as the lemnisci. The external surface of the entire body is covered by a cuticula which in many species is adorned with spines.

On its inner surface the subcuticula is lined by two layers of muscle fibres, of which those next to the body cavity are directed longitudinally, the others circularly.

A greatly reduced central nervous system or brain is located within the proboscis receptacle, from which a few small nerve fibres pass to surrounding structures. There are no highly specialized sense organs.

Genital organs in both sexes are held in place within a ligament which runs lengthwise through the body cavity. The ovary very early breaks up into a large number of floating egg masses; hence each female is incapable of producing more than one quota of eggs.

Upon fertilization each egg becomes surrounded by a series of protecting membranes and breaks away from the egg mass. Ultimately the developing eggs fill the entire body cavity. The female pore, at or near the posterior extremity, is guarded by a circular muscle, the vaginal sphincter. A short vagina receives the tubular or sac-shaped uterus, which at its forward end bears the uterine bell and the selective apparatus. The funnel-shaped uterine bell opens into the body cavity, which is divided by partitions into a dorsal and a ventral ligament-sac.

When fully mature eggs are passed through the uterine bell into the selective apparatus, they are passed on into the uterus and finally out through the vagina. Eggs not yet ready for elimination are returned to the body cavity by the selective apparatus.

Male organs consist of a pair of testes followed posteriorly by one or a series of cement glands. Accessory male structures include ducts and storage reservoirs for sperm and cement and a complicated eversible bursa, or pouch, for copulation, surrounding the cirrus.

In most species excretory wastes are eliminated through the body surface, although in some of the large forms a pair of branched protonephridial organs are associated with the reproductive organs.

Acanthocephala have been considered by many zoologists as a subdivision of the roundworms. However, in general plan as well as in detail of structure, in their development and in their relationships within the host, they closely parallel the cestodes. Their many distinctive features are best acknowledged by considering them as an independent phylum.

A. Meyer (1932-33) recognized 58 genera with somewhat more than 300 species. Approximately 100 additional species and 20 new genera had been added in the 11 years following the publication of Meyer's monograph.

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ACANTHOPTERYGII, the most specialized section of the bony fishes (Teleostii), characterized by the possession of spines on the first dorsal fin and by the absence usually of a duct connecting the air bladder with the alimentary canal. (See FISHES.) They include the perch, the mackerel, the bass (*q.v.*) and other well-known and important fishes besides numerous less noteworthy forms. In the perches and basses the anterior dorsal fin is armed with formidable spines.

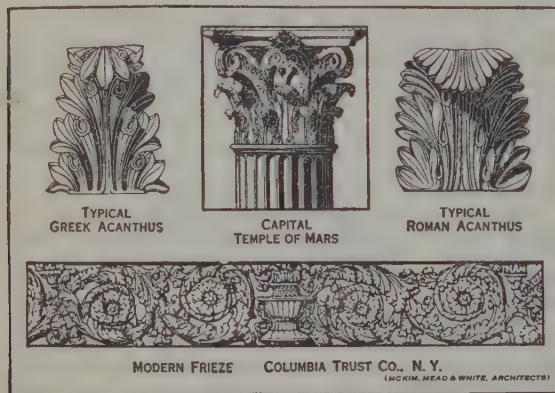
ACANTHUS, a genus of plants of the acanthus family (Acanthaceae), embracing some 20 species, mainly perennial herbs and small shrubs, native to the Mediterranean region and the warmer parts of Asia and Africa. They are bold, vigorous, handsome plants, with mostly broad, much divided, often spiny-toothed leaves. The erect stems bear stately spikes of showy white, purple or red flowers, surrounded by sharp-pointed, sometimes highly coloured bracts.

Several species are grown as ornamentals. These are mostly thistle-like plants, with stems 3 ft. to 4 ft. high, the best known of which is the bears' breech or brankursine (*A. mollis*), common in Mediterranean countries, with deeply cut, hairy, shining leaves, which are without spines, and whitish or rose-coloured flowers in spikes 1½ ft. long.

The spiny acanthus (*A. spinosus*), native to southern Europe, is so named because of its very spiny leaves. *A. perringi*, a native of Asiatic Turkey, with red flowers, is suitable for rock gardens. *A. montanus*, native to Greece, with roseate flowers, is grown in greenhouses.

In architectural decoration, the acanthus was first reproduced in metal, and subsequently carved in stone by the Greeks. It was afterwards, with various changes, adopted in all succeeding styles of architecture as a basis of ornamental decoration.

There are two types, that found in the *Acanthus spinosus*, which seems to have been followed by the Greeks, and that in the *Acanthus mollis*, which seems to have been preferred by the Romans.



BY COURTESY OF BÜHLMANN, "CLASSIC AND RENAISSANCE ARCHITECTURE" (NEFF AND HELBURN); D'ESPOUY, "FRAGMENTS D'ARCHITECTURE ANTIQUE" (CH. MASSIN ET CIE)

A CAPPELLA or **ALLA CAPPELLA**, Italian musical terms meaning literally "as in a chapel or church," whence they have come to be applied to compositions intended to be sung without instrumental accompaniment; or, alternatively, compositions accompanied in a particular way, viz., without the introduction of harmony or parts.

A CAPRICCIO, in music a direction signifying that the piece to which it is attached is of a fanciful, capricious nature, and is to be played in like manner.

ACAPULCO, a resort city and port of Mexico, at sea level on the Pacific coast in the state of Guerrero, 190 mi. S.S.W. of Mexico City. Pop. (est. 1950) 30,000, plus many transients. Acapulco has the best harbour on the Pacific coast of Mexico, and one of the finest natural anchorages in the world; it is situated on a deep, semicircular bay, nearly landlocked and accessible by land. Acapulco was a main depot for Spanish colonial fleets ply-

ing between Mexico, the Philippines and the orient, and continued to be a port of call for steamship lines running between Panamá and San Francisco as well as coastwise trading vessels. The town lies on a narrow strip of land between the bay and steeply rising mountains which encircle it. From May to November the climate is hot and humid, but from December through April it is warm and pleasant; February, March and April are almost rainless. Long a regional economic centre, Acapulco exports hides, cedar and fruit, as well as cotton, tobacco, cacao, sugar cane, Indian corn and coffee grown in the adjacent district of Tabares. No railways connect to Acapulco but a spreading network of highways and frequent air service make it accessible to visitors. Acapulco became "The Riviera of Mexico," deriving much of its livelihood from tourist trade.

A main highway, passing through Taxco and Cuernavaca, runs to Mexico City. (Hb. C.)

ACARNANIA, a district of ancient Greece, bounded on the west by the Ionian sea, on the north by the Ambracian gulf, on the east and south by Mt. Thyamus and the Achelous. Its most populous region was the plain of the Achelous, commanded by the principal town Stratus; its people long continued in semi-barbarism, communication with the rest of Greece being impeded by mountain ridges and lagoons, but there were a few Corinthian colonies on the coast, founded in the 7th century B.C.; they were ruined in the 5th, through Athenian intervention. In 391 the Acarnanians submitted to Spartan control; in 371, to Theban. In the Hellenistic age they were constantly assailed by their Aetolian neighbours. But they remodelled their ancient cantonal league, apparently after the pattern of Aetolia, and in the 3rd century they formed a close alliance with Philip V. of Macedonia in his Roman wars. For their sympathy with his successor Perseus they were deprived of their federal capital Leucas and required to send hostages to Rome (167 B.C.). The country was desolated by Augustus, who drafted its inhabitants into Nicopolis and Patrae. Acarnania took a prominent part in the national uprising of 1821; it is now joined with Aetolia as a province. Several ancient sites in Acarnania have well-preserved walls, especially Stratus, Oeniadae and Limnaea.

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ACARUS, a genus of mites (*q.v.*), represented by the human itch-mite, *Acarus scabiei*, causing an irritating skin infection. The disease was known to the ancients, but its cause was discovered only in the 18th century. See Reuben Friedman, *Biology of Acarus Scabiei* (1942). (A. Ph.)

ACASTUS, son of Pelias, but the friend of Jason; he took part in the Calydonian boar-hunt and the Argonautic expedition. After his father's death he instituted splendid funeral games in his honour. His wife Astydameia (called Hippolytē in Horace, *Odes* iii. 7, 17) fell in love with Peleus (*q.v.*), who had taken refuge at Iolcus, and accused him falsely to her husband (*cf.* BELLEROPHON; HIPPOLYTUS). Acastus thereupon left Peleus asleep on Mount Pelion, having first hidden his famous sword. On awaking, Peleus was attacked by the Centaurs, but saved by Cheiron. Having recovered his sword he returned to Iolcus and slew Acastus and Astydameia.

ACATALEPSY. In the history of philosophy the Greek term *acatalepsy* was first used by Pyrrho the sceptic to express the view that the human mind has no direct apprehension of material objects. One is consequently not justified in making assertions about what things really are in themselves. Each person can only say how things appear to him.

ACAULESCENT, a term used of a plant apparently stemless, as dandelion, the stem being almost suppressed.

ACCADIAN, an adjectival form of the name Accad or Akkad. Sumer and Akkad were the principal sub-regions of Babylonia (*q.v.*) and in view of the dialectical and ethnological differences between the peoples of the two regions, the terms Sumerian and Accadian came to represent the languages and ethnic groups of the two regions. (See SUMERIAN LANGUAGE.)

ACCA LARENTIA, in Roman legend, the wife of the shepherd Faustulus, who saved the lives of Romulus and Remus. Attempts have been made to explain the wolf legend by suggesting that Larentia was called *lupa* ("courtesan," literally "she-wolf") because of her immoral character (Livy i, 4; Ovid, *Fasti*, iii, 55). According to another account, Larentia was a beautiful girl whom Hercules won at dice (Macrobius i, 10; Plutarch, *Romulus*, 4, 5, *Quaest. Rom.*, 35; Aulus Gellius vi, 7). By his advice she married a wealthy Etruscan named Tarutius. She inherited his property and bequeathed it to the Roman people, who instituted in her honour a yearly festival called Larentalia (Dec. 23). According to some, Acca Larentia was the mother of the Lares and symbolized the fertility of the earth, in particular the city lands and their crops.

See Mommsen, "Die echte und die falsche Larentia," in *Römische Forschungen*, ii (1879); E. Pais, *Ancient Legends of Roman History* (1906); W. H. D. Rouse, *The Year's Work in Classical Studies* (1907).

ACCELERANDO (Ital.), in music a direction signifying that the tempo, or speed of performance, is to be quickened.

ACCELERATION, as used in mechanics, a term denoting the rate of change in the velocity of a moving body. It is what the increment in velocity in a unit of time would be if the rate of change were uniform for that unit. When a body falls in a vacuum near the earth's surface, the increment in velocity is about 32.16 ft. per second, and this is known as the acceleration of gravity. In astronomy the term has other uses, as when it refers to the time which the stars gain upon the sun in passing the meridian each day. (See MECHANICS; DIMENSIONAL ANALYSIS; GRAVITATION.)

ACCELERATOR, in a motor car (*q.v.*) the pedal which operates the throttle and thus controls the engine speed.

ACCELEROMETER, in aeroplane flight testing an instrument used to measure the acceleration of an aircraft in a defined direction. The most common models consist substantially of a weight supported on a diaphragm or from a cantilever spring. By recording the movements of this weight during various manoeuvres of the aeroplane the accelerations undergone by the plane itself can be computed. With the accelerations known, designers can further compute the loads placed upon the structure of the aeroplane by manoeuvres, such as spins, loops and sharp pull-outs from dives, and adjust their structural strength factors accordingly. (See AEROPLANE.) (D. SE.)

ACCENT, a term used by the earlier Greek grammarians for the musical accent which characterized their own language, but later the term became specialized for quantity in metre, whence comes the Eng. *prosody* (Lat. *accentus*, a literal translation of Gr. *προσῳδία*). In all languages there are two kinds of accent: (1) musical chromatic or pitch accent; (2) emphatic or stress accent. The former indicates differences in musical pitch between one sound and another in speech, the latter the difference between one syllable and another which is occasioned by emitting the breath in the production of one syllable with greater energy than is employed for the other syllables of the same word. These two senses are different from the common usage of the word in the statement that someone talks with a foreign or with a vulgar accent.

In different languages the relations between pitch and stress differ greatly. The pitch accent is well marked, for example, in Lithuanian and Swedish. Modern Greek has changed from pitch to stress, the stress being generally laid upon the same syllable in modern as bore the pitch accent in ancient Greek. In the majority of European languages, however, stress is more conspicuous than pitch. To the existence of stress in the original language from which Greek, Latin, Celtic, Teutonic, Slavonic and other languages of Europe are descended, must be attributed a large part of the phenomena known as ablaut or gradation. In modern languages we get *Acton* out of the O.E. *āc-tūn* (oak-town), and more recently the contrast between *New Town* and *Newton*. The strong stress accent existing in the transition period between Latin and French led to the curtailing of long Latin words like *latrocinium* or *hospitāle* into the words which we have borrowed from French into English as *larceny* and *hotel*.

In both pitch and stress accent different gradations may be

observed. In pitch, the accent may be uniform, rising or falling. Or there may be combinations of rising and falling or of falling and rising accents upon the same syllable. In ancient Greek there were (1) the acute (´), a rising accent; (2) the grave (`), apparently merely the indication that in particular positions in the sentence the acute accent is not used where it would occur in the isolated word, and (3) the circumflex, which as its form (ˆ) shows, and as ancient grammarians state, combines the rising and the falling accent upon the same syllable, this syllable being always long. Different Greek dialects varied the syllables of the word; in historical times the accent had become limited to the last three syllables of a word. The theory that, as every vowel has its own natural pitch, and a frequent interchange between *e* (a high vowel) and *o* (a low vowel) occurs in the Indo-European languages, *e* originally went with the highest pitch accent, while *o* appeared in syllables of a lower pitch, has no certain foundation since there are many exceptions. Somewhat similar distinctions characterize stressed syllables. According as the strength of the expiration is greatest either at the beginning, the end or the middle of the syllable, the accent is a falling, a rising or a rising and falling one. Syllables in which the stress is produced continuously whether increasing or decreasing are called single pointed, those in which a variation in the stress occurs without being strong enough to break the syllable into two are called double pointed. There is no separate notation for stress accent, but the acute (´) is used for the increasing, the grave (`) for the decreasing stress, the circumflex (ˆ) for the rising and falling (increasing and decreasing) and (˘) for the opposite. A separate notation is needed.

The relation between the two accents in the same language at the same time is a subject which requires further investigation. In prehistoric times the stress in Latin must have rested upon the first syllable in all cases. Only on this hypothesis can be explained forms like *peperci* (perfect of *parco*) and *collido* (a compound of *laedo*), for throughout the historical period the stress rested in these words upon the second syllable from the end.

Besides the accent of the syllable and of the word, there remains a more complicated problem, the accent of the sentence. From earliest times some words have become parasitic or enclitic upon other words. Pronouns more than most words are modified from this cause, but conjunctions like the Gr. *τε* ("and"), the Lat. *que*, have throughout their whole history been enclitic upon the preceding word. An important word may be enclitic, as in English *don't, shan't*.

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ACCEPTANCE, generally, a receiving or acknowledgment of receipt; in law, the act by which a person binds himself to comply with the request contained in a bill of exchange (*q.v.*), addressed to him by the drawer. Acceptance may be either general or qualified. A general acceptance is an engagement to pay the bill strictly according to its tenor and is made by the drawee subscribing his name, with or without the word "accepted," at the bottom of the bill, or across the face of it. Qualified acceptance may be a promise to pay on a contingency occurring, e.g., on the sale of certain goods consigned by the drawer to the acceptor. No contingency is allowed to be mentioned in the body of the bill on pain of rendering the bill non-negotiable. But a qualified acceptance is quite legal and equally binding with a general acceptance upon the acceptor when the contingency has occurred. It is also a qualified acceptance where the promise is to pay only part of the sum mentioned

in the bill, or to pay at a different time or place from those specified. As a qualified acceptance is so far a disregard of the drawer's order, the holder is not obliged to take it; and if he chooses to take it he must give notice to antecedent parties, acting at his own risk if they dissent. A bill can be accepted in the first instance only by the person or persons to whom it is addressed; but if he or they fail to do so, it may, after being protested for non-acceptance, be accepted by some one else "*supra protest*," for the sake of the honour of one or more of the parties concerned in it, and he thereupon acquires a claim against the drawer and all those to whom he could have resorted.

For acceptance of an offer, see CONTRACT.

Acceptance has a further technical meaning in law in the case of delivery of goods pursuant to a prior contract for sale. Either an expression by the buyer of his assent to become owner, or his doing of some act inconsistent with the seller's ownership—such as selling or using part of the goods, will constitute such an acceptance. The effect is, in English law, to make impossible the later rejection of the goods, and leave the buyer a remedy in damages for any non-compliance of the goods with the contract. In some American States the acceptance, at least if not accompanied by an express claim of non-compliance, will wholly bar the buyer from any later claim that the goods were not up to contract. Under the prevailing American doctrine laid down in the Uniform Sales Act, however, the buyer can at his option if the goods accepted do not comply, either have damages, or return the goods and forego damages. If the contract is oral and no part payment has been made, both delivery and acceptance of some portion of the goods are necessary to make the contract enforceable at all. (X.)

United States.—In the United States trade acceptances are rediscountable at the Federal Reserve Bank if the date of maturity be not more than 90 days from the date offered for discount, except in the case of agricultural paper, for which the limit is 180 days. The Federal Reserve Bank shall take such steps as it deems necessary to satisfy itself as to the eligibility of any trade acceptance offered for rediscount and may require a recent financial statement of one or more of the parties to the instrument. To satisfy itself that the acceptance meets the primary requirement of arising out of a current merchandise transaction, the Federal Reserve Bank rules that "it must bear on its face or be accompanied by evidence satisfactory to the Federal Reserve Bank that it was drawn by the seller of the goods on the purchaser of such goods." Such evidence may consist of a certificate on or accompanying the acceptance to the following effect: *The obligation of the acceptor of this bill arises out of the purchase of goods from the drawer.* Such certificate may be accepted by the Federal Reserve Bank as sufficient evidence, provided, however, that the Federal Reserve Bank, in its discretion, may inquire into the exact nature of the transaction underlying the acceptance.

By the use of the trade acceptance, the seller of goods instead of having merely an open book account on a credit transaction, procures a negotiable evidence of the debt. The actual conversion of the original draft into a trade acceptance is accomplished when the buyer (drawee) writes across its face the word "accepted," together with the date and the place of payment, either at a banking house or at the place of business of the seller (drawer), and affixes his signature. Upon receipt of the accepted draft, the seller of goods (drawer) may either hold it to maturity and then collect, or discount it to procure immediate funds.

Authoritative information on current usage in connection with trade acceptances is published from time to time in the *Federal Reserve Bulletin* under "Rulings of the Federal Reserve Board" and "Opinions of Counsel of the Federal Reserve Board." (J. H. B.)

ACCEPTILATION, in Roman and Scots law, a verbal release of a verbal obligation. This formal mode of extinguishing an obligation contracted verbally received its name from the book-keeping term *acceptilatio*, entering a receipt, i.e., carrying it to credit. The words conveying the release had to correspond to, or strictly cover, the expressed obligation.

ACCESS, approach, or the means of approaching. In law, the word is used in various connections. The presumption of a

child's legitimacy is negated if it be proved that a husband has not had access to his wife within such a period of time as would admit of his being the father. (See LEGITIMACY.)

In the law of easements (see EASEMENT), every person who has land adjoining a public road or a public navigable river has a right of access to it from his land. So, also, every person has a right of access to air and light through an ancient window. For the right of access of parents to children under the guardianship of the court, see INFANT.

ACCESSION, in law, a method of acquiring property adopted from Roman law, by which, in things that have a close connection with or dependence on one another, the property in the principal draws after it the property in the accessory, according to the principle, *accessio cedet principali*. Accession may take place either in a natural way, such as the growth of fruit or the birth of animals, or in an artificial way. The various methods may be classified as (1) land to land by accretion or alluvion (*q.v.*), (2) movables to land (see FIXTURES); (3) movables to movables; (4) movables added to by the art or industry of man; this may be by specification, as when wine is made out of grapes, or by confusion, or commixture, which is the mixing together of liquids or solids, respectively. In the case of industrial accession ownership is determined according as the natural or manufactured substance is of the more importance, and, in general, compensation is payable to the person who has been dispossessed of his property.

In a historical or constitutional sense, the term "accession" is applied to the coming to the throne of a dynasty or line of sovereigns or of a single sovereign. "Accession" sometimes likewise signifies consent or acquiescence. Thus, in the bankruptcy law of Scotland, where there is a settlement by a 'trust-deed, it is accepted on the part of each creditor by a "deed of accession."

ACCESSORY, a person concerned in the commission of a felonious offence, not as principal, but by participation; as by advice, command, aid or concealment. In certain crimes there can be no accessories, all concerned being principals, whether present or absent at the time of their commission. There is no accessory to misdemeanour.

There are two kinds of accessories—*before the fact* and *after it*. The first is he who commands or procures another to commit felony and is not present himself; for if he be present he is an abettor (*q.v.*). The second is he who, knowing a man has committed a felony, receives, harbours or assists him. An accessory before the fact is liable to the same punishment as the principal; and there is now indeed no practical difference between such an accessory and a principal in regard either to indictment, trial or punishment. Accessories after the fact are in general punishable with imprisonment (with or without hard labour) for a period not exceeding two years. (See the Accessories and Abettors Act 1861.)

ACCIACCATURA, in music, an old type of ornament in pianoforte and organ playing which consisted in reinforcing a particular note by striking simultaneously with it the note below it, the latter being then immediately released. (From Ital. *acciacatura*, to crush.) Nowadays it is more often applied to the shorter kind of *appoggiatura* (*q.v.*).

ACCIAJUOLI, DONATO (1428–1478), Italian scholar, was born at Florence and became gonfalonier of the city in 1473. His works are: a Latin translation of some of Plutarch's *Lives* (Florence, 1478); Commentaries on Aristotle's *Ethics* and *Politics*; and lives of Hannibal, Scipio and Charlemagne. In the work on Aristotle he had the co-operation of his master Argyropoulos.

ACCIDENCE, the term for the grammatical changes to which words are subject in their inflections as to gender, number, tense and case (a mis-spelling of "accidents," from the Latin neuter plural *accidentia*, casual events). Also used for a book containing the rudiments of grammar, and so of any subject of art.

ACCIDENT. This term has a perplexing variety of meanings, which are, however, not entirely disconnected when considered historically. The meaning of the term varies with the antithesis intended. To this, accordingly, attention must be paid

in any context in which "accident" occurs. The following account deals with the principal antitheses and attempts to indicate the way in which the term "accident" acquired its various meanings.

(1) *Accident and Substance*.—Perhaps the oldest use of the term "accident" was by way of contrast with the term "substance" or "thing." "Substance" means the basic reality which has various qualities, stands in various relations, etc. These qualities, relations, etc., on the other hand, need a basis or support to qualify—they are "accidents," accessions to something that is there to bear them (substance). Among the schoolmen, accordingly, almost any quality was commonly called an accident; and this usage was fairly common even in the 17th century—"accident" and "substance" corresponding roughly to "quality" and "thing" respectively, as these terms are commonly used.

(2) *Accident and the Self-existing*.—In the strict sense of the term, as distinguished from its more usual meaning even among philosophers, the term "substance" means that which exists in itself and through itself, and when so interpreted its familiar contrast with "accident" naturally prompts the application of the term "accident" to anything that is dependent on some other thing. In this case, even what are commonly called "things" or "substances" will be classed among "accidents." Thus for Spinozism there is only one Substance, namely God, who alone is self-existing, while all finite things and even the so-called "infinite modes" (such as motion) are really "accidents," or dependent existents. Cartesianism, too, made this admission, or one very like it to all intents and purposes, but allowed the name "substance," in a qualified sense (that is, in the popular sense) to finite bodies and to souls.

(3) *Real Accidents*.—The antithesis between "accident" and "substance" just explained (2), clearly cuts across the distinction between "quality" and "thing," with which, according to one usage, it coincided more or less (1). Now, some of the schoolmen maintained that there are certain sense-qualities of things which are not dependent on the substances with which they are sometimes combined, but can exist by themselves, apart from such substances. These alleged independent or self-existing qualities they called "real accidents."

(4) *Accident and Essence*.—The distinctions between "substance" and "accident" explained in (1) and (2) naturally led people to regard an "accident" as something less important than substance, as something not *essential* to substance; and so the term "accident" was contrasted with whatever is not really essential to anything. Thus in logic, for instance, the so-called *fallacy of accident* is the erroneous assumption that a claim to know anything or anybody implies a knowledge even of all that is non-essential in relation to it or him. Similarly, in the doctrine of the Predicables (*q.v.*), as commonly expounded in books on logic, the predicable "accident" is contrasted with the other four predicables in the sense that any predicate asserted of a subject but not essential to it is called an "accident" of it, whereas any predicate essential to the subject of which it is affirmed belongs to one or other of the remaining predicables.

(5) *Accident, Necessity and Design*.—The kinship between what is "essential" and what is "necessary" has prompted the common use of "accident" for what is otherwise called a "chance" occurrence. And by a somewhat similar extension of its meaning the term "accident" has come to be applied in law to any occurrence or result that could not have been foreseen by the agent (because not necessarily involved in his action), or to a result not designed (and, therefore, presumably not foreseen), and lastly, to anything unexpected.

(6) *"Essential" and "Accidental" Accidents*.—One curious consequence of the multiplicity of meanings of "accident" is that by using the noun in the sense explained in (1) and the adjective in the sense explained in (4) the schoolmen distinguished between "essential" accidents and "accidental" accidents (*i.e.*, qualities).

ACCIDENTALISM, a term used (1) in philosophy for any system of thought which denies the causal nexus and maintains that events succeed one another haphazard or by chance (not in the mathematical but in the popular sense). In metaphysics, accidentalism denies the principle of universal causation, that is, the

doctrine that everything occurs or results from a definite cause. In this connection it is synonymous with Tychism, a term used by C. S. Peirce for the theories (like that of Plato, *e.g.*) which make chance an objective factor in the process of the universe. Opponents of this accidentalism maintain that what seems to be the result of chance is in reality due to a cause or causes which, owing to the lack of imagination, knowledge or scientific instruments, we are unable to detect. In ethics the term is used, like indeterminism, to denote the theory that mental change cannot always be ascribed to previously ascertained psychical states, and that volition is not causally related to the motives involved. An example of this theory is the doctrine of the *liberum arbitrium indifferentiae* (liberty of indifference), according to which the choice of two or more possibilities is affected neither by contemporaneous data of an ethical or prudential kind nor by crystallized habit (character). (2) In painting, the term is used for the effect produced by accidental lights (Ruskin, *Modern Painters*, I. ii. 4, iii., §4, 287). (3) In medicine, it stands for the hypothesis that disease is only an accidental modification of the healthy condition, and can, therefore, be avoided by modifying external conditions.

ACCIDENTALS, in music, are signs signifying that the notes to which they are attached have to be raised, lowered, or restored to their original pitch as the case may be. Thus a sharp (#) raises a note a semi-tone, a flat (b) lowers it a semi-tone, while a natural (♮) restores it once again to its former status. Each sign may also be doubled, though in the case of the double sharp, signifying the raising of the note by two semi-tones, the sign × is used instead of ##; bb, indicating a double flat, signifying the lowering of the note by two semi-tones; and ♯♯ serving to correct or cancel a preceding double-sharp or double-flat, although in modern practice a single natural (♮) is usually considered sufficient for this purpose. Accidentals introduced in the course of a piece apply only during the bar in which they occur, whereas when placed at the beginning of a composition, and constituting thereby what is called its signature, they govern the notes affected throughout the whole of the piece; but in the latter case they are not properly called accidentals. For explanation of origin and application of signs used for accidentals, see **MUSICAL NOTATION**.

ACCIDENT INSURANCE, PERSONAL. In England this type of insurance owed its origin to the risks of accident associated with early railway travel and even in the mid-20th century railway travel policies were common. Until 1908, when the Fatal Accidents (Damages) act was passed, payments under accident policies were generally applied to the reduction of damages payable to the injured person by a negligent third party. After that time, personal accident insurances became increasingly popular, especially among salaried and professional men outside the benefits of Workmen's Compensation legislation.

Accidents-only Policies.—The commonest form of policy covers accidents only. The occupation and pastimes of the proposer are indicative of the hazard. Sedentary occupations are rated lowest while rates are graded up to those engaged in manual work, with the highest rates for work in connection with woodworking machinery and other work of unusual risk.

The accident-only policy provides for payment of benefits specified following "accidental bodily injury caused solely and directly by violent external and visible means." These words are used in their ordinary meaning, and when it has been necessary to refer cases to the courts it has always been shown that, provided the occurrence causing the accident has been something which was neither expected nor designed, then the expression "accidental" has been fulfilled. There must, however, be some sign of violence and there must also be a visible effect produced upon the person concerned. The benefits provided by such a policy are in the event of:—

- | | |
|---|------------------------------|
| (1) Death | The capital sum. |
| (2) Total loss by actual physical separation at or above the ankle or wrist of two limbs, or the loss of sight of both eyes, or the loss of one limb and the loss of sight of one eye | The capital sum. |
| (3) Total loss as in (2) of one limb or the sight of one eye | One-half of the capital sum. |

The above misfortunes must occur within three calendar months of the happening of the accident.

- (4) Temporary total disablement from engaging in or giving attention to the insured's occupation. Corresponding weekly benefit.
- (5) Temporary partial disablement in similar circumstances. . . . One-third or one-quarter of benefit under (4).

The liability for the weekly payments is limited to 26 or 52 weeks, as the case may be, in respect of any one year of insurance. When one of the capital sums is payable no claim can be made for weekly compensation and if a payment has already been made for weekly compensation which is followed by a misfortune warranting a capital payment the total liability of the insurers cannot exceed the latter sum.

Accidents and Specified Diseases Policies.—Such policies are similar to accidents-only policies but provide weekly benefits in addition for certain specified diseases. Double benefits are provided if the insured person is killed or injured in an accident to a passenger lift, train, tramcar, omnibus or other licensed vehicle plying in the streets for public hire in which he is travelling as a passenger. An annuity is payable so long as the disability continues if the injury, while not entitling the payment of a capital sum, results in total disablement for not less than 12 months, or should the insured person lose completely the sight of both eyes by disease, or should he contract paralysis in at least two limbs, provided that this condition has existed for at least six months. Such policies are world-wide as regards accident cover, but cover for disease is restricted to civilized regions.

Cumulative bonus additions to the capital sums insured and discounts from premiums for life policyholders and to total abstiners are common features.

Provision can be made for the payment of medical expenses in connection with injuries or illness within the scope of the policy subject to a stated limit.

Accidents and All Sickness Policies.—Such policies are similar to those previously described, but in addition weekly payments are made to the insured if, as a result of any illness necessitating treatment by a qualified medical practitioner giving a certificate specifying the disease, he is confined to the house for not less than seven days and is totally disabled and prevented from attending to any part of his business. The period during which compensation may be payable varies between 26 and 104 weeks, though most insurers limit their liability to 52 weeks. Temporary partial disablement benefits are provided while the insured is convalescent, but the weekly payments are reduced to one-quarter of those payable for total incapacity by illness and the period is usually limited to four weeks. Such policies are terminated when the insured reaches the age of 60 and no payment is made for any illness contracted within four weeks after the commencement of the insurance. The illness risk is limited to the country in which the policy is issued, subject to the consent of the insurers should the insured propose to travel. A few insurers issue noncancellable accidents and illnesses policies. Such insurances are uncommon, but provided that the renewal premiums are paid the policy continues till the age of 55, when the insurance terminates. Premiums are calculated on an actuarial basis.

General Policy Conditions.—In the event of an accident the insured must, within 21 days, notify the insurers and send full particulars, accompanied by satisfactory medical evidence. The insured must, if required by the insurers, submit to a medical examination by the insurers' doctor and in the event of death the insurers are entitled to order a post-mortem examination at their own expense. If the insured changes his occupation he must notify the insurers and he must also advise them should he suffer any disease, physical defect or infirmity, thus giving the insurers an opportunity of reconsidering the risk. A cancellation clause is provided and the insurers may, by giving seven days' written notice to the insured, terminate their liability without prejudice to any claim which may arise prior to the termination of such notice. All differences arising out of the contract must be referred to arbitration.

Sickness Indemnities.—The benefits under such policies are

similar to those provided by the accidents-only policy and in addition a weekly indemnity is provided for periods of continuous disability not exceeding 52 consecutive weeks. If as the result of a disease or illness the insured loses the use of two limbs or the sight of both eyes the insurers will pay him, in lieu of any other indemnity, excepting surgical or hospital fees, the weekly indemnity specified in the policy during the period in which the insured is disabled up to a maximum of 100 weeks. No payment is made for any disease for which the insured is not treated by a physician nor for any disease in respect of which disability commences while the policy is not in force.

Coupon Insurance.—Before World War II there was a considerable growth in this class of business, which is generally undertaken by insurance companies on behalf of the periodicals concerned. The benefits, unlike those of the ordinary personal accident policies issued by insurance companies, apply only to more uncommon accidents and the weekly payments are generally very limited. Their most striking feature is the enormous capital sums which are offered as an inducement to buy the newspaper or magazine concerned.

Group Personal Accident Schemes.—Many commercial undertakings effect group policies to provide benefits for the whole of their employees falling within certain categories—generally the more highly paid staff who are not within the scope of the Workmen's Compensation acts. Such policies may be restricted to occupational accidents or may in some cases apply to any accident to any person within the scheme. The benefits provided are usually in a direct relationship to the earnings of the insured person and might take the following or similar form:

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|-----------------------------------|-------------------------------------|
| (1) Death | Two years' salary |
| (2) Permanent total disablement | Two years' salary |
| (3) Permanent partial disablement | One year's salary |
| (4) Permanent total disablement | First 13 weeks—full salary |
| | Next 13 weeks— $\frac{2}{3}$ salary |
| | Next 13 weeks— $\frac{1}{2}$ salary |
| | Next 13 weeks— $\frac{1}{3}$ salary |

Compensation is not usually payable for more than 52 weeks in all and is not payable until the end of the disability.

It is unusual to require individual proposal forms from the respective employees to be included but the employer would be required to declare any disabilities or infirmities suffered, to his knowledge, by any person to be included. Premiums are calculated at a rate per cent based upon the estimated salaries of the grades of staff to be included subject to adjustment at the end of each period of insurance on the salaries actually paid.

Aviation Risks.—Most policies issued in Great Britain ordinarily exclude liability for accidents happening while the policyholder is "in on or about to enter or alighting from any vessel or machine made or intended for ascending in the air." Policies are freely extended, for additional premium, to cover flying risks while the policyholder is travelling as a fare-paying passenger. Some insurers issue policies to flying services personnel to cover them while they are flying other than operationally. Such policies generally exclude war risks. The commonest form of aviation personal accident insurance is by "coupon" taken out when booking a passage. Premium rates for travel by first-class air lines are very low indeed but higher rates are required for travel by others with less satisfactory facilities.

War Risks.—Practically all policies exclude the risk of death or injury due to war. War risks are, however, insured in connection with air travel at rates varying with the war hazards in the areas to be traversed. In wartime the unexplained disappearance of an aircraft may well be due to war, but in the absence of proof the claim will be met under the policy. In wartime, therefore, the premium for flying risks tends to rise and the premium for war risks may be relatively small. (A. G. M. B.)

UNITED STATES PRACTICE

With regard to accident and health insurance in the United States, American practice differs in various details from that of Great Britain, though the general principles are the same. In America, the *proposer* is called the *applicant* and the *proposal* becomes the *application*, while the *capital sum* is styled *principal sum*. The word "indemnity" as used in American policies is

synonymous with "benefit," the amounts provided in the policies being classed as fixed or premeasured indemnity, regulated in amount by the ability or willingness of the insured to pay, and the policy becomes a valued benefit contract; there is no provision by which the amounts payable may be reduced in case of disability even though benefits payable under all insurance carried exceed the insured's earnings, but underwriters exercise great care against overinsurance in the original issue, requiring each applicant to certify that his earnings are in excess of benefits payable under all insurance carried and usually limiting the amount of insurance permitted to approximately three-fourths of the earnings.

There is never any right of subrogation in American policies by which the insured surrenders any claims against a third party who may be responsible for his injury. American policies do not carry a condition prohibiting the obtaining of additional insurance without consent of the company, but some contain a condition to the effect that if other insurance is obtained without notice to the company the amount of existing insurance is proportionately reduced. A great variety of accident policies, and also of accident and health policies, is issued in America, with many variations in amounts payable and in the sundry features. With a fixed principal sum payable for accidental death and a fixed weekly benefit payable for disability, there may be variations in the percentage of principal sum payable for loss of eyesight, or for loss of one or more limbs, or even for the degree of loss of a particular limb. Likewise, many variations occur in the period for which disability benefit is payable. It may be limited to a specified number of weeks, varying from a few to many, or the period for which benefit is payable may be limited only by the period of disability. Under the most common practice no period limit is fixed in case of disability from accident, while a limit of fifty-two weeks in case of disability from sickness is most favoured.

Partial disability is usually provided for at the rate of 40% of the total disability rate in respect to disability caused by accidental injury, but is not generally provided for in case of sickness disability, though in some instances a certain provision may be made for partial disability, or disability not requiring confinement to the house may be classified as partial and a smaller benefit provided. The usual American accident policy provides specific sums for loss of life, limb or sight and a stated weekly benefit for disability, while the usual health policy, commonly combined with the accident policy into a single document, provides a stated weekly benefit for disability due to sickness with occasional additional payments in case of complete blindness or complete paralysis. Most accident policies contain a provision doubling the benefits payable in case of accidents occurring in public passenger conveyances, elevators or burning buildings, and some include in this class other hazards more or less incident to the risk of travel.

Other provisions common in American policies include additional payments against surgical operations, hospital treatment, nursing and payment of doctors' bills in the case of non-disabling injuries. Some include an optional clause under which in case of certain specified injuries, such as fractures and dislocations, the insured may elect to take a lump sum in lieu of the disability benefit. There is no real uniformity as respects the inclusion of these subordinate features. Some accident policies are of more restricted scope and may exclude from their coverage a certain class of accidents, specified in greater or less number, in which case proportionately less premium is charged. There is also a great variety of special or "limited" policies designed to insure only against a certain class or a small number of classes of accidents. These are often referred to as "coupon" insurance because generally sold by special advertising or offered as an inducement to purchase of goods, subscription to a newspaper or other periodical. Generally they apply to accidents of least common occurrence and because of that fact a merely nominal price is charged, and are issued upon receipt of coupons attached to the advertisement.

The insuring clause most commonly in use in America differs somewhat in wording from that in use in Great Britain. Usually

it defines the insurance to be "against bodily injuries caused directly and independently of all other causes by accidental means," or by violent and accidental means, or by external, violent and accidental means, and there are other variations of verbiage without significant change of substance, the purpose always being to insure against the physical results of injury to the body caused wholly by accident, as distinguished from the natural processes following either wholly or partly from disease, degeneration or disintegration, which latter in case of disability becomes the function of health insurance and in case of death becomes the function of life insurance.

Health Insurance.—The most favoured form of health insurance in America insures against all sicknesses from whatever cause, and in such policies there are numerous variations. They may provide for all disability from the first day thereof to a specified period or without limitation. They may exclude from benefit the initial period of any disability and cover only disability after one week, or after a number of weeks or a number of months, with premiums varying in proportion. They may restrict payment of benefit to the period of confinement to house or may be without this restriction. They may exclude sickness contracted within a certain short period after the date of the policy or may cover any sickness contracted after the policy date. Additional payments may cover surgical operations, hospital treatment and nursing charges, or any or all of these may be omitted. Usually health policies stipulate that the insured must be under the treatment of a physician during any period for which disability may be claimed in order that there may be competent certification and that the necessary disability may be delimited as far as possible by proper care and treatment. So-called "limited" health policies are also issued to some extent, which confine their coverage to disability from certain diseases specifically named. Untold variations in this respect may be devised with proportionate variations in premium.

Statutory Provisions.—Those provisions of accident and health policies that relate to the performance and operation of the contract after issue are generally regulated by law. Many states have enacted statutes prescribing certain "standard provisions" which must be included in all such policies and prohibiting the inclusion of any contradictory or inconsistent conditions. Even in the states where such statutes have not been enacted it is the common practice of the companies to issue the same policies uniformly in all of them. These provisions govern such matters as the pro-rata reduction of the insurance in case of a change of occupation to one more hazardous, alterations or assignments of policies, reinstatement after lapse, the timely giving of notice and filing of proof of claim, examination by the company's physician in connection with claims, time for payment after proof, right of cancellation by insured in case of change of occupation to one less hazardous, rights of beneficiary, time when legal proceedings may be instituted. Certain other provisions may be included or omitted at the option of the issuing company. These permit reservation by the company of a right to cancel or to refuse to renew the policy, reduction of the amount of insurance in case additional insurance is obtained without notice, deduction from any benefit payable of premium then due and unpaid, limitation of the amount of insurance one person may have under various policies in the same company, limitation of the coverage within certain minimum and maximum age limits.

American policies do not require notice by the insured of a change of occupation, but the effect of such change, if any, is regulated by the statutory provisions. No notice is required from the insured of any change in his state of health except when it is to be made the basis of a claim for benefit. No arbitration clause is included in American policies, such a provision being commonly held illegal as tending to oust the courts of their jurisdiction.

Physical Condition of Applicant.—In the underwriting of both accident and health insurance the general physical condition of the applicant is given much weight, the application requiring disclosure of his present physical condition and past health record, which may influence the action of the underwriter even in the

issue of accident insurance where the state of health suggests susceptibility to more serious results in case of accident than would be common with a normal person, while both physical condition and health record are even more carefully considered when the application is for health insurance because of the possibly greater susceptibility to disease or sickness.

Premium Rates.—The premium rates for accident insurance are governed wholly by occupation, a basic rate first being fixed to cover the general hazards of life outside of the occupation and this rate being increased in proportion to additional hazards involved by the occupational exposure. For this purpose all known occupations are classified by the companies and they are brought into groups of relatively equal risk, resulting in some eight or more different rate classes as indicated by developed experience. Rates for health insurance do not commonly vary according to occupation, though benefit provisions often vary for the purpose of adjusting the cost in such occupations as involve particular exposure to occupational disease.

Canadian Practice.—In the dominion of Canada general practices and forms of policies are very similar to those of the United States and statutory standard provisions also are required, these being similar to those in use in the United States.

See M. W. Van Auken, *Ready Reference Digest of Accident and Health Insurance Law* (1922); S. S. Huebner, "Modern Insurance Tendencies," *Am. Acad. of Pol. Sci., Annals*, vol. cxxx, no. 219 (1927); S. B. Ackerman, *Insurance* (1939). (S. M. LA M.)

ACCIDENTS, INDUSTRIAL; see INDUSTRIAL ACCIDENTS.

ACCIIUS or **ATTIUS, LUCIUS**, Roman tragic poet, the son of a freedman, was born at Pisaurum in Umbria, in 170 B.C. He must have lived to a great age, since Cicero (*Brutus*, 28) speaks of having conversed with him. His plays, which are praised by ancient writers (Horace, *Epistles*, ii, 1, 56; Cicero, *Pro Plancio*, 24), were mostly free translations from the Greek, but a few (including *Brutus* and *Decius*) were on Roman subjects. About 700 lines are extant and are given in Ribbeck (*Tragic Lat. Reliq.*).

Accius wrote other works of a literary character: *Didascalicon* and *Pragmaticon libri*, treatises in verse on the history of Greek and Roman poetry and dramatic art in particular; *Parerga* and *Praxidica* (perhaps identical) on agriculture; and an *Annales*. He also introduced innovations in orthography and grammar.

See M. Boissier, *Le Poète Accius* (1856); L. Müller, *De Accii fabulis Disputatio* (1890); O. Ribbeck, *Geschichte der römischen Dichtung* (1892); editions of the tragic fragments by Ribbeck (1897), of the others by Bährens (1886); F. Plessis, *Poésie latine* (1909).

ACCLAMATION, in deliberative or electoral assemblies, a spontaneous shout of approval or praise (Lat. *acclamatio*), the adoption of a resolution or the passing of a vote of confidence or choice unanimously, in distinction from a ballot or division. In the Roman senate votes were passed by acclamation in such forms as *Omnes, omnes, Aequum est, Iustum est*, etc.; and the praises of the emperor were celebrated in prearranged sentences by the whole body of senators. In ecclesiastical councils vote by acclamation is common, the question being put in the form, *placet* or *non placet*. The Sacred college has elected popes by acclamation, when the cardinals simultaneously "acclaimed" one of their number as pontiff. In modern parliamentary usage a motion is carried by acclamation when approval is expressed by shouting such words as *Aye* or *Agreed*.

ACCLIMATIZATION. As in the case of so many words used by the biologist and physiologist, the word acclimatization is hard to define. With increase in knowledge and understanding, meanings of words change. Originally, the term acclimatization was taken to mean only the ability of human beings or animals or plants to accustom themselves to new and strange climatic conditions. A man or a wolf moves to a hot climate and is uncomfortable there; but after a time, he is better able to withstand the heat. But aside from temperature, there are other aspects of climate. A man or an animal may become adjusted to living at higher altitudes than those he was originally accustomed to. At ordinary mountain altitudes, this does not involve much of an adjustment to change in atmospheric pressure, for mountain climbers suffer more from lack of oxygen than from

change in pressure. At really high altitudes, such as aviators may be exposed to, however, the low atmospheric pressure becomes a factor of primary importance. In changing to a new environment, a man may, therefore, meet new conditions of temperature or pressure, and in addition he may have to contend with different chemical surroundings. On high mountains, the amount of oxygen in the atmosphere may be relatively small; in crowded cities, he may become exposed to relatively high concentrations of carbon dioxide or even carbon monoxide; and in various areas, he may be exposed to conditions in which the water content of the atmosphere is extremely high or extremely low. Thus in the case of higher animals and man, the concept of acclimatization includes the phenomena of increased toleration of high or low temperature, of altered pressure, and of changes in the chemical environment.

Moreover, when we consider lower animals and plants, we find that the environment to which they are exposed may be very different from the environment of a terrestrial mammal. Fishes may live at or near the surface of the ocean, or they may live at great depths; also, a fish may live in fresh water or in salt water. The ability of an aquatic animal to change from one type of environment to another is the same sort of a phenomenon as the ability of a terrestrial animal to change from one climate to another. Numerous investigators have tried to transfer fish, clams, crabs, etc., from salt water to fresh, or from fresh water to salt, and they have examined the conditions which favour the success of such transfers. Unless we choose to draw artificial distinctions between one type of organism and another, we must adopt a very broad definition of acclimatization, a definition that will include all types of organisms and all types of environments. Let us define acclimatization, therefore, as the process in which an organism or a part of an organism becomes accustomed or inured to an environment which is normally unsuitable to it or lethal for it. By and large, acclimatization is a relatively slow process. The term should not be taken to include relatively rapid adjustments such as our sense organs are constantly making. This type of adjustment is commonly referred to by the physiologist as "adaptation." Thus our touch sense soon becomes accustomed to the pressure of our clothes and we do not feel them; we soon fail to hear the ticking of a clock; obnoxious odours after a time fail to make much impression on us; and our eyes in strong light rapidly become insensitive.

On the other hand, when an adjustment to an unfavourable environment requires several generations, this is scarcely acclimatization in the strict sense (although often in the past it has been so considered). If a species of animal or plant is moved to an unfavourable environment, the individuals of the species may, after a number of generations, be better able to withstand the unfavourable conditions than were the animals and plants that first moved into the new environment. This may not so much be due to any change or acclimatization during the lifetime of the original animals or plants or their descendants, but rather to changes or mutations from generation to generation. Such mutations are now known to be of relatively frequent occurrence (see *EVOLUTION, ORGANIC; GENE*). The mutations which are more apt to prosper in a given environment will tend to survive (as a result of natural selection); the unfavourable mutations tend to die off. So, for example, if wheat plants are moved to an excessively cold climate, during successive generations if mutations appear which are better able to withstand the cold, these mutant plants are the ones which will survive. This type of natural selection is well known, and it can indeed be hastened by artificial selection on the part of the agriculturist. The end result is to produce new strains or races of a species, better able to withstand a particular environment than was the original species. We are dealing here with a phenomenon familiar to students of heredity. The change in the species is a very different process from the acclimatization change which occurs during the life of an individual. If one considers the behaviour of a species for a number of generations, it is hard to distinguish between the changes produced as a result of mutation followed by natural selection and the changes produced as a result of true acclimatization.

The fundamental fact about acclimatization is that all animals and plants have some capacity to adjust themselves to changes in their environment. This is one of the most remarkable characteristics of living organisms, a characteristic for which it is extremely difficult to find explanations. Adjustment can be made to high or low temperatures, to changes in pressure or to changes in chemical environment. These various kinds of adjustment will be considered separately. But before entering into a logical treatment of the various facts and theories concerning the different types of acclimatization, an attempt will be made to present a brief discussion of the ability of various animals and plants to change their habitat from one region of the earth's surface to another. This subject has been studied primarily from the viewpoint of human welfare and human economy.

Acclimatization of Various Species, Including Man.—

Early writers on biology and natural history, as well as early travellers and explorers, were interested in the possibility of importing animals and plants from one country to another. Tobacco, originally found in America, was introduced into Turkey and other countries. Cotton likewise was transplanted. Rubber and quinine, originally produced in South America, became staple crops of the East Indies. Flowers and shade trees found their way from one country to another. So, too, horses were imported into the Americas, and various other domestic animals were introduced into different parts of the world. Sometimes noxious insects or other types of pests find their way into countries originally free from them. The entrance of such undesirable organisms is a matter of great economic importance, but from our point of view it has no great theoretical interest. An animal or a plant from a strange country may be successfully introduced into the homeland, or it may not be able to live there. Usually the important variable is temperature. Some animals seem to be able to exist anywhere. Thus, as Charles Darwin pointed out in his *Origin of Species*, rats and mice can live in very cold climates as well as in the tropics. Some other animals are very sensitive to changes of temperature. Possibly, in part at least, the ability of rats and mice to live in different climates is due to their nocturnal habits. Both rats and mice are quite sensitive to high temperatures and are much more readily killed by heat than are cats and cows. It is very doubtful if rats or mice could withstand any lengthy exposure to the rays of the tropical sun.

Years ago, as new countries were discovered and developed, societies were founded to promote the exchange of species of animals and plants from one part of the world to another. The most famous of these societies was the Société d'Acclimatation in Paris. Not always is the introduction of a species attended with any difficulty. Some species thrive away from their natural habitat, often even better than in their homeland. In such instances there is no need for the species to become accustomed or inured to the new habitat, and in reality acclimatization does not occur. The organism becomes naturalized but not acclimatized (see NATURALIZATION OF PLANTS AND ANIMALS).

The question of human acclimatization has interested historians, geographers, sociologists and medical men. The early Greek writers wondered why white men did not successfully colonize tropical countries. The difficulties of white settlers in the tropics are manifold, and the problems are extremely complex. It is hard to distinguish between the direct adverse effects of climate and the deterioration and death caused by the many types of tropical disease. In addition, the white man in the tropics often has had to face the competition of coloured races perhaps more capable of withstanding the heat. Then, too, the conditions of life are often strange and difficult and this may be a factor in the causation of what has been called "tropical neurasthenia." In modern times, when sanitary and health conditions have been improved, as in Panama and in northeastern Australia (eastern Queensland), acclimatization of white settlers is favoured. Some medical authorities have urged that if tropical disease could be prevented, white men in the tropics would prosper. Others have insisted that, quite apart from disease, the climate itself is harmful. Women are said to be paler in the tropics. In very hot regions, according to some observers, the effects of old age appear

earlier. Some physicians claim that old-age vision (presbyopia), which in temperate climates usually is not noticeable until a man reaches the age of 45, may become evident in Europeans in the tropics about 10 years earlier. Hot climates have also been blamed for premature loss of memory.

Surprisingly enough, little attempt has been made to study the conditions which favour successful existence in hot countries. Of course air conditioning can change the climate within the home, and this, along with the introduction of modern methods of transportation, may eventually be a partial solution of the practical problem of life in the tropics. But on the physiological side, our knowledge is meagre. All authorities are agreed that excessive use of alcohol is fatal for anyone who attempts to live under conditions of excessive heat. Some Australian experts believe that manual labour is helpful to the health of dwellers in the tropics. Because salt is lost through the sweat, men in the tropics and workers in industries in which they are exposed to high temperatures are urged to eat salt occasionally. Presumably there are benefits from this practice, but they are not very great. Diet may be an important factor in determining human resistance to heat. It is generally agreed that in warm climates there is an unconscious tendency for people to choose diets lower in protein and fat and higher in carbohydrates. Such a practice is perhaps beneficial and there may be a theoretical reason why it should be. This will be brought out later.

As is well known, men can to some extent become acclimatized to life at high mountain altitudes. This acclimatization is primarily an adjustment to the low oxygen concentration of the air over the mountains. When a man first ascends a high mountain, his heart beats faster, and he becomes breathless; he may also be nauseated and vomit, his head may ache and his nose may bleed. After a short stay, these symptoms of mountain sickness tend to disappear. The physiological adjustment is somewhat complex, but for one thing there is an increase in the ventilation of the lungs, so that more air passes through them in any given interval of time. Also, the haemoglobin of the blood comes to have a greater affinity for oxygen than it normally possesses. In addition, the actual concentration of haemoglobin in the blood increases.

Heat.—In general, animals show a very definite ability to become acclimatized to temperatures somewhat above those they can normally withstand. To cite but a single example out of many, the common American black bass (*Micropterus salmoides*), if it is kept in warm water at a temperature of 86° F. for four days, becomes more resistant to heat. Normally, when these fish are exposed to high temperatures, 50% of them die when exposed for an hour to a temperature of 93° F., whereas those kept in the warm water for four days reached their death point only at a temperature of 100° F. Thus, their tolerance to heat had been raised approximately 7° F. On the other hand, when the fishes were kept for 16 days at a temperature of 50° F., half of them died when exposed to a temperature of 86° F. for an hour. Other fishes show a similar behaviour. Toad tadpoles raised in the warmth were found to be able to stand temperatures about 6° F. higher than those raised in colder water. Lower animals show a somewhat similar behaviour. Thus, for example, protozoa can be acclimatized so that they will withstand temperatures 4° or 5° (F.) higher than those temperatures which normally kill them. In the summer, as might be expected, animals are commonly better able to resist heat than in winter. Thus, in the case of the common sand crab of the Massachusetts coast (*Emerita talpoida*), the lethal heat temperature is 18° higher in summer than it is in the winter.

The mechanism of heat acclimatization is uncertain. In man, changes in the sweating mechanism or in the blood circulation may play a part. But only a few mammals sweat, and acclimatization to heat is very generally exhibited by all sorts of organisms, even by those which completely lack blood. As a matter of fact, essentially all living cells are heat sensitive, and the temperatures which kill them are often only a few degrees above those at which they are accustomed to living. In lower animals heat death is simply due to the death of the constituent cells. In

higher animals, some cells appear to be more sensitive than others, and the death or injury of these cells apparently produces toxic substances which injure and eventually kill the animal as a whole. At any rate, this is a commonly held view. In general, those organisms which are killed at the higher temperatures have more solid fats; that is to say, fats with higher melting points. This is a broad truth which holds both for animals and plants. Thus fishes, which die at relatively low temperatures, have fats fluid at ordinary temperatures; whereas the warm-blooded mammals and birds have solid fats. Similarly, plants which live in the tropics seem generally to have more solid fats than those which live in temperate climates. Various experimenters have shown that when animals are reared at higher temperatures, their fats tend to become more solid. Such a change in the melting point of the fats may be a factor in the acclimatization of animals and plants to heat. It should perhaps also be pointed out that recent nutritional studies have shown that if animals eat sugar, the fat produced within the body from this sugar has a high melting point. Thus a diet rich in carbohydrate should be favourable for men or animals in the tropics, and this may perhaps be correlated with the fact already noted that men in hot countries seem unconsciously to prefer such a diet.

Cold.—There have been relatively few studies on the ability of animals to become acclimatized to cold. Fishes accustomed to warm water are unable to withstand sudden transfer to cold water. At Naples, the eggs of the sea urchin (*Paracentrotus lividus*) can not develop at temperatures below 61° F. in summer, but in the wintertime these eggs can develop at temperatures as low as 47° F.

In agriculture, the ability of plants to become acclimatized to the cold is a matter of great practical importance. Tropical plants are killed at temperatures above freezing. In cold countries, plants frequently suffer injury from frost. As a result of breeding experiments, and as a result also of chance mutations, cold-resistant varieties of wheat and other crop plants have been obtained, and these varieties have made farming possible in regions where it might otherwise have been impractical. But even for any given variety of a plant, some increase in so-called cold hardness is possible. For when plants are grown at lower temperatures they are better able to withstand frost. However, they should not be grown at temperatures too close to the freezing point, for this is apt to weaken them rather than make them more hardy. When plants are exposed to the cold, there may be an increase in the amount of sugar or salt contained in the plant cells, and such increases would tend to prevent freezing. Possibly also, in hardy plants water is prevented from freezing by an increased tendency for it to be bound chemically in such a way that it does not act like ordinary water. Some workers believe that cold hardness is primarily due to an increase in the amount of this "bound water." However, this explanation does not seem to fit all cases. A protein jelly, such as a gelatin gel, does not freeze as readily as a fluid protein solution. It is possible, therefore, that the state of fluidity of the vital protoplasm may be a factor in determining cold hardness. At any rate, this has been suggested.

Marine and Fresh-Water Acclimatization.—Ordinarily, animals which live in the ocean die rather rapidly if they are placed in fresh water; also fresh-water animals die in sea water. This is not always true, for the eel and the salmon can pass from sea water to fresh water and back again without injury. If fresh-water animals are placed in water containing a large amount of salt, they tend to lose water from their cells; and in the case of simpler animals, there is a considerable loss of water. This is due to a process called osmosis, and osmosis also causes an inflow of water into the cells of a marine animal placed in fresh water. As a matter of fact, the cells of all animals are in equilibrium with the solutions in which they are bathed. If these solutions become more dilute, the cells increase in volume; if on the other hand, the concentration of the solutions is increased, the cells lose water and shrink. Many higher animals are enclosed in stiff integuments which prevent the free passage of water to the constituent cells and such animals are less sensitive to changes in

the salt content of the outer medium; although, of course, within the bodies of the animals the cells are in equilibrium with the blood or other fluids of the animal.

Sea water contains many types of salts, but by far the most abundant of these is ordinary table salt (sodium chloride), and the concentration of salt in sea water is approximately the same as that of a 3% solution of table salt. If fresh-water animals, normally incapable of living in sea water, are placed in a very dilute salt solution and then salt is gradually added over a period of weeks or even months, it is in some instances possible to acclimatize the animals so that they can live in solutions as salty as or even saltier than sea water. Also, by gradually adding fresh water to the sea water in which marine forms are living, they can be made to live in solutions whose lack of salt would ordinarily kill them rapidly. Many experiments of this sort have been performed. Different types of animals vary widely in their capacity to become acclimatized. All sorts of adjustments are involved. Presumably, with an increase in salt content of the surrounding medium, both the cells and the body fluids of the animals become richer in salt. An important factor is the ability of an animal to excrete salt. Ordinary fishes are able to excrete salt through their gills and this aids them in their adjustment to the salt water of their surroundings. On the other hand, the excretion of water by animals enables them to get rid of excess water taken in through the skin. Thus, a frog immersed in water is continually taking up water through the skin and excreting it by way of the kidneys. Thus, obviously, excretory processes may play a part in the ability of animals to accustom themselves to changes in the salt content of their watery environment.

Chemical Acclimatization.—All sorts of organisms show some power of accustoming themselves to a wide variety of poisons. Bacteria and protozoa may acquire an increased resistance to such substances as mercuric chloride, quinine, etc. Such acclimatization becomes a factor in the treatment of disease, for protozoan and bacterial parasites which are normally killed by a certain concentration of a drug may after a time become resistant. Bacteria and protozoa reproduce very rapidly—the average length of life of a bacterium is only about 20 min.—and accordingly, in studies of acclimatization in these lower organisms, the acclimatized organisms are descendants of the original organisms. Thus, in such experiments new types of organisms may arise in successive generations as a result of mutation. Some of these new mutated types may be more resistant than the original forms, and these more resistant mutations would tend to be selected out; that is to say, they would show a greater tendency for survival. Accordingly, in experiments with bacteria and protozoa it is hard to distinguish between acclimatization in the strict sense and changes primarily due to mutation and natural selection.

In higher animals, true acclimatization to chemicals undoubtedly occurs. Mice and rabbits can become somewhat acclimatized to the presence of carbon monoxide in the atmosphere. Man can train himself to eat increasing amounts of certain poisons and he can then acquire a tolerance for these poisons. Tolerance to poisons has been widely studied by pharmacologists. Various types of explanation are possible. Thus, it has been thought that when a tolerance to arsenic is acquired, there is less absorption of the poison from the intestine. Tolerance to alcohol may involve a decreased absorption, an increased or more rapid excretion, a decrease in the amount of alcohol which reaches the brain, or an increase in the rate at which alcohol is chemically transformed within the body. Modern studies tend to disprove all these possibilities, and apparently human tolerance for alcohol is primarily due to an acclimatization of the cells of the central nervous system.

Many living organisms produce poisonous substances. Thus, toadstools are notoriously poisonous and so too are many higher plants; as well as scorpions, spiders, snakes, etc. In general, the organism producing the poison is immune to its effects. A man can be made tolerant to some particular variety of snake poison; that is to say, he is made immune to it. Similar immunity may be acquired for various bacterial poisons. The attempt to understand this type of immunity is of such importance to bacteriology and medicine that an entire science has been built around it.

One of the most interesting types of chemical acclimatization is that shown by bacteria and yeasts toward food substances in their environment. Yeasts commonly live by fermenting sugars, but normally they are capable of utilizing certain types of sugars and not others. If a yeast colony be grown in a medium containing an unusual type of

sugar, one which it does not have the power to attack, after a time it may acquire this power.

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ACCOLADE, a ceremony used in conferring knighthood; but whether it was an embrace (according to the use of the modern French word *accolade*), or a slight blow on neck or cheek, is not agreed. Gregory of Tours writes that the early kings of France kissed the knights on the left cheek; and William the Conqueror is said to have made use of the blow in conferring knighthood on his son Henry. At first it was given with the fist, but for this was substituted a gentle stroke with the flat of the sword on the side of the neck, or on either shoulder. In Great Britain the sovereign still employs this latter form. "Accolade" is also a technical term in music-printing for a sort of brace joining separate staves; and in architecture it denotes a form of decoration on doors and windows.

ACCOLTI, BENEDETTO (1415-1464), Italian jurist and historian, was born at Arezzo, in Tuscany. He was for some time professor of jurisprudence in the University of Florence, and in 1458 became chancellor of the Florentine Republic. In conjunction with his brother Leonardo he wrote in Latin a history of the first crusade, entitled *De Bello a Christianis contra Barbaros gesto pro Christi Sepulchro et Judaea recuperandis libri tres* (Venice, 1532; Italian trans., 1543; French trans., 1620), which, though itself of little interest, is said to have furnished Tasso with the historic basis for his *Jerusalem Delivered*.

His brother FRANCESCO (c.1416-c.1484) was also a distinguished jurist.

ACCOLTI, BERNARDO (1465-1536), Italian poet, born at Arezzo, was the son of Benedetto Accolti. Known in his own day as *l'Unico Aretino*, he acquired great fame as a reciter of impromptu verse. He was listened to by large crowds, composed of the most learned men and the most distinguished prelates of the age. His works were published at Florence in 1513 and have been several times reprinted.

His brother, PIETRO ACCOLTI (1455-1532), was made cardinal by Julius II. He was abbreviator under Leo X, and drew up in 1520 the bull against Luther. In 1524 he became archbishop of Ravenna.

Pietro's nephew, BENEDETTO (1497-1549), was also a cardinal, under Clement VII, and a writer of Latin verse.

See E. Guarnera, *Bernardo Accolti* (Palermo, 1901).

ACCOMMODATION, in theology has two chief meanings. (1) It is used to describe the method of adapting the presentation of truth to the learners' capacity. In a sense all revelation of God must be "accommodated" to man: the naked revelation would be so dazzling as to blind him. When Jesus withheld certain truths from the disciples because they could not yet bear them (John xvi. 12) he was practising accommodation. Teaching by symbol or parable, too, is accommodation. (2) When words used with a definite reference to one subject are applied to another subject we have accommodation in a more special sense. Thus Matthew ii. 15 states that Jesus was taken to Egypt that the word of the prophet, "Out of Egypt did I call my son," might be fulfilled: but the prophecy quoted, Hosea xi. 1, quite clearly means Israel by "my son."

In biology accommodation is used to describe adjustments achieved by an individual organism over and above those which it makes as part of its inheritance. In psychology it means "the process by which habit is modified, cancelled and added to" (J. M. Baldwin).

For accommodation in optics see OPTICS.

ACCOMMODATION BILL: see BILL OF EXCHANGE.

ACCOMPANIMENT, a musical term for that part of a vocal or instrumental composition added to support and heighten the principal vocal or instrumental part; either by means of other vocal parts, single instruments or the orchestra. Owing to the early custom of only writing the accompaniment in outline, by means of a figured bass (*q.v.*), to be filled in by the performer, and to changes in the number, quality and types of the instruments of the

orchestra, "additional" accompaniments have been written for the works of some of the older masters; such are Mozart's "additional" accompaniments to Handel's *Messiah* (see article on HANDEL). In the case of songs an accompaniment may consist merely of a few chords of the simplest kind or take the most elaborate form and constitute the most striking feature of the composition. In the latter case the performance of such accompaniments calls for the highest skill and constitutes a distinctive branch of the pianist's art, demanding the amplest powers of execution and first-class musicianship, especially when the player is called upon, as sometimes happens, to transpose a difficult accompaniment at sight for the convenience of the singer. Accompanying is also an important branch of conducting, in the case of concertos, choral music, and so forth.

ACCOMPLICE, in law, one who is associated with another or others in the commission of a crime, whether as principal, abettor, or accessory (*q.v.*). Although the uncorroborated evidence of an accomplice is admissible in law, and may be acted upon by a jury, it is the duty of the judge to warn the jury that it is always dangerous to convict on such evidence, and he should advise them not to convict (*R. v. Baskerville*, 25 Cox. C.C. 524).

ACCORAMBONI, VITTORIA (1557-1585), an Italian lady famous for her great beauty and accomplishments and for her tragic history. She was born in Rome of a family belonging to the minor noblesse of Gubbio, which migrated to Rome. After refusing several offers of marriage for Vittoria, her father betrothed her to Francesco Peretti (1573), a nephew of Cardinal Montalto, who was regarded as likely to become pope. Vittoria was admired by the most brilliant men in Rome, and being luxurious and extravagant she and her husband were soon plunged in debt. Among her admirers was P. G. Orsini, duke of Bracciano, and her brother Marcello, wishing to see her the duke's wife, had Peretti murdered (1581). The duke himself was suspected of complicity as he was believed to have murdered his first wife Isabella de' Medici. They were married shortly after. But attempts were made to annul the marriage; Vittoria was imprisoned, and only liberated through the interference of Cardinal Carlo Borromeo. On the death of Gregory XIII., Cardinal Montalto, her first husband's uncle, was elected in his place as Sixtus V. (1585); he vowed vengeance on the duke of Bracciano and on Vittoria, who, warned in time, fled first to Venice and thence to Salò in Venetian territory. Here the duke died in Nov. 1585, bequeathing all his personal property to his widow. Vittoria, overwhelmed with grief, went to live in retirement at Padua, where she was followed by Lodovico Orsini, a relation of her late husband and a servant of the Venetian republic, to arrange amicably for the division of the property. But Lodovico hired a band of bravos and had Vittoria assassinated (Dec. 22, 1585). He himself and nearly all his accomplices were afterwards put to death by order of the republic.

About Vittoria Accoramboni much has been written and she has been greatly maligned by some biographers. Her story formed the basis of Webster's tragedy, *The White Devil* (1612), and of Ludwig Tieck's novel *Vittoria Accoramboni* (1840); it is told in D. Gnoli's vol. *Vittoria Accoramboni* (Florence, 1870), and an excellent sketch of her life is given in Countess E. Martinengo-Cesaresco's *Lombard Studies* (London 1902).

ACCORD, in law, an agreement between two parties, one of whom has a right of action against the other, to give and accept in substitution for such right any good legal consideration. Such an agreement when executed discharges the cause of action and is called *Accord and Satisfaction*. This specific form of pleading is obsolete in England.

ACCORDION, a small portable reed wind instrument with keyboard, one of the smallest members of the organ family, invented in 1829 by Damian, in Vienna. It consists of a bellows of many folds, to which is attached a keyboard with from five to 50 keys. The keys on being depressed, while the bellows are being worked, open valves admitting the wind to free reeds, the pitch of the note being determined by the length and thickness of the reeds. The right hand plays the melody on the keyboard, while the left works the bellows and manipulates the two or three bass harmony keys, which sound the simple chords of the tonic and

dominant. The archetype of the accordion is the cheng (*q.v.*) or Chinese organ, between which and the harmonium it forms a connecting link structurally. Improvements in the construction of the accordion produced the concertina (*q.v.*), melodion and melophone.

ACCORSO (ACCURSIUS), **MARIANGELO** (c. 1490–1544), Italian critic, was born at Aquila in the kingdom of Naples. He was a great favourite with Charles V., at whose court he resided for 33 years, and by whom he was employed on various foreign missions. He was the first editor of the *Letters of Cassiodorus*, with his *Treatise on the Soul* (1538); and his edition of *Ammianus Marcellinus* (1533) contains five books more than any former one. The affected use of antiquated terms, introduced by some of the Latin writers of that age, is humorously ridiculed by him, in a dialogue in which an Oscan, a Volscian and a Roman are introduced as interlocutors (1531).

ACCOUNT, a term of very various use in book-keeping, banking and stock exchange terminology (see **BANKING AND CREDIT**) indicating counting, reckoning, especially of moneys paid and received, hence a statement made as to the receipt and payment of moneys. The following are some of its chief usages:—

Balanced account, an account in which the total debits equal the total credits and which has been ruled off to indicate that fact.

Balancing account, an account contained in a subsidiary ledger which shows in aggregate and also in reverse, as to debit and credit, the total of the detail accounts. The use of such an account makes a ledger self-balancing. The information contained in a balancing account is essentially that found in a *controlling account* although the debits and credits appear in reversed order in the *balancing account*.

Closed account, same as *balanced account*.

Contra account, an account of contrary tendency which must be considered with another account because of an interlocking relationship. For example, a customer of a business may also be a creditor. If the amount he owes as a customer is less than the amount that is due him as a creditor, the business may remit a check for the net amount. The term used in referring to the amount due from the customer in this case is *contra account*.

Controlling account, an account in the general ledger which reflects in aggregate the details of two or more accounts of the same tendency. Ordinarily the underlying accounts are operated in a subsidiary ledger.

Impersonal account, an account which is not a *personal account*. Any expense or income account is an impersonal account.

Mixed account, an account containing two or more separate classes of transactions. The "merchandise account," for example, contains a record of purchases, sales, purchase returns, purchase allowances, sales returns, sales allowances, freight and cartage, etc. In modern accounting, a separate account called a *simple account* is maintained for each class of transactions.

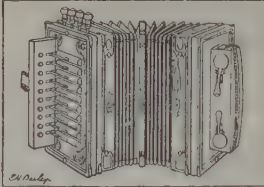
Nominal account, an account which reflects a change in the financial condition of a business. Thus, it is an account which finally finds its way into the profit and loss account; e.g., sales, purchases, interest, discount, salaries, wages, commission and advertising expense. All of the accounts appearing in a statement of income, and profit and loss, are *nominal accounts*.

Open account, an account which is not in balance, i.e., an account containing a debit or a credit excess; opposite of *closed account*.

Personal account, an account operated under the name of an individual, an organization or a business enterprise.

Private Account, an account maintained in a Private Ledger. Information of a confidential nature which ought to be shown on the accounting records can best be treated in the private set of accounts.

Real account, an account used in displaying the financial status



THE ACCORDION, ONE OF THE SMALLEST MEMBERS OF THE ORGAN FAMILY, WAS INVENTED BY DAMIAN, A VIENNESE, IN 1829

of a business. All accounts used in a "balance sheet" are real accounts; thus they represent assets, liabilities and capital.

Simple account, an account containing entries relating to a single class of transactions; opposite of mixed account. Sales returns, purchase allowances, interest on notes receivable and administrative salaries are *simple accounts*. (See **ACCOUNTANCY AND ACCOUNTANTS**; **BOOKKEEPING**.)

As a stock exchange term, "account" is used in several senses:—

(1) The periodical settlements occurring, in London, monthly for British Government and a few other first-class securities, and fortnightly for all others.

(2) The period between two settlements. A 19-day account is one in which 19 days elapse between one pay day and another.

(3) The volume or condition of commitments. A speculator is said to have a large account open when he has dealt heavily either for the rise or fall.

An account is also any statement as to acts or conduct, or quite simply any narrative report of events, etc. A further sense-development is that of esteem, consideration. (G. L. C.)

ACCOUNTANCY AND ACCOUNTANTS. Originally, accountancy was the same thing as account-keeping or bookkeeping, and "accountant" and "bookkeeper" were interchangeable terms, but an increasing recognition of the importance of accounting in the development of modern business methods has led here, as elsewhere, to the division of labour. In the early days of navigation it was doubtless reasonable to assume that the man who navigated a canoe was in all probability also the man who designed and constructed it: to-day, the distinctions between the engineer officer, the naval architect and the shipbuilder are clearly defined and well recognized. Much the same process of evolution has been going on in the accountancy world, and although the distinction may not yet be universally accepted, it may be stated that, whereas the bookkeeper is the person who keeps the books or accounting records of an undertaking, the accountant is rather the person who decides how such records ought to be kept. The term accountancy is now generally applied to all the work that falls to the lot of the accountant, although under modern conditions (as is shown later on) that work is now exceedingly varied and often extends far beyond the region of accounts.

Early History.—Very little is known of the origin of accountancy as a profession. In the modern acceptance of the word, however, a professional man is one who places his skill and learning at the disposal of all and sundry for a reward, as distinct from one who serves a single employer. Accordingly, while there are several references in mediæval and even classic times to stewards and auditors, these references do not throw much light upon the origin of professional accountancy, as the persons referred to were manifestly in the whole-time employment of a single individual or body. The first association of accountants of which there is any record is the *Collegio dei Raxomati*, which was founded in Venice in 1581, but it is by no means certain that the members of this body were professional or public accountants, or whether they were not rather employees of public bodies. At Milan, however, in 1742, the Government established a scale of charges for accountants, so it may be assumed that then, if not earlier, professional accountancy (as here defined) actually existed in that city. It has been said that the first Scottish professional accountant was one George Watson, born in Edinburgh in 1645; but whether he was really able to carry on a practice as a professional accountant in addition to his "large private banking business" seems somewhat doubtful. Holden's *Triennial Directory of London, Westminster and Southwark* was first published in 1799, and contains the names of 11 accountants. The *British Universal Directory*, published in 1790, had given the names of five accountants only. It seems clear, therefore, that there was very little professional accountancy in London before the 19th century, and in the issue of Holden for 1822 the number of practising accountants had only risen to 73. Indeed, little progress was made by professional accountancy in Great Britain, or elsewhere, until the middle of the 19th century, when (so far at least as Great Britain is concerned) it received a great impetus from

the growth of limited liability companies, and a little later from the Bankruptcy Act, 1869, which to a very large extent withdrew the administration of insolvent estates from the hands of public officials. The advent of the limited liability company led to business operations being undertaken upon a scale which had formerly not been thought of. The proper control of these large scale operations naturally called for better accounting systems than had formerly been deemed adequate.

Organization.—The first step in the direction of organizing professional accountancy in Great Britain was taken when the *Society of Accountants* in Edinburgh was incorporated by Royal Charter in 1854. Similar societies in Glasgow and Aberdeen were also incorporated by Royal Charter in 1855 and 1867 respectively. Each of these bodies, however, had assigned to it definite geographical limitations, although the individual members of all three may, and do, practise in various parts of the world. The *Institute of Accountants* was formed in London in 1870, was incorporated by Royal Charter in 1880 as *The Institute of Chartered Accountants in England and Wales*, provision at the same time being made for all accountants then practising in England or Wales to become members. *The Society of Incorporated Accountants and Auditors* was registered under the Companies Act in 1885. (For particulars of these and other bodies see ACCOUNTANTS' SOCIETIES.) *The Institute of Chartered Accountants in Ireland* was incorporated in 1888.

Accountancy Elsewhere.—But little development has as yet taken place on the continent of Europe as regards professional accountancy, but professional bodies have existed in Holland, Sweden and Belgium since 1895, 1899 and 1903 respectively. Most British colonies have one or more professional bodies of their own.

Duties.—It has been stated that originally accountants were bookkeepers. Hence, naturally, as soon as the necessity or desirability of checking, criticizing or auditing the records of accounting parties was appreciated, skilled accountants whose probity could be relied upon would naturally be selected for the work. In the first instance, accordingly, professional accountants were in the main auditors of other people's accounts. Where the auditing was not a whole-time job there were obvious economies in securing the services of a professional accountant, while the fact that he was a professional accountant ensured his independence. As, however, the centre of gravity tended to shift in Great Britain from agriculture to industry, the professional accountant found thrust upon him an ever-enlarging sphere of activities over and above his primary function as an expert in accounts. Thus, professional accountants are frequently called upon to design systems of accounting (in recent times increasingly mechanized) for new or growing concerns; to assist in the establishment of an adequate system of cost accounts; to prepare business statistics; to investigate accounts in connection with partnership changes, the amalgamation of business interests, or the flotation of companies formed to acquire established businesses; to deal with compensation cases on the compulsory purchase of businesses by railway companies or public bodies; to give expert evidence on matters relating to accounts; to prepare accounts for the use of counsel; and to act as arbitrators in differences relating to matters of accounts or finance. Besides acting as directors of companies, dealing mainly with financial affairs, they also very frequently act as secretaries of companies whose operations are not upon a sufficiently large scale to justify a whole-time appointment, and the accounts of executors and trustees under wills and settlements are often kept by professional accountants. In addition, professional accountants act as trustees in bankruptcy; trustees under deeds of arrangement; liquidators of companies; receivers for debenture holders; and managers of businesses where a receiver is in possession of the assets.

Mode of Entering the Profession.—Anyone desirous of becoming an English chartered accountant must first serve under articles with a practising member for five years, or three years in the case of graduates. A premium of from 150 to 500 guineas is usually required. Before signing articles, the pupil must have passed the preliminary examination of the Institute, or some

accepted equivalent of matriculation standard. After half the period of articles has expired, the pupil may submit himself for his intermediate examination in general commercial knowledge, bookkeeping and accounts and auditing; on the termination of his articles, before admission as a member, he must pass his final examination in advanced bookkeeping and accountancy (including costing and taxation); auditing; partnership and executorship law and accounts (including the rights and duties of executors, trustees and receivers); bankruptcy and company law; the principles of mercantile law and the law of arbitrations and awards; and either (a) economics, (b) banking, currency and foreign exchanges or (c) actuarial science. The regulations of the Society of Incorporated Accountants and Auditors similarly provide for articles of clerkship with a practising incorporated accountant, and the society's examinations must be passed. For candidates who for any reason are unable to enter into articles, the society provides an alternative method of qualifying by nine years' approved experience in lieu of five years' articles. The nine years' experience must be gained in the office of a practising incorporated or chartered accountant, or—subject to certain conditions—of a municipal or county treasurer or accountant.

The regulations of Scottish chartered accountants as to admission, etc., are upon similar lines, there being a general examining board which deals with candidates article to members of all three bodies. In Scotland as a rule no premium is charged, but no salary is paid during the period of articles. The Institute of Chartered Accountants in Ireland also has similar regulations.

Statutory Regulations.—In New Zealand and the Transvaal there are statutory registers of public accountants, and only those upon the register are permitted to undertake certain specified accountancy duties. The registration of professional accountants has been mooted at various times from 1889 onwards, but opinions are so divided as to its desirability that statutory registration in Great Britain seems as far off as ever.

BIBLIOGRAPHY.—Richard Brown, *A History of Accounting and Accounts* (1905); A. H. Woolf, *A Short History of Accountants and Accounts* (1912); L. R. Dicksee, *The Fundamentals of Accountancy* (1921); *The Accountant*, vol. i. (1877); *The Accountants' Journal*, vol. i. (1883); *The Accountants' Magazine*, vol. i. (1897); *Incorporated Accountants' Journal*, vol. i. (1889). (L. R. D.)

United States.—Accountancy, in the United States, is among the newer professions. In the short time of its existence it has not acquired the traditions which characterize such of the older professions as law, medicine and theology. The first formal recognition was given to accountancy in the laws of New York State in April 1896. Since that time all of the States have officially recognized the public accountant by creating the title, certified public accountant (C.P.A.), such title to be granted or awarded to applicants who satisfy the requirements regarding character, education and professional skill of the State in which recognition is sought. While there is still a lack of uniformity among the several States in the matter of requirements, there is a constant tendency toward greater strictness as laws are modified and new legislation enacted.

As indicative of the requirements imposed by State laws, the following summary sets forth the standard maintained by New York State: (a) an applicant for the certificate of certified public accountant must submit evidence that he is over 21 years of age and of good moral character; (b) he must have completed at least four years of high-school and since January 1, 1938, must also have completed a course in a college of accountancy registered by the department of education; (c) he must submit evidence of five years' experience in accountancy, at least two of which must have been in the office of a certified public accountant and of no less grade than that of junior accountant; such two years' accounting experience must have been in the office of a certified public accountant in this State or in the office of one residing in another State holding a certificate from such State granted on no lower requirement than that of this State, and he must submit evidence of three years' experience attained prior to his admission to the C.P.A. examination; (d) he must take professional examinations conducted by the State department of education in the following subjects: theory of accounts, auditing,

practical accounting and commercial law. The passing grade in each subject is 75%. A candidate who fails in one subject only may take a subsequent examination in that subject to be given within two years from the date of the examination at which he passed the other three subjects.

In the United States, as in other countries, a high standard of professional ethics is fostered. The accountant acting as custodian of his client's interests must safeguard them in every legitimate way. His service to the client carries with it a strict responsibility to the client which cannot be divided or escaped. Confidences of the client must be held inviolable. The acceptance of contingent fees is frowned upon by members of the profession. As an obligation to the client, the accountant must keep himself informed on current developments in the profession.

Education for accountancy, in the United States, was formally provided for as early as 1881. In that year the Wharton School of Finance and Economy of the University of Pennsylvania was established. In 1898 the University of Chicago opened its College of Commerce and Politics (later known as the School of Commerce and Administration), and the University of California its College of Commerce. Two years later there were established at New York University the School of Commerce, Accounts and Finance; at Dartmouth College the Amos Tuck School of Administration and Finance; and at the University of Vermont, a department of economics and commerce. In the first quarter of the new century business education developed throughout the entire country so that at the opening of the year 1925 about 183 American colleges and universities provided instruction in business. In practically all of these schools, education for accountancy has dominated the business curricula.

See T. A. Budd, *The Interpretation of Accounts* (1927); R. B. Kester, *Accounting Theory and Practice* (1933) and Sanders, Hatfield and Moore, *Statement of Accounting Principles* (1938).

(J. T. MA.; X.)

ACCOUNTANT-GENERAL, a former official of the court of chancery, whose duties have been transferred to the paymaster-general.

ACCOUNTANTS' SOCIETIES. Under British law there is no restriction on the right to practice as an accountant, although the designations of the recognized professional bodies (e.g., "chartered" and "incorporated" accountant) are protected by decisions of the courts, which have confined their use to members of the body concerned.

Until the passing of the Local Government Act, 1933, generally speaking only chartered or incorporated accountants could audit the accounts of municipal corporations, but under that act a municipal corporation may adopt either the system of district audit (by district auditors of the Ministry of Health) or professional audit. In the latter event the auditors must be members of one or more of the following: (1) Institute of Chartered Accountants in England and Wales, incorporated by royal charter in 1880; (2) Society of Incorporated Accountants and Auditors, incorporated in 1885, and with branches throughout the British Dominions; (3) Society of Accountants in Edinburgh (the earliest, formed in 1854); (4) Institute of Accountants and Actuaries in Glasgow; (5) Society of Accountants in Aberdeen; or (6) The Association of Certified and Corporated Accountants, formed in 1939 by the amalgamation of the Corporation of Accountants and the London Association of Accountants. There are other statutory limitations on the right to act as auditor in certain cases. No qualification is laid down for the auditors of limited companies, but it is usual for such appointments to be made from among the members of the older bodies. There is a body of chartered accountants in Eire.

United States.—In the United States there are societies of certified public accountants. In addition to the various State societies there are several important national organizations the chief of which, the American Society of Certified Public Accountants and the American Institute of Accountants, were amalgamated in 1937 under the latter title. The National Association of Cost Accountants is composed of professional accountants and others whose interests lie in the cost phases of accounting. For information regarding American professional requirements, see **ACCOUNTANCY AND ACCOUNTANTS**.

ACCOUNT CURRENT, a running account which is likely to extend over an interminable period and which, if balanced, is usually opened again immediately; e. g., a holding company which markets merchandise may have an account current with a subsidiary company which manufactures a product. The entire output of the factory may be turned over to the holding company and periodic charges made for merchandise thus transferred. The holding company may make advances from time to time to cover values received. Thus the account may not be in balance for a considerable time although an accurate statement of debits and credits will always be available in the account current. Merchants who sell on consignment frequently maintain accounts current with their consignees. An account current differs from the usual trade account in that the latter is usually settled at regular intervals, monthly, seasonally or otherwise. (G. L. C.)

ACCOUNT RENDERED, an expression used in referring to an account a statement of which has already been delivered to the customer. In business it is customary, for the purpose of verification, to send to each customer whose account is not in balance a statement showing the debits (charges) and credits for the current period (usually one month). If this balance is not liquidated before the end of the following period, the next statement of account has as its first entry "Account rendered" or "To account rendered" and the unpaid balance is shown. Thus an economy of time results because it becomes unnecessary to include all items arising since the account was last in balance. (G. L. C.)

ACCOUNT SALES, a financial statement rendered by a merchant who has received goods on consignment showing sales, charges (usually commission and guaranty), and a net amount either credited to consignor's account or remitted by cheque. This form of financial statement is used extensively by commission merchants and factors and serves the consignor or principal as a basis for accounting.

ACCOUNT SALES of merchandise received from A. B. BLANK to be sold for his account and risk RENDERED BY BLACK AND WHITE, 27 WASHINGTON ST., NEW YORK CITY, April 15, 19—			
19—			
April 4 Received:			
Lot No. 3			\$1,200.00
	SALES		
April 8 Lot No. 3			1,450.00
	CHARGES		
Freight and cartage		\$37.50	
Commission 5%		72.50	110.00
E.&O.E.	Net proceeds by cheque enclosed		\$1,340.00

(G. L. C.)

ACCOUNTS PAYABLE, in accounting terminology, amounts owed by a business to its creditors and not evidenced by notes, bonds, acceptances or other recognition. Loans from officers or partners of an enterprise should be considered as loans payable rather than accounts payable; creditors' accounts with debit balances should be listed as other accounts receivable rather than as a deduction from accounts payable. In its broader sense, the term includes amounts received in advance for merchandise that has not been shipped, rentals received in advance, etc.

ACCOUNTS PAYABLE LEDGER, a subsidiary ledger containing the accounts of creditors. It is a device used to facilitate the bookkeeping of a business enterprise. The operation of this type of ledger makes possible a division of labour in an accounting department; the work of posting to creditors' accounts can be carried on independently of the work on customers' accounts and general ledger accounts. The sum of the account balances in the accounts payable ledger should agree with the balance of accounts payable controlling account as shown in the general ledger. (See **BOOKKEEPING**.) (G. L. C.)

ACCOUNTS RECEIVABLE, in accounting terminology, amounts due to a business by its trade debtors for merchandise sold to them, or for services rendered, on a credit basis. It should be noted that only obligations arising from trade transactions should be included. Loans to officers of a company should be considered as loans receivable rather than accounts receivable; creditors' accounts with debit balances should be listed as other accounts receivable rather than as a deduction from accounts payable. In the preparation of a balance sheet, this term, without qualification, may be assumed to represent items which can be collected within a period usual to the trade or industry of which the business is a part. In its broader sense, the term includes all unsettled claims against debtors which are not represented in the form of bonds, promissory notes or trade acceptances.

(G. L. C.; X.)

ACCOUNTS RECEIVABLE LEDGER, a subsidiary ledger containing the accounts of customers. In a business organization which sells on credit to many customers, it is impracticable to keep customers' accounts in the general ledger. The necessity of having several clerks posting the accounts at the same time makes a segregation imperative. An additional advantage lies in the greater ease with which errors can be localized. In a small business with a limited number of accounts, one accounts receivable ledger will suffice; in a larger business involving many thousands of accounts, 15 or 20 customers' ledgers may be required. The grouping of accounts is usually arranged on an alphabetical basis; e.g., if two such ledgers are used, one would contain accounts of customers whose names start with letters from A-K, and the other, L-Z. Sometimes the grouping is arranged on a territorial basis; e.g., a separate ledger might be kept for the customers served by each branch office of a business, in which case the names would be arranged alphabetically in each ledger. The accounts receivable ledger is kept in agreement with the general ledger by means of controlling account; the total of the balances of customers' accounts should agree with the balance in the controlling account. Ordinarily, a separate controlling account is kept for each accounts receivable ledger. (See BOOK-KEEPING.)

(G. L. C.)

ACCOUTREMENT (a French word, probably derived from *à* and *coudre* or *coudre*, an old word meaning one who has charge of the vestments in a church), clothing; apparel; a term used especially, in the plural, of the military equipment of a soldier other than his arms and clothing.

ACCRA, capital and largest city of the Gold Coast dependency. Pop.: 135,456, census of 1948 (2,712 non-Africans). Although situated only 5° 37' N. (0° 10' W.), it benefits from being on the one reach of the Guinea coast having a marked dry season and small annual rainfall (29 in. falling on 68 days), and correspondingly sparse vegetation. Originally, and still, an African fishing station, it takes its name from *Nkran* (ant), by which the inhabitants were known to the tribesmen of the forested interior. Its site is a wave-cut cliff 25 to 40 ft. high, which projects at three readily defensible points to form coves that provide partial shelter for the landing of dugouts and surfboats. For three centuries after the Portuguese built the first European fort, about 1565, control of these landing places was hotly contested. Between 1642 and 1673 the Danes fortified the easternmost promontory (Christiansborg), the Dutch built Ft. Crèvecoeur 1½ mi. to the west, and the English erected Ft. James on the point ½ mi. farther along. After changing hands repeatedly in combat, the first two were purchased by the British government from their original owners in 1850 and 1868, respectively. The capital of Gold Coast colony (the coastal settlements) was brought from Cape Coast castle (q.v.) in 1876. Administration of the remaining area of the dependency was added: Northern Territories protectorate in 1897, Ashanti in 1901 and Togoland mandate in 1922. Christiansborg remains as the compound in which Government House has been built. Parts of the other forts exist in downtown Accra. Africans occupy most of the older residential area near the business district, and suburbs have been laid out exclusively for them within a mile or two. The land between the town and Christiansborg is devoted to public purposes, largely administrative functions. Ad-

jacent and on higher ground stands the European residential quarter. Beyond it is the military headquarters of the dependency, and an airfield used for regular service after 1937 by Imperial Airways. During World War II this dry and open plain was converted into an air base to serve as the principal landing for planes crossing the Atlantic, and as the West African headquarters for the United States air transport command.

Six miles north of the centre of town is Achimota, where the Prince of Wales college was opened in 1927. It is the ranking educational institution in west Africa, teaching Africans from kindergarten through college. Government services, not duplicated elsewhere in the dependency, include a hospital where nurses are trained, a training depot for policemen, an asylum for mental cases, the Central Agricultural laboratory and the supreme court. Water is piped throughout the settlement, and there are municipal baths.

A jetty about 450 yd. long extends the protection of the Ft. James promontory by further reducing the impact of the surf along the harbour front. In its lee a lighterage pier reaches beyond the breakers, but need be used only during the season of highest surf. The leading export is cacao, most of which comes by rail from points as far inland as the terminus, Kumasi. Roads usable throughout the year reach all sections of the dependency, but many are roundabout.

Under the constitution inaugurated in 1945, Accra elects two of five municipal members of the governor's legislative council. The municipal council, set up in 1894, was reconstituted in 1943 with a majority of African members and also a majority of elected members.

(D. WH.)

ACCRETION, an addition to that which already exists; increase in any substance by the addition of particles from the outside. In law, the term is used for the increase of property caused by gradual natural additions, as on the seashore or on a riverbank or by the formation of a riverine island. (See ALLUVION.)

ACCRINGTON, municipal and parliamentary borough, Lancashire, England, 23 mi. N.W. of Manchester, on the London Midland region railway route. Population (1951) 40,671. Area, 6.9 sq.mi. It lies in a deep valley on the Hindburn, a feeder of the Calder.

Accrington (Akerenton, Alkerington, Akerington) was granted by Henry de Lacy to Hugh, son of Leofwine, in Henry II's reign, but came again into the hands of the Lacys, and was given by them (c. 1200) to the monks of Kirkstall, who converted it into a grange. It returned to the Lacys in 1287, was granted in parcels and, like their other lands, became merged in the duchy of Lancaster. In 1836 Old and New Accrington were merely straggling villages with about 5,000 inhabitants. By 1861 the population had grown to 17,688 because of the railway junction, and it increased with the rapid development of the Lancashire coal field. Cotton spinning and printing works, cotton-mill machinery works, dye works, collieries and transport work employ the people. A girls' high school was opened in 1939. The Church of St. James dates from 1763. The original chapel was probably an oratory which was an offshoot of Kirkstall abbey. Ecclesiastically, Accrington was dependent on Altham till after the middle of the 19th century. The town was incorporated in 1878. Together with the urban districts of Church, Clayton-le-Moors and Oswaldtwistle, Accrington returns one member to parliament.

ACCRUED DIVIDENDS, the amount of the dividend on a stock which may be presumed to have been earned during the period between the last dividend payment and a later stipulated date. Of course such an accrual of dividend is a mere presumption since dividends are necessarily uncertain until, at the end of a dividend period, it has been ascertained that there is a surplus from which to pay one, and it has been duly declared. It is quite unusual to sell stock for a certain price plus accrued dividends, although in the cases of stock with dividend guaranteed (see STOCK) or in cases of preferred stock of companies in which the dividend is practically certain, it is sometimes done. Stocks are not sold with accrued dividend on organized exchanges, although it is the common custom to sell bonds with accrued interest

(*q.v.*). The term accrued dividend must not be understood to carry intimation that dividends are in arrears (*q.v.*), that idea being conveyed by the expression cumulated dividend or accumulated dividend (*q.v.*) (See DIVIDENDS.) (J. H. B.)

ACCRUED EXPENSES. Some business costs are of a continuous nature, such as wages, interest, rent, etc. The accountant records in a summary entry (usually at the close of a period) the cumulative effect of these transactions for the relevant period. The debit may be to an expense account or, if the cost is to be capitalized as an element of inventory or fixed asset, to an asset account. The credit is usually to a liability; the resulting wages payable, etc., is referred to as an accrued expense payable and appears on the statement of financial position. In a larger sense, all costs accrue, and those which are incurred in earning the revenue of a period are allocated to that period as expenses. (P. Kr.)

ACCRUED INCOME, or ACCRUED REVENUE. Certain business transactions are of a continuous nature, such as the earning of interest or of rent. The accountant records in a summary entry (usually at the close of a period) the cumulative effect of these transactions for the relevant period, usually by a debit to a receivable and a credit to a revenue account. The resulting interest receivable, etc., is referred to as accrued income or accrued revenue receivable. It appears on the statement of financial position. In a larger sense we say that all revenues from sales of goods and services accrue and are recorded during the accounting period. (P. Kr.)

ACCRUED INTEREST, the amount of interest on a bond which has been earned over the period from the date of the last interest payment to some specified date, but which will not be paid by the issuer of the bond until the next regular interest date. Bonds are almost invariably sold at a certain price plus accrued interest. Thus if the interest dates on a certain bond are Feb. 1 and Aug. 1, and the bond is sold on May 1, the buyer will pay the seller the stipulated price plus the interest for the three months during which the seller's money has been invested in the bond, and on Aug. 1 he will receive from the issuing corporation the full six months' interest for the period from Feb. 1 to Aug. 1. Half of this interest will repay the buyer for the accrued interest which he paid to the seller, and the other half will be the interest for the three months during which his own money was invested in the bond. By specific agreement or notification bonds may be sold "flat"; *i.e.*, without considering any accrued interest. Defaulted bonds and income bonds are usually sold flat since the interest to be received from them, if any, is always problematical. (J. H. B.)

ACCUMULATED DIVIDEND, dividend on cumulative stock which was due but was not paid during one or more previous dividend periods. Such unpaid back dividends accumulate and it is essential that they be paid in full before any dividend can legally be paid on the common stock. (See CUMULATIVE PREFERENCE SHARE; DIVIDENDS.)

ACCUMULATION, in law, the continuous adding of the interest of a fund to the principal, for the benefit of some person or persons in the future. Previous to 1800 this accumulation of property was not forbidden by English law, provided the period during which it was to accumulate did not exceed that forbidden by the law against perpetuities; *viz.*, the period of a life or lives in being, and 21 years afterward. In 1800, however, the law was amended in consequence of the eccentric will of Peter Thellusson (1737-97), an English merchant, who directed the income of his property, consisting of real estate of the annual value of about £5,000 and personal estate amounting to more than £600,000, to be accumulated during the lives of his children, grandchildren and great-grandchildren, living at the time of his death, and the survivor of them. The bequest was held valid (*Thellusson v. Woodford*, 1798, 4 Vesey, 237).

To prevent such a disposition of property in the future, the Accumulations act, 1800 (known also as the Thellusson act) was passed, by which (as altered and re-enacted by the Law of Property act, 1925) it was enacted that no property should be accumulated for any longer term than either (1) the life of the

grantor or settlor; or (2) the term of 21 years from his death; or (3) during the minority of any person living or *en ventre de sa mère* at the time of his death; or (4) during the minority of any person who, if of full age, would be entitled to the income directed to be accumulated. The act does not extend to any provision for payment of the debts of the grantor or of any other person, nor to any provision for raising portions for the children or remoter issue of the settlor, or any person interested under the settlement, nor to any direction touching the produce of timber or wood. It does not apply to property in Ireland. The act has been amended by the Accumulations act, 1892, which forbids accumulations for the purpose of the purchase of land for any longer period than during the minority of any person or persons who, if of full age, would be entitled to receive the income. The Accumulations act, 1800, was applied to heritable property in Scotland by the Entail Amendment act, 1848, and the saving clause as to provision for payment of debts was dis-applied to Scotland by the Entail act, 1914. Accumulations act, 1892, applies to Scotland. (See TRUST AND TRUSTEES.)

ACCUMULATIVE STOCK: see CUMULATIVE PREFERENCE SHARE.

ACCURSIUS (Ital. ACCORSO), **FRANCISCUS** (1182-1260), Italian jurist, was born at Florence about 1182. A pupil of Azo, he first practised law in his native city, and was afterward appointed professor at Bologna, where he had great success as a teacher. He undertook the great work of arranging into one body the almost innumerable comments and remarks upon the Code, the Institutes and Digests, the confused dispersion of which among the works of different writers caused much obscurity and contradiction.

This compilation, bearing the title *Glossa ordinaria* or *magistralis*, but usually known as the Great Gloss, though written in barbarous Latin, has more method than that of any preceding writer on the subject. The best edition of it is that of Denis Godefroi (1549-1621), published at Lyons in 1589, in 6 vol. folio. When Accursius was employed in this work, it is said that, hearing of a similar one proposed and begun by Odofred, another lawyer of Bologna, he feigned indisposition, interrupted his public lectures and shut himself up, till with the utmost expedition he had accomplished his design.

Accursius was greatly extolled by the lawyers of his own and the immediately succeeding age, and he was even called the idol of juriconsults, but those of later times formed a much lower estimate of his merits. There can be no doubt that he disentangled the sense of many laws with much skill, but it is equally undeniable that his ignorance of history and antiquities often led him into absurdities, and was the cause of many defects in his explanations and commentaries. He died at Bologna in 1260. His eldest son Franciscus (1225-93), who also filled the chair of law at Bologna, was invited to Oxford by King Edward I, and in 1275 or 1276 read lectures on law in the university.

ACCUSATION, a legal term signifying the charging of another with wrong-doing, criminal or otherwise. For the accusation of another of a crime or of misconduct for the purpose of extortion, see BLACKMAIL.

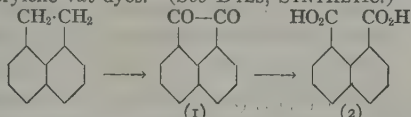
ACCUSATIVE, a case of the noun, denoting primarily the object of verbal action or the destination of motion.

ACE, the number one at dice, or the single point on a die or card; also a point in the score of racquets, lawn tennis, tennis and other court games. From its conventional use as the highest in a suit in card games, the word came to be used during World War I to signify an aeroplane pilot of supreme skill and daring.

ACELDAMA (AKELDAMA, R. V.), land (originally a potter's field) said in Matthew to have been bought by the priests for a burial ground for strangers with the money which was returned by Judas and could not be put into the treasury "because it was the price of blood," Aramaic אַרְמֵי הַדָּם, "the field of blood," Acts i, 19; cf. Matt. xxvii, 8. Acts ascribes its purchase to Judas himself, perhaps by mere compression. Manuscript authority gives AKELDAMACH (Ἀκελδανάχ, Westcott and Hort) "the field of thy blood," which is unsuitable. Klostermann's suggestion, *Probleme im Aposteltexte* (1883, pp. 1-8), "the field of sleep" (*dmak*, "he

slept," used especially of sleep in death; e.g., Targum of Job, iii, 12, Syr.: *dmaka*, "sleep") is very attractive, suggesting "cemetery," and although there is no other example of such a Jewish title the figure is old (Dan. xii, 2). If so, Akeldama will be only the popular, perhaps Christian, nickname. In any case Acts i, 19 can hardly be as early as St. Peter's speech in which it is incorporated. No plausible explanation is given for "ch" being added to Akeldama, and there is only one exactly parallel case, the mysterious *Sirach* for *Sira* (Ecclus. L, 27 [29]). Tradition from the 4th century places the plot on the Hill of Evil Counsel—"a little level plot overhanging the valley of Hinnom." . . . The potters probably "had here a cave in which their work was carried on." (See Schnick, P E F Q, 1892, pp. 283-289.) (A. L. W.)

ACENAPHTHENE, an aromatic hydrocarbon first isolated from coal tar by M. P. E. Berthelot and subsequently synthesized from α -ethylnaphthalene. Crystallizing from alcohol in colourless needles, it melts at 95° C. and boils at 278°. Its formula is $C_{12}H_{10}$. On oxidation with chromic acid it yields (1) acenaphthenequinone employed in the manufacture of ciba scarlet and other red vat dyes; (2) naphthalic acid, a starting point in the production of certain perylene vat dyes. (See DYES, SYNTHETIC.)



Acenaphthene, which readily undergoes nitration and sulphonation, forms a characteristic orange picrate melting at 161°.

See A. E. Everest, *The Higher Hydrocarbons* (1927).

(G. T. M.)

ACEPHALI (*ἀκεφάλαι*) a term applied to sects having no head or leader; and in particular to a strict Monophysite sect that separated itself, in the end of the 5th century, from the rule of the patriarch of Alexandria (Peter Mongus) and remained "without king or bishop" till it was reconciled by Mark I (799-819) (Gr. *ἀ* privative, and *κεφαλή*, head).

The term was also used to denote *clerici vagrantes*; i.e., clergy without title or benefice (cf. Hinschius, i, p. 64).

Certain persons during the reign of King Henry I were called *Acephali* because they had no lands by virtue of which they could acknowledge a superior lord. The name was also given to certain legendary races described by ancient naturalists and geographers as having no heads, their mouths and eyes being in their breasts, generally identified with Pliny's Blemmyae.

See Gibbon, ch. xlvii (vol. v, p. 129 in Bury's ed.).

ACERACEAE, a natural family of dicotyledonous plants allied to the Sapindaceae, consisting of 2 genera and about 125 species, all but 2 belonging in the genus *Acer*. This genus consists of trees always with opposite and mostly simple and usually lobed or toothed, rarely entire leaves, the characteristic fruits consisting of paired, winged, one-sided carpels, a typical samara. The genus *Acer* is mostly confined to the north temperate zone and is highly developed in species in North America and in temperate and subtemperate Asia. For a monographic treatment, see F. Pax, *Aceraceae*, Pflanzenreich 8 (iv, 163), 1-89, fig. 1-14 (1902). See MAPLE. (E. D. M.)

ACERENZA (anc. *Acheruntia*), town in province of Potenza, Italy, the seat of an archbishop, 15½ mi. N.E. of the station of Pietragalla, which is 9 mi. N.W. of Potenza by rail, 2,730 ft. above sea level. Pop. (1936) 4,625 (town), 4,788 (commune).

ACERRA, town and episcopal see, province of Naples, Italy, 9 mi. N.E. from Naples. Pop. (1936) 19,177 (town), 21,937 (commune). The town lies on the right bank of the river Agno, 90 ft. above sea level, in a fertile but somewhat marshy district which in the middle ages was very malarious. The ancient name (*Acerrae*) was also borne by a town in Umbria and another in Gallia Transpadana (the latter modern Pizzighettone on the Adda, 13 mi. N.W.N. of Cremona). It became a city with Latin rights in 332 B.C., and later a *municipium*. It was destroyed by Hannibal in 216 B.C., but restored in 210; in 90 B.C. it served as the Roman headquarters in the Social War, and was successfully held against the insurgents. It received a colony under Augustus, but

appears to have suffered much from floods of the river Clanis. Under the empire no more is heard of it, and no traces of antiquity, beyond inscriptions, remain.

ACERRA, in Roman antiquity, a small box or pot for holding incense, as distinct from the turibulum (thurible) or censer in which incense was burned. The name was also given by the Romans to a little altar placed near the dead, on which incense was offered every day till the burial. In ecclesiastical Latin the term *acerra* is still applied to the incense boats used in the Roman ritual.

ACETABULUM, the Latin word for a vinegar cup, an ancient Roman vessel, used as a liquid measure (equal to about half a gill); it also became used technically in zoology, by analogy for certain cup-shaped parts; e.g., the suckers of a mollusc, the socket of the thighbone, etc.; and in botany for the receptacle of fungi.

ACETALDEHYDE or simply aldehyde, is the second aldehyde (*q.v.*) of the aliphatic series. Its molecular formula is C_2H_4O , and its structure is CH_3-CHO . It is a colourless liquid boiling at 21° C., and possessing a powerful characteristic odour. It occurs in the crude ethyl alcohol (*q.v.*) obtained by the fermentation of sugars and in the crude methyl alcohol obtained by the destructive distillation of wood. It is manufactured both by the oxidation of ethyl alcohol and by the hydration of acetylene (*q.v.*). It is transformed by reduction into ethyl alcohol and by oxidation into acetic acid (*q.v.*).

ACETAMIDE: see AMIDES.

ACETANILID, also called antifebrin, made by interaction of glacial acetic acid with aniline (*q.v.*). It is a febrifuge or antipyretic, used in headaches and fevers, of which it reduces the pain without removing cause. It may cause aniline poisoning, a depressant action on the heart muscle, resulting in collapse, nausea, vomiting and a blueness of lips and nails. The last is caused by chemical changes in the blood, whereby red corpuscles lose their power to carry oxygen.

Acetanilid is a white, crystalline substance melting at 115° C., boiling at 305° C. and soluble in water, alcohol or ether. Its chemical formula is $C_6H_5.NH.CO.CH_3$.

ACETATES: see ACETIC ACID.

ACETIC ACID, the organic acid which gives to vinegar (from which it derives its name) its characteristic sharp taste, is the second of the series of aliphatic acids, formic acid (*q.v.*) being the first.

Its formula is $CH_3.CO_2H$, and it occurs in nature in plant juices occasionally as free acid but more generally as calcium or potassium salts.

Three processes are available for large-scale production of acetic acid, $CH_3.COOH$.

1. Fermentation Processes.—Several species of bacterium convert dilute alcoholic liquors into impure acetic acid in the form ordinarily known as vinegar. This bacterial fermentation, which takes place in the presence of air and a certain amount of nutrient phosphates and nitrogenous material necessary for the feeding of the bacteria, involves the oxidation of ethyl alcohol (see ALCOHOL) into dilute acetic acid. A more concentrated acid is obtainable by neutralizing the dilute acid with lime to form calcium acetate and then distilling a mixture of this salt with concentrated sulphuric acid.

Except for the manufacture of vinegar, the fermentation process is no longer an important factor in the industrial preparation of acetic acid.

In the oxidation of alcohol to acetic acid the living acetic bacteria may be replaced by specific enzymes (unorganized ferments) or even by spongy platinum or palladium since either of these, in the presence of air, oxidizes the alcohol first to acetaldehyde and then to acetic acid.

2. Destructive Distillation of Wood.—A relatively small proportion of the acetic acid of commerce is now obtained by the destructive distillation of wood, the hard woods yielding 4.7% to 6.5% of the concentrated acid.

3. Synthetic Acetic Acid.—The starting point in the industrial synthesis of acetic acid is calcium carbide made in the electric

furnace from limestone and coal. The acetylene evolved from the carbide by addition of water is converted into acetaldehyde by passing into hot dilute sulphuric acid containing mercuric sulphate. The acetaldehyde is further oxidized by air or oxygen in the presence of a catalyst consisting of the oxides of metals such as iron, vanadium and uranium, acetic acid being thereby formed.

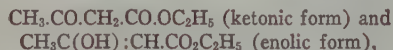
In 1950 about 220,000 tons of synthetic acetic acid were made in the United States.

Anhydrous acetic acid, usually termed glacial acetic acid owing to its icelike crystallization at 16.7°C ., has a very pungent odour and boils at 118°C . to a heavy inflammable vapour. Its alkali salts are soluble in water. Ferrous and ferric acetate are used as mordants in dyeing (*q.v.*). Normal lead acetate is known in commerce as sugar of lead and basic copper acetates are known as verdigris (*q.v.*).

Acetic acid and the acetates are detected by heating with ethyl alcohol and sulphuric acid; ethyl acetate is evolved and recognized by its fragrant odour. When heated with arsenious oxide, acetates give rise to the malodorous and highly poisonous cacodyl oxide.

Pharmacology and Therapeutics.—Glacial acetic acid is sometimes used as a caustic for corns. The soluble acetates, and especially potassium acetate, are used mainly as alkaline diuretics and to counteract acidosis. After absorption in the blood, they are oxidized to carbonates, increasing the alkalinity of the blood or reducing the acidity of the urine without the disturbing influence of alkalis on the digestive tract.

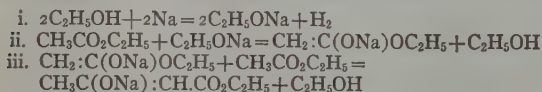
ACETOACETIC ESTER, ethyl acetoacetate is an outstanding example of a chemical substance having a dual character arising from the possession of two different molecular structures. Such substances are called tautomeric compounds (*see* ISOMERISM). The substance is an ester (which see), and has the molecular formula $\text{C}_6\text{H}_{10}\text{O}_5$. The two tautomeric forms are represented by



and ordinary specimens of the ester as handled in commerce may be regarded as consisting of 93% of the former in equilibrium with 7% of the latter. When treated by reagents which combine with ketones, such as sodium bisulphite, hydroxylamine, phenylhydrazine and hydrocyanic acid, the ketonic character of the ester is manifested, and when acted upon by reagents such as phosphorus pentachloride, diazomethane, ammonia and amines, which detect alcoholic (enolic) groups, then its enolic nature is revealed.

In 1911 L. Knorr separated the two forms of the ester in a state of purity. The ketonic modification was frozen out of the equilibrium mixture at -78°C . and the enolic modification was isolated in the liquid condition by decomposing the sodium derivative with hydrogen chloride at the same low temperature. In these experiments it was found to be essential to use silica vessels. The ester was first discovered by A. Geuther in 1863. The original method of production is still employed on a manufacturing scale. Sodium, either molten or in wire form, is added to dry ethyl acetate containing a little ethyl alcohol. When all the metal has dissolved the mixture is acidified with dilute acetic or sulphuric acid and the crude acetoacetic ester, which is partially miscible with water, separates as an oil on addition of common salt and is purified by distillation under diminished pressure. The ester is a colourless, fragrant liquid boiling, with slight decomposition, at 181°C . under a pressure of 760 mm.

The sodium condensation requires the presence of a small amount of alcohol. The role of this alcohol is made apparent by the following probable mechanism of the reaction:



In the chemical laboratory acetoacetic ester is a valuable synthetic reagent, for its sodium derivative when acted on by an

alkyl iodide yields an alkylacetoacetic ester, and the sodium derivative of the latter ester by similar means furnishes a dialkylacetoacetic ester. These alkyl- and dialkylacetoacetic esters may be employed in producing either higher ketones or higher fatty acids.

The ester has also been employed in the synthesis of pyridines (*q.v.*), quinolines (*q.v.*), furans (*q.v.*), pyrazoles (*q.v.*), pyrroles (*q.v.*), and compounds of the purine (*q.v.*) group.

In addition to the foregoing scientific uses acetoacetic ester is utilized industrially in the manufacture of synthetic drugs and dyes. Of these drugs the best known is antipyrine (*q.v.*) which is prepared by methylating phenylmethylpyrazolone, the condensation product of acetoacetic ester and phenylhydrazine.

Several important dyes belong to the pyrazolone series. Eriochrome red (Chrome fast red B) is manufactured by successively condensing acetoacetic ester with phenylhydrazine and with diazotized 1-amino- β -naphthol-4-sulphonic acid. A series of yellow dyes and pigment colours is similarly produced by condensing the ester successively with various aromatic hydrazines and diazocompounds (*see* DYES, SYNTHETIC).

ACETONE is present in very small quantities in normal urine, in the blood, and in larger quantities in diabetic patients, and is the simplest representative of the aliphatic ketones. It results with other ketones from the destructive distillation of wood and other cellulosic derivatives, and for this reason it is present in crude wood spirit (methyl alcohol). It has the formula $\text{CH}_3\cdot\text{CO}\cdot\text{CH}_3$ and is thus dimethyl ketone. Acetone is a colourless, fragrant, inflammable, mobile liquid, boiling at 56.3°C . and miscible in all proportions with water, alcohol and ether. It has very useful solvent properties, dissolving considerable quantities of acetylene gas (*q.v.*). It dissolves many fats and resins and is a solvent for cellulose nitrate and acetate. On account of the latter properties, it finds extensive use in the manufacture of cordite and of artificial silk.

On account of its valuable properties as a solvent and as an organic reagent, acetone is prepared on a large scale, the processes available being as follows:—

1. The dry distillation of calcium acetate leading to the formation of acetone and calcium carbonate.
 2. The catalytic (*see* CATALYSIS) decomposition of glacial acetic acid into acetone, carbon dioxide, and water when it is passed over heated metallic oxides such as alumina and thoria.
 3. The fermentation of maize, rice, horse chestnut meal or other starchy materials with a bacterium discovered by A. Fernbach, the starch present being converted into a mixture of normal butyl alcohol (6 parts), acetone (3 parts) and ethyl alcohol (1 part).
 4. The dehydrogenation or oxidation by air of isopropyl alcohol in the presence of heated metallic or metal oxide catalysts.
- Acetone is employed in many organic syntheses. Dehydrating agents convert it successively into mesityl oxide and phorone, and on distillation with sulphuric acid it is transformed by elimination of water into mesitylene (1:3:5-trimethylbenzene). In conjunction with *orthonitrobenzaldehyde*, it has been used to prepare synthetic indigo.

Therapeutic Applications.—The ketones in general give rise to narcosis and lowering of blood pressure and acetone itself produces intoxication and sleep but is less powerful than ether or chloroform, although less toxic than ethyl alcohol. When treated with chlorine, bromine, or iodine in presence of alkali, acetone is converted respectively into chloroform, bromoform, or iodoform. It is the starting point in the production of the narcotic drug *suphonal*.

BIBLIOGRAPHY.—Lloyd C. Cooley, *Ind. Eng. Chem.* (1937); Carleton Ellis, *The Chemistry of Petroleum Derivatives* (1934-37).

ACETOPHENONE or phenyl methyl ketone is the simplest representative of the mixed aliphatic-aromatic ketones. It crystallizes in colourless leaflets with a characteristic odour; it melts at 20°C . and boils at 202°C ., is volatile in steam and has the composition, $\text{C}_6\text{H}_5\cdot\text{CO}\cdot\text{CH}_3$. It occurs to a small extent in coal tar and, having feebly basic properties, is extracted from the heavy oil fractions (b.p. 160 – 190°) with sulphuric acid.

Acetophenone condenses with phenylhydrazine but does not combine with sodium hydrogen sulphite. It results from the distillation of a mixture of dry calcium acetate and benzoate but is best prepared by condensing benzene and acetyl chloride with aluminium or ferric chloride in carbon disulphide. It has anaesthetic and soporific properties and under the name of hypnone has been used as a drug to induce sleep. With hydroxylamine it condenses to acetophenoneoxime, $C_6H_5.C(CH_3):NOH$, which, under the influence of phosphorus pentachloride in ether is converted into the isomeric acetanilide, $C_6H_5.NH.CO.CH_3$, this transformation being an example of the so-called Beckmann change which occurs with ketone oximes in general *p*-Aminoacetophenone also has anaesthetic properties, whereas the condensation product of acetophenone and phenetidine is an antipyretic substance. On adding sodium to acetophenone dissolved in ethyl acetate the sodium derivative of benzoylacetone is produced from which benzoylacetone, $C_6H_5.CO.CH_2.CO.CH_3$ is obtained by acidification, this condensation being a typical example of the Claisen reaction.

ACETYLENE is a colourless gaseous compound of 7.74% of hydrogen and 92.24% of carbon, used as a fuel both in the oxy-acetylene process for the welding and cutting of metals and also for isolated or independent lights. It is the simplest of all unsaturated organic compounds and has the composition $HC:CH$ (see CHEMISTRY: Organic). It changes to a colourless transparent liquid under a pressure of 61.6 atmospheres at the critical temperature of $36.5^\circ C$. At a pressure slightly above 1 atmosphere and below $-81.8^\circ C$, the liquid contracts and crystallizes. The crystals melt at $-81.8^\circ C$, at a pressure above 1 atmosphere and sublime at $-83.6^\circ C$, at 1 atmosphere.

Acetylene is an endothermic compound, which means that heat is absorbed in its formation from carbon and hydrogen and that it can decompose to the elements with liberation of heat. For this reason liquid and solid acetylene and gaseous acetylene at a pressure above about 2 atmospheres are violently explosive when subject to shock, spark or sudden heating even in the absence of oxygen. The sale or transportation of acetylene in these forms is generally prohibited.

The density of gaseous acetylene is 0.9056 (air = 1) and its mean coefficient of expansion between $0^\circ C$. and $100^\circ C$. is 0.003738 (air is 0.003671). Because it has a greater density and a higher energy content than other common fuel gases it gives a greater heating or lighting effect. The density of liquid acetylene is 0.613 at $-80^\circ C$. and its coefficient of expansion is 0.0024.

Acetylene is very soluble in certain liquids which contain oxygen or nitrogen and do not contain acidic hydrogen; in other classes of liquids the solubility is much lower. This behaviour has been attributed to an electrostatic attraction between a hydrogen atom in acetylene and an atom of oxygen or nitrogen in the solvent. The approximate number of volumes of acetylene (calculated at $25^\circ C$.) soluble in 1 volume of some typical liquids at 1 atmosphere is as follows:

Solvent	Volumes	Temp. $^\circ C$.	Solvent	Volumes	Temp. $^\circ C$.
Acetaldehyde . . .	60	-10	Benzene . . .	4	20
Methyl acetate . .	52	-10	Paraffin oil . .	1.5	20
Dimethyl formamide	37	20	Acetic acid . . .	6	20
Acetone	18	18	Ethyl alcohol . .	6	20
Dioxane	16	25	Water	1.15	15

The solubility of acetylene in all solvents increases with decreasing temperature and increasing pressure. The solubility is of interest because acetylene must be stored and transported as a solution under pressure (see below) and because it is possible to use selective solvents for the separation of acetylene from industrial mixed gases (see below). Since the solubility of acetylene in water at moderate pressure is limited, water and aqueous solutions can be used as washing or confining liquids in generating plants and gas holders.

Acetylene from Calcium Carbide.—In 1945 nearly all acetylene was made from calcium carbide, a compound of calcium and carbon, having the formula CaC_2 and therefore containing in its pure state 37.47% carbon. It interacts with water immediately on contact, yielding acetylene and slaked lime: $CaC_2 + H_2O \rightarrow Ca(OH)_2 + C_2H_2$. Commercial calcium carbide contains about

20% of inert material and ordinarily yields 4.80 cu.ft. of moist acetylene per lb. at $60^\circ F$. and 30 in. pressure or the equivalent figure, 300 litres of moist acetylene per kg. at $15^\circ C$. and 760 mm. A good grade of calcium carbide has a specific gravity of 2.22 and resembles fine-grained granite or hard limestone in appearance and hardness. The commercial product is broken and screened to lumps of convenient size for different uses, and is packed for transport in air tight steel drums. Since it evolves acetylene slowly when exposed to damp air and rapidly when wetted, calcium carbide is everywhere subject to special regulations for transport and storage.

The industrial preparation of calcium carbide was initiated in 1892 by T. L. Wilson, a Canadian electrical engineer at Spray, N.C. Its manufacture is conducted on a large scale in most localities where water power is available at low cost, notably in Norway and Sweden, Shawinigan (Quebec) and Niagara. It is made by heating together in the electric furnace a mixture of lime with about 40% of coke or anthracite. The reaction begins at the solid contact surface of lime with carbon and attains an appreciable rate at about $1,700^\circ C$., the melting point of a eutectic of lime with calcium carbide in the presence of ordinary impurities. After the reaction is initiated it occurs chiefly between the fused lime in the eutectic and solid carbon. Carbon monoxide is evolved and in modern furnaces is collected as a by-product. The reaction is $CaO + 3C \rightarrow CaC_2 + CO$. The melting point of the flux of lime and calcium carbide rises until 52% of calcium carbide accumulates, then falls until the mixture containing 68% calcium carbide melts at $1,750^\circ C$. or lower, and then again rises towards the melting point of pure calcium carbide, estimated at about $2,300^\circ C$. As the temperature approaches this point a decomposition of calcium carbide to calcium and carbon sets in, and this constitutes a limiting factor, which prevents the formation of pure calcium carbide in this way. In the United States, it has been found most economical to stop the operation when the calcium carbide content reaches 78–80%.

Acetylene is obtained by bringing calcium carbide into contact with water, and innumerable forms of generators have been devised with the object of effecting and controlling the reaction so that acetylene shall be liberated at the desired rate. The reaction is one in which heat is set free, about 166 B.T.U. being released for each cu.ft. of acetylene formed. This heat of reaction may produce localized temperatures high enough to cause polymerization (*q.v.*) of part of the acetylene or even to decompose it to carbon and hydrogen, unless overheating is prevented by the use of excess water. In small generators water commonly drips on the carbide at a rate controlled by a hand-operated valve or by the restriction of the free egress of the evolved gas. In large generators, however, the carbide is either dropped into a large excess of water, or is intermittently submerged by a local excess of water. Provision should be made for the sludge of slaked lime, which is the residue of the decomposition of carbide, to settle down out of close contact with the carbide which has already been decomposed. The sludge is, in most instances, withdrawn at intervals in a semifluid condition. This sludge of calcium hydroxide has little value, and, since about 1935, methods using a minimum of water and yielding a dry powdered calcium hydroxide have received increasing attention. In generators of this type the heat of reaction is used in converting a part of the water into steam, which is later condensed out of the acetylene. It is important that generators liable to be recharged at short intervals be so constructed that air cannot enter the heated interior during discharging and recharging, both because of the danger of ignition and because air is an undesirable impurity in acetylene for some uses.

Acetylene from calcium carbide contains characteristic impurities. Nitrogen, arsenic, sulphur and silicon occur as calcium compounds in carbide, and on treatment with water these yield the corresponding hydrides: ammonia, phosphine, arsine, hydrogen sulphide and silicane. Acetylene generated from modern carbide usually contains less than 0.015% of ammonia, 0.015–0.025% of phosphine, less than 0.01% of hydrogen sulphide, and less than 0.0003% of arsine. At the high temperatures that sometimes

occur in acetylene generators, these simple hydrides may combine with acetylene to yield organic impurities; e.g., divinyl sulphide has been identified as an impurity in acetylene from calcium carbide. High temperatures may also result in the formation of benzene and other aromatic hydrocarbons from acetylene. The crude acetylene from the generator also contains moisture, finely divided solids, air, and sometimes traces of hydrogen and simple aliphatic hydrocarbons. These impurities are minimized in modern practice by selection of suitable materials for carbide manufacture and by careful control of acetylene generation, but some purification of the gas is necessary.

In large acetylene plants the gas may be dried by refrigeration, or by the use of aluminum oxide, or by washing with a solution of calcium chloride. The removal of the phosphine and some of the other hydride impurities is accomplished by oxidation with 85% sulphuric acid or by Granjon's material, a mixture of ferric chloride, ferric oxide, manganese dioxide, mercuric chloride and cupric sulphate. Commercial purifying materials, containing chromic acid or hypochlorites have also been used for this purpose. When the removal of oxygen from acetylene is essential, an aqueous alkaline solution of sodium hydrosulphite containing a small quantity of anthraquinone beta sulphonic acid is employed as a washing liquid. The total removal of all impurities has been accomplished only by liquefaction and distillation of acetylene, and this is considered too hazardous for commercial application. Pure acetylene is a rare laboratory chemical.

Carbides of the other alkali and alkaline earth metals also yield acetylene, but they have disadvantages which debar them from industrial production and use.

Acetylene from Other Hydrocarbons.—M. Berthelot in 1862 first identified and named acetylene as a product of the pyrolysis, or thermal decomposition, of other organic compounds. This was the basis of an old laboratory method for the preparation of acetylene, but the method was neglected until petroleum, natural gas, and coke-oven gas became abundant and cheap enough to make the process economically attractive. In Germany during 1940-45 some acetylene was made from gases containing methane. In the United States little acetylene has actually been produced by this method but much research has been done on the manufacture of acetylene from natural gas or from petroleum fractions which are least valuable for other purposes. The method consists of heating an organic compound, usually a gaseous or liquid hydrocarbon, to a temperature of 1,300-1,700° C. for a fraction of a second, cooling the resulting gas mixture below 400° C. with extreme rapidity, and separating the acetylene from the other gaseous products. The heating may be accomplished by an electric discharge, by partial combustion of the raw material or by contact with a heated surface. It must be of very short duration because acetylene decomposes to carbon and hydrogen, with which it is in equilibrium in this temperature range. The rapid cooling is usually accomplished by expansion and is essential to prevent conversion of acetylene to aromatic hydrocarbons, which occurs over most of the cooling range. The power consumption in the manufacture of acetylene by pyrolysis, even with electrical heating, is estimated to be somewhat less than in the production of acetylene from carbide.

Acetylene commonly comprises about 5-25% of the mixed gases produced by this method, and its separation is the most expensive step in the process. The small proportion of hydrocarbons containing four or more carbon atoms can be removed by refrigeration or extracted by cold solvents. Traces of more reactive hydrocarbons such as butadiene, methyl acetylene, diacetylene and some olefins can be removed by reaction with sulphuric or phosphoric acid or aluminum chloride. Small quantities of acidic impurities such as hydrogen sulphide, hydrogen cyanide and carbon dioxide can be eliminated by an alkaline wash. Acetylene then is usually extracted by a selective solvent from the remaining mixture containing methane, ethane, ethylene and much hydrogen. A number of good solvents for acetylene have been proposed for this use, but most of them dissolve an undesirably high proportion of ethylene. In Germany water has been used as a solvent to extract acetylene from a gas mixture under a pressure

of about 20 atmospheres. Water is especially effective for the separation of acetylene from ethylene at high pressures because of the comparatively low solubility of ethylene. The solubility of acetylene in water increases approximately in proportion to the partial pressure of acetylene up to 5 atmospheres and to a slightly lesser extent at still higher pressures. Further research on the pyrolytic method and the recovery of acetylene from mixed gases may make this procedure a serious competitor of the carbide process.

Dissolved Acetylene.—The relatively large solubility of acetylene in acetone was first observed by G. Claude and A. Hess in 1897 who stated in the *Comptes Rendus* of that year that the solubility was also very nearly proportional to the pressure, being about 300 volumes at a pressure of 12 atmospheres. They pointed out that the coefficient of expansion of the solution in acetone was very much lower than that of liquid acetylene and, moreover, that the solution did not explode when a wire in it was raised to bright redness. Their observations led ultimately to the development of the present method of supplying acetylene in portable steel cylinders in which it is safely stored under pressure as a solution in acetone. Acetone increases in volume by 4.4% for each atmosphere pressure at which it is saturated with acetylene. Consequently acetone in which acetylene is dissolved under an absolute pressure of 16 atmospheres occupies $1 + (16 \times 0.044)$ times its original volume. This pressure was that to which steel cylinders packed with porous material were permitted by law to be charged with acetylene in Great Britain, and the strength and construction of the cylinders was also specified by law. Similar regulations were enforced in other countries. Since the volume of the acetone solution varies with the amount of acetylene dissolved, it is obvious that the cylinders in use must be only partially filled with the liquid, the remaining space being occupied by compressed gaseous acetylene. Such compressed free acetylene would be liable to explode if the cylinder were exposed to great heat or shock but this risk is avoided by first filling the cylinder with inert porous material the interstices in which will be sufficiently small to prevent any explosion from spreading beyond the point at which it is initiated. Various porous materials have been used for this purpose, e.g., dried clay, porous brick, infusorial earth, kieselguhr and charcoal, singly or in admixture with or without a binder. The porous material generally preferred is the vegetable fibre kapok, the resilient properties of which cause it to be evenly distributed and free from large open spaces. Current practice in 1945 in Great Britain was to pack the cylinder uniformly with kapok until the solid matter of the latter occupied one-fifth of the capacity of the cylinder, thus leaving four-fifths as interstices in the kapok packing. The acetone is run in to fill a further two-fifths, leaving two-fifths of the internal volume of the cylinder for expansion of the acetone on charging with acetylene and any subsequent exposure to heat. Cylinders of dissolved acetylene thus prepared are convenient and safe. Several proposals and patents for substituting other solvents for acetone in acetylene cylinders had not been applied commercially up to 1945.

Fuel Uses.—Acetylene requires 2.5 times its volume of oxygen or 11.95 times its volume of air to effect its complete combustion. It is used for lights in portable lamps, buoys, road signals, isolated premises, etc., but the consumption of acetylene for lighting is small compared to its use in the industrial welding and cutting of metals, for which purposes it is consumed in a blowpipe to which a supply of undiluted oxygen is given from a steel cylinder containing that gas under pressure. In welding, a reducing flame is maintained by using less than the proportion of oxygen required for complete combustion, whereas in cutting metals an excess of oxygen is admitted to oxidize the metal. Since acetylene is an endothermic compound its heat of combustion is greater than that of the constituent carbon and hydrogen. On this account acetylene affords a higher flame temperature than other fuel gases, above 3,000° C. in a correctly designed and operated torch.

Chemical Uses.—The simple composition, availability and reactivity of acetylene make it a suitable starting material for the industrial synthesis of several other organic compounds.

Acetaldehyde has been manufactured at Shawinigan, Que., Can.,

and in central Europe since about 1917 by the chemical combination of water with acetylene in the presence of sulphuric acid and mercuric sulphate as catalysts. Much of the acetaldehyde is oxidized to produce acetic acid. Sodium acetate has been made by the Dow Chemical company at Midland, Mich., by the reaction of acetylene on a concentrated aqueous solution of sodium hydroxide with liberation of hydrogen gas. A somewhat related reaction is the formation of acetone from acetylene and steam in the presence of certain alkaline earth or rare earth oxides or hydroxides. Several firms in Europe and the United States manufacture vinylacetate by the chemical addition of acetic acid to acetylene in the presence of a mercuric salt and sulphuric acid or a sulphonic acid. The vinylacetate is used as a constituent of synthetic resins. In a further stage of this reaction the addition of acetic acid to vinylacetate produces ethylidene diacetate. This substance is then decomposed by heating with a catalyst to yield acetaldehyde and acetic anhydride, which is required for the manufacture of cellulose acetate. The reaction of chlorine with acetylene is usually carried out in the presence of gaseous diluents or solvent liquids to prevent explosions. A number of catalysts (e.g., ferric chloride) have been employed to promote the reaction. A mixture of the two possible dichloroethylenes results from the reaction of molar proportions of chlorine with acetylene. The addition of a second molar portion of chlorine yields tetrachloroethane. This substance is converted to trichloroethylene by the loss of hydrogen chloride. These chlorine derivatives of acetylene find use as industrial solvents for oily materials.

The DuPont company of Wilmington, Del., during the period 1930-35, developed a process for the production of a synthetic elastomer or rubber substitute from acetylene. The process was based on the discovery by Dr. J. A. Nieuwland that a saturated solution of cuprous chloride and ammonium chloride containing the solid salts in suspension converted acetylene to a gaseous dimer, vinyl acetylene, $\text{HC}\equiv\text{C}-\text{CH}=\text{CH}_2$ and a liquid trimer, divinyl acetylene, with smaller proportions of other polymers. Vinyl acetylene was found to add hydrogen chloride in the presence of cuprous chloride to produce the liquid chloroprene, which polymerized to a rubber-like substance, neoprene. This material was extensively used during 1943-46 in the manufacture of tires and tubes and other elastic articles. It is superior to rubber in resistance to heat, oxidation and disintegration by oils. In volume of acetylene consumed and value of the product this was the most important chemical use of acetylene.

A hydrogen atom of acetylene may be replaced by an atom of certain metals to form a class of substances called acetylides. Some of these compounds are useful for the laboratory preparation of compounds containing the ethynyl group, $-\text{C}\equiv\text{CH}$.

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(R. R. V.)

ACETYLENE, IN MEDICINE. Acetylene, which when pure loses its usual offensive smell, is an anaesthetic when inhaled and was first used as such in 1924. Like ethylene (*q.v.*) it is in the experimental stage at present. Its efficiency is between that of gas-oxygen and ether. It has the advantage that far greater amounts of oxygen can be given with it, up to about 50%, than with ethylene or nitrous oxide. (W. S. S.)

ACHAEA. (1) A district on the north coast of the Peloponnese, between the mountains of Erymanthus and Cyllene and the Corinthian gulf; bounded on the west by Elis, east by Sicyon, sometimes included in Achaea. The 12 cities in its narrow fertile coastland formed a religious confederacy, meeting in Poseidon's sanctuary at Helicé: from this developed the political ACHAEAN LEAGUE (*q.v.*) of Hellenistic times.

(2) Achaea Phthiotis is a district S. of Thessaly (Thessalia) and W. of the Gulf of Pagasae (Vólos). For the origin of the name, and relations between north and south Achaea, see ACHAEANS.

(3) "Achaea" was the name given by the Romans to the province formed in 140 B.C. for the mainland of Greece south of

Thessaly, Epirus and Acarnania, which were included in "Macedonia." Its administrative capital was Corinth (Kórinthos).

(4) Achaea in the middle ages was a principality, formed within the same region after the Latin conquest of the Eastern empire (A.D. 1204): the first prince being William de Champlitte (d. 1209). It survived, with various dismemberments, until 1430, when the last prince, Centurione Zaccaria, ceded the remnant to his son-in-law, Theodorus II, despot of Mistra. In 1460 it was conquered, with the rest of the Morea, by the Turks.

(5) Achaea in modern Greece is the Peloponnesian district (1), mainly engaged in currant growing, the crop being shipped from Patras (Pátrai) and Aegion (Vostitza).

ACHAEAN LEAGUE, a confederation of the towns of Achaea in ancient Greece. Isolated on their narrow strips of plain, these towns were exposed to the raids of pirates from the north of the Corinthian gulf. As a protection against such dangers the earliest league of 12 Achaean cities arose. In the 4th century, we find it fighting in the Theban wars (368-362 B.C.), against Philip (338) and Antipater (330). Antigonos Gonatas dissolved the league; but by 280 B.C. four towns combined again, and before long the ten surviving cities of Achaea had renewed their federation. Much was due to Aratus (see ARATUS OF SICYON), who initiated an expansive policy; in 228 it included Arcadia, Argolis, Corinth (Kórinthos) and Aegina (Aígina).

Aratus probably also organized the new federal constitution. The league embraced city-States which maintained their internal independence and powers of self-government. Only in foreign politics and war was their competence restricted.

The central government was democratic. The legislative powers resided in a popular assembly, meeting at Aegium, in which every member of the league over 30 years of age could speak; each city counted one on a division. Extraordinary assemblies could be convoked in special emergencies. A council of 120 delegates served as a committee for preparing the assembly's programme. The chief magistracy was the *strategia* which combined with an unrestricted command in the field a large measure of civil authority and had practically the sole power of introducing measures before the assembly. The ten *demiourgoi*, who presided over this body, formed a kind of cabinet. Philopoemen (*q.v.*) transferred the seat of assembly from town to town by rotation, and placed dependent communities on an equal footing with their former suzerains.

The league prescribed uniform standards and coinage; it summoned contingents, imposed taxes and fined or coerced refractory members.

The first federal wars were against Macedonia, against Antigonos Gonatas and Aetolia and, with Aetolia, against Demetrius. A greater danger arose (227-223) from the attacks of Cleomenes III. (*q.v.*) Owing to Aratus's irresolute generalship the indolence of the burghers and the inadequacy of its troops, the league lost much of its territory. The assembly negotiated with Antigonos Doson, who recovered the lost districts but retained Corinth for himself (223-221). When Philip V. came to the rescue against the Aetolians he annexed much of the Peloponnese. Under Philopoemen the league, with a reorganized army, routed the Aetolians (210) and Spartans (207, 201). After their neutrality during the Macedonian War the Roman general, T. Quintus Flamininus, restored their lost possessions, bringing the Peloponnese under Achaean control. In 150 B.C. the league, in defiance of Rome, attacked Sparta. The federal troops were routed near Corinth by L. Mummius Achaicus (146). The Romans now dissolved the league, and took measures to isolate the communities. Augustus instituted an Achaean synod comprising the dependent cities of Peloponnese and central Greece.

The chief defect of the Achaean league lay in its lack of provision for securing efficient armies and regular payment of imposts, and for dealing with disaffected members. It is the glory of the league, however, to have combined city autonomy with an organized central administration, and in this way to have postponed the entire destruction of Greek liberty for over a century. (See *ROME: Ancient History*.)

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Greek History; L. Whibley, *A Companion to Greek Studies* (1916). The chief classical authorities are Polybius (esp. ii, iv, v, xiii, and xviii.), who is followed by Livy (xxii., xxxv., xxxviii., etc.); Pausanias vii. 9. 24.

ACHAEANS. The name Achaeans is used in the Homeric poems in much the same sense as that in which the name Hellenes came to be used in later times. To Homer the Hellenes were a small tribe in Southern Thessaly (*Il.* ii. 684), but from the 8th century onwards the name became a general designation for all Greek-speaking peoples. Whether the name Achaeans was quite so general in its application is still a matter of doubt, but for practical purposes we may regard it as parallel. According to the traditional genealogies Achaeus was the son of Xuthus, son of Hellen.

The name has been connected with that of the Germanic tribe, Ingaevones, a connection that is possible but, perhaps, not very convincing. No light is thrown by it upon the meaning of the name. The Achaeans were a Greek-speaking people, but whether their dialect was Aeolic, Ionic or of the Arcadian type is a question that cannot yet be decided. The Homeric poems are in an artificial literary dialect.

The exact relationship between the Achaeans and Mycenaean culture is still a matter of doubt. The view held by Sir William Ridgeway was that the Achaeans were invaders from the north, a people of northern characteristics, of the fair-haired, grey-eyed type, bringing to Greece a civilization of Danubian origin distinguished by the use of iron, similar to the Hallstatt and Villanova cultures. The former inhabitants were, in his view, of a short, dark Mediterranean type, but Greek-speaking. It was the Achaeans who, according to this view, brought the *labialising* dialects to Greece.

The view more generally held, however, has been that the Mycenaean peoples were not Greek-speaking. The question depends to some extent upon another: What was the language spoken by the Minoan peoples of Crete, of whose culture the Mycenaean was an offshoot? There is no real evidence that the Minoans spoke Greek, or even an Indo-European language at all, and indeed there are many considerations that point to the conclusion that they did not.

A third and more recent view is that the Greek-speaking peoples came to Greece in three separate waves, Ionian, Achaean and Dorian, the first invasion occurring about the 17th century B.C. The Mycenaean civilization was an Achaean civilization, Greek-speaking, and differing in certain notable respects, for example, in dress, from the Minoan. The Greek invaders subdued a previous non-Greek population and first destroyed the Minoan civilization, afterwards reconstituting it, mingled with northern elements, their advent having much the same effect as the barbarian conquest of the Roman empire.

The facts hitherto known are these. There had existed an early population of Greece having a close connection with Anatolia. A large number of place names occur throughout the Greek mainland as well as in Macedonia, Epirus and Thrace which are paralleled in Asia Minor, notably those in *-ιος* and *=σος*. These are generally regarded as being non-Indo-European and therefore non-Greek. The Greeks were aware of the existence of earlier inhabitants of their country and the Aegean islands, whom they called by the general name of Pelasgians (*q.v.*), distinguishing, however, Leleges and Carians, the latter of whom inhabited the south-western corner of Asia Minor in historical times.

Again, it is probable, if not certain, that the whole Peloponnese, and possibly parts of Central Greece, were inhabited by Ionians previous to their conquest by Achaeans. The traditional home of the Ionians was in the north-eastern Peloponnese, whence they were driven to Attica and the Cyclades by an Achaean invasion. The fact that the name Ionian was applied to the sea west of Greece, on whose shores no Ionians lived in historical times, nor could have done so for many centuries previously, shows that the whole Peloponnese at least must once have been regarded as Ionian. The Achaeans emerge into history in the middle of the 14th century B.C. In the year 1922 a reference to

them (Akhkhiyawa) in one of the Hittite texts of that date was read by Dr. Forrer. They were at that time an important naval power situated in the western regions of Asia Minor and the island of Lesbos, and were under the leadership of a prince named Attarsiyas. They appear to have been also in Cyprus and Pamphylia. Later, as has been already mentioned, in the Homeric age the Achaeans were lords of the Peloponnese and as far north as Thessaly, and their name, so far as can be gathered, was employed as a general designation for all Greeks.

The physical characteristics of the Achaeans are difficult to determine, and not a very safe guide. Three passages in the *Odyssey* refer to tallness of stature as a mark of beauty, and it was, perhaps, therefore rare. Heroes are sometimes referred to both by Homer and Hesiod as fair-haired (*ξανθός*) (though the epithet may mean nothing more than not having black hair) and we know that both in classical and Roman times blue or grey eyes were rare in Greece.

In classical times the name Achaeans was confined to the people inhabiting the strip of land along the north coast of the Peloponnese, between the Corinthian gulf and the northern Arcadian mountains. They were for the most part subject to Dorian overlords, and their dialect was Doric. After the days of the Macedonian supremacy the Achaean League became one of the most powerful influences in Greece, and it was this fact that led the Romans, when they made the country into a province, to give it the name of Achaia. (*See* DORIANS; IONIANS; GREECE, *History*.)

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ACHAEMENES (HAKHAMANI), the eponymous ancestor of the royal house of Persia, the Achaemenidae. According to Darius in the Behistun inscription and Herod. iii. 75, vii. 11, he was the father of Teispes, the great-grandfather of Cyrus. Whether he really was an historical personage, or merely the mythical ancestor of the family, cannot be decided. According to Aelian (*Hist. anim.* xii. 21), he was bred by an eagle. We learn from Cyrus's proclamation that Teispes and his successors had become kings of Anshan; i.e., a part of Elam (Susiana), where they ruled as vassals of the Median kings, until Cyrus the Great in 550 B.C. founded the Persian empire. After the death of Cambyses, the younger line of the Achaemenidae came to the throne with Darius, whose father Hystaspes was, like Cyrus, the great-grandson of Teispes. Cyrus, Darius and all the later kings of Persia call themselves Achaemenides (*Hakhāmanishiya*). With Darius III. *Codomanus* the dynasty became extinct and the Persian empire came to an end (330 B.C.). The adjective *Achaemenius* is used by the Latin poets as the equivalent of "Persian" (Horace, *Odes*, ii. 12, 21). *See* PERSIA. The name Achaemenes is borne by a son of Darius I., brother of Xerxes. After the first rebellion of Egypt, he became satrap of Egypt (484 B.C., Herod. vii. 7). He commanded the Persian fleet at Salamis, and was (460 B.C.) defeated and slain by Inarus (Herod. iii. 12), the leader of the second rebellion of Egypt (*see also* Diodorus xi. 71).

ACHAEMENIDAE, the Graecized name of the family of the ancient Persian kings. (*See* PERSIA: *Ancient History*.)

ACHARD, FRANZ CARL (1753–1821), Prussian chemist, was born at Berlin on April 28, 1753, and died at Kunern, in Silesia, on April 20, 1821. He was a pioneer in turning to practical account A. S. Marggraf's discovery of the presence of sugar in beetroot, and by the end of the 18th century he was producing considerable quantities of beet sugar, though by a very imperfect process, at Kunern, on an estate which was granted him, about 1800, by the king of Prussia. There, too, he carried on a school of instruction in sugar-manufacture. He published several volumes of chemical and physical researches and discovered, among other things, a method of working platinum.

ACHARIUS, ERIK (1757-1819), Swedish botanist, was a pupil of Linnaeus at Uppsala University, and devoted himself to the study of lichens. His most important works are *Lichenographia Universalis* (1810) and *Synopsis methodica Lichenum* (1814).

ACHATES, the companion of Aeneas in Virgil's *Aeneid*. The expression "fidus Achates" has become proverbial for a loyal and devoted companion.

ACHELOUS (mod. *Aspropotamo*, "white river"), the largest river in Greece (130m.). It rises in Mt. Pindus, and, dividing Aetolia from Acarnania, falls into the Ionian Sea. Its water is charged with fine mud, which is deposited along its banks in fertile, marshy plains. At its mouth, a number of small islands (Echinades) have been enveloped in this deposit. It was formerly called Thoas, from its impetuosity, and its upper portion Inachus, the name Achelous being restricted to the shorter eastern branch. The name is given to several other rivers in Greece, and appears in cult and in mythology as that of the typical river-god.

ACHENBACH, ANDREAS (1815-1910), German landscape painter, was born at Cassel on Sept. 29, 1815, and died on March 31, 1910. He was a pioneer of the German realistic school. He studied at Düsseldorf under Schirmer, but emancipated himself from the contemporary school of landscapists which delighted in the representation of romantic scenery. He was the first artist of the Düsseldorf school who painted nature for its own sake. As a young man he sought inspiration in Holland and Norway. His pictures of the stormy North sea, of Dutch canal scenes and of Rhineland villages contrasted favourably with the sentimental landscapes of his contemporaries. His works are to be found at the Berlin National Gallery, the New Pinakothek in Munich, and the galleries at Dresden, Darmstadt, Cologne, Düsseldorf, Leipzig and Hamburg.

His brother, **OSWALD ACHENBACH** (1827-1905), is distinguished for his colourful renderings of the Bay of Naples, of Rome and of Venice. He broke away from the traditional classicist interpretation of these scenes and revelled in strong and glowing colour effects. His works are exhibited at most of the important German galleries of modern art.

ACHERNAR, α Eridani, the brightest star in the constellation Eridanus (*q.v.*).

ACHERON (Gr. river of "woe"), name of several rivers of Greece. In Greek mythology the name is specially given to a river of Hades, over which departed souls were ferried by Charon. Later Greek and Roman poets used it to designate the lower world generally.

ACHESON, EDWARD GOODRICH (1856-1931), American inventor, was born at Washington (Pa.), on March 9, 1856. He was compelled to earn his living at an early age, but devoted his leisure to mechanical invention and experiment. Becoming interested in electricity, he entered the employ of Thomas A. Edison. In 1881 he assisted in the preparation of the Edison exhibit at the Paris International Exposition and later, for the Edison interests, installed the first electric lights in Italy, Belgium and Holland. On returning to the United States he resumed his experiments. He discovered a new abrasive substance of great cutting power, which he named carborundum. Inventing a method of producing a remarkably pure synthetic graphite, he organized in 1899 the Acheson Graphite Co., to handle the patent. This company met with great success. His numerous patents cover methods of producing metallic silicon cheaply; the lubricants known as oildag, aquadag and gredag; the treatment of clay to increase plasticity (Egyptianized clay).

ACHIACHARUS, the name of an eastern sage whose "sayings" spread far and wide and had a remarkable influence on the world's gnostic literature. His history and moralizing sayings have been preserved, in whole or in part and with interesting minor variations, in Syriac, Arabic, Ethiopic, Armenian and Slavonic translations, and fragments of his teaching have survived among the Jewish papyri from Elephantine (*see below*). Rumanian and old Turkish versions are also in existence.

In the story of his life he is represented as the chief adviser of the Assyrian king Sennacherib. He adopted a nephew, Nadan by name, to succeed him. Profligate and wearied by Achiacharus'

unending inculcation of wisdom in proverbial form, Nadan brought about his uncle's downfall. But saved from death by his executioners, Achiacharus survived in an underground dungeon and resumed his former position at court when the king was in dire need of his services as an envoy and magician who could satisfy the demands of the king of Egypt. Thus he built a castle in the air and twisted ropes out of sand. On his return to Assyria he took vengeance on his nephew, flogged him, condemned him to his former dungeon-dwelling, constantly visited him to taunt him and give him instruction in which, as in Aesop's fables, animals and birds give expression to shrewd moral and ethical ideals. Nadan avoided execution by swelling out suddenly and bursting asunder, thus anticipating and possibly inspiring one of the New Testament descriptions of the end of Judas.

The date of composition and the original home of this work are matters of dispute. The Elephantine Papyri provide evidence that it was in existence by the fifth century B.C. The mention of Sennacherib may well point to Mesopotamia as its original home. But the story and the sententious sayings contained in it are probably far older than the Assyrian Empire. Sennacherib's name was probably inserted in the story when it had already assumed a fixed form in most other respects and had already embarked on its career of permeating the literature and thought of Palestine, Egypt and the Mediterranean coastlands.

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ACHILL, the largest island off Eire, separated from the Curraun peninsula of the west coast by the narrow Achill sound. Pop. (1936) 4,875. It is included in Mayo. Its shape is triangular, and is 15 mi. from east to west and 12 mi. from north to south. Area 57 sq.mi. The island is mountainous, the highest points being Slieve Croaghaun (2,192 ft.) in the west, and Slievemore (2,204 ft.) in the north; the extreme western point is the bold and rugged promontory of Achill head, and the northwestern and southwestern coasts consist of cliffs reaching 800 ft. in Minaun, near Keel on the south. The seaward slope of Croaghaun is abrupt and the scenery beautiful. Desolate bogs alternate with the mountains; and the inhabitants earn a scanty subsistence by fishing and tillage, or go to England and Scotland during the harvesting. The Congested Districts board made efforts to improve the condition of the people, and a branch of the Great Southern railway to Achill sound, together with a swivel bridge across the sound, improved communications. In Dugort is a Protestant colony, known as "the Settlement," founded in 1834. There are megalithic remains at Slievemore and elsewhere.

ACHILLES, son of Peleus (*q.v.*) and Thetis; bravest, hand-somest and swiftest of the army of Agamemnon. According to Homer, he was brought up by his mother at Phthia with his cousin and his intimate friend Patroclus; his teachers were Phoenix and Cheiron. The non-Homeric tales of his childhood contain obvious folk-tale themes. Thetis had seven children, all of whom she put into the fire or a cauldron (*see HERCULES*), to make them immortal. All died save Achilles; because Peleus interfered at this point, Thetis left him. (Fairy Bride theme.) Or, Thetis dipped the child in the waters of the river Styx, by which (like Sigurd Fafnirs-bane) he became invulnerable, except that part of his heel by which she held him; whence the proverbial "heel of Achilles."

During the first nine years of the war as described in the *Iliad*, Achilles ravaged the country round Troy, and took 12 cities. In the tenth year occurred the quarrel with Agamemnon. In order to appease the wrath of Apollo, who had visited the camp with a pestilence, Agamemnon had restored Chryseis, his prize of war, to her father, a priest of the god, but as a compensation deprived Achilles, who had openly demanded this restoration, of his favourite slave Briseis.

Achilles refused further service, and rejected offers of compensation for the insult. During his absence the Greeks were hard pressed, and at last he allowed Patroclus to personate him, lending him his chariot and armour. When Hector slew Patroclus Achilles

was reconciled to Agamemnon, got new armour from Hephaestus, slew Hector, and, after dragging the body about at the wheels of his chariot, restored it to Priam at his earnest entreaty.

The *Iliad* concludes with the funeral rites of Hector. It makes no mention of the death of Achilles, but hints at its taking place "before the Scaean gates." The *Odyssey* mentions his funeral. The *Aethiopis* took up the story of the *Iliad*. It told how Achilles, having slain the Amazon Penthesileia and Memnon (*q.v.*), was himself slain by Paris, whose arrow was guided by Apollo to his vulnerable heel. He was worshipped in many places: at Leuke, where he was honoured with offerings and games, in Sparta, Elis, and especially Sigeum on the Hellespont, where his famous tumulus was erected.

Beyond these legends there probably lies a real man, certainly not a sun-, river- or other god. No certain statue of him, but numerous other representations in art, survive.

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ACHILLES, TENDON OF: see TENDON OF ACHILLES.

ACHILLES TATIUS, of Alexandria, Greek rhetorician, author of the erotic romance, the *Adventures of Leucippe and Cleitophon*, flourished about A.D. 450, perhaps later. Suidas, who alone calls him Statius, says that he became a Christian and eventually a bishop (like Heliodorus, whom he imitated) but there is no evidence of this. Photius, while severely criticizing his lapses into indecency, highly praises the conciseness and clearness of his style, which, however, is artificial and laboured.

The large number of existing mss. attests the popularity of the romance. (*Editio princeps*, 1601; first important critical edition by Jacobs, 1821; later editions by Hirschig, 1856; Hercher, 1858. There are translations in many languages; in English by Anthony Hildes, 1638, and R. Smith, 1855.)

Suidas also ascribes to this author an *Etymology*, a *Miscellaneous History of Famous Men*, and a treatise *On the Sphere*. Part of the last is extant under the title of *An Introduction to the Phaenomena of Aratus*. But if the writer is the *prudētissimus Achilles*, referred to by Firmicus Maternus (about 336) in his *Matheseos libri*, iv, 10, 17 (ed. Kroll), he must have lived long before the author of *Leucippe*. The fragment was first published in 1567, then in the *Uranologion* of Petavius, with a Latin translation, 1630.

ACHILLINI, ALESSANDRO (1463–1512), Italian philosopher and anatomist, was born at Bologna, Oct. 29, 1463. A much admired lecturer at Bologna and Padua, he was called the "second Aristotle." He made some important studies of human anatomy and was one of the first anatomists to dissect a human cadaver. His philosophical works were printed in one volume in Venice in 1508, and reprinted with additions in 1545, 1551 and 1568. Among his anatomical writings were *Corporis humani anatomia* and *Anatomicae annotationes*. He died at Bologna on Aug. 2, 1512.

His brother, GIAN FILOTEO ACHILLINI (1466–1538), was the founder of the Academy of Viridario at Bologna in 1511, and the author of *Il Viridario* and other writings, verse and prose. His grand-nephew, CLAUDIO ACHILLINI (1574–1640) was a lawyer who achieved some fame as a versifier of the school of the Secentisti, a group of Italian writers characterized by affectation and extravagance of style.

BIBLIOGRAPHY.—His works were printed at Venice (1508, 1545, 1551 and 1568).

ACHIMENES, a genus of plants (family Gesneriaceae, to which belong also *Gloxinia* and *Streptocarpus*), natives of tropical America, and well known in cultivation as stove or warm greenhouse plants. They are herbaceous perennials, generally with hairy serrated leaves and handsome flowers. The corolla is tubular with a spreading limb, and varies widely in colour, being white, yellow, orange, crimson, scarlet, blue or purple.

ACHIN (Dutch, Atjeh), and dependencies, is a Dutch government in Sumatra, Netherlands Indies. It forms the northern extremity of the island, the boundary extending from Salahadj, a point on the east coast, just north of Aru bay, to a point on the west coast, about midway between Singkel and Barus, has

an area of 21,448 sq.mi. and is divided into four districts. It is very mountainous, with long ranges, running parallel with the axis of the island, and, particularly, in the east and extreme northwest, spurs projecting towards the coast. Most of the interior is mountainous, but, except in the extreme north, there is a fairly wide coastal plain, narrower in the east than in the west. The highest peaks are Bandahara (9,876 ft.) on the southern central boundary, Abongabong (9,794 ft.) in the central part and Leuser (11,092 ft.) in the south. In the north the coast is varied, the cliffs, crowned with dense vegetation, rising precipitously from the sea in places, while in other parts there are beaches or cultivated and populated plains. Elsewhere the coast is flat, and, in places, marshy. The rivers are short, run down sharply to the coast, and have little value for shipping, except small native boats. The ports of Achin are Oleh-leh and Sigli on the north and Lhokseumawe and Idi on the east coast, but large vessels go to the free port of Sabang on the island Pulu Weh, 50 mi. north of Oleh-leh. Oleh-leh is the gateway to Kota Raja, the capital of Achin. Kota Raja is situated on the Achin river, some three miles up from the sea. The capital of Achin, when this was the wealthiest and most powerful sultanate in northern Sumatra, having suzerainty over territory in the Malay Peninsula, Kota Raja still possesses remains of its former glory, but it consists largely of wooden and attap-roofed houses, built in *kampongs*, with the old Achinese citadel (now garrison-quarters), a large mosque, the modern residences of the governor and civil staff, offices of the administration, European business premises, together with two small hotels. Three bridges span the river. Kota Raja has a cable station, is connected by telegraph with Medan, and then across the island with Padang and the south generally. A steam tramway links it up with Oleh-leh and, across country, with Sigli, on the northeast coast, whence it proceeds to Kuala Simpang (Aru bay), where it joins up with the lines in Deli (east coast of Sumatra province). An agricultural adviser, representing the department of agriculture, trade and industry, is stationed at Kota Raja, and the town has a population of 10,724, composed of 1,137 Europeans and Eurasians, 6,146 natives, and 3,441 foreign Asiatics. The principal industries of Achin are silk weaving, gold working, wood carving and ship-building, and there is a fishing and coasting trade. Rice is the food staple, grown more under *sawah* culture than *ladang*, and there are irrigation works for rice culture. Pepper, copra and areca nuts and rubber are the chief exports, but sugar cane and fruit trees are grown, cattle-breeding is carried on. There are over 100,000 ac. under rubber (Hevea). Imports (1939) 2,502,000 and exports 7,442,000 guilders. Pop. (1930) 1,003,062, composed of—Europeans and Eurasians 3,244, natives 975,945, and foreign Asiatics, including Chinese, 23,873. The Achinese are Malayan, but smaller and thinner than the Malays, with darker skin and larger eyes. The people of the highlands (*orang tunong*) are prouder and more courageous and independent than those of the lowlands (*orang baroh*), but both are fond of warfare. The nobility usually claim Arab descent, and there are evidences of old-time contact with Hindus. Both men and women wear the characteristic wide Achinese trousers; the women are skillful weavers; the men fairly good craftsmen and skilled agriculturists. Rice, fish and vegetables, eaten twice daily, form the usual fare, betel-nut is used universally, and opium-smoking is indulged in, but strong drink is used only among the upper classes. Houses are built on piles, divided into several rooms, generally with front and back veranda, reached by steps. They stand in a fenced courtyard, with fruit trees about them—the domestic animals and birds live underneath—and are usually untidy in appearance. In a *meneusak*, without the village, the young unmarried men and strangers sleep, and it is also used for meetings and religious observances. Society is divided into families; there are traces of an old matriarchal form, but the patriarchal system is now general. Marriage is celebrated at an early age, divorce is rare, and polygamy is not common, except among the highest classes. The position of the Achinese woman is high. Achin is under direct Dutch government, but many Achinese chiefs exercise authority as government officials. The Achinese are Mohammedans.

The people are fond of competitions in recitations of poetry and of musical performances on native instruments; also of feasts and gambling, while animals are kept for fighting purposes.

See C. Snouck Hurgronje, *The Achehese* (Leyden, 1906).

HISTORY

Northern Sumatra was visited by a number of European travellers in the middle ages; for example, Marco Polo, Friar Odoric and Nicolo de' Conti (*q.v.*). But the first voyager to visit Achin, known then by that name, was Alvaro Tellez, a captain of Tristão da Cunha's fleet, in 1506. It was then a mere dependency of the adjoining state of Pedir. By 1526 Achin had assimilated all the other states of northern Sumatra, but its power was at its height in the time of Sultan Iskandar Muda (1607–36). At that period the territory extended from Aru opposite Malacca round the north to Benkulen on the west, 1,100 mi. of seaboard; the island of Nias with the continental states of Johor, Pahang, Kedah and Perak were subject states.

The traders of the 17th century went to Achin for gold. The first Dutch (1599) and first English (1602) commercial ventures to the Indies were to Achin. Letters were sent from Queen Elizabeth and King James I to the princes of Achin. But jealousy and suspicion interfered with trade and the English factory, erected several times, was not long maintained. The French attempted unsuccessfully in 1621 to establish relations as, in spite of all difficulties, the trade was important. William Dampier (*c.* 1688) speaks of the number of foreign merchants settled there.

The Portuguese were constantly warring with the kings of Achin until the former lost Malacca (1641). Iskandar Muda sent 60,000 men against Malacca in 1615, but the Portuguese held out. From 1641 four queens successively reigned over Achin, but in 1699 the Arab or fanatical party suppressed female government and put a chief of Arab blood on the throne. From that time Achin's power decayed rapidly.

After the restoration of Java to the Netherlands in 1816 a good deal of weight was attached by the neighbouring British colonies to the maintenance of influence in Achin, and in 1819 a treaty of friendship was concluded by Achin with the Calcutta government which excluded other European nationalities from fixed residence in Achin. When the British government, in 1824, made a treaty with the Netherlands, surrendering the remaining British settlements in Sumatra in exchange for certain possessions on the continent of Asia, no reference was made in the articles to the Indian treaty of 1819; but an understanding was exchanged that it should be modified while no proceedings hostile to Achin should be attempted by the Dutch.

This reservation was formally abandoned by the British government in a convention signed at The Hague on Nov. 2, 1871; and in March 1873 the government of Batavia declared war upon Achin. Doubtless there was provocation, for the sultan of Achin had not kept to the understanding that he was to guarantee immunity from piracy to foreign traders; but the necessity for war was greatly doubted, even in the Netherlands. A Dutch force landed at Achin in April 1873 and attacked the palace but was defeated. Another attempt ended in the fall of Achin in Jan. 1874. General van der Heyden seemed to have quelled them (1878–81), but in 1896 they revolted again and not till 1898 and the succeeding year did General van Heutsz restore order. In 1901 the pretender sultan fled to the Gajoes, a neighbouring tribe inland and for three years heavy fighting went on. Later the coastal regions were subdued, but in the interior there was recurrent trouble. Japan occupied the area in March 1942, during World War II.

See P. J. Veth, *Atchin en zijne betrekkingen tot Nederland* (Leyden, 1873); J. A. Kruijt, *Atjeh en de Atjehers* (Leyden, 1877); Kielstra, *Beschrijving van den Atjeh-oorlog* (The Hague, 1885); Renaud, *Jaarboek van het Mynwezen* (1882); J. Jacobs, *Het familie-en Kampong-gleven op Groot Atjeh* (Leyden, 1894); C. Snouck Hurgronje, *De Atjehers* (Batavia, 1894, trans. 1906); W. Volz, *Nord-Sumatra; Die Gajoländer* (Berlin, 1912). See also *Tijdschrift voor Taal en Volkenkunde Nederlandse Indie*.

ACHINESE, a Sumatran tribe of Proto-Malayan stock modified by Hindu and Arab elements, the darker complexion of the

lowlanders as distinct from the highlanders of the tribe being attributed to a greater infusion of south Indian blood. They are Muslims but not strict and early in the 13th century became important in the East Indies, having commercial and political relations with Egypt, Europe and Japan. Noted for valour and love of freedom, they long maintained their independence against the Dutch. They are excellent craftsmen; women go unveiled and there is little polygamy. Their language, though Malayan, contains many Sanskrit words, and there are other remnants of their former Hindu or Buddhist culture.

See E. Marsden, *History of Sumatra* (1783); C. Snouck Hurgronje, *The Achehese* (1906).

ACHINSK. (1) A province in the Siberian area of the R.S.F.S.R. Area 25,169 sq.mi. Population 392,000; urban 24,997; rural 367,003. It consists of pine, spruce and birch forest, with open grassy areas on which rye and wheat are grown by the peasants and immigrant colonists. The winter is severe and occasionally early frosts ruin the crops. Gold is found to the west of the town of Achinsk. (2) A market centre, lat. 56° 30' N., long. 90° 35' E., on the Chulym river, which links it with the Ob river. It is on the Trans-Siberian railway and has a branch to the rich Minusinsk district.

ACHOLI, a Negro people of the upper Nile valley, akin to the Shilluks of the White Nile. They frequently decorate the temples or cheeks with wavy or zigzag scars and also the thighs with scrolls; some pierce the ears. Their huts are circular with a high peak, a mud sleeping platform, jars of grain and a sunk fireplace; they are decorated with geometrical or conventional designs in red, white or gray. The Acholi are good hunters, using nets and spears, and keep goats, sheep and cattle. In war they use spears and long, narrow shields of giraffe or ox hide. Their language is Nilotic. Their religion is a vague fetishism.

ACHROMATIC LENS, a combination of two or more lenses corrected for chromatic aberration. (See OPTICS; LENS; PHOTOGRAPHY: *Photographic Lenses*.)

ACHURCH, JANET (Mrs. C. CHARRINGTON) (1864–1916), English actress, was born in Manchester. She first appeared at the Olympic theatre, London, Jan. 8, 1883, with Geneviève Ward in the farce of *Betsy Baker*. Two years later she joined Frank Benson's company and played Shakespearean heroines; but her chief success was gained as Nora Helmer in Henrik Ibsen's *A Doll's House*, when that play was first produced in England in 1889. She appeared later in other Ibsen plays and in those of Bernard Shaw.

ACIDALIUS, VALENS (1567–1595), German scholar and critic, was born at Wittstock on May 25, 1567, and died at Neisse on May 25, 1595, at the age of 28. Acidalius wrote notes on Velleius Paterculus (1590), Curtius (1594), the panegyrists, Tacitus and Plautus, published after his death.

See Leuschner, *Commentatio de A. V. Vita, Moribus, et Scriptis* (1757).

ACIDIMETRY, the determination of the quantity of available acid in a sample of material. (See CHEMISTRY: *Analytical Chemistry*.)

ACIDS AND BASES. Acid is the name loosely applied to any substance which, in water solution, tastes sour, changes the colour of indicators (*e.g.*, reddens blue litmus), reacts with some metals (*e.g.*, iron) to liberate hydrogen and “neutralizes” bases. Base is the name loosely applied to any substance which, in water solution, is slippery to the touch, tastes bitter, reverses the colour changes produced by acids on indicators (*e.g.*, turns red litmus blue) and neutralizes acids. Neutralization is the process whereby an acid and a base enter into a chemical reaction which destroys the characteristic properties of both and produces a compound known as a salt.

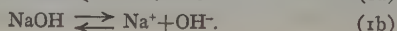
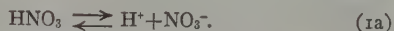
There are several different scientific definitions of acids and bases in current use; these will be explained below.

Among the industrially important acids are sulphuric, nitric, hydrochloric, phosphoric and acetic; among the industrially important bases are sodium and potassium hydroxides, sodium and potassium carbonates, calcium oxide (lime) and ammonia. Sulphuric acid (*q.v.*) is manufactured in the United States for about

\$17 a ton at the rate of more than 8,000,000 tons per year. It is thus one of the most important of chemical products; the tonnage produced annually greatly exceeds that of any metal except iron. Sulphuric acid is used in the refining of petroleum, in storage batteries, in "pickling" steel, in the manufacture of fertilizer, etc. Nitric acid (*q.v.*) and acetic acid (*q.v.*) are widely used in chemical industry. Among the uses for the former are the manufacture of explosives and of dyestuff intermediates; among the uses for the latter are the manufacture of plastics and of solvents. Sodium and potassium hydroxide (see **ALKALI**) are used in soap manufacture; sodium carbonate is one of the important ingredients for the manufacture of glass and is used in the household as washing soda. Ammonia (*q.v.*) is widely used, in the form of ammonium sulphate, as a fertilizer; it is also the raw material for the production of much nitric acid. The references already cited give the details regarding the manufacture and use of these compounds; here only the theory of acids and bases is considered.

History.—Almost the only acid substance known to the Egyptians, Greeks and Romans was vinegar which was produced by the action of air on wine (fermentation). Vinegar is a dilute and impure solution of acetic acid in water; the word "acid" is derived from the Greek *ὄξυς*, sour, and *ῥος*, vinegar. Impure acetic acid (vinegar) was utilized industrially by the ancients. Theophrastus of Eresus, in the 4th century B.C., gave directions quite similar to comparatively modern ones for the preparation of white lead pigment from vinegar and metallic lead. Sodium carbonate (obtained by the evaporation of alkaline water from arid regions) and potassium carbonate (from wood ashes) were known in ancient times; lime was obtained, as it is today, by roasting calcium carbonate. The manufacture of sodium and potassium hydroxides by the action of lime on sodium and potassium carbonates was also practised. The exact dates at which these substances were first prepared is unknown, but the manufacture of glass (which required sodium carbonate) was practised in Egypt at least as early as 1400 B.C.

During the middle ages, the alchemists slowly increased the knowledge of acids and bases. The preparation of nitric acid (*aqua fortis*) by the destructive distillation of a mixture of alum, iron sulphate and potassium nitrate was described by Geber around 1300, and the preparation of sulphuric acid by the destructive distillation of iron sulphate was known before 1600. (See **ALCHEMY**.) Still later, an explanation was sought for the behaviour of acids and bases. One of the early theories was that of Bertrand (1683), who suggested that "... an acid is a liquid body composed of small, firm and pointed particles, slightly resembling fine and delicate needles." He supposed that alkalis consist of "particles which have between their junctions pores of different structures" and that neutralization results when the needles of the acid enter the pores of the alkali. According to the phlogiston theory current in the early 18th century, the acids, such as sulphurous, phosphoric, etc., which are produced by combustion, were regarded as elementary substances. This misapprehension was abandoned along with the phlogiston theory, and temporarily replaced by Antoine Laurent Lavoisier's doctrine (1778) that oxygen is the acid-producing element. About 1808-10, the researches of Sir Humphry Davy and of J. L. Gay-Lussac and L. J. Thénard on hydrochloric acid established beyond doubt that hydrogen and not oxygen is the element essential (although not sufficient) for acidic properties. The hydrogen theory of acids was extended by S. A. Arrhenius, who showed (1887) that, in aqueous solution, acids are partly ionized (*i.e.*, they are partly separated into charged particles called ions). He further suggested that an acid should be defined as a substance which ionizes in water to yield hydrogen ions; a base should be defined as a substance which ionizes in water to yield hydroxide ions. The definitions of acids and bases given above will hereafter be called the "classical" ones. For example, nitric acid was assumed to ionize according to equation (1a); sodium hydroxide according to equation (1b):

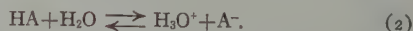


The characteristic properties of acids and bases were ascribed respectively to the hydrogen ion, H^+ , and the hydroxide ion, OH^- . A substance containing hydrogen which does not ionize in aqueous solution to produce hydrogen ions (*e.g.*, methane, CH_4) is then not an acid. In qualitative terms, a strong acid, when dissolved in water, largely or completely ionizes and thus produces a high concentration of hydrogen ions, whereas a weak acid when dissolved in water is only slightly ionized, and thus produces only a low concentration of hydrogen ions. Modern concepts of both acids and bases have been developed from Arrhenius' theory.

The "Hydrogen-Ion" Theory of Acids.—An enormous amount of evidence supporting Arrhenius' theory of acids and bases has been accumulated since the 1880s. (See **SOLUTIONS: Solutions of Electrolytes**.) It is a pertinent fact, for example, that a solution of hydrochloric acid in water conducts electricity and that, when the current passes, hydrogen gas is liberated at the negative electrode (*i.e.*, the cathode). In dilute solutions of the acid, oxygen is liberated at the positive electrode (*i.e.*, the anode). These facts (and many others) can be explained by assuming that hydrochloric acid in aqueous solution is an assembly of chloride ions, Cl^- , and of hydrogen ions. The hydrogen ion, H^+ , exists in water only as the hydrate, H_3O^+ (H^+ plus H_2O), called the hydronium ion; the evidence for this statement will be presented later.

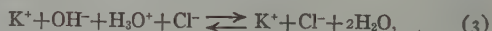
Many of the reactions of aqueous solutions of acids and bases can be explained on the basis of the ionic theory. For example, the existence of charged particles in the solution accounts for the fact that the solution conducts electricity. The existence of H_3O^+ ions (hydrated hydrogen ions) is consistent with the fact that hydrogen gas is liberated at the cathode, for these positively charged hydronium ions are repelled by the positive electrode and attracted to the negative one, where they are discharged; hydrogen and water are thus liberated.¹ Similarly, a solution of sodium hydroxide in water is assumed to consist of an assembly of sodium ions, Na^+ , and hydroxide ions, OH^- . During electrolysis, the negatively charged hydroxide ions migrate toward the anode and are there discharged to form oxygen and water. The interpretation here advanced is made much more plausible by quantitative experiments on the changes in composition which, during electrolysis, take place in those portions of the solution near the electrodes (transference experiments; see **ELECTROCHEMISTRY**).

The ionic theory helps to account for differences in the strengths of acids and bases. Any acid, HA , when introduced into water, rapidly comes to chemical equilibrium with its ions (see **Quantitative Studies of Acids and Bases**, below; also **THERMODYNAMICS**):



Bases ionize similarly to give hydroxide ions. Such an ionization reaction may be essentially complete, as it is in an aqueous solution of the strong base sodium hydroxide, which is largely ionized even in the solid state; or it may be far from complete, as it is in an 0.1 molar aqueous solution of acetic acid, where less than 1.5% of the acid is dissociated into ions, and the rest remains as un-ionized molecules.

The ionic theory is also useful in explaining the process of neutralization. When an acid and a base neutralize one another, the hydronium (hydrated hydrogen ion) and hydroxide ions combine to form water; if equivalent quantities of the two materials are present, the reaction proceeds essentially to completion because water is only slightly dissociated into ions. The chemical equation for the reaction between potassium hydroxide and hydrochloric acid is written



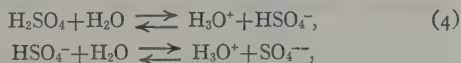
which may be simplified to



¹Although all acids when electrolyzed liberate hydrogen at the cathode, it is not true that all compounds which liberate hydrogen at the cathode are acids. During the electrolysis of the aqueous solutions of some salts, the weak acid water, rather than the salt itself, is decomposed. Such salts, however, have no acidic properties; for example, they do not redden blue litmus.

where the potassium and chloride ions, which do not really enter into the chemical reaction, are omitted. However, these ions are present after the neutralization; with the water produced by the neutralization and the excess water present as a solvent, the ions form a solution of potassium chloride (a salt).

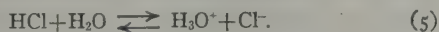
Many acids ionize in water to give more than one hydronium ion; these are called polybasic acids because each molecule of acid can neutralize more than one molecule of base. For example, sulphuric acid is dibasic; it ionizes in two steps:



and forms two series of salts, corresponding to NaHSO_4 and Na_2SO_4 ; phosphoric acid (H_3PO_4) is tribasic and forms three series of salts. Bases (e.g., $\text{Ba}[\text{OH}]_2$) which can ionize to give more than one hydroxide ion per molecule are called polyacid bases. The characteristic reactions of acids other than neutralization and salt formation (e.g., the colour changes of indicators, the formation of hydrogen with metals and of carbon dioxide with carbonates) can also be explained in terms of the ionic theory. Furthermore, this theory has led to an understanding of the mechanism by which acids catalyze some reactions. For example, the role of strong acids in the bromination of acetone is explained in terms of ionization equilibria. (See REACTION KINETICS.) The explanations for the characteristic reactions of bases parallel those for the reactions of acids.

Some acids are inorganic compounds and some are organic compounds. Among the former are sulphuric, nitric, hydrochloric, perchloric, hydrofluoric, hydrobromic, phosphoric, sulphurous, hypochlorous and arsenic acids. The organic acids are further subdivided according to the structural feature in the molecule which is responsible for the acid properties. For example, there are carboxylic acids (acetic, butyric, benzoic, phthalic, stearic, oleic, etc.), sulphonic acids (benzene sulphonic acid, naphthalene disulphonic acid, etc.), phenols (phenol, or carbolic acid, cresol, etc.), enols (ascorbic acid or vitamin C, etc.) and other types too numerous to mention. Bases include the hydroxides of sodium, potassium, calcium, barium, copper, iron and other metals, as well as the hydroxides related to ammonia and to numerous organic compounds most of which are amines (compounds closely related to ammonia) such as methylamine, aniline and pyridine. There are a few compounds such as aluminum and zinc hydroxides and water, which have both slight acidic and slight basic properties; these substances are called amphoteric.

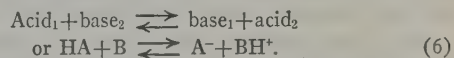
The Hydronium Ion.—The hydrogen ion in aqueous solution was for a long time written simply as H^+ . This notation implied that the proton (the nucleus of a hydrogen atom [see ATOM]) could exist free in solution. The proton has no electrons around its nucleus and is therefore a small particle. Hence, the electrostatic field in its neighbourhood should be great. On these theoretical grounds, the existence of protons in aqueous solution appears doubtful. All the ions known to exist under such conditions have two or more electrons around their nuclei. A number of experiments have lent support to the notion that the hydrogen ion exists in aqueous solution only as the hydronium ion, H_3O^+ . Among these can be cited the fact that liquid hydrogen chloride is a nonconductor of electricity. This compound, however, when dissolved in water, conducts current well. These phenomena are just what would be expected if pure hydrogen chloride did not ionize (i.e., if H^+ alone could not exist under the conditions cited). When gaseous hydrogen chloride dissolves in water, the following strongly exothermic reaction presumably takes place:



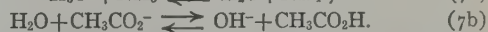
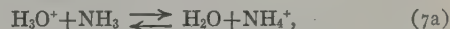
X-ray analysis shows definitely that the hydronium ion does exist at least under certain circumstances. For example, the lattice of crystalline perchloric acid monohydrate consists of hydronium and perchlorate (ClO_4^-) ions. It is true that ions other than the hydrogen ion interact with water; moreover, hydronium ion in aqueous solution tends to combine with water to form hydrates of an indefinite type. But whereas, in crystalline and molten

salts, ions other than the hydrogen ion can exist, there is no evidence for the existence of uncombined protons in either solid or liquid phases. (Free protons can exist under special circumstances in the gas phases; e.g., in a cyclotron.) In view of these facts, the hydronium ion, H_3O^+ , will here be written for the hydrogen ion in aqueous solution.

Bronsted-Lowry Definition.—A broader definition of acids and bases was introduced by J. N. Bronsted and T. M. Lowry simultaneously and independently in 1923. According to this definition, any compound which can transfer a proton to any other compound is an acid; the compound which accepts the proton is a base. Two considerable advantages of the Bronsted-Lowry definition are that it can be applied to nonaqueous solutions and that it codifies and simplifies acid-base reactions. It is not inconsistent with the classical definition of acids in terms of hydrogen ions, but is rather an extension of the older concept. According to the Bronsted-Lowry scheme, all acid-base equilibria are then represented by the equation:



Here A^- and B are described as the conjugate bases of the acids HA and BH^+ , respectively; similarly, HA and BH^+ are the conjugate acids of the bases A^- and B . In such generalized equations the presence or absence of an electric charge on any particle does not necessarily indicate the net charge on the particle in question. It merely shows that an acid has one more positive or one less negative charge than its conjugate base, and conversely that a base has one less positive charge or one more negative charge than its conjugate acid. Examples of acid-base equilibria are shown in equations (7a) and (7b):



In these equations, ammonium ion is the acid conjugate to the base ammonia, acetic acid is the acid conjugate to the base acetate ion, hydronium ion is the acid conjugate to the base water, and water is the acid conjugate to the base hydroxide ion. (Water is thus seen to be amphoteric.) According to the Bronsted-Lowry scheme, the existence of acids implies the existence of bases (and vice versa), just as the existence of oxidizing agents implies the existence of reducing agents (and vice versa).

It has long been known that an aqueous solution of pure sodium acetate gives a basic reaction toward litmus. This fact may be explained by equation (7b), which shows that the reaction between water and acetate ion produces some hydroxide ions, which are responsible for the colour changes of the indicator. In classical language, reaction (7b) is described as the hydrolysis of the acetate ion; in Bronsted-Lowry's terminology, it is called the ionization of the base, acetate ion.

The hydrolysis (equation [7a]) of ammonium chloride (classical) is similarly replaced by the ionization of the acid, ammonium ion (Bronsted-Lowry). A solution of aniline hydrochloride has about the same acidity as one of acetic acid; it is, therefore, both convenient and informative to state that the anilinium ion, $\text{C}_6\text{H}_5\text{NH}_3^+$, is an acid of about the same strength as acetic acid.

The Bronsted-Lowry definition considerably enlarges the number of compounds considered (on the basis of the classical definition) as acids and bases. The class of bases is expanded to include not only the hydroxide ion and amines but also the acetate ion, phosphate ion, carbonate ion, sulphide ion, etc., since each of these negative ions can acquire a proton from an appropriate acid. Similarly, the class of acids is expanded to include the ammonium ion, anilinium ion, the oxonium ion of alcohol, etc., since each of these positive ions can transfer a proton to an appropriate base. Furthermore, the hydrogen (or hydronium) and hydroxide ions are no longer considered the exclusive bearers of acidic and basic properties; an example in which un-ionized molecules function as acids is afforded by the phenomenon of general acid catalysis.

One of the characteristic properties of acids and of bases is that they increase the rate of (i.e., they catalyze) certain chemi-

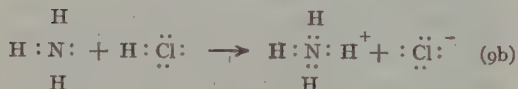
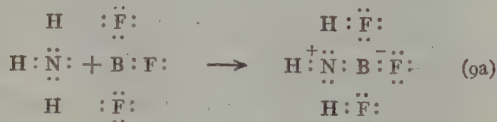
cal reactions. There are a number of reactions, such as the hydrolysis (inversion) of cane sugar, which are catalyzed exclusively by hydronium ions; similarly, there are reactions catalyzed exclusively by hydroxide ions. But there are reactions (*e.g.*, the decomposition of nitramide) which are catalyzed by all bases, reactions (*e.g.*, the hydrolysis of ethyl orthoacetate) which are catalyzed by all acids and reactions (*e.g.*, the bromination of acetone) which are catalyzed by all acids and all bases, the terms acid and base being used here in the Bronsted-Lowry sense.

The rate constant (*see* REACTION KINETICS) for a reaction of the third type can be represented as a sum

$$k = k_0 + \sum_A k_A c_A + \sum_B k_B c_B, \quad (8)$$

where k_A is the rate constant associated with each acid present at a concentration c_A , k_B is the rate constant associated with each base present at a concentration c_B , k_0 is the rate constant for catalysis by water and the symbol $\sum$ indicates a summation over all acids (or bases) present in the solution. In those general acid or general base reactions, the mechanism of which is understood, the rate-controlling step is actually the acid-base reaction; *e.g.*, the reaction whereby a base removes a proton from a weak acid. Here the usefulness of the Bronsted-Lowry definition is obvious.

Lewis Definition.—G. N. Lewis has suggested (1923) a definition for the word acid which extends this class of compounds even beyond the limits set by Bronsted and Lowry. According to the electronic concept of valence (*see* CHEMISTRY), a proton from an acid, during neutralization, becomes attached to an unshared pair of electrons in the molecule of a base. Lewis used the word acid to include all substances which, during a chemical reaction, become attached to an unshared pair of electrons in some other molecule. This definition includes, besides the conventional acids, such substances as aluminum chloride, boron trifluoride and zinc chloride. For example, boron trifluoride (*see* equation [9a]) reacts with ammonia much as does hydrogen chloride (equation [9b]). The electronic structures of the reactants and reaction products are shown in equations (9a) and (9b):

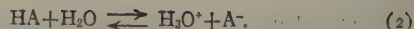


Furthermore, in certain nonaqueous solvents, boron trifluoride and aluminum chloride react with indicators to produce the same colour changes produced by conventional acids; these same reagents catalyze many reactions (*e.g.*, the Friedel-Crafts reaction) which are known to be acid catalyzed. It should be noted that the Lewis definition of acid departs from both the classical and Bronsted-Lowry use of the word, in that hydrogen is no longer considered essential to acidity.

The analogy which Lewis has pointed out between conventional acids, such as sulphuric, and materials, such as boron fluoride, is an important one. Whether these materials should be called acids is a matter of nomenclature depending on personal preference and usage. Most chemists in 1946, however, referred specifically to the substances in question as "Lewis acids" or as "electrophilic reagents" or as "cationoid reagents."

Quantitative Studies of Acids and Bases.—It has previously been pointed out that those acids which in aqueous solution are largely dissociated into ions are called strong acids; those which under similar conditions are only slightly dissociated are called weak acids. There have been many quantitative investigations of the strengths of acids in various solvents; here only aqueous solutions will be discussed.

In water, any acid HA is ionized according to equation (2),



The equilibrium constant for the reaction is represented by equation (10):

$$\frac{[\text{H}_3\text{O}^+][\text{A}^-]}{[\text{HA}]} = K_A, \quad (10)$$

where the expressions in brackets represent the activities of the acid and its ions. (The activity of each ion or molecule is approximated in dilute solution by its concentration; *see* THERMODYNAMICS.) The activity of water is omitted from equation (10) because it is for all practical purposes constant and can therefore be included in the equilibrium constant K_A . A strong acid then is one with a large value for its ionization constant K_A ; indeed, the value of this constant is a quantitative measure of the strength of the acid in question. In accordance with the equation (10), the more dilute the solution, the more extensively is the acid ionized. If it is possible by some analytical technique to determine the concentration of hydronium ions in solution, where the gross concentration of ionized and un-ionized acid is known, K_A may be computed. No purely chemical method of analysis for H_3O^+ can succeed because, when hydronium ions are removed by any reaction whatsoever, the equilibrium (2) is rapidly re-established and more acid is ionized. Chemical methods, therefore, determine only the gross amount of acid present, not the amount ionized at any given moment; these methods are then useful for quantitative analysis of solutions of acids and bases. There are, however, many physical methods for determining the momentary concentration (or activity) of the hydronium ions. (*See* HYDROGEN IONS.) They include colorimetric, conductimetric, electro-metric, catalytic and other methods. Here only the colorimetric method will be outlined, as an example of the type of procedure which can be employed.

If the ion A^- , or the acid HA, is coloured, or if both are coloured and the colours differ, then the ionization constant can be determined colorimetrically. The colour intensity per mole of the ion A^- is determined from a solution of its sodium or potassium salt; the colour intensity per mole of the acid HA is determined from an aqueous solution of a mixture of the acid in question and some strong acid (such as hydrochloric) which represses the ionization of the weaker acid. The concentrations of the ion A^- and of the acid HA are then determined colorimetrically, or spectrophotometrically, for any solution in which both are present. From considerations of electrical neutrality, the concentration of hydronium ion can then be computed. The method described can be extended to include ultra-violet and Raman as well as visible spectra.

The ion product of water, K_w , has been accurately determined (*see* equation [3a]) and from this constant and the ionization constant of any acid, the ionization constant of the conjugate base may be computed as follows:

$$[\text{H}_3\text{O}^+][\text{OH}^-] = K_w = 1 \times 10^{-14} \text{ at } 25^\circ \text{C.},$$

$$\frac{[\text{H}_3\text{O}^+][\text{A}^-]}{[\text{HA}]} = K_A, \quad (11)$$

$$\frac{[\text{HA}][\text{OH}^-]}{[\text{A}^-]} = K_w/K_A = K_B.$$

Here as before the symbols HA and A^- do not necessarily represent uncharged and charged particles, respectively; they are intended only to show that any acid has one more positive charge (or one less negative charge) than its conjugate base. For example, it is convenient sometimes to speak of the acid strength of the ammonium ion and sometimes of the base strength of ammonia; the two ionization constants are related by equations (11).

It is to be noted that, with an amphoteric substance, HA, the equations (11) relate the acid ionization constant of HA with the basic ionization constant of the conjugate base A^- , and also relate the basic ionization constant of HA with the acid ionization constant of the conjugate acid H_2A^+ . There is on the other hand no general quantitative relationship between the acid and basic ionization constants of the amphoteric substance HA, itself.

In aqueous solution, sulphuric acid, nitric acid and hydrochloric acid are all strong acids; that is to say, they are all largely ionized. The ionization constant of hydrochloric acid and the first ionization constant of sulphuric acid are in fact so large that they have not yet been properly measured in water; the ionization constant of nitric acid, although large, is measurable. Most organic acids, on the other hand, are weak acids, and some of them are very weak. Table I contains the ionization constants of some representative acids.

TABLE I.—The Ionization Constants of Selected Acids in Water (25° C.)

Acid	K _A
Perchloric acid (HClO ₄)	Too great to measure
Benzene sulphonic acid (C ₆ H ₅ SO ₃ H)	Too great to measure
Sulphuric acid (H ₂ SO ₄)	Too great to measure
Hydrochloric acid (HCl)	Too great to measure
Nitric acid (HNO ₃)	6.24
Bisulphate ion (HSO ₄ ⁻)	1.0 × 10 ⁻²
Phosphoric acid (H ₃ PO ₄)	7.5 × 10 ⁻³
Sulphurous acid (H ₂ SO ₃)	1.3 × 10 ⁻²
Chloroacetic acid (CH ₂ ClCO ₂ H)	1.38 × 10 ⁻³
Formic acid (HCO ₂ H)	1.8 × 10 ⁻⁴
Acetic acid (CH ₃ CO ₂ H)	1.8 × 10 ⁻⁵
Carbonic acid (H ₂ CO ₃)	4.3 × 10 ⁻⁷
Dihydrogenphosphate ion (H ₂ PO ₄ ⁻)	6.2 × 10 ⁻⁸
Phenol (C ₆ H ₅ OH)	1.1 × 10 ⁻¹⁰
Bicarbonate ion (HCO ₃ ⁻)	4.7 × 10 ⁻¹¹
Water (H ₂ O)	1.8 × 10 ⁻¹⁶
Acetophenone (C ₆ H ₅ COCH ₃)	Too small to measure
Triphenylmethane (C ₆ H ₅) ₃ CH	Too small to measure

It should be pointed out that most of the ionization constants which cannot be measured for aqueous solution can be measured (or at least estimated) for solutions in other solvents. The strengths of some representative bases are shown in Table II.

TABLE II.—The Ionization Constants of Selected Bases in Water (25° C.)

Base	K _B
Sodium hydroxide (NaOH)	Too great to measure
Guanidine (NH ₂ C[NH(NH ₂) ₂])	Too great to measure
Diethylamine ((C ₂ H ₅) ₂ NH)	9.6 × 10 ⁻⁴
Ammonia (NH ₃)	1.8 × 10 ⁻⁵
Diethanolamine ((C ₂ H ₅ OH) ₂ NH)	7.6 × 10 ⁻⁷
Diethylaniline (C ₆ H ₅ N(C ₂ H ₅) ₂)	3.7 × 10 ⁻⁸
Aniline (C ₆ H ₅ NH ₂)	3.8 × 10 ⁻¹⁰
Water	1.8 × 10 ⁻¹⁶
Urea	Too small to measure
Acetanilide	Too small to measure

It should be noted that with the aid of equations (11) all the data in Tables I and II could have been presented respectively in terms of the ionization constants of the conjugate bases and acids.

The differences in acid and base strength among compounds of the types listed have to a considerable extent been accounted for. The fact that ammonia is a much stronger base than water is related to the atomic structures of nitrogen and oxygen. Oxygen, with a higher nuclear charge, does not attract the positively charged protons as strongly as does nitrogen. The fact that aniline is a weak base compared with ammonia has been ascribed to quantum mechanical resonance (*see* RESONANCE, THEORY OF), and the fact that chloroacetic acid is stronger than acetic acid has been ascribed to the electrostatic effect of the carbon-chlorine dipole.

For some purposes, it is convenient to speak not of the activity of the hydronium ion but of the logarithm of that quantity.

For a discussion of this matter *see* HYDROGEN IONS.

Nonaqueous Solvents.—Water solutions have been more thoroughly investigated than any other solutions, but the phenomena of acidity and basicity are by no means limited to solutions in water; in fact, nonaqueous solutions exhibit a broader range of acidity and basicity than do aqueous solutions. In water solution, no acid much stronger than H₃O⁺ can exist, for otherwise it would transfer a proton to the solvent; similarly, in water solution no base much stronger than hydroxide ion can exist since otherwise this base would react with water and accept a proton from it. For nonaqueous solvents, the classical definitions of acids

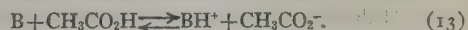
and bases must be abandoned; the simplest adequate definition is that of Bronsted and Lowry.

Two solvents of particular interest, which illustrate the principles involved, are liquid ammonia (boiling at -33° C.) and pure acetic acid (b.p. 118° C.). An acid dissolved in liquid ammonia reacts with the solvent according to equation (12):

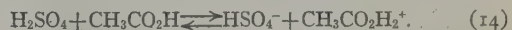


This equation is analogous to equation (2) for water. In liquid ammonia, the ammonium ion is the solvated proton; it functions as an acid. Similarly, the amide ion, NH₂⁻, functions as a base. Solutions of the ammonium ion in liquid ammonia liberate hydrogen from active metals (*e.g.*, sodium), change the colour of indicators, conduct electricity and neutralize solutions of amide ions. Both the acid in the ammonia system, NH₄⁺, and the base, NH₂⁻, exert strong catalytic effects on reactions carried out in ammonia.

Acids and bases function in analogous fashion in glacial acetic acid. Here the strongest possible base is the acetate ion; any stronger base reacts with the solvent



Strong acids such as sulphuric ionize according to the equation



Solutions of both acids and bases in acetic acid neutralize one another, conduct electricity and strongly catalyze chemical reactions.

A valuable acidity scale has even been constructed for sulphuric acid as a solvent; many of the important chemical properties of this acid have thereby been correlated and explained.

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ACINACES, from the Greek. An ancient Persian sword, short and straight, and worn, contrary to the Roman fashion, on the right side, or sometimes in front of the body, as shown in the bas-reliefs found at Persepolis. Among the Persian nobility it was frequently made of gold, being worn as a badge of distinction. The acinaces was an object of religious worship with the Scythians and others (Herod., iv, 62).

ACIREALE (anc. Acis), town and episcopal see, province of Catania, Sicily; 9 mi. N.E. from Catania by rail. Pop. (1936) 19,440 (town), 36,871 (commune). The thermal springs were used by the Romans.

Acireale took its name from the river Acis, into which Acis, the lover of Galatea, was changed after he had been slain by Polyphemus.

ACIS, in Greek mythology, the son of Pan (Faunus) and the nymph Symaethis, a beautiful shepherd of Sicily, the lover of the Nereid Galatea. His rival, the Cyclops Polyphemus, surprised them together and crushed him to pieces with a rock. His blood, gushing forth from beneath, was metamorphosed by Galatea into the river bearing his name (now Fiume di Jaci) (Ovid, *Met.*, xiii, 750; Silius Italicus, *Punica*, xiv, 221).

ACKER, CHARLES ERNEST (1868–1920), U.S. inventor and manufacturer, was born in Bourbon, Ind., on March 19, 1868. Following his graduation from Cornell university in 1888 he practised electrical engineering in Chicago, Ill., until 1893. He originated a process for making caustic soda from molten salt by electrolysis, and established works in Niagara Falls, N.Y., for the manufacture of soda and other chemical products. He devised various other chemical and electrochemical processes, and obtained numerous patents for his inventions pertaining to electrochemical manufacture. In recognition of his services to chemical technology he was awarded in 1902 the Elliott Cresson medal of the Franklin institute.

Acker died in Ossining, N.Y., on Oct. 18, 1920.

ACKERMAN, FRANCIS (c. 1335–1387), Flemish soldier

and diplomat, was born at Ghent. He was partly responsible for inducing Philip van Artevelde to become first captain of the city of Ghent in 1382. He secured for Ghent assistance from the citizens of Brussels, Louvain and Liège, and, as admiral of the Flemish fleet, visited England and obtained a promise of help from King Richard II.

After Artevelde's death in Nov. 1382, Ackerman acted as leader of the Flemings. He took part in the conclusion of the treaty of peace between Ghent and Philip the Bold, duke of Burgundy, in Dec. 1385. Trusting in Philip, and ignoring the warnings of his friends, Ackerman remained in Flanders and was murdered at Ghent on July 22, 1387, leaving a memory of chivalry and generosity.

See Jean Froissart, *Chroniques*, ed. by S. Luce and G. Raynaud (Paris, 1869-97); Johannes Brandon, *Chronodromon*, ed. by K. de Lettenhove in the *Chroniques relatives à l'histoire de la Belgique sous la domination des ducs de Bourgogne* (Brussels, 1870).

ACKERMANN, JOHANN CHRISTIAN GOTTLIEB (1756-1801), German physician, was born at Zeulenroda, in Upper Saxony, on Feb. 17, 1756, and died at Altdorf on March 9, 1801. At the age of 15 he became a student of medicine at Jena under E. G. Baldinger, whom he followed to Göttingen in 1773, and later he studied for two years at Halle. A few years of practice at Stendal, 1778-99, where there were numerous factories, enabled him to add many valuable original observations to his translation, 1780-83, of Bernardino Ramazzini's (1633-1714) treatise on diseases of artificers.

In 1786 he became professor of medicine at the University of Altdorf, in Franconia, occupying first the chair of chemistry and then, from 1794 until his death in 1801, the chair of pathology and therapeutics.

He wrote *Institutiones Historiae Medicinae* (Nuremberg, 1792) and *Institutiones Therapiae Generalis* (Nuremberg and Altdorf, 1784-95), in addition to various handbooks and translations.

ACKERMANN, LOUISE VICTORINE CHOQUET (1813-1890), French poet, was born in Paris on Nov. 30, 1813. Educated by her father in the philosophy of the encyclopaedists, Victorine Choquet went to Berlin in 1838 to study German, and there married in 1843 Paul Ackermann, an Alsatian philologist. After little more than two years of happy married life her husband died, and Mme. Ackermann went to live at Nice. In 1855 she published *Contes en vers*, and in 1862 *Contes et poésies*. Very different from these simple and charming *contes* is the work on which Mme. Ackermann's real reputation rests. She published in 1874 *Poésies, premières poésies, poésies philosophiques*, a volume of sombre and powerful verse, expressing her revolt against human suffering. Soon after the publication of this volume Mme. Ackermann moved to Paris, where she gathered round her a circle of friends, but published nothing further except a prose volume, the *Pensées d'une solitaire* (1883; Eng. trans., Glasgow, 1921), to which she prefixed a short autobiography. She died at Nice on Aug. 2, 1890.

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ACKERMANN, RUDOLPH (1764-1834), Anglo-German inventor and publisher, was born on April 20, 1764, at Schneeberg, in Saxony. He had been a saddler and coachbuilder for ten years in different German cities and in Paris and London, when, in 1795, he established a print shop and drawing school in the Strand. Ackermann set up a lithographic press, and applied it in 1817 to the illustration of his *Repository of Arts, Literature, Fashions, etc.* (monthly until 1828). Thomas Rowlandson and other distinguished artists were regular contributors. He also introduced the fashion of the once popular English annuals, beginning in 1825 with *Forget-Me-Not*; and he published many illustrated volumes of topography and travel—*The Microcosm of London* (1808-11), *Westminster Abbey* (1812), *The Rhine* (1820), *The World in Miniature* (1821-26), etc. Ackermann was an enterprising man; he patented (1801) a method for rendering paper and cloth waterproof, erected a factory at Chelsea for the purpose

and was one of the first to illuminate his own premises with gas. Indeed, the introduction of lighting by gas owed much to him. After the battle of Leipzig Ackermann collected nearly £250,000 for German sufferers. He died at Finchley, Middlesex, on March 30, 1834.

ACKNOWLEDGMENT, an admission that something has been given or done, a term used in law in various connections. The acknowledgment of a debt, if in writing signed by the debtor or his agent, is sufficient to take it out of the statutes of limitations. The signature to a will by a testator, if not made in the presence of two witnesses, may be afterward acknowledged in their presence. The acknowledgment by a woman married before 1882 of deeds for the conveyance of real property, not her separate property, requires to be made by her before a judge of the high court, or of a county court, or before a perpetual or special commissioner. Before such an acknowledgment can be received, the judge or commissioner is required to examine her apart from her husband, touching her knowledge of the deed, and to ascertain whether she freely consents. In some British colonies this acknowledgment applies even to separate estates. An acknowledgment to the right of the production of deeds of conveyance is an obligation on the vendor, when he retains any portion of the property to which the deeds relate, and is entitled to retain the deeds, to produce them from time to time at the request of the person to whom the acknowledgment is given, to allow copies to be made and to undertake for their safe custody (Conveyancing act, 1881, section 9). The term acknowledgment is, in the United States, applied to the certificate of a public officer that an instrument was acknowledged before him to be the deed or act of the person who executed it. Acknowledgment money was the sum paid in some parts of England by copyhold tenants on the death of the lord of the manor.

ACKTÉ, AÏNO (1876-1944), Finnish opera singer, was born at Helsingfors (Helsinki) Aug. 23, 1876. Her studies took place in Paris. In 1897 she made her debut in *Faust* at the Paris Grand Opéra. From 1904 to 1906 she was principal soprano at the Metropolitan Opera house, and from 1907 to 1910 at Covent Garden, London. In 1910 she achieved a great personal triumph at Covent Garden in the title role of Richard Strauss's *Salome*, and was invited by the composer to perform that role in Dresden, Ger., and Paris. In 1911 she founded the annual Finnish Opera festival at Savonlinna, and in 1938 was appointed general manager of the National Opera in Finland. She had a voice of great power, range and flexibility. She died at Helsinki Aug. 8, 1944. (D. E.)

ACLAND, SIR HENRY WENTWORTH, BART. (1815-1900), English physician and man of learning, was born near Exeter on Aug. 23, 1815, and died at Oxford on Oct. 16, 1900.

Educated at Harrow and at Christ Church, Oxford, he was elected fellow of All Souls college in 1840, and then studied medicine in London and Edinburgh. Returning to Oxford, he was appointed Lee's reader in anatomy at Christ Church in 1845, and in 1851 Radcliffe librarian and physician to the Radcliffe infirmary. He was regius professor of medicine at Oxford from 1858 to 1894. He was also a curator of the university galleries and of the Bodleian library, and from 1858 to 1887 he represented his university on the General Medical Council, serving as president from 1874 to 1887. Acland took a leading part in the revival of the Oxford medical school and in introducing the study of natural science into the university. The establishment of the Oxford university museum, opened in 1861, as a centre for the encouragement of the study of science, especially in relation to medicine, was largely the result of his efforts. "To Henry Acland," said his lifelong friend, John Ruskin, "physiology was an entrusted gospel of which he was the solitary preacher to the heathen" at Oxford. Acland published a study of the outbreak of cholera at Oxford in 1854, together with various pamphlets on sanitary matters, and served on the royal commission on sanitary laws in England and Wales in 1869.

See *Sir Henry Wentworth Acland*, a memoir by J. B. Atlay, with portraits (1903).

ACME, the highest point attainable. (Gr. ἀκμή, "point.")

ACMITE, or AGRITE: see PYROXENE.

ACNE is a skin disease which has no specific aetiology. It is an inflammation located in and around the hair follicles and sebaceous glands of the skin. It is not peculiar to any age or to either sex, although certain age groups are more susceptible; it occurs more frequently at the time of puberty and in early adult life. The disease is related in a measure to diet and to hormonal activity. It may be an accumulation of sebaceous material within the follicles but there also may be superimposed infection with more or less marked inflammation and resultant scar formation. The more severe form is known as acne vulgaris. The principles of treatment are based upon a proper diet, personal hygiene and medication as prescribed by a physician. Some drugs, the bromides and iodides, cause acniform lesions.

The term acne rosacea is used to describe an inflammation of skin of a chronic nature which is not related to the ordinary form of acne. In this disease there is marked redness of the nose and cheeks and sometimes inflammation with suppuration and disfigurement. The treatment is not always satisfactory and should be supervised by someone skilled in the treatment of skin disorders. (See also SKIN DISEASES.) (F. L. A.)

ACOELOMATA, a word sometimes used in zoology in contradistinction to Coelomata (*q.v.*) to denote those animals in which no second body cavity (coelom, *q.v.*) is present. In the usage adopted by Hyman (1940) the group includes only the Platyhelminthes (*q.v.*) and Nemertinea (see NEMERTEA).

ACOEOMETI, an order of Eastern monks who celebrated the divine service without intermission day or night (Gr. ἀκοιμητος, sleepless). This was done by dividing the communities into choirs, which relieved each other by turn in the church. Their first monastery was established on the Euphrates in the beginning of the 5th century. In Constantinople (*c.* 460) the famous monastery of the Studium, founded by the consular Studius, was put in the hands of the Acoemeti and became their chief house, so that they were sometimes called Studites.

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ACOLYTE, the highest of the four minor orders in the Roman Church (Gr. ἀκόλουθος, follower). The office is unknown in the Eastern Church, except among the Armenians who borrowed it from the West. Before the Council of Nicaea (325) it was only found at Rome and Carthage. In 251, Pope Cornelius, in a letter to Fabius of Antioch, mentions among the Roman clergy 42 acolytes, placing them next after the subdeacons (Eusebius, *Hist. Ecc.* vi. 43), giving no hint that the office was a new one. The *Liber Pontificalis* says that Pope Victor (186-197) made *sequentes clerici*, a term which may possibly denote acolytes. While the office was well known in Rome, it was evidently not at first an order through which, as to-day, every candidate to the priesthood must pass. St. Cyprian of Carthage (200?-258) used acolytes to carry his letters, but this seems to be the only place in Africa where they were known. The Irish Church did not know them; and in Spain the Council of Toledo (400) makes no mention of them. The *Statuta Ecclesiae Antiqua*, a Gallican collection for the province of Arles, early 6th century, mentions the acolyte, but does not give, as for the other orders, any form of ordination. The Roman books are silent, and in the *Leoline Sacramentary* and the so-called *Gelasian Mass-book* there is the same silence, though one ms. of the 10th century, given by Muratori, contains a form of ordination of an acolyte. The office is often mentioned in the *Ordines Romani*, but only in *Ordo VIII.* (not earlier than 7th century) do we find a very simple form for admitting an acolyte to his office. The evidence available, therefore, indicates that the acolyte was only a local office, not a necessary step to sacred orders. In England, acolytes first occur, both as office and order, in the Pontifical attributed to Egbert of York (732-766); and Aelfric (1006) in both his pastoral epistle and canons mentions the acolyte. It would seem, then, that the acolyte became an order in the Gallican Church first, and afterwards found its way as such into the Roman books before the fusion of the two rites under Charlemagne.

The duties of the acolyte, as given in the Roman Pontifical, are identical with those mentioned in the *Statuta Ecclesiae*

Antiqua of Arles: "to carry the candlesticks, to light the lamps of the church, to administer wine and water for the Eucharist." The *Ordines Romani* divides the acolytes into *Palatini*, who served the pope at the Lateran palace, *Stationarii*, who served at churches where there was a "station," and *Regionarii*, or those attached directly to the regions; and gives us a glimpse of their duties. When the pope rode in procession to the station an acolyte walked before him, bearing the holy chrism; and at the church seven acolytes with candles went before him to the altar, while two others, bearing the vessel that contained a consecrated Host, presented it for his adoration. At the communion the acolytes received in linen bags the consecrated Hosts to carry to the assisting priests. The official dress of the acolyte (*Ordo V.*) was a close-fitting linen garment (*camisia*), a napkin hanging from the left side, a white tunic, a stole (*orarium*) and a chasuble (*planeta*) which he took off when he sang on the steps of the *ambo*.

At the present day the duties of acolytes are now performed, almost everywhere, by laymen. The office has been revived unofficially in the Church of England, as a result of the Tractarian movement.

See MORIN, *Commentarius in sacris Ecclesiae ordinationibus*, ii. p. 209, iii. p. 152 (Antwerp, 1685); Martène, *De Antiquis Ecclesiae ritibus*, ii. pp. 47 and 86 (Antwerp, 1739); Mabillon, *Musaeum Italicum II.* for the *Ordines Romani*; Muratori, *Liturgia Romana Vetus*; Cabrol, *Dictionnaire d'archéologie chrétienne et de liturgie*, vol. i. col. 348-536.

ACOMA, a tribe and town of the Pueblo Indians in New Mexico, forming an isolated western settlement of the Keres stock. The town is strikingly situated on a mesa rising 350ft. sheer above the surrounding plain, in which lie the Pueblo farm-lands at a distance of some miles. It is reputed to be the oldest inhabited settlement in the United States, a distinction which, however, may be challenged by Zuñi and Oraibi. Discovered by Coronado's army in 1540, Acoma surprised and defeated a Spanish detachment in 1598, lost heavily in its subjugation next year, received a permanent mission early in the 17th century, rebelled with the other Pueblos in 1680, but was reconquered. The original population was perhaps 1,000, the present one is about 500.

ACOMINATUS (AKOMINATOS), **MICHAEL** (*c.* 1140-1220), Byzantine writer and ecclesiastic, was born at Chonae (the ancient Colossae). He studied at Constantinople, and about 1175 was appointed archbishop of Athens. After the capture of Constantinople by the Franks and the establishment of the Latin empire (1204), he retired to the island of Ceos, where he died. He wrote homilies, speeches and poems which, with his correspondence, throw considerable light upon the miserable condition of Attica and Athens at the time. His memorial to Alexis III. Angelus on the abuses of Byzantine administration, the poetical lament over the degeneracy of Athens, and the monodes on his brother Nicetas and Eustathius, archbishop of Thessalonica, deserve special mention.

BIBLIOGRAPHY.—Edition of his works by S. Lambros (1879-80); Migne, *Patrologia Graeca*, cxi.; see also A. Ellissen, *Michael Akominatos* (1846), containing several pieces with German translation; F. Gregorovius, *Geschichte der Stadt Athen im Mittelalter*, i. (1889); G. Finlay, *History of Greece*, iv. p. 133-134, (1877).

His younger brother, **NICETAS** (Niketas), sometimes called **CHONATES**, who accompanied him to Constantinople, held several appointments under the Angelus emperors (amongst them that of "great logothete" or chancellor) and was governor of the "theme" of Philippopolis at a critical period. After the fall of Constantinople he fled to Nicaea, where he settled at the court of the emperor Theodorus Lascaris, and devoted himself to literature. He died between 1210 and 1220. His chief work is his *History*, in 21 books, of the period from 1180 to 1206. In spite of its florid style, it is of considerable value as a record (on the whole impartial) of events of which he was either an eye-witness or had heard at first hand. Its most interesting portion is the description of the capture of Constantinople. The little treatise *On the Statues* destroyed by the Latins (perhaps, as we have it, altered by a later writer), is of special interest to the archaeologist. His dogmatic work (*Θεσαυρὸς Ὁρθοδοξίας*, *Thesaurus Orthodoxae Fidei*), extant in a complete form in ms., is one of the

chief authorities for the heresies of the 12th century.

BIBLIOGRAPHY.—*History*, editio princeps, H. Wolf (1857); and in the *Bonn Corpus Scriptorum Hist. Byz.*, 1st ed., Bekker (1835); Rhetorical Pieces in C. Sathas, *Μεσαιωνική βιβλιοθήκη*, i. (1872); *The-saurus* in Migne, *Patrologia Graeca*, cxxxix., cxi.; see also C. A. Sainte-Beuve, "Geoffroy de Villehardouin" in *Causeries du Lundi*, ix.; S. Reinach, "La fin de l'empire grec," in *Esquisses Archéologiques* (1888); C. Neumann, *Griechische Geschichtsschreiber im 12 Jahrhundert* (1888); Gibbon, *Decline and Fall*, ch. ix.; and (for both Michael and Nicetas) C. Krumbacher, *Geschichte der byzantinischen Literatur* (1897).

ACONCAGUA, a province in the northern part of central Chile, bounded on the north by Coquimbo, east by Argentina, south by Santiago and Valparaíso, and west by the Pacific. In 1928, at which time the province annexed Valparaíso, its area was 7,180 sq.mi. During the '30s, however, the geographical limits of many of the provinces were redefined, with the result that Valparaíso was again made a separate province, the territory of Coquimbo was expanded, and the area of Aconcagua was reduced to 3,940 sq.mi.; population (1940 census), 118,049. The surface of the land is for the most part mountainous, interrupted by broad valleys, including the northern reaches of the famous Central valley of Chile, which lies between the coastal ranges and the piedmont alluvial slopes of the Andes. The major valleys, however, are transverse and include those of the Aconcagua and Ligua rivers, together with those of their tributaries. Climat-ically the province lies in a transitional zone between the arid northern part of Chile and the subhumid central part. The annual rainfall, which amounts to but a few inches, coincides with the winter season; summers are rainless, but the drought is miti-gated somewhat along the coast by the presence of persistent fogs. Inland the skies are clear in summer and the temperatures are high. The natural vegetation (cacti, scrub and grasses) re-sembles closely the *chaparral* of the southwestern Pacific area of the United States, or the *maqui* of Mediterranean Europe. The valleys are highly fertile, and where irrigation is employed crops of alfalfa, wine grapes, fruits and vegetables are produced in abundance. San Felipe, capital of the province, is on the Río Aconcagua in a rich agricultural centre, connected by rail (Trans-andine railway) with Valparaíso (80 mi.), and by rail and car with Mendoza, Argentina.

ACONCAGUA, an extinct volcano in the southern Andes with a height of 22,835 ft., usually regarded as the loftiest moun-tain in America. It is situated on the boundary line between Chile and Argentina in 32° 39' S. and 70° 1' W. On its southern slope is the source of the Aconcagua river which flows westerly to the Pacific ocean through a course of about 200 miles. The summit of Aconcagua was first scaled in 1897 by Vines and Zurbriggen of the FitzGerald expedition.

BIBLIOGRAPHY.—Edward Ambrose FitzGerald, "Exploration on and around Aconcagua," *Geographic Journal*, vol. xii., pp. 469-494 (1898) and "The First Ascent of Aconcagua," *McClure's Magazine*, vol. xi. (1898); Sir William Martin Conway, *Aconcagua and Tierra del Fuego* (1902).

ACONCIO, GIACOMO (1492-1566?), pioneer of religious toleration, was one of the Italians, like Peter Martyr and Bernardino Ochino, who repudiated Roman Catholic doctrine and ultimately found refuge in England, where he worked as an engineer on various public works. Before reaching England he had published a treatise on the methods of investigation, *De Methodo, hoc est, de recte investigandarum tradendarumque Scientiarum ratione* (1558); and his critical spirit placed him outside all the recognized religious societies of his time.

On his arrival in London he had joined the Dutch Reformed Church in Austin Friars, but he was "infected with Anabaptis-tical and Arian opinions" and was excluded from the sacrament by Grindal, bishop of London. The real nature of his heterodoxy is revealed in his *Stragemata Satanae* (1565). The "stratagems of Satan" are the dogmatic creeds which rent the Christian church. Aconcio sought to reduce dogma to a minimum in the hope of finding a common denominator for the various creeds.

BIBLIOGRAPHY.—See Gough's *Index to Parker Soc. Publ.*; Strype's *Grindal*, pp. 62, 66; Bayle's *Dictionnaire*; G. Tiraboschi, *Storia della lett. Italiana* (1805-13); *Österreichisches Biogr. Lexikon*; *Nouvelle biogr. générale*; *Dict. Nat. Biogr.*

ACONITE (*Aconitum*), a genus of plants belonging to the Ranunculaceae, the buttercup family, commonly known as acon-ite, monkshood or wolfsbane, and embracing about 60 species, chiefly natives of the mountainous parts of the northern hemi-sphere. They are distinguished by having one of the five blue or yellow coloured sepals (the posterior one) in the form of a helmet; hence the English name monkshood. Two of the petals placed under the hood of the calyx are supported on long stalks, and have a hollow spur at their apex, containing honey. They are handsome plants, the tall stem being crowned by racemes of showy flowers. *Aconitum napellus*, common monkshood, is a doubtful native of Britain, and is of therapeutic and toxicolog-ical importance. Its roots have occasionally been mistaken for horse-radish. The aconite has a short underground stem, from which dark-coloured tapering roots descend. The crown or upper portion of the root gives rise to new plants. When put to the lip, the juice of the aconite root produces a feeling of numb-ness and tingling. The horse-radish root, which belongs to the family Cruciferae, is much longer than that of the aconite, and it is not tapering; its colour is yellowish, and the top of the root has the remains of the leaves on it.

Many species of aconite are cultivated in gardens, some having blue and others yellow flowers. *Aconitum lycoctonum*, wolfs-bane, is a yellow-flowered species common on the Alps of Switz-erland. The roots of *Aconitum ferox* supply the famous Indian (Nepal) poison called bikh, bish or nabee. It contains consider-able quantities of the alkaloid pseudaconitine, which is the most deadly poison known. *Aconitum palmatum* yields another of the celebrated bikh poisons. The root of *Aconitum luridum*, of the Himalayas, is said to be as virulent as that of *A. ferox* or *A. napellus*. As garden plants the aconites are very ornamental, hardy perennials. They thrive well in any ordinary garden soil, and will grow beneath the shade of trees. They are easily propa-gated by divisions of the root or by seeds.

Chemistry.—The active principle of *Aconitum napellus* is the alkaloid aconitine, first examined by P. L. Geiger and Hesse (*Ann.*, 1834, 7, p. 267). Alder Wright and A. P. Luff obtained apoaconitine, aconine and benzoic acid by hydrolysis; while, in 1892, C. Ehrenberg and A. Purfürst (*Journ. Prat. Chem.*, 1892, 45, p. 604) observed acetic acid as a hydrolytic product. This, and allied alkaloids, have formed the subject of many investi-gations by Wyndham Dunstan and his pupils in England, and by Martin Freund and Paul Beck in Berlin. But their constitu-tion is not yet solved, there even being some divergence of opin-ion as to their empirical formulae. Aconitine ($C_{35}H_{46}NO_{11}$, accord-ing to Dunstan; $C_{36}H_{47}NO_{11}$, according to Freund) is a crystalline base, soluble in alcohol, but very sparingly in water; its alcoholic solution is dextrorotatory, but its salts are laevorotatory. When heated it loses water and forms pyraconitine. Hydrolysis gives acetic acid and benzoic acid, the chief constituent of the alkaloids picroaconitine and napelline; further hydrolysis give aconine. Pseudoaconitine, obtained from *Aconitum ferox*, gives on hydroly-sis acetic acid and veratryl-pseudoaconine, the latter of which suffers further hydrolysis to veratric acid and pseudoaconine. Japaconitine, obtained from the Japanese aconites, known locally as "kuza-uzu," hydrolyses to japbenzoic acid and japaconine. Other related alkalo-ids are lycaconitine and myoconitine which occur in wolfsbane, *Aconitum lycoctonum*. The usual test for solutions of aconitine consists in slight acidulation with acetic acid and addition of potassium permanganate, which causes the formation of a red crystalline precipitate. In 1905, Dunstan and his collaborators discovered two new aconite alkaloids, indaconitine in "mohri" (*Aconitum chasmanthum*, Stapf), and bikhaconitine in "bikh" (*Aconitum spicatum*); he also proposes to classify these alkaloids according to whether they yield benzoic or veratric acid on hydrolysis (*Jour. Chem. Soc.*, 1905, 87, pp. 1620, 1650).

From the root of *Aconitum napellus* are prepared a liniment and a tincture. The dose of the latter (*Brit. Pharmacop.*) is of importance as being exceptionally small, for it is not advisable to give more than at most five drops at a time. The official preparation is an ointment which contains one part of the alkaloid

in fifty. It must be used with extreme care, and in small quantities, and it must not be used at all where cuts or cracks are present in the skin.

Pharmacology of Aconite and Aconitine.—Aconite first stimulates and later paralyzes the nerves of pain, touch and temperature, if applied to the skin, broken or unbroken, or to a mucous membrane, the initial tingling therefore gives place to a long-continued anaesthetic action. Taken internally aconite acts very notably on the circulation, the respiration and the nervous system. The pulse is slowed, the number of beats per minute being actually reduced, under considerable doses, to 40, or even 30, per minute. The blood-pressure synchronously falls, and the heart is arrested in diastole. Immediately before arrest the heart may beat much faster than normally, though with extreme irregularity, and in the lower animals the auricles may be observed occasionally to miss a beat, as in poisoning by veratrine and colchicum. The action of aconitine on the circulation is due to an initial stimulation of the cardio-inhibitory centre in the medulla oblongata (at the root of the vagus nerves), and later to a directly toxic influence on the nerve-ganglia and muscular fibres of the heart itself. The fall in blood-pressure is not due to any direct influence on the vessels. The respiration becomes slower owing to a paralytic action on the respiratory centre and, in warm-blooded animals, death is due to this action, the respiration being arrested before the action of the heart. Aconite further depresses the activity of all nerve-terminals, the sensory being affected before the motor. In small doses it therefore tends to relieve pain, if this be present. The activity of the spinal cord is similarly depressed. The pupil is at first contracted and afterwards dilated. The cerebrum is totally unaffected by aconite, consciousness and the intelligence remaining normal to the last. The antipyretic action which considerable doses of aconite display is not specific, but is the result of its influence on the circulation and respiration and of its slight diaphoretic action.

Therapeutics.—The indications for its employment are limited, but definite. It is of undoubted value as a local anodyne in sciatica and neuralgia, especially in ordinary facial or trigeminal neuralgia. The best method of application is by rubbing in a small quantity of the aconitine ointment until numbness is felt, but the costliness of this preparation causes the use of the aconite liniment to be commonly resorted to. This should be painted on the affected part with a camel's hair brush dipped in chloroform, which facilitates the absorption of the alkaloid. Aconite is indicated for internal administration whenever it is desirable to depress the action of the heart in the course of a fever. Formerly used in every fever, and even in the septic states that constantly followed surgical operation in the pre-Listerian epoch, aconite is now employed only in the earliest stage of the less serious fevers, such as acute tonsillitis, bronchitis and, notably, laryngitis. The extreme pain and rapid swelling of the vocal cords—with threatened obstruction to the respiration—that characterize acute laryngitis may often be relieved by the sedative action of this drug upon the circulation. In order to reduce the pulse to its normal rate in these cases, without at the same time lessening the power of the heart, the drug must be given in doses of about two minims of the tincture every half-hour and then every hour until the pulse falls to the normal rate. Thereafter the drug must be discontinued. It is probably never right to give aconite in doses much larger than that named. There is one condition of the heart itself in which aconite is sometimes useful. While absolutely contraindicated in all cases of valvular disease, it is of value in cases of cardiac hypertrophy with overaction. But the practitioner must be assured that neither valvular lesion nor degeneration of the myocardium is present.

Toxicology.—In a few minutes after the introduction of a poisonous dose of aconite, marked symptoms supervene. The initial signs of poisoning are referable to the alimentary canal. There is a sensation of burning, tingling and numbness in the mouth, and of burning in the abdomen. Death usually supervenes before a numbing effect on the intestine can be observed. After about an hour there is severe vomiting. Much motor weakness and cutaneous sensations similar to those above described

soon follow. The pulse and respiration steadily fail, death occurring from asphyxia. As in strychnine poisoning, the patient is conscious and clear-minded to the last. The only post-mortem signs are those of asphyxia. The treatment is to empty the stomach by tube or by a non-depressant emetic. The physiological antidotes are atropine and digitalin or strophanthin, which should be injected subcutaneously in maximal doses. Alcohol, strychnine and warmth must also be employed.

ACONITINE: see ACONITE.

ACONTIUS, in Greek legend, a beautiful youth of the island of Ceos. During the festival of Artemis, at Delos, Acontius saw and loved Cydippe, a well-born Athenian maiden. He wrote on an apple the words, "I swear to wed Acontius" and threw it at her feet. She picked it up, and mechanically read the words aloud, thus binding herself by an oath. Therefore, although she was betrothed more than once, she always fell ill before the wedding took place. The Delphic oracle at last explained the matter, and she married Acontius.

(Callimachus, *Aitia*, III, 1 Mair; see his notes [p. 204 of the Loeb ed.] for other authorities.)

ACORN, the fruit of the oaks (*Quercus*) and tanbarks (*Lithocarpus*); a word also used, by analogy with the shape, in nautical phraseology for a piece of wood keeping the vane on the mast-head.

ACORN SHELLS, popular English name given to sessile forms of barnacles (*g.v.*) common on rocks, piers, etc., on sea coasts; in America often called rock-barnacles. (See CIRRIPIEDIA.)

ACORUS CALAMUS, sweet-sedge or sweet-flag, a marsh plant which shares with the cuckoo pint (*Arum*) the representation in Britain of the family Araceae and is found throughout the north temperate zone. The name is derived from *acorus*, Gr. ἄκωρος, the classical name for the plant. It was the *Calamus aromaticus* of the mediaeval druggists and perhaps of the ancients, though the latter has been referred by some to citronella grass, *Cymbopogon nardus*.

The plant is a herbaceous perennial with a long, branched rootstock creeping through the mud, about $\frac{3}{4}$ inch thick, with short joints and large brownish leaf-scars.

The leaves are tufted, flat, sword-like, sweet-scented, 3 or 4 ft. long and about an inch wide, closely arranged in two rows as in the true Flag (*Iris*); the tall flowering stems (scapes), which very much resemble the leaves, bear an apparently lateral, blunt, tapering, spike-like cluster (spadix) of densely packed, very small flowers.

A long leaf (spathe) borne immediately below the cluster forms an apparent continuation of the scape, though really a lateral outgrowth from it, the spadix being terminal. The rootstock yields the drug calamus, and a variegated form is cultivated for ornament.

ACOSMISM. This term was coined by Fichte and Hegel on the model of the term atheism. According to the ordinary view, reality consists of God and a world (cosmos) of finite objects usually conceived as having been created by Him and made to conform to certain laws. Now atheism is the theory which denies the existence of God, and so identifies reality with a godless world of objects and events which exist of themselves and have an inherent order of their own. Acosmism is the contrary view that denies the independent reality of a world of finite objects and events, and regards God as the sole ultimate reality. In accordance with the common practice of denouncing anybody as an atheist whose conception of God was different from theirs, Spinoza was generally described as an atheist by his contemporaries and others. Hegel protested against the injustice of this. Spinoza, he said, was so far from denying the existence of God that he acknowledged no other ultimate reality—so far from being an atheist he was an acosmist. Fichte similarly applied the term to himself in reply to similar accusations. The term acosmism has since been applied also to philosophies like those of the Vedanta, of Buddhism, and of Schopenhauer. Apart from its polemical uses the term acosmism, with its suggestion of an illusory world, is not a happy equivalent of the term pantheism. Strictly speaking, a pantheism like that of Spinoza no more denies the reality of

the world than it denies the reality of God. It simply identifies the universe with God, and for that very reason regards the universe all the more as a world of order, a real *cosmos*. Moreover, there is an important sense in which pantheism is essentially *cosmic*, namely, in the sense that it regards man from the standpoint of the universe, instead of regarding the universe from the point of view of man (see ANTHROPOCENTRIC PHILOSOPHY). "Acosmism" is therefore not only an inadequate, but also a misleading description of pantheism.

ACOSTA, JOAQUIN (c. 1795-1852), Colombian historian and soldier, was an officer in Bolívar's army, and a member of congress. He travelled in Colombia and in Spain, collecting material for his *Compendio histórico del descubrimiento y colonización de la Nueva Granada*, which was published in Paris in 1848.

ACOSTA, JOSÉ DE (1539?-1600), Spanish author, was born at Medina del Campo about the year 1539. He joined the Jesuits in 1551, and in 1571 was sent as a missionary to Peru; he acted as provincial of his Order from 1576 to 1581, was appointed theological adviser to the Council of Lima in 1582, and in 1583 published a catechism in Quichua and Aymara—the first book printed in Peru. In 1598 he became rector of the Jesuit college at Salamanca, where he died on Feb. 15, 1600. His treatise, *De natura novi orbis libri duo* (Salamanca, 1588-89), may be regarded as the preliminary draft of his celebrated *Historia natural y moral de las Indias* (Seville, 1590), which was speedily translated into Italian (1596), French (1597), Dutch (1598), German (1601), Latin (1602), and English (1604). The *Historia* is in three sections: books I and II deal with generalities; books III and IV with the physical geography and natural history of Mexico and Peru; books V, VI, and VII, with the religious and political institutions of the aborigines. Apart from his sophistical defense of Spanish colonial policy, de Acosta deserves high praise as an acute and diligent observer. Among his other publications is *De procuranda salute Indorum libri sex* (Salamanca, 1588).

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ACOSTA, URIEL (d. 1647), Jewish author, was born at Oporto near the end of the 16th century. Educated in the Roman Catholic faith, he was received into the synagogue at Amsterdam and exchanged his baptismal name of Gabriel for Uriel. His wayward disposition, however, found no satisfaction in Judaism. He was twice excommunicated, and twice readmitted to the synagogue. In his autobiography, *Exemplar humanæ vitæ*, printed in 1687 and again in 1847, Acosta declared his hostility both to Christianity and Judaism, but spoke most bitterly of Judaism. He committed suicide in 1647. The story of Acosta's life provided K. F. Gutzkow with the material of the tragedy of *Uriel Acosta* (1847).

ACOUSTICS OF BUILDINGS is that part of the science of sound which deals with the production, transmission and absorption of sound in buildings. The primary use of the findings of this science is in the acoustical design of buildings to minimize noise, that is, unwanted sounds, and to transmit wanted sounds to listeners undistorted and with sufficient intensity. Attempts to attain these ideals involve a consideration of the noise to be controlled, the reduction of mechanical disturbances, the soundproofing of building constructions and the acoustical adjustment of rooms for listening. The following discussion will take up these topics in the order named, assuming the statements of the general principles of acoustics and hearing, as given in the articles on **SOUND** and **HEARING**.

Noise.—Sources of noise, which may be either inside or outside buildings, are such things as typewriters, radios, auto horns, whistles and talking; these sources create sounds that travel in the air. Other sources set up vibrations in the structure of the building, either directly, as when machines are attached to the structure, or indirectly, as when vehicles or drilling devices set up vibrations in the ground which are transmitted into the building. To protect listeners in the building, it is necessary to inter-

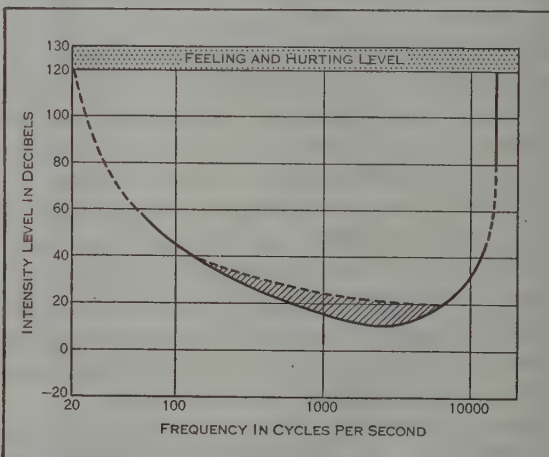
pose discontinuities in the paths of these disturbances. Table I shows that the range of sounds, which must be tolerated by the ear, is enormous, extending from a "threshold" value of one arbitrary unit for a faint sound that can just be detected to 1,000,000,000,000 units for a very loud sound.

TABLE I.—Intensity of Sound

Units	Decibels	Type of Noise
1,000,000,000,000	120	
100,000,000,000	110	Aeroplane engine
10,000,000,000	100	
1,000,000,000	90	Heavy traffic, pneumatic drill
100,000,000	80	
10,000,000	70	Noisy office, telephone conversation, ordinary traffic
1,000,000	60	Average office
100,000	50	Ordinary conversation
10,000	40	Quiet home, quiet conversation
1,000	30	
100	20	
10	10	Rustle of leaves, whisper
1	0	

Smaller numbers to express this vast range have been developed by using the *decibel* unit, the number of decibels between two intensity levels being obtained by taking ten times the logarithm of the ratio of the intensities. Although the tolerable range is very great, the absolute energy of sounds is very small, an average voice having only about one-millionth of the energy needed to operate an ordinary electric lamp.

Hearing.—Since any control of sound in buildings is made for the convenience and comfort of the occupants, the acoustician should consider the performance of the ear and the phenomena of hearing when making any adjustments. Extensive experiments in this connection have been made by the Bell Telephone Laboratories because of the importance of speech and hearing in telephony. Harvey Fletcher published data obtained by young persons with normal hearing, showing the frequency and intensity limits of sounds that can be perceived without discomfort (*Speech and Hearing*, 1929). In 1942 Fletcher published an important article (*Proc. Inst. Radio Eng.*, June, 1942) based on (1) Measurements of the threshold and frequency limits of more than 500,000 people at the New York and San Francisco world's fairs in 1940; (2) Measurements of the discomfort level of sound; (3) Measurements of room noise in a wide variety of locations, and (4) Measurements of the frequency limits and the maximum and minimum levels of speech, orchestral music, and the various instruments of the orchestra. Some of the results of the first two sets of measurements are shown in Fig. 1, which gives the limits of hearing of the average listener (50% of the listeners tested at the world's fairs) under quiet condi-



COURTESY OF BELL TELEPHONE LABORATORIES; FROM "PROCEEDINGS OF THE INSTITUTE OF RADIO ENGINEERS"

FIG. 1.—LIMITS OF HEARING AND ROOM NOISE

tions. The lower curve shows the hearing threshold for pure tones for the average listener, while the line of 120 decibels gives the upper limit, above which sounds become uncomfortably



BY COURTESY OF (4) JOHN E. VOLKMAN, REPRODUCED FROM "JOURNAL OF THE ACOUSTICAL SOCIETY OF AMERICA"; PHOTOGRAPH (5) EZRA STOLLER

1. Interior of Bryn Mawr church, Bryn Mawr, Pa., with a high-ceilinged auditorium which requires sound-absorbing materials on the side walls. Walter T. Karcher and Livingston Smith, architects
2. Hall of Music, Indiana university. Irregular ceiling and side walls reduce reflection and echoes. A. M. Strauss, architect
3. Constitution Hall, Washington, D.C. Objectionable side-wall reflection of sound is practically eliminated by the sloping banks of upholstered seats. The late John Russell Pope, Otto R. Eggers and Daniel Paul Higgins, architects
4. Listening studio of Radio Corporation of America, Indianapolis, Ind., showing polycylindrical surfaces with axes mutually perpendicular
5. Exterior of Berkshire Symphonic music shed, Tanglewood, Stockbridge, Mass. With a rectangular stage and open-sided auditorium, the acoustics are good for auditors both inside and outside the shed. Joseph Franz, engineer

loud and even harmful. The area enclosed between these two limits, called the average auditory sensation area, gives the range of sounds as to frequency and intensity which can be heard comfortably by the average listener; it therefore determines the range within which noise is audible and also the range within which wanted sounds must lie if they are to be heard. Any noise which is present in sufficient intensity and which lies above the threshold curve, encroaches and limits the useful auditory sensation area. The shaded area indicates the extent, according to Fletcher, to which noise in average residences and average motion-picture theatres reduces the area. In the average business office, the encroachment is approximately 15 decibels more, and in the average factory location, it is 35 decibels more. Guided by the information in Fig. 1, the acoustician is concerned to reduce noise so as to keep its encroachment as small as possible and, in auditoriums, to try to push it below the lower curve.

Vibrations that are due to machinery and near-by street traffic can enter a building structure and cause floors to vibrate and create a rattling of loose windows, doors and other constructions. These disturbances annoy workers and reduce their efficiency. The trouble may be reduced by using "quiet-running" motors and rubber-tired vehicles. Machines should be dynamically balanced and should rest on resilient supports that "give" somewhat under the load—the popular notion that a sheet of cork under the machine will control the vibrations is misleading. For low-frequency machines, the supports should be damped; for high frequencies, the supports should be elastic without damping. These details can be calculated prior to the installation of the machines. (Timoshenko, *Vibrations Problems in Engineering*; J. P. den Hartog, *Mechanical Vibrations*; Slocum, *Noise and Vibration Engineering*.)

Soundproofing involves the use of special constructions that will reduce the transmission of noise. Numerical values of the reduction of sound by partitions are obtained experimentally. Measurements are taken for the sound incident on one side of a partition and also for the reduced sound that emerges from the other side. For example, if an incident sound of 1,000,000 units intensity is reduced to 1,000 units by the partition, the decibel loss is 30 db. ($10 \times \log 1,000,000/1,000 = 30$ db.). This means that a loud radio sound of 80 db. level in one room would be reduced 30 db. by the partition and

Double partitions stop more sound than single partitions, particularly if the two elements are separated by an air space, which should be 4 in. or more thick. Bridging the air space with wood studding or packing it with sawdust or similar materials is usually detrimental. Any openings in the continuity of a wall for ventilators or pipes should be controlled, since sound passes easily through an air passage. Ventilating ducts are lined on the inside with sound-absorbing materials, according to definite rules formulated by air-conditioning engineers. Floors are more difficult to insulate than walls. The impact sounds of footsteps on ordinary floors or masonry floors can be heard almost as loudly in the room below as in the room above the floor. A floating floor on masonry with a suspended ceiling below gave the best results. (Bureau of Standards, *ibid.* p. 7.) Generally, the controlling qualities of a partition that determine its insulation are its weight and its possibility of vibration. A brick wall, because of its weight and small vibration, makes one of the best insulators, but it is too heavy and bulky for extensive use, so that many lighter and smaller partitions have been developed. These thinner units are likely to vibrate under the impact of sound and will thus transmit certain low frequencies, so that they are undesirable for broadcasting rooms and similar enclosures where great insulation is needed. An approximate estimation of the effect on hearing by reduction of sound is given as follows:

"With an average reduction factor of 25 db., normal speech can be understood quite easily and distinctly through the partition.

"With an average reduction factor of 30 db., loud speech can be understood fairly well if conditions are quiet.

"With an average reduction factor of 35 db., loud speech is audible, but not easily intelligible under quiet conditions.

"With an average reduction factor of 40 db., normal speech is not audible, loud speech can be faintly heard but not easily understood, and for all practical purposes the partition can be considered soundproof. Separating partitions between apartments should have a factor of about 40.

"Greater insulation than 40 db. is needed to reduce loud piano and radio sounds" (Acoustical Materials Association).

It has been shown in an important paper on loudness that, except for low frequencies, a reduction of 9 decibels makes a sound appear approximately half as loud. (Fletcher and Munson, *Jour. Acous. Soc. Amer.*, 9, p. 1, 1937.)

Acoustics of Rooms become satisfactory when the noise level is reduced, as explained in Fig. 1, and adjustments are made to insure the effective production and reception of wanted sounds. Fig. 2 shows how sound starts from a source S, and proceeds outward in spherical waves with a rapid velocity of about 1,100 ft. per sec. On striking the boundaries of the room, sound waves are reflected, losing a little energy in the process, then they proceed to another boundary for another reflection, and so on until they become inaudible. As a numerical example, consider a room with a volume of 100,000 cu.ft. that is bounded by 20,000 sq.ft. of hard plaster walls and a wooden floor

TABLE II.—Effects of Various Partitions in Soundproofing

Partition	Weight	Sound reduction
Heavy wrapping paper	.016 lb. per sq. ft.	2.0 db.
One-inch hairfelt	.75 " " " "	5.8 " "
One-half-inch fibre board	.75 " " " "	19.0 " "
Light door	" " " "	22.0 " "
One-quarter-inch plate glass	3.5 " " " "	30.0 " "
Four-inch clay tile, plastered	29 " " " "	40.0 " "
Four-inch wood stud,	15.6 " " " "	42.0 " "
Concrete wall,	26 " " " "	42.0 " "
Eight-inch brick wall	87 " " " "	50.0 " "

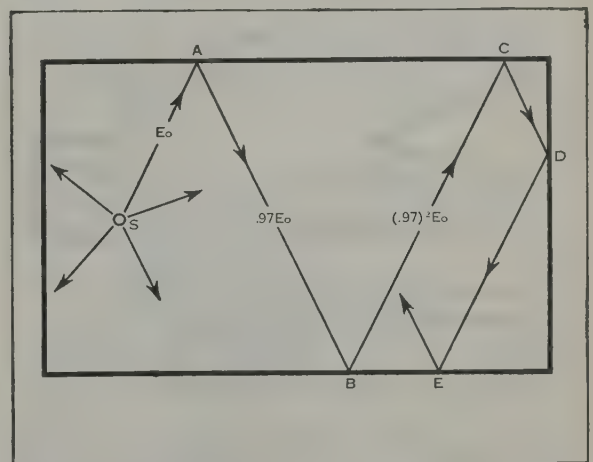
would have only a 50 db. level in the adjoining room. Table II exhibits a few data chosen from the extensive tables published by Vern O. Knudsen (*Architectural Acoustics*, 1932), Paul Earls Sabine (*Acoustics and Architecture*, 1932) and the National Bureau of Standards (*Report BMS-17*, 1939; *Supplement to Report BMS-17*, 1940).

Inspection of the results shows that the door and the glass (window) transmit more sound than the walls do, so that it is a mistake to install highly-insulating partitions unless double doors and windows are also used. This last statement is strikingly illustrated by the following example (Bureau of Standards, *ibid.* p. 9): Consider a brick building containing a single room, with plastered brick walls, 8 in. thick, a

TABLE III.—Relative Sound Transmissions of Parts of a Brick Building

Material	Area	Relative transmission
Brick walls	1,200 sq. ft.	48 units
Cement roof	600 " "	60 " "
Windows	150 " "	2,400 " "
Door	21 " "	67 " "
Total		2,575

plastered cement slab roof, 6 in. thick, several windows and a door. Inspection of the data shows that the windows, with only 150 sq.ft. area, transmit 2,400 units of sound energy out of the total of 2,575 units, the door transmits 67 units, while the roof and the walls, with much larger areas, transmit only 60 and 48 units respectively.



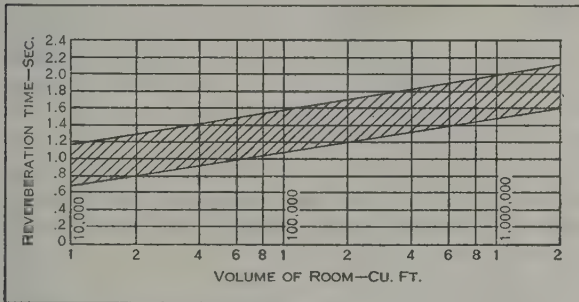
REPRINTED BY PERMISSION FROM "ACOUSTICS OF BUILDINGS," BY F. R. WATSON, PUBLISHED BY JOHN WILEY & SONS, INC.

FIG. 2.—REFLECTION OF SOUND WAVES IN A ROOM

that absorb an average of 3% of the incident sound energy at each reflection. Calculations show that while the sound decreases in energy to one-millionth of its initial value, it will make 461 reflections, and will travel a distance of 9,220 ft. in a "time of reverberation" of 8.22 sec. (Watson, *Acoustics of Buildings*, p. 32, 1941.) Under these conditions, the hearing will be very unsatisfactory. Before the first word of a speech dies out, several other words will have been uttered that will mix with the earlier ones, thus producing a confusion that

Echoes.—An echo is a reflected sound that reaches the auditor about one-fiftieth of a second or more after the direct sound. If the reflecting surface is curved so as to converge the sound, the resulting echo is marked and annoying. Plane walls produce weak echoes, while convex walls diverge the reflected sound and are very beneficial in reducing echoes and in producing a more uniform distribution of sound in the room. Fig. 4 pictures the concentration of sound by a curved surface (left), and shows the beneficial scattering set up by convex panels in the wall (right). The amount of curvature suggested by Potwin in 1939 is a rise of 1 in. in each 10 in. along the wall surface. A rectangular-shaped room without curves is generally preferred, with convex segments and sound-absorbing panels in critical locations.

Reverberation, or too great prolongation of sound, is the most usual acoustical defect in auditoriums. It is a common observation that the reverberations so noticeable in an empty house disappear when the house is furnished. So, in an auditorium, an adjustment is brought about by installing a sufficient amount of sound-absorbing material, selected to give the optimal time of reverberation, and by placing it where it will be most effective. Fig. 5 gives a graphical representation of the acoustical adjustment of an auditorium of 80,800 cu.ft. volume, with an insufficient amount of 570 units of absorption before correction, and with 2,300 units after correction. The optimal time of reverberation selected for this auditorium was taken as 1.3 sec. when an audience of 200 was to be present. The shaded area in Fig. 6



COURTESY OF ACOUSTICAL MATERIALS ASSOCIATION

FIG. 6.—TIMES OF REVERBERATION FOR AVERAGE SOUND FREQUENCY

indicates the times of reverberation for the average sound frequency of 512 cycles per sec. that has been used by acoustical engineers in recent years. (Acoustical Materials Association, *Bulletin VIII*, 1941.) For other frequencies than 512 cycles, somewhat different times have been used. (Maxfield and Potwin, *Jour. Acous. Soc. Amer.*, 11, p. 390, 1940.)

Sound-Absorbing Materials.—The absorption of sound in an auditorium is a vital consideration in securing good acoustics. Installing wires is a useless procedure. Irregularities in the shape of the walls, columns, coffering and similar devices may break up the regular reflection and make the resultant sound more diffuse, but absorption must take place to reduce the reverberation. Since the usual building materials used in a room are plaster, wood and glass, all of which absorb only about 3% of the incident sound, it has become necessary to develop other materials with greater absorption. Some products absorb sound when they vibrate, particularly when backed by an air space, but most materials are effective because of their porosity, by which sound energy is transformed into heat by friction in the pores.

Sound-absorbing tests are made to determine the absorption coefficients that are needed when calculating the time of reverberation. A method was developed in 1895 by Wallace Sabine to measure the time of decay of pure tones in an empty reverberation room and again when an absorbing sample was placed on the floor. (*Collected Papers on Acoustics*, 1922.) Results obtained in different laboratories by this method were not in agreement. In 1939 a number of physicists discussed a new method in which the decay of sound in a room involves the normal acoustic impedance and the normal modes of vibration. ("Symposium on the Measurement of Absorption Coefficients and the Application of Acoustic Absorbents," *Jour. Acous. Soc. Amer.*, 11, pp. 37-106, 1939.) A wide choice of sound-absorbing materials is now (1943) available, as illustrated by the following sample information (Acoustical Materials Association, Chicago, Illinois, *Bulletin No. VIII*, 1941, which lists many materials):

Frequencies	128	256	512	1024	2048	Average Coefficients
	0.12	0.15	0.47	0.95	0.78	0.60

The coefficients are determined for five frequencies, and an average is taken of four of them (256-2,048) to give the noise-reduction coefficient, which is used to express the relative sound-absorbing efficiency of the material. A coefficient of 1.00 indicates 100% absorption. In addition to the data shown in the tabulation, the *Bulletin* gives the following information:

"The material is in the form of cast units having a surface com-

posed or resembling small uniform granules. The binder may be gypsum or any other suitable mineral binder; it is $\frac{3}{4}$ inches thick; weighs 2.37 lbs./sq.ft.; is cemented to plaster board; its surface is painted white having a light reflection value of 65 per cent" (Acoustical Materials Association).

Acoustic Field Tests in auditoriums are conducted to ascertain to what extent the acoustic conditions will give acceptable production and hearing of speech and music. The intelligibility of speech is tested when a speaker on the stage recites a list of specially selected words, while observers in different locations in the room write down what they think they hear. For satisfactory conditions, 80% or more of the words should be heard correctly. (N. A. Watson and V. O. Knudsen, *Jour. Acous. Soc. Amer.*, 11, p. 406, 1940.) The time of reverberation is measured by a high-speed level recorder that gives the time rate of decay of the sound in decibels. A sound-level meter gives the loudness in different parts of the room to determine the uniformity of distribution of sound. The performance of the sound-amplifying system and the sound effects it produces in the auditorium are investigated by a trained radio engineer—not a simple test.

Ideal Auditorium Acoustics.—In 1928 Floyd R. Watson proposed a theory that good acoustics in auditoriums could be expected by following two rules: (1) provide a stage with reflecting surfaces so that performers can "hear themselves", and (2) design the auditorium for listening so that the reflected sound will be reduced to be comparable with "dead" outdoor conditions, but with extraneous noise controlled. (Watson, *Acoustics of Buildings*, Chap. VII, 1941.) After 1928, various developments appeared to confirm the predictions of this theory. Burris-Meyer in 1941 modified a concert stage to give it the characteristics of a small, reverberant room, and received the enthusiastic approval of the performers. (*Jour. Acous. Soc. Amer.*, 13, p. 16.) Stahl and Loudon (*Jour. Acous. Soc. Amer.*, 13, p. 9, 1941) found a "live end-dead end" room useful for testing absorption.

BIBLIOGRAPHY.—*Jour. Acoustical Society of America*, 1929-42; V. O. Knudsen, *Architectural Acoustics*, 1932; P. E. Sabine, *Acoustics and Architecture*, 1932; F. R. Watson, *Acoustics of Buildings*, 1941; National Bureau of Standards, *Report BMS-17 and Supplement*, 1939-40; P. M. Morse, *Vibration and Sound*, 1936; also, references in the foregoing article. (See also SOUND.) (F. R. W.)

ACQUI, city and episcopal see, province of Alessandria, Italy; from the town of that name it is 21 mi. S.S.W. by rail. Pop. (1936) 9,643 (town), 18,336 (commune). Its warm sulphur springs were already famous as Aquae Statiellae in Roman times. Part of the ancient bath establishment has been found; and south of the town are lofty arches of the aqueduct which supplied it. The place was connected by road with Alba Pompeia and Augusta Taurinorum. The town possesses a fine Gothic cathedral.

ACRANIA, or CEPHALOCHORDATA, a subphylum of the Chordata, including only *Amphioxus* (q.v.) and its allies.

ACRE. A harbour town or city of Palestine (Egypt. 'Ak (a), Assy. Akku, Heb. Akko, Gr. Ake [Josephus, 'Arke], Lat. Ac(c)e; on Crusading coins Ac(c)on, Arab. 'Akka). From the 3rd century B.C. it was known as Ptolemais, perpetuating, perhaps, the name of Ptolemy II (Philadelphus). The name St. Jean d'Acre dates from the time when it was the headquarters of the Knights Hospitallers.

Topography.—Acre is situated on a low, rocky promontory at the northern end of the Bay of Acre. A strong wall, shot pitted, girds it to seaward, and to landward a double rampart. The ancient harbour has silted up leaving now only a few feet depth of water. In the roadstead there is good anchorage for small craft. To the south of the city, broadening as it advances, stretches the formerly marshy Plain of Acre. There enters the sea not far from the city the classic river Belus (Na'mān) which of old provided, and still provides the *murex* from which the Phoenicians extracted the renowned Tyrian purple.

History.—Acre has had a most stirring and tragic history. Its strategic position on the military highway along the coast, its proximity to the western entrance to the Plain of Esdraelon, its significance as the natural port not only for Galilee, but for Damascus and the Hauran, coupled with the peculiar military value of its site, attached to it an enduring importance, both political and commercial. The name first appears in the conquest lists of the Egyptian monarchs Thutmose III (c. 1500 B.C.) and Seti I (c. 1315 B.C.). From the Amarna dispatches of Amenhotep IV (c. 1375 B.C.) it would appear that the caravans of Burra-Buriash II, king of Babylonia were plundered, much to his annoyance, by the king of Acre. In the Old Testament it is named (Judges i, 31) as one of the places whence the Israelites did not drive the Canaanite inhabitants. At the beginning of the 7th century B.C.

when the Assyrian was in the pride of his strength Acre appears to have been subordinate to Tyre for a time at least, since the two names are regularly coupled in inscriptions (Sinaherib, Asarhaddon). It is first mentioned apart in the records of Ashurbanipal (668-628). During the Persian period Acre is not much in evidence. It appears, however, to have been the rendezvous for Artaxerxes Mnemon in his expedition against Egypt (Strabo civ. 2). From this time on "for Egypt, for Asia Minor, for the Greek isles and mainland, and for Italy its harbour was the most convenient on the Syrian coast, and its history till the end of the New Testament period is that of the arrival of great men from these shores, of the muster of large armies, of the winter camps of the invaders of the Syrian hinterland, and of bitter conflicts between Greeks and Jews" (G. A. Smith). Josephus and the Books of the Maccabees record its varying fortunes. Within its walls the Syrian Greeks, routed by Simon Maccabaeus, sought refuge (164 B.C.). In the struggle for the Syrian throne, Alexander Balas wrested Acre from Demetrius (153). Jonathan was lured within its gate (Acre has only one) by Trypho and taken prisoner (143). Round about the year 104 B.C. Alexander Jannaeus laid siege to Acre but abandoned it from fear of Ptolemy Lathyrus, who besieged and took it, but was forced to yield it to his mother Cleopatra. Tigranes of Armenia stormed it (70 B.C.) but relinquished it under fear of the Romans and it surrendered without a struggle to the Parthian Pacorus (Josephus, *B.J.* i. 13). Herod entertained Caesar here and here he built a gymnasium. It was established a *colonia* by Claudius. St. Paul spent a day in Ptolemais while coasting from Tyre to Caesarea (Acts xxi. 7). In the wars with the Jews the Roman leaders realized its value as main base for their armies (Varus, Vitellius, Petronius, Cestius, Vespasian).

In Christian times Ptolemais became a bishopric and its bishop attended the great councils of the Church, Caesarea (198), Nicea (325), Constantinople (381), Chalcedon (451), Jerusalem (536). The Arabs took possession of the city in 638. Baldwin I. captured it with the aid of a Genoese fleet in 1104 (1st crusade). Saladin re-captured it in 1187 (2nd crusade). In 1191 after a siege by Guy de Lusignan of about two years, it was taken on the arrival of Richard Coeur de Lion (3rd crusade), and was finally lost in 1291. The Turks under Selim I entered into possession in 1517, after which the city fell into decay. Its revival began in 1749 with its capture by Omar ez-Zahir, and it emerged into prominence, prosperity and virtual independence under his successor "Ahmad el-Jazzar" ("the butcher"). Supported by a British fleet under Sir Sidney Smith it resisted Napoleon successfully in 1799. The year 1832 saw its capture and wreck by Ibrahim Pasha of Egypt. On Nov. 4, 1840, the city was attacked by the allied fleets (British, Austrian, Turkish) under Sir Charles Napier and after three hours' bombardment reduced. Restored in the following year to Turkey it remained in Turkish hands till Sept. 23, 1918, when it was occupied by the 13th Cavalry brigade (5th Cavalry division) of the Egyptian Expeditionary force with little or no opposition.

Modern.—Acre with a population (est. 1940) of 9,500 (8,000 Muslims) is in British mandated territory and under the administrative partition of Palestine in the northern province (Phoenicia and Galilee). Under Turkish rule it was the chief town of a governmental district. Formerly the chief port of shipment for grain brought on camel-back from the Hauran, its trade was much diminished with the opening of the Damascus-Beirut railway in 1896 and practically extinguished when the Haifa-Damascus railway in 1906 diverted what remained to Haifa. It has now a small coasting trade in locally grown grain, sesame seed and oil and a small export of oranges to Beirut. Brass and copper ware are made to a small extent. It is now a customs sub-station to Haifa. Acre is the chief seat of Baha'i religion, an offshoot of Babism, with an estimated number of adherents at 2,000,000. The founder 'Abdu-l Baha died here in 1921 and was succeeded by his grandson Shauki Effendi, who was made life-president of the council of nine, which regulates the affairs of the community. Few buildings of interest have survived the buffeting to which the city has been repeatedly subjected. The most no-

table, perhaps, is the large mosque built by el-Jazzar. Four commodious khans recall the times when 2,000 to 3,000 camels, grain laden, would arrive in a day. British administration has been responsible for the establishment of a government hospital, a forest nursery, and a large convict prison. A railway from Beirut along the coast to Acre was built in 1942.

BIBLIOGRAPHY.—Reland's *Palestina* (1714); E. Robinson, *Later Biblical Researches in Palestine* (1852); G. A. Smith, "Ptolemais" (*Encyc. Biblica*, 1902); Luke and Keith Roach, *The Handbook of Palestine* (1922). (E. Ro.)

Battle of Acre.—The battle of 1189, fought on the ground to the east of Acre, affords a good example of battles of the Crusades. Saladin's victory at Tiberias in 1187 had led to the fall of Jerusalem and to that of almost all the Christian strongholds in Palestine and Syria, save Tyre, Antioch, and Tripoli. The attempt to regain Acre led to the battle described below and was in turn a prelude to the Third Crusade under Richard I. of England and Philip of France. The crusading army under Guy de Lusignan, king of Jerusalem, which was besieging Acre, gave battle on Oct. 4, 1189, to the relieving army raised by Saladin. The Saracens lay in a semicircle east of the town, facing inwards towards Acre. The Christians opposed them with crossbowmen in first line and the heavy cavalry in second. At Arsuf (*q.v.*) the Christians fought coherently; here the battle began with a disjointed combat between the Templars and Saladin's right wing. The crusaders were so far successful that the enemy had to send up reinforcements from other parts of the field. Thus the steady advance of the Christian centre against Saladin's own corps, in which the crossbows prepared the way for the charge of the men-at-arms, met with no great resistance. But the victors scattered to plunder. Saladin rallied his men and, when the Christians began to retire with their booty, let loose his light horse upon them. No connected resistance was offered, and the Turks slaughtered the fugitives until checked by the fresh troops of the Christian right wing. Into this fight Guy's reserve, charged with holding back the Saracens in Acre, was also drawn, and, thus freed, 5,000 men sallied out from the town to the northward; uniting with the Saracen right wing, they fell upon the Templars, who suffered severely in their retreat. In the end the crusaders repulsed the relieving army, but only at the cost of 7,000 men.

See Oman, *Hist. of the Art of War in the Middle Ages*, vol. 1. 333-340 (1924).

ACRÉ or AQUIRY, a river of Brazil and principal tributary of the Purús, rising on the Bolivian frontier and flowing easterly and northerly to a junction with the Purús at 8° 45' S. The name is also applied to a district situated on the same river and on the former (1867) boundary line between Bolivia and Brazil. The region, which abounds in valuable rubber forests, was settled by Bolivians between 1870 and 1878, but was invaded by Brazilian rubber collectors during the next decade and became tributary to the rubber markets of Manáos and Pará. In 1899 the Bolivian Government established a customhouse at Puerto Alonso, on the Acré river, for the collection of export duties on rubber, which precipitated a conflict with the Brazilian settlers and finally brought about a boundary dispute between the two republics. In July 1899, the Acréanos declared their independence and set up a republic of their own, but in the following March they were reduced to submission by Brazil. Various disorders followed until Brazil decided to occupy Puerto Alonso with a military force. The boundary dispute was finally settled at Petropolis on Nov. 13, 1903, through the purchase by Brazil of the rubber-producing territory south to about the 11th parallel, estimated at more than 60,000 sq.m.

ACRE, a land measure used by English-speaking races. Derived from the O.E. *acer* and cognate with the Lat. *ager*, Gr. *ἀγρός*, Sans. *āgras*, it has retained its original meaning "open country," in such phrases as "God's acre," a churchyard, or "broad acres," etc. As a measure of land, it was first defined as the amount a yoke of oxen could plow in a day; statutory values were enacted in England by acts of Edward I. and III., Henry VIII., George IV.; the Weights and Measures Act 1878 defines it as 4,840 sq.yds. This is the American acre. In addition to this

statute, or imperial, acre, other acres are still, though rarely, used in Scotland, Ireland, Wales and certain English counties. The Scottish acre contains 6,150.4 sq.yd.; the Irish acre 7,840 sq.yd.; in Wales, the land measures *erw* (4,320 sq.yd.), *stang* (3,240 sq.yd.) and *paladr* are called acres.

The Leicestershire acre (2,308½ sq.yd.), Westmorland acre (6,760 sq.yd.) and Cheshire acre (10,240 sq.yd.) are examples of local values.

ACRIDINE is a solid, crystallizing in needles of melting point 110° C., found in coal-tar anthracene. It is characterized by its irritating action on the skin, and by the blue fluorescence shown by solutions of its salts.

Acridine is extracted from the crude anthracene by dilute sulphuric acid; the sulphuric acid solution is treated with potassium dichromate, and the precipitate of sparingly soluble acridine dichromate is decomposed with ammonia (C. Graebe and H. Caro, *Ann.* [1871]).

Acridine and its homologues are stable compounds of feebly basic character, belonging to the general class of heterocyclic ring compounds (see **CHEMISTRY: Organic Chemistry**). They combine readily with the alkyl iodides to form alkylacridinium iodides, which are readily transformed by the action of alkaline potassium ferricyanide to N-alkylacridones.

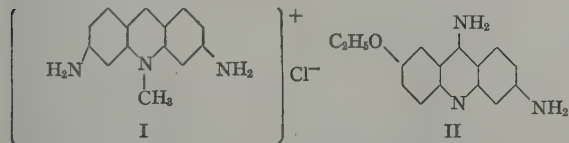
Acridine itself has the structural formula



It owes its basic properties to the presence of the tertiary nitrogen atom; it may be regarded as consisting of two benzene nuclei fused to a pyridine nucleus, and shows characteristics both of the former (homocyclic) and the latter (heterocyclic) structure.

Phenylacridine is the parent base of chrysanine, the chief constituent of the dyestuff phosphine (a by-product in the manufacture of rosaniline). The dyestuff phosphine must be distinguished from the phosphorus hydride of the same name, and from the organic derivatives of this substance, to which the general term phosphine is also given. Chrysanine (diamino-phenylacridine) forms red salts, dyeing silk and wool a fine yellow; the solutions of the salts are characterized by their fine yellowish-green fluorescence.

Several acridine derivatives and notably acriflavine (*syn.* tryptaflavine, euflavine) found extensive use during World War I as antiseptics for infected wounds (C. H. Browning and others). The preparation of acriflavine (I) and of proflavine, another acridine antiseptic of similar type, was described by L. Benda (1912).



Rivanol (II) also of the acridine series was recommended by J. Morgenroth (1921) as a powerful tissue antiseptic against spreading infection caused by streptococcus.

The antimalarial quinacrine (atabrine) is an acridine derivative. **ACRIFLAVINE**, an acridine derivative obtained from coal tar, is a reddish-brown powder with antiseptic properties. Introduced as an antiseptic in 1912 by Paul Ehrlich as tryptaflavine, it was used extensively in World War I but later was largely replaced by such chemotherapeutic agents as the sulfonamides and antibiotics.

In solutions it is used as the hydrochloride or as the less irritating base, neutral acriflavine, for irrigating wounds and for the treatment of gonorrhoea. As a urinary antiseptic, it may be taken by mouth. (F. L. A.)

ACRO, or **ACRON**, **HELENIUS**, Roman grammarian, probably flourished at the end of the 2nd century A.D. He wrote

commentaries on Terence and perhaps Persius. A collection of scholia on Horace was wrongly attributed to him.

See O. Keller (ed.), *Pseudoacronis Scholia in Horatium Vetustiora*. **ACROLITHS**, statues of a transition period in the history of plastic art, in which the trunk of the figure was of wood, and the head, hands and feet of marble. The wood was concealed either by gilding or, more commonly, by drapery, and the marble parts alone were exposed.

ACROMEGALY, a condition characterized by an enlargement of both bony and soft parts of the hands, feet and face. It occurs in adults and is due to an oversecretion of the growth hormone of the anterior lobe of the pituitary gland.

A similar overactivity in childhood and early adolescence gives rise to gigantism. (See **ENDOCRINOLOGY**.) (F. L. A.)

ACRON, a Greek physician of the 5th century B.C., born at Agrigentum in Sicily, was contemporary with Empedocles. The method of lighting large fires and purifying the air with perfumes, to put a stop to the plague in Athens (430 B.C.), is said to have originated with him.

ACROPOLIS, literally the upper part of a town (Gr. *ἄκρος* "top," *πόλις*, "city").

For purposes of defense early settlers chose elevated ground, frequently a hill with precipitous sides, and these early citadels became in many parts of the world the nuclei of large cities which grew up on the surrounding lower ground. The word acropolis, though associated primarily with Greek towns (Athens, Argos, Thebes, Corinth), is applied to all such citadels. The most famous is that of Athens, which, by reason of its historical associations and the famous buildings erected upon it, is generally known as the Acropolis (see **ATHENS**).

ACROPOLITA (AKROPOLITES), **GEORGE** (1217–1282), Byzantine historian and statesman, was born at Constantinople. At an early age he was sent to the court of John Ducas Batatzes (Vatatzes), emperor of Nicaea, by whom and by his successors (Theodorus II Lascaris and Michael VIII Palaeologus) he was entrusted with important state missions. The office of "great logothete," or chancellor, was bestowed upon him in 1244.

Acropolita's most important political task was that of effecting a reconciliation between the Greek and Latin Churches. In 1273 he was sent to Pope Gregory X, and at the Council of Lyons (1274) in the emperor's name he recognized the spiritual supremacy of Rome.

In 1282 he was sent on an embassy to John II, emperor of Trebizond, and died in the same year.

His historical work (*Χρονική Συγγραφή*, *Annales*) embraces the period from the capture of Constantinople by the Latins (1204) to its recovery by Michael Palaeologus (1261), thus forming a continuation of the work of Nicetas Acominatus. It is valuable as written by a contemporary, whose official position gave him access to trustworthy information.

He wrote several shorter works, among them being a funeral oration on John Batatzes, an epitaph on his wife Eirene and a panegyric of Theodorus II Lascaris of Nicaea. While a prisoner at Epirus, he wrote two treatises on the procession of the Holy Ghost.

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ACROSTIC, a short verse composition, so constructed that the initial letters of the lines, taken consecutively, form words (Gr. *ἄκρος*, "at the end," and *στῖχος*, "line" or "verse"). The fancy for writing acrostics is of great antiquity, having been common among the Greeks of the Alexandrine period, as well as with the Latin writers since Ennius and Plautus, many of the arguments of whose plays were written with acrostics on their respective titles. One of the most remarkable acrostics was contained in the verses cited by Lactantius and Eusebius in the 4th century, and attributed to the Erythraean sibyl, the initial letters of which form the words Ἰησοῦς Χριστὸς Θεοῦ υἱὸς σωτήρ, "Jesus Christ, the son of

God, the Saviour." The initials of the shorter form of this again make up the word 'Ιχθὺς (fish), to which a mystical meaning has been attached (Augustine, *De Civitate Dei*, 18, 23), thus constituting another kind of acrostic.

Acrostic verses have always been held in slight estimation from a literary standpoint. Dr. Samuel Butler says, in his "Character of a Small Poet," "He uses to lay the outside of his verses even, like a bricklayer, by a line of rhyme and acrostic, and fill the middle with rubbish." Addison (*Spectator*, No. 60) found it impossible to decide whether the inventor of the anagram or the acrostic were the greater block-head; and, in describing the latter, says, "I have seen some of them where the verses have not only been edged by a name at each extremity, but have the same name running down like a seam through the middle of the poem." And Dryden, in *Mac Flecknoe*, scornfully assigned Shadwell the rule of

Some peaceful province in acrostic land.

The name acrostic is also applied to alphabetical or "abecedarian" verses. Of these we have instances in the Hebrew psalms (e.g., Ps. xxv. and xxxiv.), where successive verses begin with the letters of the alphabet in their order. The structure of Ps. cxix. is still more elaborate, each of the verses of each of the 22 parts commencing with the letter which stands at the head of the part in our English translation.

At one period much religious verse was written in a form imitative of this alphabetical method, possibly as an aid to the memory. The term acrostic is also applied to the formation of words, from the initial letters of other words. 'Ιχθὺς, referred to above, is an illustration of this. So also is the word "Cabal," which, though it was in use before, with a similar meaning, has, from the time of Charles II., been associated with a particular ministry, from the accident of its being composed of Clifford, Ashley, Buckingham, Arlington, and Lauderdale.

Double acrostics are such as are so constructed, that not only initial letters of the lines, but also the middle or last letters, form words. For example:—1. By Apollo was my first made. 2. A shoemaker's tool. 3. An Italian patriot. 4. A tropical fruit. The initials and finals, read downwards, give the name of a writer and his *nom de plume*. Answer *Lamb, Elia*.

1. L yr E
2. A w L
3. M azzin I
4. B anan A

A curious and clever 20th-century development of the acrostic is the quadruple acrostic. The following, taken from R. A. Knox's *Book of Acrostics*, is a good example.

Uprights: Since there's no A, B, let us C and D.

Lights: 1. Reverse the name a schoolboy might apply, for brevity, to his weekly subsidy.

2. A lady thus (but with an S)
In Southern lands you might address.
3. Initials seen on many a truck.
4. To cattle breeders brings bad luck.

SOLUTION

Uprights: "Since there's no help, come, let us kiss and part."

- Lights: 1. HsaCteKcoP (Reverse of Pocket Cash).
2. (s) En Or It A
3. L.M.S.R.
4. PEST

Acrostics may be very simple and also very intricate. The modern acrostic seems to hit the happy medium and, whilst giving the reader plenty of food for thought, sends him occasionally into his Cruden, his classical dictionary or his encyclopaedia.

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FROM BÜHLMANN, "CLASSIC AND RENAISSANCE ARCHITECTURE," NEFF AND HELBRUNN

TWO GREEK ACROTERIA
Top and lower right, front and back of apex type. (From Fletcher, "Hist. of Arch.," Batsford.) Lower left, eaves type

ACROTERIUM or **AKROTERION**, in architecture, a statue or ornament of any kind placed on the apex or at the lower angles of a pediment. The word is sometimes restricted to the pedestal supporting such an ornament.

ACT, a word varying in significance according to the sense in which it is employed. It is often synonymous with "statute" (see **ACT OF PARLIAMENT**). It may also refer to the result of the vote or deliberation of any legislature, the decision of a court of justice or magistrate, in which sense records, decrees, sentences, reports, certificates, etc., are called *acts*. In law act means any instrument in writing, which declares or proves the truth of a bargain or transaction, as: "I deliver this as my act and deed." The origin of the legal use of the word "act" is in the *acta* of the Roman magistrates or people, of their courts of law, or of the senate, meaning (1) what was done before the magistrates, the people or the senate; (2) the records of such public proceedings. In the sense of "document" it is used in those systems of law which are derived from the Roman.

ACTA DIURNA, called also *Acta Populi*, *Acta Publica* and simply *Acta* or *Diurna*, in imperial Rome a sort of daily gazette, containing an official narrative of noteworthy events at Rome. Its contents were partly official (court news, decrees, etc.), partly private (notices of births, etc.). Thus to some extent it filled the place of the modern newspaper (*q.v.*). The *Acta* were originated by Julius Caesar, who ordered the keeping and publishing of the acts of the people by public officers. The *Acta* were exposed daily in a public place on a whitened board (see **ALBUM**). After remain-

ing there for a reasonable time they were taken down and preserved with other public documents, so that they might be available for reference.

The *Acta* differed from the *Annals* (discontinued in 133 B.C.) in that only the more important matters were given in the latter, while in the former things of less note were recorded. Their publication continued till the transference of the seat of the empire to Constantinople.

See Gaston Boissier, *Tacitus and other Roman Studies* (Eng. trans. W. G. Hutchison, 1906), p. 197-229.



AFTER A CAST IN METROPOLITAN MUSEUM OF ART
ACTAEON. MYTHICAL HERO AND HUNTER, KILLED BY HIS HOUNDS FOR HAVING ACCIDENTALLY SEEN DIANA (ARTEMIS) WHILE BATHING

statue was often set up on rocks and mountains as a protection against excessive heat, and the myth itself probably represents the destruction of vegetation during the 50 dog-days. Aeschylus and other tragic poets and artists made use of the story, which is illustrated by a noted small marble group in the British Museum.

ACTA SANCTORUM, a collection of the lives of the saints, arranged day by day according to the calendar, and compiled by the Bollandists, Belgian Jesuits. The work, first conceived at the commencement of the 17th century, has been carried on ever since, save during the period of the suppression of the Society of Jesus in Belgium. In 1925 the fourth volume for November, dealing with the days Nov. 9 and Nov. 10, was published. (See **BOLLANDISTS**.)

ACTA SENATUS or **COMMENTARIJ SENATUS**, minutes of the discussions of the Roman senate. Before the first consulship of Julius Caesar (59 B.C.), minutes of the proceedings of the senate were occasionally published, unofficially; Caesar, however, ordered them to be issued authoritatively. The keeping

of them was continued by Augustus, but their publication was forbidden. A young senator was chosen to draw up these *Acta*, which were kept in the imperial archives and public libraries. Special permission from the city praefect was necessary in order to examine them. (*See ACTA DIURNA.*)

ACTING. Greek drama is usually given first consideration in connection with the origin of dramatic art, but the basic reasons for imitation, mimicry and what is now called "acting" are found in the study of the lower races of man. Make-believe, or the desire to imitate, is, perhaps, most common among children the world over, and it appears also among many animals.

Loomis Havemeyer points out (*The Drama of Savage Peoples*) that "there is a twofold purpose in this imitation characteristic of savage peoples. The first and simplest is that it gives a pleasurable sensation similar to the real experience. And, secondly, it enables man to convey his impressions to others—i.e., it is a form of language." From the last purpose grew the gesture, or any bodily gesticulation or facial expression that serves as an aid to, or a substitute for, the spoken language of the savage. It was a common means of communication.

Development.—The evolution of acting, from its simple beginnings to modern times, is summed up by Brander Matthews (*The Development of the Drama*) "The dramaturgic faculty is evolved slowly with the growth of civilization; and play-making skill is one of the latest of human accomplishments. But the rudimentary is everywhere visible, even among the most primitive peoples. As we consider the history of human progress, we perceive that the drama is almost the very earliest of the arts, as early, perhaps, as the art of personal adornment; and we discover also that it is the very latest to attain its complete expression. But in the noblest work of the Greek dramatists, and in the most powerful plays of the Elizabethans, the same principles are applied which we discover, doubtlessly, in the rudest theatrical attempts of the lowest savages. It is out of the crude efforts, such as still may be observed among the Eskimo and the tribes of the Amazon, that the dramatic art was toilfully developed by our own predecessors as taste refined and civilization advanced. The traditions of these rude play-makers were passed down from generation to generation, and the art slowly discovered itself."

Grecian Influences.—It was not until the gods of Egypt were accepted by the Greeks that there appears any ceremony which can be truly called dramatic. The Greek drama arose through the worship of the gods of vegetation, and later developed into the form of the plays of the great dramatists. It is difficult, however, to think of the drama of the Greeks without thinking of its close connection with the dance. The myth was the subject matter; the dance was the expression of that subject matter, be it the idea of spring, the awakening of new life, or the representation of various objects such as trees and events by means of gestures, postures and attitudes. In the early religious history of Greece all the people took a part in the dramatic dances around the altar, but later, a certain few of the most capable actors were selected from the chorus to play outstanding rôles, or to play many, and sometimes all, of the parts in the play—inasmuch as the custom of wearing masks made this possible. The number of principal actors in a Greek play seldom exceeded three, and it was more common to have only one character appear at a time. Thus it was that acting became a profession, and, among the Greeks, a very noble one. The profession was confined entirely to men.

Italian Interests.—In Italy the dramatic instinct has been very pronounced among its people as far back as records show. The dramatic literature of Italy has emerged from centuries of political and religious strife, but through all these troubled days the genius of the Italian people has led it to love the drama, and more—the art of acting. Before the writing of plays, and even after, as in the *Commedia dell'arte*, it has not been uncommon for a group of people to dramatize impromptu. Given a theme on which to bring out some feeling or desire, they express this spontaneously in the form of a play. The love of music, dance and spectacle did more, perhaps, to preserve this interest in the dramatic art through the political and religious struggles—the periods

that provided no dramatic literature—than any other influence.

The Elizabethan Drama.—The art of acting was emphasized more by Shakespeare than by any other dramatist of his day. His plays show a remarkable interest in characterization, in which he brought forth every known type of humanity that would fit into the tragic or comic rôles that he created. It should be noted that between 1810 and 1835, a period described by William Archer as "the winter solstice of English drama," English acting reached its highest peak in the genius of Edmund Kean. For his greatness we have the testimony of the masterly criticism of William Hazlitt and Leigh Hunt. Yet it is doubtful that, without the strong emphasis on Shakespearean production at the time, Kean or his fellows would have so flourished. Shakespeare's own convictions as to the importance of acting, shown in Hamlet's speech to his players, cannot be overestimated, for here he incorporates the fundamentals of good acting, the important factors in the better use of the voice and body:

"Speak the speech, I pray you, as I pronounced it to you, trippingly on the tongue; but if you mouth it, as many of your players do, I had as lief the town-crier spoke my lines. Nor do not saw the air too much with your hands, thus; but use all gently; for in the very torrent, tempest, and, as I may say, whirlwind of your passion, you must acquire and beget a temperance that may give it smoothness. Oh, it offends me to the soul to hear a robustious, periwig-pated fellow tear a passion to tatters, to very rags, to split the ears of the groundlings who, for the most part, are capable of nothing but inexplicable dumb-show and noise; I would have such a fellow whipped for o'erdoing Termagant; it out-Herods Herod; pray you, avoid it."

"Be not too tame, neither, but let your own discretion be your tutor; suit the action to the word, the word to the action . . ."

Views of Diderot.—It was not until about the 18th century that the different theories, or definite systems, of acting began to appear to any extent. Denis Diderot, the French encyclopaedist, grew weary of the classical French drama, with its conventional acting, and advanced as its opposite the theory of a drama of real life, which was, among other things, to be a truer reflection of the bourgeois of France. Diderot said (*Paradoxe sur le comédien*) that "The possibilities of a good actor lie in the complete absence of sensibility," and recommended to the actor that he should watch himself during the performance, that he should listen to his voice and give only "recollections of his emotions."

Theodore Komisarjevsky, formerly producer and art director of the Moscow State and Imperial theatre, wrote of this theory: "It is proved now that an actor cannot move the audience, or be in any way creative on the stage, if he watches himself acting. Instead of being concentrated on the images he has to create, on his inner self, he becomes concentrated on his outer self, becomes self-conscious and loses the power of imagination. The better way is to act only with the help of the imagination; to create, and not to imitate or reproduce one's own life experiences. When the actor playing a part is living in a world of images created by his own phantasy, he cannot and need not watch and control himself. The images created by the actor's phantasy, and obedient to his call, control, guide and direct his emotions and actions during the performance."

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(F. L. D.; R. MY.)

MODERN TENDENCIES

The 20th century has seen several new and distinct theories of acting. Different schools, academies of acting and theatres, mostly repertory, have done a great deal towards improving the standard of acting and team work or ensemble acting, on the stage: notably, in England, the Repertory theatre in Birmingham and the Liverpool Repertory theatre; in Ireland the Abbey theatre, Dublin. Such English producers as Gordon Craig, Granville Barker, Basil Dean, J. B. Fagan, Lewis Casson, Nigel Playfair, performed very important work in improving the quality of acting, and creating stage ensembles, not only directly by their stage work, but also by their writings on the subject. In the United States, David Belasco, the Theatre Guild of New York,

the Washington Square Players, the Provincetown Playhouse and such producers as Arthur Hopkins, R. E. Jones, the Reichzts and others contributed to this improvement. Moreover, the Little Theatre movement (*q.v.*) in the U.S. must not be overlooked.

Producers such as Max Reinhardt in Germany and Firmin Gémier in Paris used, for the most part, the methods of acting created by the naturalists, André Antoine in France, and Kroneg, the producer of the German Meininger company, and developed by Otto Brahm in Berlin and by Stanislavsky in Moscow. Sometimes these producers introduced, in this naturalistic acting, ideas of the formalists, Georg Fuchs in Germany, Vsevolod Meyerhold and Alexander Tairof in Russia, Gordon Craig in England and others. Sometimes they introduced touches of the synthetic theories of acting advocated by Komisarjevsky after 1910. The majority of the French actors trained in the Conservatoire in Paris remained still under the influence, not only of the old romantic school, but also of the pseudo-classical school of acting of the 18th century.

Naturalism.—The best-known of all the new theories of acting which appeared after 1910 was the system of Stanislavsky, the leading producer and director of the Moscow Art theatre. His system was founded on the principle that an actor, having to be natural and sincere on the stage, could be so only by means of reproducing emotions experienced at some time or other in his life. That form of "psychical naturalism" became part of Stanislavsky's system as a result of "outer naturalism," which he advocated before he turned to psychology in the endeavour to find out a scientific system of acting.

The "inner naturalism" in acting was not a new feature in Stanislavsky's theory. Some French theatrical theorists had already, in the 18th century, founded their systems of acting on the same ideas. They held that an actor can represent himself on the stage only if it is desired that he should be sincere; that "love scenes are much better played by actors who are in love in real life." Like the followers of Jean Racine, Stanislavsky believed that contemporary actors living in their own time, and each one in his special atmosphere, are unable to produce other emotions than those that are applicable to the time and to the surroundings in which they lead their every-day life. To be sincere, they must place, beneath the lines and stage directions of the author, their own emotions already experienced in real life.

It is quite clear that this type of acting destroys the form created by the author of the play and the rhythm of his lines, which express the inner content and the inner movements of the play. The actor who acts by the power of his imagination passes from the form and the rhythm of the play to the inner content of it. The idealistic and emotional content of the play, which he obtains through the form and rhythm of the play, exists in his imagination, and produces the necessary working of his intellect to create a stage character with all its peculiarities. The pupil of Stanislavsky neglects the form and rhythm of the play and substitutes his own remembered, intellectual states in place of those of the author.

The Formalists.—Another system, opposed to Stanislavsky's ideas, was advocated by the symbolists, the formalists and the expressionists. Here we have a complete negation of sincerity and life-likeness; the less the acting is sincere and life-like the better. The actor must not try to create any definite characters; he must represent abstract ideas, and convey these through his speeches delivered in a formal way, and through his movements and gestures, again produced in a formal, unlife-like and "pictorial" or marionette-like style. The Russian and German formalists, Meyerhold, Tairof and Erwin Piscator, after the Revolution, became much interested in acrobatics and circus business; the movements of the actors in their productions became something akin to a *perpetuum mobile*, dominating both the psychology of the play and the meaning of the lines. Thus the acting on their stages resembled a mixture of circus and cubistic ballet performance. Later, Meyerhold returned to the more or less naturalistic style. Some impressionists, such as Leopold Jessner and Nicholas Evreinov, used formal methods interspersed with psychological touches. Actors on the French *avant-garde* stages worked on some-

what similar lines at the Atelier directed by Charles Dullin, in the productions of Georges Pitoef and Louis Jouvet. At the *Vieux Colombine*, they used the same methods of acting. Jacques Copeau, the director of that theatre, must be considered as a pioneer, in France, in the fight against naturalism and the old-fashioned Conservatoire acting. He definitely introduced such new methods of acting as the psychological and the formal on the French stage.

ACTING IN THE ENGLISH-SPEAKING COMMERCIAL THEATRE

The English-speaking theatre after 1920 accelerated its divergence from the Russian and European theatres, and acting reflected that divergence. The public bestowed its patronage upon the new and the original. The repertory system and the so-called "stock" system of revivals diminished almost to the vanishing point, although a reappearance of these systems is now happily to be seen. The theory of continuity and tradition which flourished in Europe prior to World War I relinquished any hold it had on the commercial theatre of the United States and England. Only in the case of the Shakespearean classics did the repertory idea survive, as for instance in the "Old Vic" and Stratford-on-Avon companies in England; and even there the emphasis was continually placed on fresh interpretation. The U.S. never had "schools" of acting within the European meaning of a company of actors drilled and trained by a director or producer who taught a "style." From Henry Irving, Edwin Booth and Richard Mansfield, through Gerald du Maurier, John Drew and the Barrymores, no claim, or even effort, was made to establish any method of acting. Ellen Terry and Ada Rehan, Maude Adams and Mrs. Patrick Campbell not only set no rigid principles for their craft, but lavished their scorn upon copyists.

The theatre today (1945) cannot even point to "typical" acting, so great has been the emphasis upon the fresh, the new, the unexpected. A "star" may be born between 8.30 and 11.00 P.M. of an opening night, although he may never have faced an audience before that night, so great is the public's appetite for the original. And yet that star may fade abruptly without another flicker if he cannot adapt his talents to the next play. The public is loyal to the actor, but it is noticeable that it is increasingly impatient of fads and easily tired of idiosyncrasies. It is no longer sufficient for the actor with personality and certain hallmarks of mannerism to exhibit himself, with a play as a background. The stylized actor—the actor who has too close an adherence to any manner of acting—finds that he fails to convey illusion to the audience precisely because he produces the expected. The actor who acts for a living on the English-speaking stage today does so in a theatre run by private enterprise for profit to all concerned. He must adapt his talents to the practical considerations of that theatre or he will not get a chance to do any acting. He must transmit across the footlights a clear-cut presentation of the playwright's concept and he must maintain the illusion of spontaneity for the run of the play.

Today's commercial theatre is based on the "long run." Producers, meeting the competition of the motion picture and radio, bring to each play the best obtainable elements in presentation. This is expensive, and so perforce they run the play for as long as there is patronage for it, with no regard whatsoever to the effect upon the future career of an actor. The actor, in the average successful play, must give from 200 to as many as 1,000 or more performances without interruption. He must give as valid an illusion of spontaneity at any one of these performances as on the opening night. In addition, if he desires future theatrical employment, he must also manage to maintain sufficient versatility to make him eligible for an entirely different new play. Nobody will take care of this for him but himself. How he does this in the present-day theatre, is strictly up to him. There is no formula of acting which is likely to hold good for any two plays, or for any two actors.

The actor must find his own training, because producers and directors make no effort to train him beyond a given play for which his services may be desired. Any precise method he may choose to study is his own choice and so presumably congenial

to his natural tendencies of expression. In seeking employment he is under no handicap of prejudice against any particular method of training he may have selected, nor is he necessarily handicapped if he has provided himself with no training.

The director of a production is, of course, indispensable; but he has no obligation to teach an actor how to develop a characterization, nor how to sustain a performance once it is worked out. In the ordinary circumstance the director's work with the actor is limited to the rehearsal and try-out period of a particular play, and his efforts with regard to the acting under his control are concerned entirely with that play. The opportunities for young actors to work under a good director in a number of varied plays, before playing on the commercial stage, are unfortunately very limited in the English-speaking theatre.

This practical circumstance of the "long run" has forced the actor to abandon any reliance on the theories of those who, like Meyerhold, Stanislavsky, Gordon Craig and others, attempted to find a scientific basis for acting. He must act the same part under any and all circumstances, personal and extraneous to him. However much he may yearn for the luxury of "use your own emotions in your acting," it is obviously physically impossible for him to do so for several hundred consecutive times. He has been forced to acquire a technical concept of his performance—a control—which will not desert him in order to assure the play consistency, and lest he blur or distort the playwright's intention by allowing the variations of his personal temporary emotions to dominate his performance. Naturally an actor, like anyone else, is much moved by a play. He reads it, reacts to it, works into it, gets fond of it, feels that he understands it. But once that reaction to a piece of writing has "crystallized" and has become part of his experience, it is an actor's job to get that understanding over to an audience according to the author's intention. It is quite possible for an actor to be impressed and moved, or depressed and disturbed, by his own performance. But unless he detaches himself from these personal feelings, he can never acquire the discipline which gives tempo, rhythm and balance to the production as a whole.

The acting profession has come to learn that devotion to a school of acting can hamper the flexibility necessary to meet the fresh problems presented by a new play. Acting in the commercial theatre is the composite result of individualistic processes: each actor works out his own performance, bringing such resiliency of mind as he may possess to augment his accumulated experience in solving the fresh problem presented by the new characterization. If he may have acquired a knowledge of several methods of approach, so much the easier for him to make his choice of method. But no "school" or method can rule him—it is his problem, and his choice, or his invention. Good acting, like a good play, is flesh and blood and not a bundle of tricks.

Plays are written to be seen and not to be read. They must rest on the library shelf or in the producer's file cabinet unless the acting profession has the flexibility to give them visual presentation, no matter how new the form or how bizarre the requirement. The playwright is the motive force; the acting is the essential means of communication between author and audience, and not an end in itself, as in the outmoded "vehicle" play. It matters little whether acting be termed a "creative" or an "interpretive" ingredient of the theatre. It is likely to be a skillful fusion of both. The balance will be one way or the other, depending on what a given play requires of the actor. Each acting part presents a unique problem for which the actor must be prepared, and to overcome which he must find himself unconfined by any theory. For instance, given an author of technical capacity, whose dramatic thesis is clearly developed, whose character structure has clarity, the acting is a matter of honest interpretation. Thus would the play be presented to the public as the playwright intended. But it is not usually so easy. Gaps left by the author, intentionally or unintentionally, must be filled in by the actor. An underwritten character can come to life on the stage because an actor is sufficiently flexible, not only to interpret, but to add his own creation.

The working out of the finished product which is today's com-

mmercial "theatre," has no rule of thumb for anything connected therewith, least of all for the acting. Shakespeare, as usual, said it first. To the actors, Hamlet says, "Let your discretion be your tutor." Each new play presents new problems to the actor, new decisions as to interpretation or creation. How these problems are solved, what considerations prevailed, how dramatic balance was attained to the satisfaction of author, producer, director and actor, and maintained for a long run, is something which no one on the outside of any given production can know. Nor will study of any number of productions furnish a sound basis for generalization on "acting." The fundamental of good acting is the sustained illusion of originality and spontaneity. Each actor who survives in his profession has built up, bit by bit, out of experience and temperament unique to him, his own means of sustaining that illusion. See also THEATRE: *Direction and Acting; The Actor*.

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ACTINIC RAYS, ultra-violet rays which produce chemical changes. The term is sometimes popularly applied to the ultra-violet rays which are invisible, but can be detected by their action on a photographic plate and by rendering certain substances fluorescent (see FLUORESCENCE AND PHOSPHORESCENCE). They are, to a certain extent, absorbed by the atmosphere, and, in moderate doses, have a beneficial effect on man. (See SPECTROSCOPY; LIGHT AND RADIATION IN RELATION TO HEALTH.)

ACTINIDIACEAE, a family of dicotyledonous plants, segregated from the Dilleniaceae. But four genera are recognized, the larger ones being *Actinidia*, scandent shrubs, with about 25 species, chiefly Asiatic, a few now cultivated in Europe and in the United States, the allied *Clematoclethra*, 12 species, also Asiatic, and the very large pantropic genus *Saurauia* with more than 300 species, all shrubs or small trees, characteristic of the tropics of both hemispheres. See E. Gilg and E. Wedermann, in Engler, *A. Nat. Pflanzenfam.* ed. 2, 21:36–47, f. 26–29 (1925).

ACTINIUM. The metallic element actinium has the symbol Ac, atomic number 89, atomic weight 227, is exclusively trivalent, and is radioactive, the fourth member of the natural, $4n + 3$ radioactive family. It occurs in uranium ores and can be manufactured from radium by transmutation in nuclear chain reactors (see RADIOACTIVITY, NATURAL). (G. T. Sg.)

ACTINOMETER, an instrument for measuring the heating and chemical effects of light. It is derived from the Greek, *ἀκτίς* ray, *μέτρον* measure. The name was first given by Sir John Herschel to an apparatus for measuring the heating effect of solar rays; Herschel's instrument has been discarded in favour of the pyrheliometer (Gr. *πῦρ* fire, *ἥλιος* sun). (See RADIATION, RAYS.)

The word actinometer is usually applied to instruments for measuring the actinic or chemical effect of luminous rays; their action generally depends upon photochemical changes. A type of actinometer is used in photography under the name of exposure-meter. In this instrument a section of sensitized bromide is exposed for a measured period of time. Certain practical forms are described in the article PHOTOGRAPHY.

ACTINOMYCOSIS (STREPTOTRICHOSIS), a chronic infective disease occurring in both cattle and man. In both these groups it presents the same clinical course, being characterized by chronic inflammation with the formation of granulomatous tumours, which tend to undergo suppuration, fibrosis or calcification. It used to be believed that this disease was caused by a single vegetable parasite, the ray fungus, but there is now an overwhelming mass of observations to show that the clinical features may be produced by a number of different species of parasites, for which the generic name Streptothrix is adopted.

Pathological Anatomy.—The naked-eye appearance of the different organs affected by Streptothrix infection varies according to the duration and acuteness of the disease. In some tissues the appearance is that of a simple inflammation, whereas in others

it may be characteristic. The liver when affected shows scattered foci of suppuration, which may become aggregated into spheroidal masses, surrounded by a zone of inflammation. In the lungs the changes may be any that are produced by the following conditions: (1) An acute bronchitis. (2) A phthisical lung, grey nodules being scattered here and there almost exactly simulating tuberculous nodules. (3) An acute broncho-pneumonia with some interstitial fibrosis, and a tendency to abscess formation. The most characteristic lesions are in the skin.

The disease is more common in males than in females, and more prevalent in Germany and Russia than in England. The infection is probably spread by grain (corn or barley), on which the fungus may often be found. In a great number of recorded cases the patient has been following agricultural pursuits. The disease can only be transmitted from one individual to another with considerable difficulty, and no case of direct transmission from animal to man has yet been noted.

Clinical History.—The course of actinomycosis is usually a chronic one, but occasionally the fungus gets into the blood, when the course is that of an acute infective disease or even pyæmia. The symptoms are entirely dependent on the organ attacked, and are in no way specially characteristic. During life a diagnosis of phthisis is continually made, and only a microscopic examination after death renders the true nature of the disease apparent. The nature of the skin lesion is the most evident, and here the parasite may be detected early in the illness. The only drug which appears to have any beneficial influence on the course of the disease is potassium iodide, and this has occasionally been used with great benefit. Surgical interference is usually needed.

ACTINOTHERAPY: *see* LIGHT AND RADIATION IN RELATION TO HEALTH.

ACTION: *see* PRACTICE AND PROCEDURE.

ACTIUM (mod. *PUNTA*), the ancient name of a promontory in the north of Acarnania (Greece) at the mouth of the Sinus Ambracius (Gulf of Arta) opposite Nicopolis, built by Augustus on the north side of the strait.

On the promontory was an ancient temple of Apollo Actius, which was enlarged by Augustus, who also, in memory of the battle, instituted or renewed the quinquennial games called *Actia* or *Ludi Actiaci*. Actiaca Aera was a computation of time from the battle of Actium.

There was on the promontory a small town, or rather village, also called Actium.

History.—Actium belonged originally to the Corinthian colonists of Anactorium, who probably founded the worship of Apollo Actius and the *Actia*. In the 3rd century it fell to the Acarnanians, who subsequently held their synods there. Actium is chiefly famous as the site of Octavian's decisive victory over Mark Antony (Sept. 2, 31 B.C.). This battle ended a long series of ineffectual operations. The final conflict was provoked by Antony, who is said to have been persuaded by Cleopatra to retire to Egypt and give battle to mask his retreat; but lack of provisions and the growing demoralization of his army would sufficiently account for his decision. The fleets met outside the gulf, each over 200 strong (the totals given by ancient authorities are very conflicting). Antony's heavy fighting craft endeavoured to close and crush the enemy with their artillery; Octavian's light and mobile craft made skilful use of skirmishing tactics. During the engagement Cleopatra suddenly withdrew her squadron and Antony slipped away behind her. His flight escaped notice, and the conflict remained undecided until Antony's fleet was set on fire and thus annihilated.

ACTIVISM denotes any view that lays stress on action and its requirements. In psychology it means the view that stresses the importance of conation rather than cognition (*see* ATTENTION; CONATION; PSYCHOLOGY). In philosophy it denotes the view which makes utility the test of truth (*see* PRAGMATISM), or allows moral claims to justify certain theoretical assumptions (*see* KANT), or conceives of the ultimate principle of reality as some kind of will or activity (*see* ACTUALITY THEORY; SCHOPENHAUER; SPINOZA). In science it means the view which emphasizes

the importance of the practical application of scientific discoveries—"knowledge is power" (*see* BACON, FRANCIS).

ACT OF PARLIAMENT. An act of parliament may be regarded as a declaration of the legislature, enforcing certain rules of conduct, or defining rights and conferring them upon or withholding them from certain persons or classes of persons. Acts of Parliament fall into two classes—"Public" and "Private." The former are officially defined in the Commons' Manual of Procedure as having for their object "to alter the general law," the latter, "to alter the law relating to some particular locality, or to confer rights on or relieve from liability some particular person or body of persons." The collective body of such declarations constitutes the statutes of the realm or written law of the British nation, in the widest sense, from Anglo-Saxon times to the present day. It is not, however, till the earlier half of the 13th century that, in a more limited constitutional sense, the statute-book is generally held to open, and the parliamentary records only begin to assume distinct outlines late in the reign of Edward I. It gradually became a fixed constitutional principle that an act of parliament, to be valid, must express concurrently the will of the entire legislature. It was not, however, till the reign of Henry VI, that it became customary, as now, to introduce bills into parliament in the form of finished acts; and the enacting clause, regarded by constitutionalists as the first perfect assertion, in words, of popular right, came into general use as late as the reign of Charles II. It is thus expressed in the case of all acts other than those granting money to the Crown:—"Be it enacted by the King's most excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal and Commons in this present Parliament assembled, and by the authority of the same." In the very rare cases where bills have been enacted under the Parliament Act in opposition to the will of the Lords, the formula is varied, the words "Lords Spiritual and Temporal" being omitted, and the word "Commons" being followed by "in accordance with the provisions of the Parliament Act." Where the act is a money grant the enacting clause is prefaced by the words, "Most Gracious Sovereign, we, Your Majesty's most dutiful and loyal subjects, the Commons of the United Kingdom of Great Britain and Northern Ireland, in Parliament assembled, towards making good the supply which we have cheerfully granted to Your Majesty in this session of Parliament, have resolved to grant unto Your Majesty the sums hereinafter mentioned; and do therefore most humbly beseech Your Majesty that it may be enacted, etc." Originally the collective acts of each session formed but one statute, to which a general title was attached, and for this reason an act of parliament was up to 1892 generally cited as the chapter of a particular statute, e.g., 24 and 25 Vict. c. 101. Titles were, however, prefixed to individual acts as early as 1488. Now, by the Short Titles Act 1892, it is optional to cite the most important acts to that date by their short titles, either individually or collectively. Most modern acts have borne short titles independently of the Act of 1892. (*See* PARLIAMENT; STATUTE.)

ACT OF STATE, a term in law which may be generically described as an act of the Crown, or of some officer whose act is ratified by the Crown, which the courts will treat as conclusive and binding on them in any litigation before them. Such a defence or plea in bar can never be raised by the Crown against the subject except in respect of the exercise of the prerogative in international relations. For a full exposition of the subject, *see* STATE, ACT OF; and STATE SUCCESSION.

ACTON, JOHN EMERICH EDWARD DALBERG ACTON, 1ST BARON (1834-1902), English historian, only son of Sir Richard Acton, 7th baronet, and grandson of the Neapolitan admiral, Sir J. F. E. Acton, 6th baronet (*q.v.*), was born at Naples on Jan. 10, 1834. Coming of a Roman Catholic family, young Acton was educated at Oscott till 1848, under Dr. (afterwards Cardinal) Wiseman, and then at Edinburgh, and at Munich under Döllinger, whose lifelong friend he became. He had wished to go to Cambridge, but for a Roman Catholic this was then impossible. By Döllinger he was inspired with a deep love of historical research and a profound conception of its functions as a critical instrument. He began at an early age to

collect a magnificent historical library, with the object, never in fact realized, of writing a great "History of Liberty." In politics he was always an ardent Liberal. He spent much time in the chief intellectual centres of Europe and in the United States, and numbered among his friends Montalembert, De Tocqueville, Fustel de Coulanges, Bluntschli, von Sybel and Ranke. In 1859 Sir John Acton was returned to the House of Commons for Carlisle and became a devoted admirer and adherent of Mr. Gladstone; but he was practically a silent member, and his parliamentary career came to an end in 1865. Meanwhile he had become editor of the Roman Catholic monthly paper, the *Rambler*, in 1859, on J. H. Newman's retirement from the editorship; and in 1862 he merged this periodical in the *Home and Foreign Review*.

Though a sincere Roman Catholic, his whole spirit as a historian was hostile to ultramontane pretensions, and his independence of thought and liberalism of view brought him into conflict with the Roman Catholic hierarchy. As early as Aug. 1862 Cardinal Wiseman publicly censured the *Review*; and when in 1864, after Döllinger's appeal at the Munich Congress for a less hostile attitude towards historical criticism, the pope issued a declaration that the opinions of Catholic writers were subject to the authority of the Roman congregations, Acton stopped the publication of his monthly periodical. He continued, however, to contribute articles to the *North British Review*. In 1865 he married the Countess Marie, daughter of the Bavarian Count Arco-Valley, by whom he had one son and three daughters. In 1869 he was raised to the peerage by Gladstone as Baron Acton; he was an intimate friend and constant correspondent of the Liberal leader, and the two men had the very highest regard for each other. Matthew Arnold used to say that "Gladstone influences all round him but Acton; it is Acton who influences Gladstone."

In the great crisis in the Roman Catholic world in 1870, over the promulgation by Pius IX. of the dogma of papal infallibility, Lord Acton was in complete sympathy on this subject with Döllinger (*q.v.*). Acton did not personally join the Old Catholic seceders. In 1874, when Gladstone published his pamphlet on *The Vatican Decrees*, Lord Acton wrote during Nov. and Dec. a series of letters to *The Times*, illustrating Gladstone's main theme by numerous historical examples of papal inconsistency, but demurring nevertheless to Gladstone's conclusion. In spite of his reservations, he regarded "communion with Rome as dearer than life." Thenceforth he devoted himself to persistent reading and study, combined with social life. Little indeed came from his pen, his only notable publication being a masterly essay in the *Quarterly Review* of Jan. 1878 on "Democracy in Europe"; two lectures delivered at Bridgnorth in 1877 on "The History of Freedom in Antiquity" and "The History of Freedom in Christianity"—these last the only tangible portions put together by him of his long-projected "History of Liberty"—and an essay on modern German historians in the first number of the *English Historical Review*, which he helped to found (1886). After 1879 he divided his time between London, Cannes, and Tegernsee in Bavaria. Gladstone found him a valuable political adviser, and in 1892, when the Liberal Government came in, Lord Acton was made a lord-in-waiting. Finally, in 1895, on the death of Sir John Seeley, Lord Rosebery appointed him to the Regius Professorship of Modern History at Cambridge. His inaugural lecture on "The Study of History," afterwards published with notes displaying a vast erudition, made a great impression in the university, and the new professor's influence on historical study was felt in many important directions. He delivered two valuable courses of lectures, on the French Revolution and on Modern History; but it was in private that the effects of his teaching were most marked. The great *Cambridge Modern History*, though he did not live to see it, was planned under his editorship, and all who came in contact with him testified to his stimulating powers and his extraordinary range of knowledge. He died on June 19, 1902, being succeeded in the title by his son, Richard Maximilian Dalberg Acton, 2nd Baron Acton.

Lord Acton left too little completed original work to rank among the great historians. But he was one of the most deeply

learned men of his time, and he is remembered for his influence on others. His extensive library, composed largely of books full of his own annotations, was bought immediately after his death by Andrew Carnegie and presented to John Morley, by whom it was forthwith given to the University of Cambridge.

See Herbert Paul's excellent Introductory Memoir to the interesting volume of *Lord Acton's Letters to Mrs. Drew* (1904), and the authorities cited there; also Dom Gasquet's *Lord Acton and his Circle* (1906) and a selection from his correspondence, ed. by J. N. Figgis and R. V. Laurence, with introduction (1917 seq.). A *Bibliography of the Works of Lord Acton*, by W. A. Shaw, was published by the Royal Historical Society in 1903. The *Edinburgh Review* of April 1903 contains a luminous essay; and a chapter on Acton appears in Bryce's *Studies of Contemporary Biography* (1903). Lord Acton's *Lectures on Modern History*, ed. by J. N. Figgis and R. V. Laurence, appeared in 1906; and his *History of Freedom and other Essays and Historical Essays and Studies* (by the same editors) in 1907.

ACTON, SIR JOHN FRANCIS EDWARD, BART. (1736–1811), prime minister of Naples under Ferdinand IV., was the son of Edward Acton, a physician at Besançon, and was born there in 1736, succeeding to the English title and estates in 1791, on the death of his cousin in the third degree, Sir Richard Acton of Aldenham hall, Shropshire. He served in the navy of Tuscany, and in 1775 commanded a frigate in the joint expedition of Spain and Tuscany against Algiers. In 1779 Queen Maria Carolina of Naples persuaded her brother the grand-duke Leopold of Tuscany to allow Acton to reorganize the Neapolitan navy. He became commander-in-chief of both services, minister of finance, and finally prime minister. His policy was devised in concert with the English ambassador, Sir William Hamilton, and aimed at substituting the influence of Austria and Great Britain for that of Spain, at Naples, and consequently involved open opposition to France and the French party in Italy. In Dec. 1798 he shared the flight of the king and queen. For the reign of terror which followed the downfall of the Parthenopean republic, five months later, Acton has been held responsible. In 1804 he was for a short time deprived of the reins of government at the demand of France; but he was soon restored to his former position, which he held till, in Feb. 1806, on the entry of the French into Naples, he had to flee with the royal family into Sicily. He died at Palermo on Aug. 12, 1811.

He left three children, the elder son, Sir Richard, being the father of the first Lord Acton. The second son CHARLES JANUARIUS EDWARD (1803–1847), after being educated in England and taking his degree at Magdalene college, Cambridge, in 1823, entered the Academia Ecclesiastica at Rome. He became the secretary of the congregation of the Disciplina Regolare, and auditor of the Apostolic Chamber under Gregory XVI., by whom he was made a cardinal in 1842. Cardinal Acton helped to secure the increase, in 1840, of the English vicariates-general to eight, which paved the way for the restoration of the hierarchy by Pius IX. in 1850. He died on June 23, 1847.

ACTON, a municipal borough in Middlesex, England, suburban to London, 9 mi. W. of St. Paul's cathedral; served by the G.W. Ry., the L.M.S. Ry., and the London Passenger Transport board. Pop. (1951) 67,424. Area 3.6 sq.mi. The borough, as constituted before the boundary adjustments of 1934, forms the Acton parliamentary division and returns one member. The best derivation offered for its name is from Oak-town, in reference to the extensive forest which formerly covered the locality. The land belonged from early times to the See of London, a grant being recorded in 1220. Henry III. had a residence here. At the time of the Commonwealth Acton was a centre of Puritanism. Philip Nye (d. 1672) was rector; Richard Baxter, Sir Matthew Hale (Lord Chief Justice), Henry Fielding, the novelist, and John Lindley, the botanist (d. 1865), are famous names among residents here. Acton Wells, of saline waters, had considerable reputation in the 18th century. Acton was made a municipal borough in 1921.

ACT ON PETITION, the term for a part of the procedure in the British Probate, Divorce and Admiralty Division, now of infrequent occurrence. It was more freely used in the old Admiralty and Divorce courts before the Judicature Acts. (See *DIVORCE*.)

ACTS OF THE APOSTLES. This book of the Bible was originally the sequel of the Gospel of Luke. Its separation was due to a growing view of the Gospels as a unit of sacred records, to which *Acts* stood as appendix. Historically it is of unique interest and value. The Apocryphal Acts of certain apostles, witnessing to the impression produced by our *Acts*, only emphasize this. It is the one really primitive Church history, primitive in spirit as in substance; apart from it a real picture of the Apostolic age would be impossible. With it, the Pauline Epistles are of priceless historical value; without it, they would remain bafflingly fragmentary, often even misleading owing to their "occasional" nature and emphasis.

Plan and Aim.—All agree that *Acts* is the work of an author of high literary skill, and that he exercised careful selection in the use of his materials, in keeping with a definite purpose and plan. It is of moment, then, to discover what these were. Here it is not needful to go farther back than F. C. Baur and the Tübingen school, with its theory of sharp antitheses between Judaic and Gentile Christianity, of which they took the original apostles and Paul to be typical. Gradually this position underwent modifications, as it became realized that neither Jewish nor Gentile Christianity was a uniform genus, and that the apostolic leaders from the first stood for mutual understanding and unity. The Tübingen school put the needful question, but did not return the correct answer because, as Ritschl showed (*Altkath. Kirche*, 2nd ed., 1857), their premises were inadequate. Still the attitude created by the theory persists in much that is written about *Acts*. On the whole, however, scholars now look at the book more objectively and follow up the hints as to its aim given by the author in his opening paragraph (i. 1-11). Thus (1) his second narrative is the natural sequel to his first. As the earlier book set forth in orderly sequence (*καθεξής*) the providential stages by which Jesus was led, "in the power of the Spirit," to begin the establishment of the Kingdom of God, so the later sets forth its extension by means of His chosen representatives or apostles. (2) This involves emphasis on the identity of the power, Divine and not merely human, visible in the great series of facts from first to last; God's Spirit appears as active throughout. But further (3), the Divine energy in the disciples is conditioned by the continued influence and vocation of their "Lord" at His Father's right hand in heaven: "Holy Spirit" (without the article), the holy power of His personality (*see* xvi. 7 "the Spirit of Jesus"), is the living link between His action and theirs (i. 2, 4 *seq.*, 8, ii. 1 *seq.*, *cf.* Luke xxiv. 49). And (4) the scope of this action is nothing less than all mankind (ii. 5 *seq.*), especially within the Roman empire. (5) Finally, as we see from the parallel in Luke xxiv. 46-48, the divinely appointed method of victory is through suffering (*Acts* xiv. 22), as it was for Messiah himself. This explains the space devoted to the tribulations of His witnesses, and their constancy amid them. It forms part of the virtual *apologia* for the absence of that earthly prosperity in which the ancient mind was apt to look for Divine approval. Moreover the Church's foes were chiefly Jews, whose opposition our author regards as due to blindness to the wider reading of their own religion—to which the Holy Spirit had from of old been pointing (*cf.* Stephen's speech)—and to jealousy of those who, by preaching the wider Messianic Evangel, were winning the Gentiles, and particularly proselytes, in such numbers.

These, then, seem to be the author's main *motifs*:—the *universality of the Gospel*, the *jealousy of national Judaism*, and the *Divine initiative*, manifest particularly in the gradual stages by which men of Jewish birth were led in spite of their own prejudices, to recognize the Divine will in the setting aside of national restrictions, alien to the universal destiny of Messiah's Church. The practical moral is the *Divine character of the Christian religion*, as evinced by the manner of its extension in the empire, no less than by its original expression in the Founder's life and death. Thus both parts of the author's work alike tend to produce assured conviction of Christianity as of Divine origin (Luke i. 1, 4; *Acts* i. 1 *seq.*).

This view gives the book a practical religious aim—a *sine qua non* to any theory of an early Christian writing. In spite of all difficulties, this religion is worthy of belief, even though it mean

opposition and suffering. To meet this source of doubt the author holds up the picture of earlier days, when the great Apostle of the Gentiles enjoyed protection at the hands of Roman justice. It is implied that the present distress is but a passing phase, resting on misunderstanding; for Christianity, as the true fulfilment of Israel's religion, had once been (and might again be) treated as a recognized or lawful (*licita*) religion, the more so that it had deep kinship with non-Jewish philosophic monotheism. Meantime the example of apostolic constancy should inspire like fidelity. *Acts* is in fact an Apology for the Church as distinct from Judaism, the breach with which is accordingly traced with fulness and care.

From this standpoint *Acts* no longer seems to end abruptly. Whether as exhibiting the Divine leading and aid, or as recording the normal attitude of the Roman State, the writer has reached a climax, "Paulus Romae, apex Evangelii" (Bengel). In keeping with this, verses 26-28 of chap. xxviii. are the solemn close of the work, while verses 30, 31 are an appended observation. Yet even here, by the final word of all "unmolested," the writer ends most fitly on one of his keynotes.

The full force of this is missed by those who, rightly rejecting the idea that he had in reserve enough history to furnish another work, hold that Paul was freed from the imprisonment in which *Acts* leaves him (*see* PAUL). For those, on the other hand, who see in the writer's own comment in xx. 38, uncontradicted by what follows, a broad hint that Paul never saw his Ephesian friends again, the view is open that his end was too well known to call for explicit record. Nor would such silence be disingenuous, any more than on the theory that martyrdom overtook him later. (The view that *Acts* was written before Paul's death is excluded by the date of Luke's Gospel.) To the writer Paul's death (like the horrors of Nero's Vatican Gardens in 64) was a monstrous exception to the rule of Roman policy heretofore illustrated. Not even by the Romans themselves were all Nero's acts regarded as precedents.

Authorship.—External evidence, which is early and widespread (*e.g.*, Irenaeus, Muratorian Canon, Tertullian, Clement), all points to Luke, Paul's companion, probably his physician (Col. iv. 14). Evidence for his authorship of the third Gospel counts also for *Acts*. This carries us back at least to the second quarter of the 2nd century (Justin, *Dial.* 103, and Marcion). Nor was Luke prominent enough as an associate of Paul for the belief to be a mere guess. If, then, the Lucan authorship is to be doubted, it must be on internal evidence. The form of the book, however, favours Luke, who was of non-Jewish birth (*see* Col. iv. 12-14 with 10 *seq.*), and as a physician presumably a man of culture. The medical cast of some of its language points the same way. This argument, first worked out by Dr. W. K. Hobart, *The Medical Language of St. Luke* (Dublin, 1882), has been urged afresh in Harnack's *Luke the Physician* (1907), to which reference may be made for all matters connected with Lucan authorship. The early tradition that this Luke was born in the Syrian Antioch suits the way in which the origin of the Antiochene Church and its place in the extension of the Gospel are described (*see* LUKE). Again, the attitude of *Acts* towards the Roman empire is just what would be expected from a comrade of Paul, but hardly from a man who belonged to the next generation. Finally, the book itself seems to claim to be by a companion of Paul. In chap. xvi. 10 without any previous warning it passes from the third person to the first. "But when he saw the vision, straightway we sought to go forth into Macedonia." Thenceforth "we" re-emerges at certain points in the narrative until Rome is reached. These parts at least are generally held to imply the narrative of an eye-witness. If so, this eye-witness was probably also the author of the work; for the style of the "we" passages is the same as that of the book as a whole (*see* Sir J. C. Hawkins in *Horae Synopticae*, 1899, pp. 143-147). In a word, the author of *Acts* was Luke, Paul's companion during most of his later ministry, and also his "counterpart," "as a Hellene who yet had personal sympathy with Jewish primitive Christianity" (Harnack, *op. cit.* p. 145; *see* also LUKE).

Sources.—So far from such a plan and such an author being inimical to the quest after the materials used in *Acts* one may say

that it points the way thereto, while it keeps literary analysis within scientific limits. In their light one feels that the speeches in its first part (e.g., that of Stephen)—and indeed elsewhere, too—are not “free compositions” of our author, the outcome of dramatic idealization such as ancient historians like Thucydides or Polybius allowed themselves. The Christology, for instance, of the early Petrine speeches is such as a Gentile Christian writing c. A.D. 80 simply could not have imagined. We are forced to assume the use of early Judæo-Christian material, akin to that implied also in the special parts of the Third Gospel. P. Feine (*Eine vorkanonische Ueberlieferung des Lukas*, 1891) suggested that a single document explains this material in both works, as far as Acts xii. Others maintain that at any rate two sources underlie Acts i.-xii., or even i.-xv. (see A. Harnack, *The Acts of the Apostles*, 162 seq. and Foakes Jackson and Kirsopp Lake, *The Beginnings of Christianity*, pt. i, vol. ii. 122 seq.). Certainly we can discern the presence of traditions of the Jerusalem Church and of the largely Hellenistic Church of Antioch. But it remains a question whether they reached our author in written form. If he was a careful inquirer (Luke i. 3), especially if he was in the habit of taking down in writing what he heard from different witnesses, this may explain the phenomena (including the alleged traces of “Aramaisms”). Luke would have rare facilities for collecting Palestinian materials, varying no doubt in accuracy but all relatively primitive, whether in Antioch or in Caesarea, where he probably resided for some two years in contact with Philip the Evangelist and his daughters (xxi. 8). There and elsewhere he might also learn a good deal from John Mark, Peter’s friend (I. Pet. v. 13; Acts xxi. 12).

In the second or strictly Pauline half, two main theories of the so-called “we” passages are possible: (1) that which sees in them traces of an earlier document—whether a travel-diary or a more consecutive narrative written later; and (2) that which regards the “we” as due to the author’s breaking instinctively into the first person plural where he felt himself specially identified with the history. On the former hypothesis, it is still in debate whether the “we” document lies behind more of the narrative than is definitely indicated by the formula in question (e.g., chaps. xiii.-xv., xxi. 19-xxvi.). On the latter, the presence or absence of “we” may well be due to psychological causes, rather than to the writer’s mere presence or absence. Sometimes, he may be writing as a member of Paul’s mission at the critical stages of onward advance (xvi. 10 seq., xx. 5 seq., xxvii. 1 seq.); sometimes rather as a witness absorbed in his hero’s words and deeds (so “we” ceases between xx. 15 and xxi. 1). In the former cases the whole “mission” was on the move.

Historical Value.—Questions of authorship and sources are of moment mainly as bearing on the contents as history (see *Beginnings of Christianity*, as above, pp. 265-348). *Acts* falls into two distinct parts. The first (i.-xii.) deals with the church in Jerusalem and Judæa, and with Peter as central figure—at any rate in chaps. i.-v. The difficulty here is that we have but few external means of testing the narrative (see further, *Date*). Some of it may have suffered partial transformation in oral tradition before reaching our author; e.g., the nature of the Tongues at Pentecost does not accord with what we know of the gift of “tongues” generally. The second part pursues the history of the apostle Paul; and here we can compare it with his Epistles. The result is a general harmony, without any trace of direct use of these letters; and there are many minute coincidences. But there are also two remarkable exceptions. These are, the account given by Paul of his visits to Jerusalem in *Galatians* as compared with *Acts*; and the nature of his mission, as it appears in his letters and in *Acts*.

In regard to the first point, differences as to Paul’s movements before his return to his native province of Syria-Cilicia (see PAUL) can be explained by the different interests of Paul and our author respectively. But what of the visits of Gal. ii. 1-10 and Acts xv. 20 seq.? If they refer to the same occasion, as is usually assumed, it is hard to see why Paul should omit reference to the public occasion of the visit and to the public vindication of his policy. But in fact the issues of the visits, as given in Gal. ii. 9 seq. and

Acts xv. 20 seq., are not at all the same (Harnack [*op. cit.* pp. 245 seq.] and others vainly argue that the Abstinenes defined for Gentiles were in the original text of Acts xv. 20 purely moral, and had no reference to Jewish scruples as to eating blood). Nay more, if Gal. ii. 1-10 = Acts xv., the historicity of the “Relief visit” of Acts xi. 30, xii. 25, seems excluded by Paul’s narrative before the visit of Gal. ii. 1 seq. Accordingly, Sir W. M. Ramsay and others argue that the latter visit itself coincided with the Relief visit, and see in Gal. ii. 10 witness thereto. But why, then, does not Paul refer to the public charitable object of his visit? It seems easier therefore to admit that the visit of Gal. ii. 1 seq. is one unrecorded in *Acts*, owing to its private nature as preparing the way for public developments—with which *Acts* is mainly concerned. In that case it would fall shortly before the Relief visit, to which there may be indirect explanatory allusion in Gal. ii. 10 (see further PAUL); and it will be shown below that such a conference of leaders in Gal. ii. 1 seq. leads up excellently both to the First Mission Journey and to Acts xv. (For other views see *The Beginnings of Christianity*, 273 seq., 321 seq.)

We pass next to the Paul of *Acts*. In his epistles Paul insists that he was the apostle to the Gentiles, as Peter was to the Circumcision; and that circumcision and the observance of the Jewish law were of no importance to the Christian as such. But in *Acts* it is Peter who first opens up the way for the Gentiles. It is Peter who used the strongest language in regard to the intolerable burden of the Law as a means of salvation (xv. 10 seq. cf. 1.). Not a word is said of difference between Peter and Paul at Antioch (Gal. ii. 11 seq.). The brethren in Antioch send Paul and Barnabas up to Jerusalem to ask the opinion of the apostles and elders; they state their case, and carry back the decision to Antioch. Throughout *Acts* Paul never stands forth as the unbending champion of the Gentiles. He seems anxious to reconcile the Jewish Christians by personally observing the law of Moses. He circumcises the semi-Jew, Timothy; and he performs his vows in the temple. He is particularly careful in his speeches to show how deep is his respect for the law of Moses. In all this the letters of Paul are very different from *Acts*. In *Galatians* he claims perfect freedom in principle, for himself as for the Gentiles, from the obligatory observance of the Law; and neither in it nor in *Corinthians* does he take any notice of a decision reached at Jerusalem. The narrative of *Acts*, too, itself implies something other than what it sets in relief; for why should the Jews hate Paul so much, if he was not in some sense disloyal to their Law?

There is, nevertheless, no essential contradiction here, only such a difference of emphasis as belongs to the standpoints and aims of the two writers and to different historical conditions. Peter’s function in relation to the Gentiles belongs to early Palestinian conditions, before Paul’s distinctive mission had taken shape. Once Paul’s apostolate—parallel with the more collective apostolate “the Twelve”—has proved itself by tokens of Divine approval, Peter and his colleagues frankly recognize the distinction of the two missions, and are anxious only that the two shall not fall apart by religiously and morally incompatible usages (Gal. ii. 10, cf. Acts xv.). Paul, on his side, clearly implies that Peter felt that the Law could not justify (Gal. ii. 15 seq.), and argues that it could not now be made obligatory in principle (cf. “a yoke,” Acts xv. 10); yet for Jews it might continue for the time (pending the Parousia) to be seemly and expedient, especially for the sake of non-believing Judaism. To this he conformed his own conduct as a Jew, so far as his Gentile apostolate was not involved (I Cor. ix. 19 seq.). There is no reason to doubt that Peter largely agreed with him, since he acted in this spirit in Gal. ii. 11 seq., until coerced by Jerusalem sentiment to draw back for expediency’s sake. This incident it did not fall within the scope of *Acts* (see above) to narrate, since it had no abiding effect on the Church’s extension. As to Paul’s submission of the issue in Acts xv. to the Jerusalem conference, *Acts* does not imply that Paul would have accepted a decision in favour of the Judaizers, though he saw the value of getting a decision for his own policy in the quarter to which they were most likely to defer. If the view that he already had an understanding with the “Pillar” Apostles, as recorded in Gal. ii. 1-10 (see further PAUL), be correct, it gives

the best of reasons why he was ready to enter the later public Conference of Acts xv. Paul's own "free" attitude to the Law, when on Gentile soil, is just what is implied by the hostile rumours as to his conduct in Acts xxi. 21, which he was glad to disprove as at least exaggerated (*ib.* 24 and 26). What is clear is that such lack of formal accord as here exists between *Acts* and the Epistles tells against its author's dependence on the latter, and so favours his having been a comrade of Paul himself.

Speeches.—The speeches in *Acts* deserve special notice. Ancient historians (like many of modern times) used the liberty of working up in their own language the speeches recorded by them. They did not dream of verbal fidelity; they preferred to mould a speaker's thoughts to their own methods of presentation. Besides this, some did not hesitate, for vividness' sake, to give to their characters speeches which were never uttered. Now how far has the author of *Acts* followed these practices? Some of its speeches are evidently bare summaries. Others claim to be reports of speeches really delivered. But all have been passed through one mind, and some mutual assimilation in phraseology and idea may well have resulted. They are, moreover, all of them, mere abstracts. Yet these circumstances, while inconsistent with verbal accuracy, do not destroy authenticity; and in most cases (*e.g.* xiv. 15–17) there is a varied appropriateness, as well as an allusiveness, pointing to good information (*see* under *Sources*). There is no evidence that any speech in *Acts* is the free composition of its author, without either written or oral basis; and in general he seems nearer than most ancient historians to the essentials of historical accuracy.

Miracles.—Objections to the trustworthiness of *Acts* on the ground of its miracles require to be stated more carefully than has usually been the case especially as bearing on authorship. For the idea of the "miraculous" or supernatural is hardly if at all, less marked in the "we" sections (where efforts to dissect it out are fruitless) than in the rest of the work. The scientific method, then, is to consider each "miracle" on its own merits, according as we may suppose that it has reached our author more or less directly. But even the form in which the gift of Tongues at Pentecost is conceived does not exclude Luke's authorship, since it may have stood in his source; and the first outpouring of the Messianic Spirit may soon have come to be thought of as unique by some Jewish Christians, parallel in form to the Rabbinic tradition as to the inauguration of the Old Covenant at Sinai (*cf.* Philo, *De decem oraculis*, 9, 11, and the Midrash on Ps. lxxviii. 11).

As to such historical difficulties in *Acts* as still remain, there are various possibilities of mistake intervening between the facts and the accounts which reached its author, at second or even third hand (*see* further under *Date*). Also recent research in antiquity has tended to verify such parts of the narrative as can be tested, as Sir W. M. Ramsay in particular has shown. The proofs of trustworthiness extend also to the theological sphere. What was said of the Christology of the Petrine speeches applies to the whole conception of Messianic salvation, the eschatology, the idea of Jesus as equipped by (the) Holy Spirit for His Messianic work. These and other forms of very primitive witness in *Acts* have not indeed the value of shorthand notes or even of abstracts based thereon. But they suggest that our author gave a faithful account of such words and deeds as had come to his knowledge. The perspective of the whole is no doubt his own; and as his materials furnished but few hints for a continuous narrative, this perspective, especially in things chronological, may sometimes be faulty. Yet when one remembers that by A.D. 70–80 it must have been a matter of small interest by what *tentative* stages the Messianic salvation was first extended to the Gentiles, it is surely surprising that *Acts* enters into any detail on the subject, and is not content with a summary account such as the mere logic of the matter would naturally suggest.

"Study of Sources" (*Quellenkritik*), then, solves many difficulties in the way of treating *Acts* as an honest narrative by a companion of Paul. In addition, we may also count among recent gains a juster method of judging such a book. For among the results of the Tübingen criticism was what Dr. W. Sanday called "an unreal and artificial standard, the standard of the 19th cen-

tury rather than the 1st, of Germany rather than Palestine, of the lamp and the study rather than of active life." This has a bearing, for instance, on the differences between the three accounts of Paul's conversion in *Acts*. In the recovery of a more real standard, we owe much to men like Mommsen, Ramsay, Blass and Harnack, trained amid methods and traditions other than those which had brought the constructive study of *Acts* almost to a deadlock. Nor have the results of recent similarly jealous suspicion (of which Loisy is the type) won any wide consensus among scholars.

Date.—External evidence points to the existence of *Acts* at least as early as the opening years of the 2nd century. The traces of it in Polycarp and Ignatius, when taken together, are highly probable; and the resemblance of Acts xiii. 22, and I Clem. xviii. 1, in features not found in the Psalm (lxxxix. 20) quoted by each, can hardly be accidental (*see The N.T. with Apostolic Fathers*, 48 *seq.*). That is, *Acts* was probably current in Rome as early as c. A.D. 95. With this view internal evidence agrees. In spite of some advocacy of a date prior to A.D. 70, the bulk of critical opinion is against it. The prologue to Luke's Gospel implies the dying out of eye-witnesses as a class. Many support a date about A.D. 80; some prefer 75 to 80; while a date even before 75 seems possible. Of the reasons for a date in one of the earlier decades of the 2nd century, as argued by the Tübingen school, most are now untenable. Among these are the supposed traces of 2nd-century Gnosticism and "hierarchical" ideas of organization; while the argument from the relation of the Roman state to the Christians has been turned by Ramsay into proof of an origin prior to Pliny's correspondence with Trajan, c. 112. Another fact tells against a 2nd-century date, *viz.* the failure of a writer devoted to Paul's memory to avoid seeming conflict with his Epistles. If, indeed, *Acts* uses the later works of Josephus, we should have to place it about A.D. 100. But this is far from proved.

Three points of contact with Josephus in particular are cited. (1) The circumstances attending the death of Herod Agrippa I. in A.D. 44. Here Acts xii. 21–23 is largely parallel to Jos. *Antt.* xix. 8. 2; but the latter adds an omen of coming doom, while *Acts* alone gives a circumstantial account of the occasion of Herod's public appearance. Hence the parallel, when analysed, tells against dependence. So also with (2) the case of the Egyptian pseudo-prophet in Acts xxi. 37 *seq.*, Jos. *Jewish War*, ii. 13. 5, *Antt.* xx. 8. 6; for the numbers do not agree with either of Josephus's rather divergent accounts, while *Acts* alone speaks of *Sicarii*. With these instances in mind, it is best to regard (3) the curious resemblance in v. 36 *seq.* and Jos. *Antt.* xx. 5. 1 as to the order in which Theudas and Judas of Galilee are referred to in both as accidental, the more so that again there is difference as to numbers. There may well have been another Theudas, in the period of many tumults after the death of Herod the Great to which Josephus refers in *Antt.* xvii. 10. 4, whom as a pseudo-Messiah on so small scale he might not think worth while mentioning after A.D. 70; whereas to Gamaliel the case was not long before his own time ("before these days"). Further, to make out a case for dependence, one must assume the mistaken order in Gamaliel's speech as due to gross carelessness in the author of *Acts*. Such a mistake, if really there, was far more likely to arise in oral transmission of the speech, before it reached Luke at all.

Place.—The place of composition is still an open question. Rome and Antioch have been in favour; and Blass combined both views in his theory of two editions (*see* further, *Text*). But internal evidence points to the Roman province of Asia, and the neighbourhood of Ephesus. Note the confident local allusion in xix. 9 to "the school of Tyrannus"—not "a certain Tyrannus," as in the inferior text—and in xix. 33 to "Alexander"; also the very minute topography in xx. 13–15. Affairs in that region, including the future of the church of Ephesus (xx. 28–30), are treated as though they would specially interest "Theophilus" and his circle: also an early tradition makes Luke die in the adjacent Bithynia. An *apologia* for the Church against the Synagogue's attempts to influence Roman policy to its harm would be much to the point in "Asia" (*cf.* Rev. ii. 9, iii. 9, and Sir W. M. Ramsay, *The Letters to the Seven Churches*, ch. xii.).

Text.—The *apparatus criticus* of *Acts* has grown considerably of recent years; mainly in one direction, that of the so-called "Western text." This misleading term really stands for a glossing or paraphrastic text, comparable to a Targum on an Old Testament book, which became very widespread, in both east and west, for some 200 years or more from early in the 2nd century. The sifting, however, of the readings in all our witnesses (mss., versions, Fathers) has not yet gone far enough to yield final results as to the history of this text—what in its extant forms is primary, secondary, and so on. Beginnings only have been made towards grouping our authorities (see J. H. Ropes' fine study in *Beginnings of Christianity*, pt. i., vol. iii. pp. ccxv.). Assuming, however, that the original form of the "Western" text had been reached, the question of its historical value, *i.e.* its relation to the original text of *Acts*, would remain. On this point the highest claims were made by Blass (1894 and later), who held that both the "Western" text of *Acts* (styled the β text) and its rival, the text of the great uncials (the α text), are due to the author's own hand; and that the former (Roman) is more original than the latter (Antiochene); but the theory (as Ropes shows) is untenable. Sir W. M. Ramsay pointed the way to sounder views. Already in *The Church in the Roman Empire* (1893) he held that the "Western" text in the *Codex Bezae* rested on a recension made not later than about the middle of the 2nd century. Though "some at least of the alterations in *Codex Bezae* arose through a gradual process," the revision as a whole was the work of a single reviser. His aim, in suiting the text to the views of his place and time, was to make it at once more intelligible and more complete. In his later work, *St. Paul the Traveller and the Roman Citizen* (1895), Ramsay's views gained in breadth by looking beyond the Bezan text to the "Western" text as a whole.

But all earlier work on the text of *Acts* is summed up and improved in Ropes' monumental edition (as above). Generally speaking, the text as printed by Westcott and Hort, on the basis of the earliest mss. ($\aleph B$), seems in *Acts*, as elsewhere, to be nearest to the autograph: the "Western" text, even in its earliest form, was a deliberate revision. This does not mean that it has no historical value of its own. Certain of its readings (*e.g.* xi. 28, xii. 10) may even date from the end of the 1st century and preserve living memories. But their value is mainly that of an early commentary, and lies in the light cast on ecclesiastical thought in certain quarters and epochs. *Acts*, from its very scope, was least likely to be viewed as sacrosanct in its text. Indeed there are signs that its undogmatic nature caused it to be comparatively neglected at certain times and places, as, *e.g.*, Chrysostom explicitly witnesses.

BIBLIOGRAPHY.—An account of the extensive literature that has gathered round *Acts* may be found in R. J. Knowling's ed. in *The Expositor's Greek Testament* vol. ii. (1900), and in his *Testimony of St. Paul to Christ* (1905); C. Clemen, *Die Apostelgesch. im Lichte der neueren Forschungen* (Giessen, 1905); A. Harnack, *Acts of the Apostles* (1909); J. Moffatt's *Introduction to the N.T.* (1911 and later); and particularly, Foakes Jackson and Kirsopp Lake, *The Beginnings of Christianity* pt. i. (1920-28); H. J. Cadbury, *The Making of Luke-Acts* (1927). (J. V. B.)

ACTUALITY THEORY is the view that the real is not a thing or a state at rest, but an activity or a process.

In philosophy the theory is as old as Heraclitus who conceived ultimate reality as an incessant becoming, not as static being. In modern philosophy Spinozism may be regarded as a form of this theory. For, notwithstanding the important place which the conception of "substance" holds in the philosophy of Spinoza, Spinozism when correctly interpreted is essentially dynamic, not static, in character. Of subsequent philosophers the following (among others) may be regarded as upholders of the actuality theory in some form or other. Fichte conceived of the real as the infinite activity of the absolute ego. Hegel regarded it as an absolute process, a kind of dialectical evolution. Schopenhauer described it as volitional activity or striving. Wundt likewise thought of reality as a complex of volitional activities or processes. For Bergson "there are no things, only activities" (*Creative Evolution*). Of philosophical men of science Mach, Ostwald, and Whitehead (among others) may be claimed as supporters of the actuality theory. Indeed the whole drift of present day science is to regard

"events" rather than "things" as the ultimate components of the world of reality.

In psychology the actuality theory is mainly concerned with the nature of the soul or mind. According to the popular view, which is also supported by many psychologists, the mind or soul is a substance, an abiding something which owns the mental experiences of knowing, feeling, and willing, or which exercises these activities. As against this "substantial" view of the soul, the actuality theory in psychology treats the soul as just the complex or system of these activities, experiences, or processes, and no more. The view appears to be as old as Protagoras and Aristotle. It is quite explicit in Spinoza, for whom the human soul is just a complex of ideas, and ideas are not dead, static pictures on a canvas, but living activities. Hume likewise stated that his introspective attempt to catch a glimpse of his soul revealed to him nothing but "a bundle" of sensations, etc. Of modern psychologists, Fechner, Höffding, James, Baldwin, Ebbinghaus, Sully, and Wundt (among others) may be classed among the supporters of the actuality theory, while other psychologists are more or less in sympathy with it, though they regard the whole question as pertaining to philosophy rather than to psychology. On one point, however, all modern psychologists are agreed, namely, that mental experiences are essentially events, activities, or processes, not states. And this agreement is largely the result of the contention of the upholders of the activity theory.

ACTUARY. The name of *actuarius*, sc. *scriba*, in ancient Rome, was given to the clerks who recorded the *Acta Publica* of the senate, and also to the officers who kept the military accounts and enforced the due fulfilment of contracts for military supplies. In its English form the word has undergone a gradual limitation of meaning. At first it seems to have denoted any clerk or registrar; then more particularly the secretary and adviser of any joint-stock company, but especially of an insurance company; and it is now applied specifically to one who makes those calculations as to the probabilities of human life upon which the issuance of life insurance and annuity contracts depend.

In the life insurance companies of the U.S., Canada, and Great Britain, the actuarial departments are large and the position of the actuary important.

In the United States there are two scientific organizations for the promotion of actuarial science embracing members from Canada also.

One is the Actuarial Society of America, founded in 1889, with headquarters in New York. The other is the American Institute of Actuaries, founded in 1909, with headquarters in Chicago.

Admission to membership is by examination, and beginning in 1938 the two organizations adopted the practice of having identical examinations, set by a joint committee. The mathematical parts of the examinations include advanced algebra with special emphasis upon the theory of probability, the theory of compound interest, finite differences, the differential and integral calculus, and statistics. The other parts of the examinations include the application of mathematics to life contingencies, the compilation of tables of mortality, disability, sickness, accident, etc., the underwriting of risks, life insurance accounting, the theory of banking and finance, the investment of life insurance funds, and the law as it relates to life insurance contracts.

In Great Britain there are two actuarial organizations—one, the Institute of Actuaries founded in 1848, with headquarters at Staple Inn Hall, London, and the other, the Faculty of Actuaries, founded in 1856, with headquarters in Edinburgh. Both are incorporated by royal charters and admission to each is by examination.

In 1895 the first International Congress of Actuaries was held in Brussels.

(See also INSURANCE, ARTICLES ON.)

(M. A. L.)

ACUÑA, CHRISTOVAL DE (1597-c. 1676), Spanish Jesuit missionary and explorer, was born at Burgos in 1597. He was sent on mission work to Chile and Peru, where he became rector of the college of Cuenca. In 1639 he accompanied Pedro Texiera in his second exploration of the Amazon, in order to take scientific observations, and draw up a report for the Spanish Government. The journey lasted ten months; on the explorer's

arrival in Peru, Acuña prepared his narrative, while awaiting a ship for Europe. The king of Spain, Philip IV., received the author coldly, and it is said even tried to suppress his book, fearing that the Portuguese, who had just revolted from Spain (1640), would profit by its information. Eventually Acuña returned to South America, where he died, probably soon after 1675. His *Nuevo Descubrimiento del Gran Río de las Amazonas* was published at Madrid in 1641; French and English translations (the latter from the French), appeared in 1682 and 1698.

ACUPRESSURE, the name given to a method of stopping bleeding from an artery by passing a needle through the tissue so that the vessel is compressed. A loop of wire may be passed around the free ends of the needle so that there is more pressure. The method was advocated by Sir J. Y. Simpson.

ACUPUNCTURE, a form of surgical procedure, performed by pricking the part affected with a needle. It has long been used by the Chinese in cases of headaches, lethargies, convulsions, colics, etc. It is also used to obtain fluid, through a hollow needle, for its help in making a diagnosis. It is known as tapping.

ADA, a village of Hardin county, O., U.S., on the Pennsylvania railroad, 15 mi. E. of Lima. Pop. (1950) 3,629; it lies on the watershed between the Ohio river and the Great Lakes, in a rich agricultural district.

Chief manufactures are athletic goods, sheetmetal products, lumber and flour. The village is the seat of the Ohio Northern university (Methodist).

ADA, a city of Oklahoma, 85 mi. S.E. of Oklahoma City; served by the Santa Fe, the Frisco and the Oklahoma City-Ada-Atoka railways. Pop. (1950) 15,935. Ada is the county seat of Pontotoc county, which produces natural gas and petroleum, cotton, grain, livestock, sweet potatoes, peanuts and alfalfa; and has deposits of rock asphalt, glass sand, pottery clay, lead, zinc and other minerals. The city has cotton gins and compresses; feed and corn mills; cement, stone crushing, pottery and glassworks; brickyards and grain elevators. It is the seat of the East Central State college (1909). The city was incorporated in 1901. It has a council-manager form of government.

ADAB (modern BISMAYA), an ancient town in Mesopotamia, in 32° N., 45° 30' E., 25m. S. of Nippur. It was supplied by a canal which passed through the city and irrigated the country, eventually falling into the Shatt al Hai. In the centre of the city the canal divided to form an island on which stood the temple of the mother Goddess Aruru, to whose cult the city was devoted. There are a succession of periods on the mound which rises 50ft. above the plain: 2 to 3 ft. below the platform of Ur Engur are the buildings of the kings of Akkad; 10ft. below are the plano-convex bricks of Unnina; 10ft. lower are buildings made of limestone blocks, which were used before the days of brickmaking. At a depth of 48ft. the excavators found thin unpainted wheel-made pots. The Ziggurat or temple tower is pre-Sargonic and one of the oldest in Sumer. One of the most remarkable finds was the head of a Semite in white marble.

The city appears to have enjoyed a restricted independence at the time of the kings and patesis of Lagash. The kings of Akkad and Ur certainly devoted a good deal of attention to the city, probably owing to its religious cults.

See E. J. Banks, *Bismaya or the Lost City of Adab* (1912); S. Langdon, in *Cambridge Ancient History*, vol. i. 1923.

ADABAZAR or ADAPAZARI, an important commercial town in the Izmir vilayet of Turkey, situated on the old military road from Constantinople to the east, and connected by a branch line with the Anatolian railway. Pop. (1945) 29,386. There are silk and linen industries and an export of tobacco, walnut-wood, coconuts and vegetables for the Istanbul market.

See V. Cuinet, *Turquie d'Asie* (Paris, 1890-1900).

ADAD, the name of the storm-god in the Babylonian-Assyrian pantheon, who is also known as Ramman ("the thunderer"). It seems that Ramman was the name current in Babylonia, whereas Adad was more common in Assyria. A god Hadad, a prominent deity in ancient Syria, is identical with Adad, whose name is therefore, an importation into Assyria from Aramaic

districts. Ramman is identical with Rimmon, known to us from the Old Testament as the chief deity of Damascus. The cult of a specific storm-god in ancient Babylonia is vouched for by the occurrence of the sign Im—the "Sumerian" for Adad-Ramman—as an element in proper names of the old Babylonian period. Through Aramaic influences in Babylonia and Assyria he was identified with the storm-god of the western Semites. The designation Amurru is also given to this god in the religious literature of Babylonia, which describes him as belonging to the Amorite district.

On the one hand he brings on the rain in due season, and causes the land to become fertile; on the other hand, by the storms that he sends, he brings havoc and destruction. He is pictured on monuments and seal cylinders with the lightning and the thunderbolt, and in the hymns the sombre aspects of the god on the whole predominate. His association with the sun-god, Shamash, imbues him with some of the traits belonging to a solar deity. In the theological lists he follows Shamash. At Erech in the south and Assur in the north Adad is intimately associated with Anu, the sky god. In Syria Hadad is hardly to be distinguished from a solar deity. In Babylonia and Assyria Shamash and Adad became in combination the gods of oracles and of divination in general. In the annals and votive inscriptions of the kings, when oracles are referred to, Shamash and Adad are always named as the gods addressed, and their ordinary designation in such instances is *bēlê bīrī*, "lords of divination." The consort of Adad-Ramman is Shala, while as Amurru his consort is called Ashratum.

In magic rituals the symbol of Ramman is the cypress, and his sacred number is "six," consequently the sixth day of each month was sacred to him. The principal seat of the old Sumero-Babylonian cult of the thunder god was *Muru* (𒌦), which has not been located, and the cult is mentioned in connection with the cities Padda, Akus, Simurri and Halbaba, all unknown and certainly unimportant places; but a great temple to him and Anu has been excavated at Assur.

See the special study on this deity by Hans Schlobies, *Das akkadische Wettergott in Mesopotamien* (1925); also the article BABYLONIAN AND ASSYRIAN RELIGION.

ADAEV, now Chapaev, region of the Kazakh Soviet Socialist Republic. Area 117,114 sq.mi. Pop. 136,000 (urban 3,012). The area includes the Ust Urt plateau (700 ft.) in the south, and the low plain to the north of it which apparently once linked the Caspian and Aral seas, and which is studded with salt lakes with fauna bearing evidence of this link. The soil is either gravelly and stony desert or alkaline and gypsiferous gray soil, so that vegetation is sparse. The nomad Kirghiz tribes are mainly herdsmen. The administrative centre is Chapaev. Fort Shevchenko, formerly Alexandrovsk on the Mangishlak peninsula, has a fishing industry (including seal fishery) and exports Glauber salts obtained from the shores of Kara Bugaz bay. On Mangishlak peninsula there is evidence of naphtha, ozokerite and bitumen deposits; also coal deposits were found there in 1940. In the northwest the province extends northward in a narrow strip nearly to lat. 50° N., and thus includes the naphtha area round Ulsk, where the population is mainly Russian and Tatar. Apart from this strip, the region is semi-desert; there is no railway.

ADAGIO, a term in music to indicate slow time; also a slow movement in a symphony, sonata, etc., or an independent piece, such as Mozart's pianoforte, "Adagio in B minor." The diminutive form *adagietto* means somewhat less slow than *adagio*.

ADAIR, JOHN (d. 1722), Scottish surveyor and map-maker of the 17th century. In 1703 he published the first part of his *Description of the Sea-coasts and Islands of Scotland*, for the use of seamen. The second part never appeared. Some of his work is preserved in the Advocates' Library (now the National Library of Scotland) at Edinburgh and in the King's Library of the British Museum, London.

ADALBERON or **ASCÉLIN** (d. 1030 or 1031), French bishop and poet, studied at Reims and became Bishop of Laon in 977. When Laon was taken by Charles, Duke of Lorraine, in 988, he was put into prison, whence he escaped and sought the

protection of Hugh Capet, King of France. Winning the confidence of Charles of Lorraine and of Arnulf, Archbishop of Reims, he was restored to his see; but he betrayed Laon, together with Charles and Arnulf, into the hands of Hugh Capet. He died on July 19, 1030 or 1031. Adalberon wrote a satirical poem in the form of a dialogue dedicated to Robert, King of France, in which he showed his dislike of Odilo, Abbot of Cluny, and his followers, and his objection to persons of humble birth being made bishops. The poem was first published by H. Valois in the *Carmen panegyricum in laudem Berengarii* (Paris, 1663), and in modern times by J. P. Migne in the *Patrologia Latina*, tome cxli. (Paris, 1844). Adalberon must not be confounded with his namesake, Adalberon, Archbishop of Reims (d. 988 or 989).

BIBLIOGRAPHY.—See Richer, *Historiarum libri iii. et iv.* which appears in the *Monumenta Germaniae historica, Scriptores*. Band iii. (Hanover and Berlin, 1826–92). A. Olleris, *Oeuvres de Gerbert pape sous le nom de Sylvestre II.* (Paris, 1867); *Histoire littéraire de la France*, tome vii. (Paris, 1865–69).

ADALBERT (c. 700), English saint, possibly a grandson of Oswald, king of Deira, was sent with St. Willibrord on a mission to the Frisians, and is said to have been the first archdeacon of Utrecht. In about 702 he went to preach in north Holland, where he built a church at Egmont. He is supposed to have died in 705, on June 25, and until the early 18th century that day was still kept sacred to his memory, as patron saint, in the village of Egmont. A life of Adalbert was compiled in the 10th century, by some monks in the diocese of Treves, and one by a monk at Egmont in the 12th century.

ADALBERT or **ADELBERT** (c. 1000–1072), German archbishop, was the son of Frederick, count of Goseck, a member of a noble Saxon family. Adalbert stood high in the favour of Henry III., whom he accompanied on many expeditions into Hungary, Italy, Slavonia and elsewhere. It is said that he might have been made Pope but that he saw greater possibilities of power and influence in northern Germany. In 1045 he was appointed archbishop of Hamburg-Bremen, his province including the Scandinavian countries, as well as the larger part of North Germany. He moved the seat of the bishopric from Bremen to Hamburg, sent missionaries to Finland, Greenland and the Orkney Islands, and aimed at making Bremen a patriarchal see for northern Europe, with 12 suffragan bishoprics.

He consolidated and increased the estates of the church, exercised the powers of a count, denounced simony, and initiated financial reforms. The presence of this powerful and active personality was greatly resented by the Saxon duke of the north, Bernard II., who regarded him as a spy sent by Henry. Adalbert gave substantial help to the emperor in the struggle with Baldwin, count of Flanders, by concluding a treaty (1049) with Sweyn of Norway and Denmark, who sent a fleet to the Netherlands coast. The archbishop's ambition to secure ecclesiastical control of northern Europe was furthered in 1052 by a papal brief which put all the Christians of the north, from the Icelanders in the west to the Finns in the east, under the see of Bremen. Adalbert himself became papal legate for the north. For a time his ecclesiastical pretensions estranged Sweyn, but in the end the Norwegian king acquiesced.

Adalbert, who wished to free his lands entirely from the authority of the duke, Bernard II., aroused hostility by an attack on the privileges of the great abbeys, and after the emperor's death in 1056 his lands were ravaged by Bernard. He took a leading part in the government of Germany during the minority of Henry IV., and was styled *patronus* of the young king, over whom he exercised considerable influence. Having accompanied him on a campaign into Hungary in 1063, he received large gifts of crown estates and obtained the office of count palatine in Saxony. His power aroused so much opposition that in 1066 the king was compelled to assent to his removal from court. In 1069 he was recalled by Henry, when he made a further attempt to consolidate a northern patriarchate, which failed owing to the hostility of the papacy and the condition of affairs in the Scandinavian kingdoms. He died at Goslar, and was buried in the cathedral which he had built at Bremen. Adalbert was a man of large ideas and a strong, energetic character. He fortified and improved

Bremen, and it was called the *New Rome* by his biographer, Adam of Bremen.

See Adam of Bremen, *Gesta Hammenburgensis ecclesiae pontificum*, edited by J. M. Lappenberg, in the *Monumenta Germaniae historica, Scriptores*, Band vii. (1826–92); C. Gruenhagen, *Adalbert Erzbischof von Hamburg und die Idee eines Nordischen Patriarchats* (1854).

ADALBERT, originally VOYTECH (c. 950–997), known as the apostle of the Prussians, the son of a Bohemian prince, was born at Libice (Lobnik, Lubik). He was educated at the monastery of Magdeburg; and in 983 was chosen bishop of Prague. The extreme severity of his rule repelled the Bohemians, whom he vainly strove to wean from their national customs and pagan rites. Discouraged by ill success, he withdrew to Rome until 993, when, in obedience to the Pope, he returned to his own people. Finding little amendment, however, in their course of living, he returned to Rome, and obtained permission from the Pope to devote himself to missionary labours in N. Germany and Poland. While preaching in Pomerania he was assassinated by a heathen priest.

See U. Chevalier, *Répertoire des sources historiques du moyen âge*, Bio.-Bibl. (1905); Bolland, *Acta Sanctorum*, April 23; H. G. Voigt, *Adalbert von Prag* (1898), a thoroughly exhaustive monograph.

ADALIA, the ancient *Attaleia* (q.v.) (med. *Antaliyah*; the crusaders' *Satalia*), the largest seaport on the south coast of Asia Minor, Turkey, though in point of trade second to Mersina. The unsuitability of the harbour for modern steamers, the bad anchorage outside and the extension of railways from Smyrna greatly lessened its former importance as an emporium for west central Anatolia, although it retains considerable importance as the administrative capital of a rich and isolated vilayet. Adalia played a considerable part in the mediaeval history of the Levant. Kilij Arslan had a palace there. The army of Louis VII sailed thence for Syria in 1148, and the fleet of Richard of England rallied there before the conquest of Cyprus. Conquered by the Seljuks of Konia, and made the capital of the province of Tekké, it passed after their fall through many hands, including those of the Venetians and Genoese, before its final occupation by the Ottoman Turks under Murad II (1432). The port is served by coasting steamers of the local companies only. Adalia is an extremely picturesque, but ill-built and backward place. Population (1950) 27,478.

See C. Lanckoronski, *Villes de la Pamphylie et de la Pisidie*, i. (1890).

ADAM, the Hebrew word for "man"; when used without the article implying the human species (e.g., Gen. i. 26 and the familiar phrase "son" or "sons of man," i.e., a human being or human beings), with the article a human individual, corresponding generally to the Latin *homo* and the Greek *ἄνθρωπος*. (The absence of the article in Gen. ii. 20b and iii. 17 is probably accidental, being due to the vocalization of the Hebrew text, not to its original consonants.) But in Gen. ii. 25 and v. 1 it may be a proper name, applied to the first man created. It is certainly in this sense that the word is employed in Gen. v. 2–6, and so it has been generally used, in the popular language both of Jews and of Christians.

The narrative of Gen. i. in giving an account of the "creation" of man does not necessarily imply that a single pair only was thus formed at the first. Throughout that chapter the impression the reader receives is that a large number of individuals in each species come into being at once. This, however, in its present form, is the later of the two narratives of creation, though it is probably a revision of a very ancient tradition, going far back behind the earliest appearance of Israel as a nation, and based on that common stock of thought which spread from Mesopotamia over western Asia before the middle of the 2nd millennium B.C.

With the narrative in Gen. ii. 4–25—the earlier in its present form—the case is different. Here we have most certainly the theory that all humanity is sprung from a single pair, a "man" and his "woman." The narrative is naïve in its detail and elementary in its theology. There is no account of the creation of the earth, or speculation as to how it came into being; it is

assumed. There is, however, no life, whether animal or vegetable, and the ordinary processes of the weather have not yet begun. The clayey soil is moistened by "mist," and from this material "Yahweh," afterwards to be the God of Israel, models the figure of a man. Then He breathes into his nostrils, and so—breath being regarded as one of the primary "givers of life"—brings to life this earthen model. The next problem is what to do with this living toy, and Yahweh makes a proper home for him by planting a garden and making all kinds of useful trees grow in it. There is



AFTER A WOODCUT FROM "BERGOEMENSIS, SUPPLEMENTUM CHRONICARUM," VENICE, 1492
EVE TEMPTING ADAM TO EAT THE FORBIDDEN FRUIT AND THEIR EXPULSION FROM THE GARDEN OF EDEN

more to be done; the man's needs are far from being satisfied, for he will require suitable companionship. It is not enough that he should exist alone, and experiment alone can show what will satisfy him.

Yahweh's first attempt at providing a suitable companion follows the method by which the man himself has been made. All kinds of forms are modelled from the wet clay, and brought before the man. At the sight of each he makes some sound, and the sound, expressing as it does the man's attitude towards the creature, becomes its name. But in no case does the name thus spontaneously given suggest that the problem is solved; the experiment has failed. Another method must be tried. Yahweh throws the man into an anaesthetic slumber and takes a rib from his side, carefully mending the place afterwards. Then He "builds" the rib into a form, and brings that to the man. Now he exclaims "wo-man," and the terms in which he greets the new figure show that at last the experiment is successful. Ultimately from this pair the whole human race descends.

Here, then, we have certain theories about human nature, held by the Israelite of the middle monarchy. Though the view of God is crude and anthropomorphic, yet it is clear that He is the author of man's being. Man's nature is bipartite—it is assumed that what is true of the common ancestor will be true of all his descendants. He consists of a body, made of the same kind of material as the soil from which all things spring, together with another element, a life-soul, which does not come from the ground, but is imparted by God Himself. The difference between the sexes is recognized, as also the fact that they are mutually complementary, but the sex instinct is at present undeveloped.

Other familiar features of human life are thus left unexplained. Man no longer lives in the garden, nor finds that the soil always yields a generous response to his efforts. The sex life is strongly developed and the subordination of woman is generally recognized. The hostility between man and other creatures, especially the snake tribe, needs explanation, and all these facts are accounted for in the second narrative, that of Gen. iii., commonly described as the story of the Fall.

Such is the Biblical story of the first man, and, apart from genealogies in Gen. iv. 25, v. 1-6, Chron. i. 1, he is never mentioned again by name in the Old Testament. The narrative has

affinities with others known to the ancient world, and the story of the Fall, at least, has a parallel in Ez. xxviii. Mesopotamians told of the formation of man from clay mingled with the blood of Bel, of Adapa, who narrowly missed attaining immortality, and of Ea-bani, made by Ishtar from clay, and seduced from his wild and primitive ways by a harlot. If all these have a common source with the Biblical narrative (which is quite possible), then we are more than ever impressed with the way in which the Hebrew genius for religion transmuted them, and, in spite of the crudities of language and thought, adapted them to universal religious experience.

Later thinkers and writers greatly expanded the story, and drew from it conclusions which were originally foreign to it. Rabbinic thought ascribed to Adam before the Fall a superhuman grandeur. One legend indeed, followed in the Koran, relates that all the angels were ordered to fall down and worship Adam, and that Satan refused, on the ground that he was made of fire and the man of clay. Others ascribed to Adam's fall the mortality of the human race, though in the original story there is no suggestion that man was originally created immortal. The doctrine of hereditary guilt appeared, and has formed the basis of much Christian theology. Apart from a single reference in Jude 14 and the mention of the name in the Lucan genealogy of Christ, St. Paul is the only New Testament writer who mentions Adam. He regards him as a type or summary of the whole human race in its natural state, and contrasts him and his kind with the new order of being that came into existence with Christ—"the second Adam," the originator of the higher spiritual plane: To him the "natural" man is, as to the old Hebrew, bipartite, consisting of "flesh" and "life"; the man who is in Christ has received a third element, the "Spirit." And to Pauline thought Christ is the starting point at which this third element first enters, just as the "Adam" of Gen. i.-v. is the starting point of the lower human order. (T. H. R.)

ADAM, the name of a family of French sculptors. **LAMBERT SIGISMUND** (1700-1759) executed many pieces for the French royal residences and for Frederick the Great of Prussia. **NICOLAS SÉBASTIEN**, his brother (1705-1778), was responsible for the tomb of Catherine Opalinska at Nancy. Another brother, **FRANÇOIS GASPARD BALTHASAR**, executed many of the monuments at Sans Souci and Potsdam.

See Dussieux, *Artistes français à l'étranger* (1855); Lady Dilke, *French Architects and Sculptors of the 18th century* (1900).

ADAM, ADOLPHE CHARLES (1803-1856), French composer of light operas which enjoyed great favour, was born in Paris July 24, 1803, and died there May 3, 1856. Boieldieu taught and encouraged him and he became in due course one of the most prolific and popular composers of his time. Of his 53 stage works *Le Postillon de Longjumeau* merits particular mention, while his ballet *Giselle* is still performed.

ADAM, ALEXANDER (1741-1809), Scottish teacher and antiquarian, was born on June 24, 1741 near Forres, Morayshire, and died in Edinburgh on Dec. 18, 1809. He became rector of Edinburgh High School in 1768, and had among his pupils many boys who afterwards became famous, among them Sir Walter Scott, Lord Brougham, and Jeffrey. He introduced Greek into the school curriculum, and defied tradition by publishing a *Principles of Latin and English Grammar* in English instead of Latin. His best-known work is his *Roman Antiquities* (1791).

See A. Henderson, *An Account of the Life and Character of A. A.* (1810).

ADAM, SIR FREDERICK (1781-1853), British general, fought during the Napoleonic wars from Egypt, in 1801, to Waterloo; afterwards he was high Commissioner of the Ionian Isles and governor of Madras.

ADAM, JULIETTE (1836-1936), French writer, known also by her maiden name of Juliette Lamber, was born at Verberie (Oise) Oct. 4, 1836. She has given an account of her childhood, rendered unhappy by the dissensions of her parents, in *Le Roman de mon enfance et de ma jeunesse* (Eng. trans., 1902). In 1852 she married a doctor named La Messine, and published in 1858 her *Idées antiproudhoniennes sur l'amour, la femme et le mariage*,

in defence of Daniel Stern (Mme. d'Agoult) and George Sand. On her husband's death she married, in 1868, Antoine Edmond Adam (1816-1877), prefect of police in 1870, and subsequently life-senator; and she established a salon which was frequented by Gambetta and the other republican leaders against the conservative reaction of the 'seventies. In the same interest she founded in 1879 the *Nouvelle Revue*, which she edited for the first eight years, and in the administration of which she retained a preponderating influence until 1899. She wrote the notes on foreign politics, and was unremitting in her attacks on Bismarck and in her advocacy of a policy of *revanche*. The famous *Lettres sur la politique extérieure* in this review are from her pen. Mme. Adam was also generally credited with a share in the authorship of papers on various European capitals signed "Paul Vasili." The most famous of her numerous novels is *Païenne* (1883). Her reminiscences, *Mes premières armes littéraires et politiques* (1904), *Mes sentiments et nos idées avant 1870* (1905), and later volumes in 1907, 1909 and 1910, contain much interesting gossip about her distinguished contemporaries. Mme. Adam saw the revolution of '48, the Second Empire, the Siege of Paris, the Treaty of Versailles, and lived to see the *revanche* she had fought and prayed for when the second Treaty of Versailles was signed in 1919. In her youth she had belonged to the anti-clerical Liberal Party, but in the disillusionments of her later days she moved with her time, and just as *Païenne* had reflected a free-thinking age, *Chrétienne* (1913) was a glorification of the Catholic tradition. She died on Aug. 23, 1936.

See W. Stephens, *Madame Adam, la grande française* (1917).

ADAM, MELCHIOR (d. 1622), German divine and biographer, wrote *Vitae Germanorum philosophorum* (Heidelberg-Frankfurt, 1615-20). Pierre Bayle acknowledges his debt to this work, which deals principally with German scholars of the 16th century.

ADAM, PAUL (1862-1920), French novelist, was born in Paris on Dec. 7, 1862, and died there on Jan. 2, 1920. He was prosecuted for his first novel, *Chair molle* (1885), but was acquitted. He collaborated with Jean Moréas in *Le thé chez Miranda* (1886), and with Moréas and Gustave Kahn he founded the *Symboliste*, coming forward as one of the earliest defenders of symbolism. Among his numerous novels should be noted *Le mystère des foules* (1895), a study in Boulangism, *Lettres de Malaisie* (1897), a fantastic romance of imaginary future politics. In 1899 he began a novel-sequence, giving the history of the Napoleonic campaigns, the restoration, and the government of Louis Philippe, comprising *La force* (1899), *L'enfant d'Austerlitz* (1901), *La ruse* (1902), and *Au soleil de Juillet* (1903). In 1900 he wrote a Byzantine romance, *Basile et Sophia*.

He was an indefatigable traveller, and in his later years much occupied with economic theory. *Le Trust* (1910) was the fruit of one of his journeys to America. Later books were *Stéphanie* (1918) and during the World War *Reims dévastée* and *Le Lion d'Arras*.

ADAM, ROBERT (1728-1792), British architect, the second son of William Adam of Maryburgh, in Fife, and the most celebrated of four brothers, John, Robert, James, and William Adam, was born at Kirkcaldy in 1728. He studied at the University of Edinburgh, and probably received his first instruction in architecture from his father, who gave proofs of his own skill and taste in the Edinburgh Royal Infirmary (now demolished). Somewhere between 1750 and 1754 he visited Italy, where he spent three years studying the remains of Roman architecture. There he was struck with the circumstance that practically nothing had survived of the Greek and Roman masterpieces except public buildings, and that the private palaces, which Vitruvius and Pliny esteemed so highly, had practically vanished. One example of such work, however, was extant in the ruins of Diocletian's palace at Spalato, in Dalmatia, and this he visited in July 1757, taking with him the famous French architect and antiquary, C. L. Clérissieu, and two experienced draughtsmen, with whose assistance, after being arrested as a spy, he managed in five weeks to accumulate a sufficient number of measurements and careful plans and surveys to produce a restoration of the entire

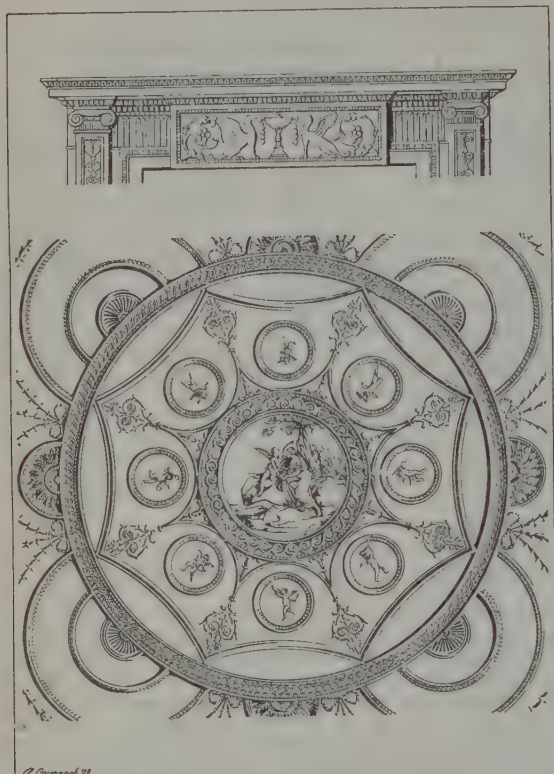
building in a fine work which he published in 1764, *The Ruins of the Palace of Diocletian, etc.* Adam regarded this as the last great achievement of Roman architecture, whereas to later students it appears to mark the beginning of the decadence. The influence of these studies was apparent directly and indirectly in much of his subsequent work, which, indeed, was in great measure founded upon them.

After his return to England he came rapidly to the front, and in 1762 he was appointed sole architect to the king and the Board of Works. Six years later he resigned this office, in which he was succeeded by his brother James—who, however, held the office jointly with another—and entered parliament for the county of Kinross. In 1768 he and his three brothers leased the ground fronting the Thames, upon which the magnificent terrace of the Adelphi, one of their greatest achievements, was built for £1,200 on a 99 years' lease. The Adelphi was still standing in 1928, though imminently in danger from rebuilding proposals. The site presented attractive possibilities. A steep hill led down Buckingham street to the river-side, and the plan was to raise against it, upon a terrace formed of massive arches and vaults and facing the river, a dignified quarter, of fine streets and stately buildings, suggestive of the Spalato ruins. Splendid, however, as the terrace and its houses are, both in conception and execution, the underground work which upholds them is perhaps more remarkable still. Between 1773 and 1778 the brothers issued a fine series of folio engravings and descriptions of the designs for many of their most important works, which included several great public buildings and numberless large private houses; a fine volume was published in 1822. For the remaining years of Robert's life the practice of the firm was the most extensive in the country; his position was unquestioned, and when he died in 1792 he was laid to rest in Westminster Abbey almost as a matter of course.

As an architect, Adam was strongly under Roman and Italian influences, and his style and aims were exotic rather than native. It was the signal triumph of his genius that he was able so to mould and adapt classical models as to create a new manner of the highest charm and distinction. Out of simple curvilinear forms, of which he principally preferred the oval, he evolved combinations of extraordinary grace and variety, and these entered into every detail of his work. In his view the architect was intimately concerned with the furniture and the decorations of a building as well as with its form and construction; and this view he carried rigorously into practice, and with astonishing success. But whatever care he might have expended upon the flowing curves of a moulding or a decoration, it was strictly kept in its place; it contributed its share and no more to the total effect. He imparted the unity of a single imposing structure to a number of private houses grouped in a block which is so characteristic a feature of modern town building. A delightful but theoretically undesirable characteristic of his work is the use of stucco. Upon it he moulded delicate forms in subtle and beautiful proportions. His "compo" was used so successfully that the patent was infringed; many of his moulds still exist and are in constant use. That most difficult feature, the column, he handled with enthusiasm and perfect mastery; he studied and wrote of it with minute pains, while his practice showed his grasp of the subject by all avoidance of bare imitation of the classic masters who first brought it to perfection. His work might be classic in form but it was independently developed by himself. It would be impossible here to give a list of the innumerable works which he executed. In London, of course, the Adelphi stands pre-eminent; the screen and gate of the Admiralty and part of Fitzroy square are by him, and much of the older portion of Finsbury circus, besides whole streets of houses in the west end. There are the famous country houses of Lord Mansfield at Kenwood (Highgate) and Luton Hoo, and decorations and additions to many more.

Robert Adam—with, there is reason to suspect, some help from his brother James—has left as deep and enduring a mark upon English furniture as upon English architecture. Robert Adam was no doubt at first led to turn his thoughts towards furniture by his desire to see his light, delicate, graceful interiors, with their large

sense of atmosphere and their refined and finished detail, filled with plenishings which fitted naturally into his scheme. His own taste developed as he went on, but he was usually extremely successful, and cabinetmakers are still reproducing his most effective designs. In his furniture he made lavish use of his favourite decorative motives—wreaths and paterae, the honeysuckle and the fan ornament which he used so constantly. Thus an Adam



FROM BOLTON, "ARCHITECTURE OF R. AND J. ADAM," BY PERMISSION OF "COUNTRY LIFE"

A CHARACTERISTIC MANTELPIECE BY ROBERT ADAM IN THE ADELPHI. DETAIL OF ADAM DRAWING-ROOM CEILING IN GARRICK'S HOUSE, ADELPHI

house is a unique product of English art. From façade to fire-irons, from the chimneys to the carpets, everything originated in the same order of ideas, and to this day an Adam drawing room is to English what a Louis Seize room is to French art. In nothing were the Adams more successful than in the fine proportions of their mantelpieces and doors. The former, by reason of their simplicity and the readiness with which the "compo" ornaments can be applied and painted, are still made in cheap forms in great number.

John Adam succeeded to his father's practice as an architect in Edinburgh. James Adam studied in Rome, and eventually was closely associated with Robert; William is variously said to have been a banker and an architect.

See John Swarbrick, *Robert Adam and His Brothers* (1916); Arthur T. Bolton, *Architecture of Robert and James Adam* (1922). Both are illustrated. Mr. Bolton's book contains photographs of many Adam houses, and of many Adam interiors; among country houses, Hatchlands, Shardloes, Harewood house, Bowood, Kedleston, Syon house and Kenwood; among the great houses of London, Lansdowne house; and many public and private buildings in Scotland.

ADAM, WILLIAM (1751-1839), British lawyer and politician, was a Whig and a supporter of the policy of Fox. At the English bar he obtained a very considerable practice. He was successively attorney and solicitor general to the prince of Wales, one of the managers of the impeachment of Warren Hastings, and one of the counsel who defended the first Lord Melville when impeached.

ADAMAWA, a region in the Sudan which lies roughly between 6° and 11° N. and 11° and 15° E. During the 19th century it was an independent emirate (or sultanate), but is now partitioned between British Nigeria and British and French Cameroons. In all these territories administrative units with the name Adamawa survive.

Adamawa owes its origin and name to Adama, a Fulani emir who established the emirate during the first half of the 19th century. In 1809, under the leadership of Othman dan Fodio of Sokoto, the Moslem Fulani who had lived in the Sudan for many centuries began a holy war (*Jihad*) against the non-Moslem Negroes. Adama conquered the area now known as Adamawa where he and his Fulani followers established an aristocracy controlling the many tribes such as Batta, Chamba and Lala which had opposed Fulani rule. Adama, who died in 1848, made Yola his capital and founded such cities as Garua, Ngaundere, Tibati, and placed them under the rule of Fulani emirs.

Adama was succeeded by four of his sons. Lowal (1848-72) was ruling when H. Barth visited Adamawa (1851); Saanda (1872-90) consolidated the empire; Zubeiru (1890-1901) attempted to defend it against Great Britain and Germany but in 1903 he was killed by rebellious Lala when fleeing from his pursuers. After Adamawa had been partitioned in 1901, Bobo Amadu, Adama's fourth son, became emir of Yola, the British section of the state.

Adamawa is a hilly region which is traversed by the Benue river. Although predominantly flat (average about 1,000 ft.), there are a few high mountain groups of which Mt. Alantika (6,000 ft.) and the Mandara mountains are the most prominent. The densely populated area belonging to the savanna zone is rather fertile and offers opportunities for agricultural and pastoral pursuits. While the Negro groups grow durra, groundnuts, yams and cotton, the Fulani are primarily cattle breeders. Hausa, Kanuri and Arabs live as traders throughout Adamawa.

(See also CAMEROONS; NIGERIA.)

See S. Passarge, *Adamawa* (Berlin, 1895); K. Strümpell, *Die Geschichte Adamawas* (Hamburg, 1912); H. Barth, *Travels in North and Central Africa* (1890).

(H. A. Wf.)

ADAM (or ADAN) DE LE HALE (c. 1238-1288), French troubadour, was born at Arras. His patronymic is generally modernized to La Halle, and he was commonly known to his contemporaries as Adam d'Arras or Adam le Bossu, sometimes simply as Le Bossu d'Arras. Adam studied grammar, theology and music at the Cistercian abbey of Vaucelles, near Cambrai. He joined the household of Robert II, count of Artois, in 1272; and from 1283 was attached to Charles of Anjou, brother of Charles IX, whose fortunes he followed in Egypt, Syria, Palestine and Italy. At the court of Charles, after he became king of Naples, Adam wrote his *Jeu de Robin et Marion*, the most famous of his works. He died between 1285 and 1288. Adam's shorter pieces are accompanied by music, of which a transcript in modern notation, with the original score, is given in E. de Coussemaker's edition.

His *Jeu de Robin et Marion* is cited as the earliest French play with music on a secular subject, and on the strength of it he has been dubbed by some the father of *opéra comique*. It takes the form of a dramatic pastoral introducing a number of characters and consists of a dialogue varied by refrains already current in popular song. The melodies to which these are set have the character of folk music, and are more spontaneous and melodious than the more elaborate music of his songs and motets. A modern adaptation, by Julien Tiersot, is occasionally performed. Another of his plays, *Le jeu Adan or Le jeu de la Feuillée* (c. 1262), was a satirical drama in which he introduced himself, his father and the citizens of Arras, with their peculiarities. His works include further a *Congé*, or satirical farewell to the city of Arras, and an unfinished *chanson de geste* in honour of Charles of Anjou, *Le roi de Sicile*, begun in 1282.

BIBLIOGRAPHY.—The only ms. which contains the whole of Adam's work is the La Vallière ms. (No. 25, 566) in the Bibliothèque Nationale, Paris, dating from the latter half of the 13th century. Many of his pieces are also contained in Douce ms. 308, in the Bodleian library, Oxford. His *Oeuvres complètes* (1872) were edited by E. de Coussemaker. See J. Tiersot, *Sur le jeu Robin et Marion* (1898); L. Nicod, *Les Partures Adan, Les Jeux partis d'Adam de la*

Halle (1917); and, for full bibliography of works on the subject, No. 6 of the *Bibliothèque de bibliographies critiques*, by Henri Guy.

ADAMITES or ADAMIANS, a sect of heretics that flourished in North Africa in the 2nd and 3rd centuries. Basing itself probably on a union of certain gnostic and ascetic doctrines, this sect pretended that its members were re-established in Adam's state of original innocence.

ADAMNAN or **ADOMNAN** (c. 624–704), Irish saint and historian, was born at Raphoe, Donegal, Ireland. In 679 he was elected abbot of Hy or Iona, being ninth in succession from the founder, St. Columba. In 686, while on a visit to King Aldfrith of Northumbria, he was led to adopt the Roman rules on the date of Easter and on the tonsure, but failed to enforce the change upon his monks.

We owe to Adamnan two valuable works, the anecdotic *Life of St. Columba*, preserving the authentic traits of the saint, and the *De locis sanctis*, an account of Arculf's travels in the Holy Land, which, in the longer version of Bede, was a kind of guidebook to the holy places in Palestine throughout the middle ages.

Adamnan is sometimes credited with *Adamnan's Vision*, the Irish version of which is in a 12th century ms. in Dublin.

BIBLIOGRAPHY.—Thirteen mss. of the original Arculf-Adamnan narrative exist, and fully 100 of Bede's abridgment of the former; the most important, containing all the plans, are (1) Berne, Canton library, 582, of 9th century; (2) Paris, National library, Lat. 13,048, of 9th century; a third ms., London, Brit. Mus., Cotton, Tib. D.V., of 8th–9th centuries, though damaged by fire and lacking the illustrations, is of value for the text, being the oldest of all. The best edition is that of Tobler in *Itinera et Descriptiones Terrae Sanctae* (1877); we may also mention that of 1870, by Delpit, in his *Essai sur les anciens pèlerinages à Jérusalem*. See further Delpit's remarks upon Arculf in the same work, 260–304; C. R. Beazley, *Dawn of Modern Geography*, i, 131–41 (1897); and J. L. Macpherson, *Arculfus' Pilgrimage to the Holy Land* (1899). The *Life of St. Columba* was edited by J. T. Fowler (1894).

ADAM OF BREMEN (died c. 1076), historian and geographer, was, according to one tradition, born at Meissen (Saxony) before 1045. In 1069 he appears as a canon of Bremen and master of the cathedral school. On the death of Adalbert, archbishop of Bremen, in 1072, he began the *Historia Hammaburgensis Ecclesiae*, which he finished about 1075. Adam's *Historia*—known also as *Gesta Hammaburgensis Ecclesiae Pontificum*, *Bremensium praesulum Historia* and *Historia ecclesiastica*—is a primary authority, not only for the great diocese of Hamburg-and-Bremen, but for all north German and Baltic lands (down to 1072), and for the Scandinavian colonies as far as America.

Here occurs the earliest mention of Vinland, and here are also references of great interest to Russia and Kiev, to the heathen Prussians, the Wends and other Slav races of the south Baltic coast, as well as to Finland, Thule or Iceland, Greenland and the polar seas, which Harald III (Haardraade) and the nobles of Frisia had attempted to explore in Adam's own day (before 1066). Adam's account of north European trade at this time, and especially of the great markets of Jumne at the mouth of the Oder, of Birka in Sweden and of Ostrogard (old Novgorod?) in Russia, is also of much value.

His work, which places him among the first and best of German annalists, consists of four books or parts, and is compiled partly from written records, and partly from oral information mainly gathered from experience or at the courts of Adalbert and Sweyn II (Estrithson), king of Denmark. Of his minor informants he names several, such as Adelward, dean of Bremen, and William the Englishman, "bishop of Zealand," formerly chancellor of Canute the Great, and an intimate of Sweyn Estrithson. The fourth (perhaps the most important) book of Adam's *History*, variously entitled *Libellus de Situ Daniae et reliquarum quae trans Daniam sunt regionum*, *Descriptio Insularum Aquilonis*, etc., has often been considered, but wrongly, as a separate work.

BIBLIOGRAPHY.—Ten mss. exist, of which the chief are (1–2) Copenhagen, Royal library, Old Royal Collection, No. 2296, of 12th to 13th cents.; No. 718, of 15th cent.; (3) Leyden university, Voss. Lat. 123, of 11th cent.; (4) Rome, Vatican library, 2010; (5) Vienna, Hof-u. Staatsbibliothek, 413, of 13th cent.; (6) Wolfenbüttel, Ducal library, Gud. 83, of 15th cent. There are 15 editions of the *Historia*, in whole

or part; the first published at Copenhagen (1579; the first of the *Libellus* or *Descriptio Ins. Aquil.* appeared at Stockholm in 1615); the best at Hanover (1846; by Lappenberg, in *Scriptores Rerum Germanicarum*; re-issued by L. Weiland, 1876); and at Paris (1884; in Migne's *Patrologia Latina*, clxvi). See also C. R. Beazley, *Dawn of Modern Geography*, ii, 514–48 (1901).

ADAMS, ABIGAIL SMITH (1744–1818), wife of John Adams (q.v.), second president of the United States, was born in Weymouth, Mass., on Nov. 23, 1744. She was the daughter of William Smith, a Congregational minister, and was descended through her mother, Elizabeth Quincy, from Thomas Shepard of Cambridge, a noted Puritan divine. Despite scanty education and delicate health, she became a terse and vigorous writer and exercised much influence on the social and political life of her time. In 1764 she was married to John Adams, then practising law in Boston. During the first ten years of this union she lived in peace and quiet, though always ardently sharing her husband's interests in the growing disputes that culminated in war. In this period she became the mother of a daughter and three sons, one of whom, John Quincy Adams, rose to the presidency of the United States. But during the second ten years of married life she was practically separated from her husband, who was absent attending congress and serving on diplomatic missions in Europe. She resolutely supported him in his insistence upon the Declaration of Independence and aided him and his cause with loyal zeal.

In 1784 she rejoined her husband in France and in 1785 accompanied him to England, where, as the wife of the first minister of the United States, she then but newly lost American colonies, to the court of George III, she met with social discourtesies which she long resented. From 1789 to 1801, when her husband was successively vice-president and president, she lived in a simple manner in Washington. Since the publication by C. F. Adams in 1876 of *The Familiar Letters of John Adams and his Wife* increased interest has centred in the career of the stout-hearted Puritan woman who was both the wife and the mother of a president of the United States. She died at Braintree, now Quincy, Mass., on Oct. 28, 1818.

BIBLIOGRAPHY.—Laura Elizabeth Richards, *Abigail Adams and Her Times* (1917); Gamaliel Bradford, *Portraits of American Women* (1919); Dorothea Bobbé, *Abigail Adams, the Second First Lady* (1929).

ADAMS, BROOKS (1848–1927), U.S. historian, was born in Quincy, Mass., June 24, 1848. He graduated from Harvard university in 1870, and practised law in Boston until 1881. Thanks to a large inheritance, he had ample independent income which enabled him to travel extensively in Europe, the middle east and India. Very close to his elder brother Henry, also a historian, Brooks carried on with him an active correspondence in which they both developed the idea, revolutionary at the time, that by its nature and substance U.S. democracy was foreordained to degradation and decay. In 1895 he published his *Law of Civilization and Decay* in which he developed his theory of history, the conviction that the centre of trade had consistently followed a westward movement from the ancient crossroads in the east to Constantinople, Venice, Amsterdam and finally London, occurring in accord with a law relating to the density of populations and the development of new and centralizing techniques of trade and industry.

His *America's Economic Supremacy* (1900) accurately foresaw within 50 years a world in which there would be only two powers, Russia and the United States, with the latter possessing economic supremacy. In 1913 he published *The Theory of Social Revolutions*, a study of defects in the American form of government, developing the idea of the imminent danger in the existence of great wealth exerting private power but declining to accept responsibility. After Henry Adams' death, Brooks Adams prepared for publication his brother's book *The Degradation of the Democratic Dogma* (1920) to which he wrote the introduction, a kind of family chronicle that began with John Quincy Adams' troubles and ended with the renunciation by the two grandsons of the democratic dogma. The roots of his Puritan ancestry were deep. An agnostic, a profound sceptic, he returned in the last years of his life to the church at Quincy where, overcoming his lifelong shyness, he stood up and made a

public profession of his faith. Brooks Adams died in Boston, Feb. 13, 1927.

Adams' other writings include *The Emancipation of Massachusetts: The Dream and the Reality* (rev. ed., 1919); *The New Empire* (1902); *America's Economic Supremacy* (rev. ed., 1947). (M. W. CH.)

ADAMS, CHARLES FOLLEN (1842-1918), U.S. humorous poet, was born in Dorchester, Mass., April 21, 1842. He received a common school education. Early in the Civil War he entered the Union army and at Gettysburg was wounded and taken prisoner. In 1872 he began writing verses in German dialect, chiefly humorous, for juvenile periodicals. Collections of his verse were published under the title *Leedle Yawcob Strauss, and Other Poems* (1877) and *Dialect Ballads* (1887). His complete poetical writings under the title *Yawcob Strauss, and Other Poems*, with illustrations by "Boz," were published in 1910. He died in Boston, Mass., March 8, 1918.

ADAMS, CHARLES FRANCIS (1807-1886), U.S. diplomatist, son of John Quincy Adams, and grandson of John Adams, was born in Boston, Mass., Aug. 18, 1807. His father, having been appointed minister to Russia, took him in 1809 to St. Petersburg, where he acquired a perfect familiarity with French, learning it as his native tongue. After eight years spent in Russia and England, he attended the Boston Latin school for four years, and in 1825 graduated at Harvard. He lived for two years in the executive mansion, Washington, during his father's presidential term, studying law and moving in a society where he met Webster, Clay, Jackson and Randolph. Returning to Boston, he devoted ten years to business and study, and wrote for the *North American Review*. He also undertook the management of his father's pecuniary affairs, and actively supported him in his contest in the house of representatives for the right of petition and the anti-slavery cause. In 1835 he wrote an effective and widely read political pamphlet, entitled, after Edmund Burke's more famous work, *An Appeal from the New to the Old Whigs*. He was a member of the Massachusetts general court from 1840 to 1845, sitting for three years in the house of representatives and for two years in the senate; and in 1846-48 he edited a party journal, the *Boston Whig*. In 1848 he was prominent in politics as a "Conscience Whig," presiding over the Buffalo convention which formed the Free Soil party and nominated Martin Van Buren for president and himself for vice-president. He was a Republican member of the 36th congress, which assembled Dec. 5, 1859, and during the second session (Dec. 3, 1860-March 4, 1861) he represented Massachusetts in the congressional committee of 33 at the time of the secession of seven of the southern states. His selection by the chairman of this committee, Thomas Corwin, to present to the full committee certain propositions agreed upon by two-thirds of the Republican members and his calm and able speech of Jan. 31, 1861, in the house served to make him conspicuous before congress and the country. Together with William H. Seward, he stood for the Republican policy of concession; and, while he was criticized severely and charged with inconsistency in view of his record as a "Conscience Whig," he was of the same mind as President Lincoln, willing to concede nonessentials, but holding rigidly to the principle, properly understood, that there must be no extension of slavery. He believed that as the Republicans were the victors they ought to show a spirit of conciliation, and that the policy of righteousness was likewise one of expediency, since it would have for its result the holding of the border slave states with the north until March 4, when the Republicans could take possession of the government at Washington. With the incoming of the new administration, Secretary Seward secured for Adams the appointment of minister to Great Britain. So much sympathy was shown in England for the south that his path was beset with difficulties; but his mission was to prevent the interference of Great Britain in the struggle; and while the work of Lincoln, Seward and Sumner, and the cause of emancipation, tended to this end, the American minister was insistent and unyielding, and knew how to present his case forcibly and with dignity. He laboured with energy and discretion to prevent the sailing of the "Alabama"; and, when unsuccessful in this, he persistently urged upon the British government its responsibility for the destruction of American merchant vessels by the privateer. In his own diary

he shows that underneath his calm exterior was keen anxiety. Adams was instrumental in getting Lord John Russell to stop the "Alexandra," and to order the detention in Sept. 1863 of the two ironclad rams intended for the Confederate states. Adams remained in England until May 1868. His last important work was as a member, in 1871-72, of the tribunal at Geneva which settled the "Alabama" claims. He died at Boston, Nov. 21, 1886.

He edited the works of John Adams (1850-56), and the *Memoirs of John Quincy Adams* (1874-77). See the excellent biography (1900) by his son, Charles Francis Adams, Jr., and E. W. Adams, *Great Britain and the American Civil War* (1925).

ADAMS, CHARLES FRANCIS (1886-), secretary of the navy in President Hoover's cabinet, was born in Quincy, Mass., Aug. 2, 1886, great-grandson of John Quincy Adams, 6th president, and great-great-grandson of John Adams, 2nd president of the United States; A.B., Harvard, 1888; LL.B., 1892; admitted to Suffolk bar 1893. He was a member of Quincy City council, 1893-95; mayor, 1896-97; treasurer of Harvard college, 1898-1929; amateur skipper on yacht "Resolute," which won the International Yacht Races, 1920; appointed secretary of the navy, March 5, 1929. He was a member of the American delegation at the London Naval conference, 1930.

ADAMS, CHARLES KENDALL (1835-1902), U.S. educator and historian, was born in Derby, Vt., on Jan. 24, 1835. He graduated in 1861 at the University of Michigan, where he was instructor of history in 1862, assistant professor of history in 1863-67 and professor of history in 1868-85. From 1885 to 1892 he was president of Cornell university, succeeding A. D. White (q.v.), and from 1892 to 1902 he was president of the University of Wisconsin. He edited *Representative British Orations* (1884). His published works include *Democracy and Monarchy in France* (1874) and *Christopher Columbus* (1892). He died in Redlands, Calif., on July 26, 1902.

See Charles Foster Smith, *Charles Kendall Adams* (1924).

ADAMS, CLEMENT (1519?-1587), English author. He is supposed to have been tutor to the royal pages at Greenwich. His *Anglorum Navigatio ad Moscovitas* is an account of the journey to Moscow made by Richard Chancellor and Sir Hugh Willoughby in 1553, and an English translation was printed by Richard Hakluyt in his *Principal Navigations*, vol. i (1598).

ADAMS, EPHRAIM DOUGLASS (1865-1930), U.S. educator and historian, brother of Henry Carter Adams (q.v.), was born in Decorah, Ia., Dec. 18, 1865. He graduated in 1887 from the University of Michigan from which in 1890 he received the degree of doctor of philosophy. From 1891 to 1899 he was assistant and associate professor of history and sociology, and from 1899 to 1902 professor of European history in the University of Kansas. He was associate professor of history at Stanford university from 1902 to 1906, when he was made professor.

His published writings include *Control of the Purse in the United States Government* (1804), *The Influence of Grenville on Pitt's Foreign Policy* (1904), *British Interests and Activities in Texas* (1910), *The Power of Ideals in United States History* (1913), *Great Britain, America and Democracy* (1919), *Great Britain and the American Civil War* (1925).

ADAMS, FRANK DAWSON (1859-1942), Canadian geologist, was born at Montreal, Que., Sept. 17, 1859. He graduated with first rank honours from McGill university, Montreal, in 1878 and took postgraduate work at McGill, Yale and Johns Hopkins university, Baltimore, Md. He received his Ph.D. from Heidelberg in 1892. Adams was appointed lecturer in geology at McGill in 1889 and in 1893 was promoted to the Logan chair of geology. He became dean of engineering in 1908 and vice-principal of the university in 1920, retiring in 1924.

Adams's contribution to pre-Cambrian geology was in determining the true nature of the foliated anorthosites, and in his description of the Grenville and its separation from the pre-Cambrian complex. He investigated the behaviour of rocks under great variations in temperature and pressure, and shed much light on the manner in which internal changes in the structure of the earth were brought about. He died Dec. 29, 1942. (J. J. O'N.)

ADAMS, GEORGE BURTON (1851-1925), U.S. educator and historian, was born in Fairfield, Vt., June 3, 1851.

He graduated from Beloit college, Beloit, Wis., in 1873, and received the degree of doctor of philosophy from the University of Leipzig, Germany, in 1886. He was professor of history in Drury college, Springfield, Mo., from 1877 to 1888, when he became professor of history at Yale. From 1895 to 1913 he was editor of the *American Historical Review*. He edited Duruy's *Middle Ages*, Bémont and Monod's *Medieval Europe*, and *Select Documents of English Constitutional History*. He died in New Haven, Conn., May 26, 1925.

His published works include *Civilization During the Middle Ages* (1894), *The Growth of the French Nation* (1896), *European History* (1899), *The Origin of the English Constitution* (1912), *Outline Sketch of English Constitutional History* (1918), *The British Empire* (1919) and *The Constitutional History of England* (1921).

ADAMS, HANNAH (1755–1831), American writer, was born in Medfield, Mass., in 1755. She is said to be the first woman in America to have made literature a profession. By private study, which she began at an early age, she acquired much varied learning, including some acquaintance with Latin and Greek. Through family reverses she was compelled from her 17th year to provide for herself. Her writings, though they brought reputation and friends, yielded but little pecuniary profit. Among her chief works were *Views of Religious Opinions* (1784), *History of New England* (1799), *Evidences of Christianity* (1801) and *History of the Jews* (1812). Her *Autobiography*, with additions by Hannah F. Adams, was published in 1832. She died in Brookline, Mass., Nov. 15, 1831.

ADAMS, HENRY (1838–1918), American historian, son of Charles Francis Adams and grandson of John Quincy Adams, was born in Boston, Mass., on Feb. 16, 1838. He graduated at Harvard in 1858, studied abroad, and was private secretary to his father when the latter was a congressman and minister to England. Thereafter for a brief time he did political writing in Washington; and from 1870 to 1877 he was assistant professor of history at Harvard, for most of the period also acting as editor of the *North American Review*. He is considered to have been the first to conduct historical seminary work in the United States. His *History of the United States from 1801 to 1817* (9 vols. 1889–91, new ed. 1909) took its place as the best work on the administrations of Presidents Jefferson and Madison, being specially notable for its account of the diplomatic relations of the United States during this period, and for its essential impartiality. This, like his other historical and biographical works such as the *Life of Albert Gallatin* (1879), *John Randolph* (1882), *Historical Essays* (1891), and *Chapters of Erie and Other Essays* (1871, with Charles Francis Adams, Jr.), won him a reputation among scholars. His *Mont Saint-Michel and Chartres* (1913, privately printed 1904) and *The Education of Henry Adams* (1918, privately printed 1906) revealed him to a much wider audience as a writer of delicate sensibilities and refined taste. *Mont Saint Michel and Chartres* is one of the most valuable studies of mediaevalism yet produced in America, not only for the aid which it affords in the appreciation of the literary and architectural monuments of the past, but for the conception which it gives of the animating forces which produced these monuments. The autobiography which attempted to show how ill-adapted eighteenth-century man and education were for the needs of the twentieth century was one of the most widely discussed books of its decade in America. Correlating with these books to a certain extent was Adams's *Letter to American Teachers of History* (1910). He died in Washington on March 27, 1918. Posthumous publications were *The Degradation of the Democratic Dogma* (1919, with an introduction by Brooks Adams) and *Letters to a Niece and Prayer to the Virgin of Chartres* by Henry Adams, with *A Niece's Memories* by Mabel La Farge (1920). After his death he was named by Henry Holt as the author of *Democracy*, an anonymous novel of 1880.

His elder brother, **JOHN QUINCY ADAMS** (1833–1894), a graduate of Harvard (1853), practised law, and was for several terms a Democratic member of the Massachusetts general court. In 1872 he was nominated for vice president by the Democratic faction that refused to support Horace Greeley.

Another brother, **CHARLES FRANCIS ADAMS, JR.** (1835–1915),

born in Boston, on May 27, 1835, graduated at Harvard in 1856, and was admitted to the bar in 1858. During the Civil War he served on the Union side, receiving, in 1865, the brevet of brigadier general. He was president of the Union Pacific railroad from 1884–90, having previously become widely known as an authority on the management of railways. In 1900–01 he was president of the American Historical Association. He died in Washington, D.C., on March 20, 1915. His autobiography was published in 1916 with a memorial address by Henry Cabot Lodge.

Among his writings are: *Railroads, Their Origin and Problems* (rev. ed. 1887); *Three Episodes of Massachusetts History* (1892); a biography of his father, *Charles Francis Adams* (1900); *Lee at Appomattox and Other Papers* (1902); *Three Phi Beta Kappa Addresses* (1907); *Studies Military and Diplomatic 1775–1865* (1911); and *Atlantic Historical Solidarity* (1913), lectures delivered at Oxford.

Another brother, **BROOKS ADAMS** (1848–1927), was born in Quincy, Mass., on June 24, 1848, graduated at Harvard in 1870, and until 1881 practised law. He died in Boston, Feb. 13, 1927.

His writings include: *The Emancipation of Massachusetts: The Dream and the Reality* (rev. ed. 1919); *The Law of Civilization and Decay* (1895); *America's Economic Supremacy* (1900); and *The New Empire* (1902).

ADAMS, HENRY CARTER (1852–1921), American economist, was born at Davenport, Ia., Dec. 31, 1852. He was educated at Iowa college and Johns Hopkins university, where he was a fellow 1876–78, and in French and German universities. He afterwards taught at Cornell university, and in 1887 became professor of political economy and finance in the University of Michigan. He also became statistician to the Interstate Commerce Committee and was in charge of the transport department in the 1900 census. His principal works include *The State in Relation to Industrial Action* (1887); *Public Debts* (1887); *The Science of Finance* (1888); *Economics and Jurisprudence* (1897); *Description of Industry* (1918) and *American Railway Accounting* (1918). He died Aug. 11, 1921.

ADAMS, HERBERT (1858–1945), American sculptor, was born at West Concord (Vt.) on Jan. 28, 1858. He was educated



BY COURTESY OF GRAND CENTRAL GALLERIES
ADAMS'S POLYCHROME BUST "PRIA-MAVERA" SHOWS A LEANING TOWARD THE ITALIAN "QUATTRO-CENTO" AND THE WORK OF THE DELLA ROBBIAS

at the Worcester Institute of Technology and at the Massachusetts normal art school, and in 1885–90 he was a pupil of Antonin Mercié in Paris. In 1890–98 he was an instructor in the art school of Pratt institute, Brooklyn, New York. In 1906 he was elected vice-president of the National Academy of Design, New York, and from 1917–20 served as president. He experimented successfully with some polychrome busts and tinted marbles, notably in the "Rabbi's Daughter" and a portrait of Julia Marlowe, the actress. He was at his best in his portrait busts of women, the finest example being the study, completed in 1887, of Miss A. V. Pond, whom he afterwards married. Among his other productions are a fountain for Fitchburg (Mass., 1888); a number of works for the Congressional library, Washington, including the bronze doors ("Writing") begun by Olin Warner, and the statue of Prof. Joseph Henry; memorial tablets for the Boston State House; a memorial of Jonathan Edwards at Northampton (Mass.); statues of Richard Smith, the type-founder, in Philadelphia, and of William Ellery Channing, in Boston (1902); the Vanderbilt memorial bronze doors for St. Bartholomew's church, New York; the group of figures for McMillan fountain in McMillan park, Washington (D.C.); reliefs for tomb of Ellen Axson Wilson (Mrs. Woodrow Wilson). He died May 21, 1945.

ADAMS, HERBERT BAXTER (1850–1901), American historian and educationalist, was born at Shutesbury (Mass.) on April 16, 1850. He graduated at Amherst, at the head of his class,

in 1872; and after studying at Göttingen and Berlin he received the degree of Ph.D. at Heidelberg in 1876, with the highest honours. Thereafter almost until his death he was connected with the Johns Hopkins university, Baltimore (Md.), becoming professor of American and institutional history in 1891. He was one of the founders of the American Historical Association, of which he was secretary until 1900. In 1882 he founded the "Johns Hopkins University Studies in Historical and Political Science," of which he became editor. It was as a teacher, however, that Adams rendered his most valuable services, and many American historical scholars owe their training, and to a considerable extent their enthusiasm, to him. He died at Amherst (Mass.) on July 30, 1901. Among his writings are: *Maryland's Influence in Founding a National Commonwealth* (1877); *Methods of Historical Study* (1884); *Maryland's Influence upon Land Cessions to the United States* (1885); and *The Life and Writings of Jared Sparks* (1893).

See Herbert B. Adams: *Tributes of Friends* (1902); extra vol. (xxiii.) of "Studies in Historical and Political Science."

ADAMS, JOHN (1735-1826), second president of the United States of America, was born Oct. 30, 1735, in what is now the town of Quincy



BIRTHPLACE OF JOHN ADAMS, SECOND PRESIDENT OF THE UNITED STATES OF AMERICA. AT QUINCY, MASS.

(Mass.). His father, a farmer, also named John, was of the fourth generation in descent from Henry Adams, who emigrated from Devonshire, England, to Massachusetts about 1636; his mother was Susanna Boylston Adams. Young Adams graduated from Harvard college in 1755, and for a time taught in school at Worcester and studied law in the office of Rufus Putnam. In 1758 he was admitted to the bar. From an early age he developed the habit of writing descriptions of events and impressions of men. The earliest of these is his report of the argument of James Otis in the superior court of Massachusetts as to the constitutionality of writs of assistance. This was in 1761, and the argument inspired him with zeal for the cause of the American colonies. Years afterwards, when an old man, Adams undertook to write out at length his recollections of this scene; it is instructive to compare the two accounts. John Adams had none of the qualities of popular leadership which were so marked a characteristic of his second cousin, Samuel Adams; it was rather as a constitutional lawyer that he influenced the course of events. He was impetuous, intense and often vehement, unflinchingly courageous, devoted with his whole soul to the cause he had espoused; but his vanity, his pride of opinion and his inborn contentiousness were serious handicaps to him in his political career. These qualities were particularly manifested at a later period—as, for example, during his term as president. He first made his influence widely felt and became conspicuous as a leader of the Massachusetts Whigs during the discussions with regard to the Stamp Act of 1765. In that year he drafted the instructions which were sent by the town of Braintree to its representatives in the Massachusetts legislature, and which served as a model for other towns in drawing up instructions to their representatives; in Aug. 1765 he contributed anonymously four notable articles to the *Boston Gazette* (republished separately in London in 1768 as *A Dissertation on the Canon and Feudal Law*), in which he argued that the opposition of the colonies to the Stamp Act was a part of the never-ending struggle between individualism and corporate authority; and in Dec. 1765 he delivered a speech before the governor and council in which he pronounced the Stamp Act invalid on the ground that Massachusetts, being without representation in parliament, had not assented to it. In 1768 he removed to Boston. Two years later, with that degree of moral courage which was one of his distinguishing characteristics, as it has been of his descendants, he, aided by Josiah Quincy, Jr., defended the British soldiers who were arrested after the "Boston Massacre," charged with caus-

ing the death of four persons, inhabitants of the colony. The trial resulted in an acquittal of the officer who commanded the detachment, and most of the soldiers; but two soldiers were found guilty of manslaughter. These claimed benefit of clergy and were branded in the hand and released. Adams's upright and patriotic conduct in taking the unpopular side in this case met with its just reward in the following year, in the shape of his election to the Massachusetts House of Representatives by a vote of 418 to 118.

John Adams was a member of the Continental Congress from 1774 to 1778. In June 1775, with a view to promoting the union of the colonies, he seconded the nomination of Washington as commander-in-chief of the army. His influence in congress was great, and almost from the beginning he was impatient for a separation of the colonies from Great Britain. On June 7, 1776, he seconded the famous resolution introduced by Richard Henry Lee (*q.v.*) that "these colonies are, and of a right ought to be, free and independent states," and no man championed these resolutions (adopted on July 2) so eloquently and effectively before the congress. On June 8 he was appointed on a committee with Jefferson, Franklin, Livingston and Sherman to draft a Declaration of Independence; and although that document was by the request of the committee written by Thomas Jefferson, it was John Adams who occupied the foremost place in the debate on its adoption. Before this question had been disposed of, Adams was placed at the head of the board of war and ordnance, and he also served on many other important committees.

In 1778 John Adams sailed for France to supersede Silas Deane in the American commission there. But just as he embarked that commission concluded the desired treaty of alliance, and soon after his arrival he advised that the number of commissioners be reduced to one. His advice was followed and he returned home in time to be elected a member of the convention which framed the Massachusetts constitution of 1780, still the organic law of that commonwealth. With James Bowdoin and Samuel Adams, he formed a sub-committee which drew up the first draft of that instrument, and most of it probably came from John Adams's pen.

Before this work had been completed he was again sent to Europe, having been chosen, Sept. 27, 1779, as minister plenipotentiary for negotiating a treaty of peace and a treaty of commerce with Great Britain. Conditions were not then favourable for peace, however; the French Government, moreover, did not approve of the choice, inasmuch as Adams was not sufficiently pliant and tractable and was from the first suspicious of Vergennes; and subsequently Benjamin Franklin, Thomas Jefferson, John Jay and Henry Laurens were appointed to co-operate with Adams. Jefferson, however, did not cross the Atlantic, and Laurens took little part in the negotiations. This left the management of the business to the other three. Jay and Adams distrusted the good faith of the French Government. Outvoting Franklin, they decided to break their instructions, which required them to "make the most candid confidential communications on all subjects to the ministers of our generous ally, the king of France; to undertake nothing in the negotiations for peace or truce without their knowledge or concurrence; and ultimately to govern yourself by their advice and opinion"; and, instead, they dealt directly with the British commissioners, without consulting the French ministers. Throughout the negotiations Adams was especially determined that the right of the United States to the fisheries along the British-American coast should be recognized. Political conditions in Great Britain, at the moment made the conclusion of peace almost a necessity with the British ministry, and eventually the American negotiators were able to secure a peculiarly favourable treaty. This preliminary treaty was signed Nov. 30, 1782. Before these negotiations began, Adams had spent some time in the Netherlands. In July 1780 he had been authorized to execute the duties previously assigned to Henry Laurens, and at The Hague was eminently successful, securing there recognition of the United States as an independent government (April 19, 1782), and negotiating both a loan and, in Oct. 1782, a treaty of amity and commerce, the first of such

treaties between the United States and foreign powers after that of Feb. 1778 with France.

In 1785 John Adams was appointed the first of a long line of able and distinguished American ministers to the court of St. James's. When he was presented to his former sovereign, George III. intimated that he was aware of Adams's lack of confidence in the French Government. Replying, Adams admitted it, closing with the outspoken sentiment: "I must avow to your Majesty that I have no attachment but to my own country"—a phrase which must have jarred upon the monarch's sensibilities. While in London Adams published a work entitled *A Defence of the Constitutions of Government of the United States* (1787). In this work he ably combated the views of Turgot and other European writers as to the viciousness of the framework of the state governments. Unfortunately, in so doing, he used phrases savouring of aristocracy which offended many of his countrymen—as in the sentence in which he suggested that "the rich, the well-born and the able" should be set apart from other men in a senate. Partly for this reason, while Washington had the vote of every elector in the first presidential election of 1789, Adams received only 34 out of 69. As this was the second largest number he was declared vice-president, but he began his eight years in that office (1789-97) with a sense of grievance and of suspicion of many of the leading men. Differences of opinion with regard to the policies to be pursued by the new government gradually led to the formation of two well-defined political groups—the Federalists and the Democratic-Republicans—and Adams became recognized as one of the leaders, second only to Alexander Hamilton, of the Federalists.

In 1796, on the refusal of Washington to accept another election, Adams was chosen president, defeating Thomas Jefferson; though Alexander Hamilton and other Federalists had asked that an equal vote should be cast for Adams and Thomas Pinckney, the other Federalist in the contest, partly in order that Jefferson, who was elected vice president, might be excluded altogether, and partly, it seems, in the hope that Pinckney should in fact receive more votes than Adams, and thus, in accordance with the system then obtaining, be elected president, though he was intended for the second place on the Federalist ticket. Adams's four years as chief magistrate (1797-1801) were marked by a succession of intrigues which embittered all his later life; they were marked, also, by events such as the passage of the Alien and Sedition acts, which brought discredit on the Federalist party. Moreover, factional strife broke out within the party itself; Adams and Hamilton became alienated, and members of Adams's own cabinet virtually looked to Hamilton rather than to the president as their political chief. The United States was, at this time, drawn into the vortex of European complications, and Adams, instead of taking advantage of the militant spirit which was aroused, patriotically devoted himself to securing peace with France, much against the wishes of Hamilton and of Hamilton's adherents in the cabinet. In 1800, Adams was again the Federalist candidate for the presidency, but the distrust of him in his own party, the popular disapproval of the Alien and Sedition acts and the popularity of his opponent, Thomas Jefferson, combined to cause his defeat. He then retired into private life. On July 4, 1826, on the 50th anniversary of the adoption of the Declaration of Independence, he died at Quincy. Jefferson died on the same day. In 1764 Adams had married Abigail Smith (1744-1818), the daughter of a Congregational minister at Weymouth (Mass.). She was a woman of much ability, and her letters, written in an excellent English style, are of great value to students of the period in which she lived. President John Quincy Adams was their eldest son.

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ADAMS, JOHN COUCH (1819-1892), British astronomer, was born at Lidcot farmhouse, Laneast, Cornwall, on June 5,

1819. He was educated at St. John's College, Cambridge, and was senior wrangler and first Smith's prizeman of his year, 1843. While still an undergraduate he read of certain unexplained irregularities in the motion of the planet Uranus and determined to investigate them, with a view to ascertaining whether they might not be due to the action of a remote undiscovered planet. Elected fellow of his college in 1843, he at once attacked the problem. It was this: from the observed perturbations of a known planet to deduce by calculation, assuming only Newton's law of gravitation, the mass and orbit of an unknown disturbing body. By Sept. 1845 he obtained his first solution, and handed to Prof. Challis, the director of the Cambridge Observatory, a paper giving the elements of what he described as "the new planet."

It was not until July 1846 that the search for the new planet was begun at Cambridge. Meanwhile the French astronomer Leverrier had been working along similar lines with equally successful results, and a controversy arose as to whether the discovery of the new planet, Neptune, should be ascribed to the English or the French astronomer. As the facts became known the world recognized that the two astronomers had independently solved the problem of Uranus. The new planet, at first called *Leverrier* by F. Arago, received by general consent the neutral name of *Neptune*. Its mathematical prediction was an unsurpassed intellectual feat.

In 1851 Adams became president of the Royal Astronomical Society. His lay fellowship of St. John's College came to an end in 1852, but Pembroke College elected him in the following year to a lay fellowship which he held for the rest of his life. In 1858 he became professor of mathematics at St. Andrews, but lectured only for a session, when he vacated the chair for the Lowndean professorship of astronomy and geometry at Cambridge. Two years later he succeeded Challis as director of the Observatory, where he resided until his death.

Although Adams's researches on Neptune were those which attracted widest notice, his subsequent work on gravitational astronomy and terrestrial magnetism was not less remarkable. In 1852 he published new and accurate tables of the moon's parallax, which superseded J. K. Burckhardt's, and supplied corrections to the theories of M. C. T. Damoiseau, G. A. A. Plana and P. G. D. de Pontécoulant. In the following year his memoir on the secular acceleration of the moon's mean motion partially invalidated Laplace's famous explanation, which had held its place unchallenged for 60 years. For these researches the Royal Astronomical Society awarded him its gold medal in 1866. The great meteor shower of 1866 turned his attention to the Leonids, whose probable path and period had already been discussed by Prof. H. A. Newton. Adams ascertained that this cluster of meteors, which belongs to the solar system, traverses an elongated ellipse in 33 years and three months, and is subject to definite perturbations from the larger planets, Jupiter, Saturn and Uranus. These results were published in 1867. Ten years later, when G. W. Hill of Washington expounded a new method for dealing with the problem of the lunar motions, Adams briefly announced his own unpublished work in the same field, which, following a parallel course, had confirmed and supplemented Hill's.

The determination of the constants in Gauss's theory of terrestrial magnetism occupied him at intervals for more than 40 years. The calculations involved great labour, and were not published during his lifetime. They were edited by his brother, Prof. W. Grylls Adams, and appear in the second volume of the collected *Scientific Papers*. Numerical computations of this kind might almost be described as his pastime. The value of the constant known as Euler's, and the Bernoullian numbers up to the 62nd, he worked out to an incredible degree of accuracy. For Newton and his writings he had a boundless admiration; many of his papers, indeed, bear the cast of Newton's thought. He laboured for many years at the task of arranging and cataloguing the great collection of Newton's unpublished mathematical writings, presented in 1872 to the University by Lord Portsmouth, and wrote the account of them issued in a volume by the University Press in 1888.

The post of astronomer-royal was offered him in 1881, but he

preferred to pursue his peaceful course of teaching and research in Cambridge. After a long illness he died at the Cambridge Observatory on Jan. 21, 1892, and was buried in St. Giles's cemetery, near his home.

BIBLIOGRAPHY.—*The Scientific Papers of John Couch Adams*, 4to vol. i. (1896), and vol. ii. (1900), edited by William Grylls Adams and Ralph Allen Sampson, with a memoir by Dr. J. W. L. Glaisher, were published by the Cambridge University Press. The first volume contains his previously published writings; the second those left in manuscript, including the substance of his lectures on the Lunar Theory. A collection, virtually complete, of Adams's papers regarding the discovery of Neptune was presented by Mrs. Adams to the library of St. John's College. A description of them by Prof. Sampson was inserted in the *Memoirs of the Royal Astronomical Society* (vol. liv. p. 143).

ADAMS, JOHN QUINCY (1767–1848), eldest son of President John Adams, sixth president of the United States, was born on July 11, 1767, in that part of Braintree that is now Quincy (Mass.), and was named after John Quincy (1689–1767), his mother's grandfather, who was for many years a prominent member of the Massachusetts legislature. In 1778 and again in 1780, young Adams accompanied his father to Europe; studying in Paris in 1778–79 and at the University of Leyden in 1780. In 1780, also, he began to keep that diary which forms so conspicuous a record of the doings of himself and his contemporaries. In 1781, at the age of 14, he accompanied Francis Dana (1743–1811), American envoy to Russia, as his private secretary; but Dana was not received by the Russian Government, and in 1782 Adams joined his father at Paris, where he acted as “additional secretary” to the American commissioners in the negotiation of the treaty of peace which concluded the War of Independence. Instead of accompanying his father to London, he, of his own choice, returned to Massachusetts, graduated at Harvard college in 1787, three years later was admitted to practice at the bar and at once opened an office in Boston. A series of papers written by him in which he controverted some of Thomas Paine's doctrines in the *Rights of Man*, and later another series in which he ably supported the neutral policy of the Administration toward France and England, led to his appointment by Washington as minister to the Netherlands in May 1794. There was little for him to do at The Hague, but in the absence of a minister at London, he transacted certain public business with the English foreign secretary. In 1796 Washington appointed him minister to Portugal, but before his departure thither his father John Adams became president and changed his destination to Berlin (1797). While there, he negotiated (1799) a treaty of amity and commerce with Prussia. On Thomas Jefferson's election to the presidency in 1800, the elder Adams recalled his son, who returned home in 1801. The next year, he was elected to the Massachusetts senate, and in 1803 was sent to Washington as a member of the Senate of the United States.

Up to this time, John Quincy Adams was regarded as belonging to the Federalist Party, but he now found its general policy displeasing to him, was frowned upon, as the son of his father, by the followers of Alexander Hamilton, and found himself practically powerless as an unpopular member of an unpopular minority. He was not, and indeed never was, a strict party man. On the first important question that came before him in the Senate, the acquisition of Louisiana, he voted with the Republicans, regardless of the opposition of his own section. In Dec. 1807 he warmly seconded Jefferson's suggestion of an embargo and vigorously urged instant action, saying: “The president has recommended the measure on his high responsibility. I would not consider, I would not deliberate; I would act!” Within five hours the Senate had passed the Embargo bill and sent it to the House. The support of a measure so unpopular in New England caused him to be hated by the Federalists there, and cost him his seat in the Senate; his successor was chosen on June 3, 1808, several months before the usual time of filling the vacancy, and five days later Adams resigned. In the same year he attended the Republican congressional caucus which nominated Madison for the presidency, and thus definitely joined the Republicans. From 1806 to 1809 Adams was professor of rhetoric and oratory at Harvard.

In 1809 President Madison sent Adams to Russia to represent

the United States. He arrived at St. Petersburg (Leningrad) at the psychological moment when the tsar had made up his mind to break with Napoleon. Adams therefore met with a favourable reception and a disposition to further the interests of American commerce in every possible way. On the outbreak of the war between the United States and England in 1812, he was still at St. Petersburg. In September of that year, the Russian Government suggested that the tsar was willing to act as mediator between the two belligerents. Madison precipitately accepted this proposition and sent Albert Gallatin and James Bayard to act as commissioners with Adams; but England would have nothing to do with it. In Aug. 1814, however, these gentlemen, with Henry Clay and Jonathan Russell, began negotiations with English commissioners which resulted in the signature of the Treaty of Ghent on Dec. 24 of that year. After this Adams visited Paris, where he witnessed the return of Napoleon from Elba, and then went to London, where, with Henry Clay and Albert Gallatin, he negotiated (1815) a “Convention to Regulate Commerce and Navigation.” Soon afterwards he became U.S. minister to Great Britain, as his father had been before him, and as his son, Charles Francis Adams, was after him. After accomplishing little in London, he returned to the United States in the summer of 1817 to become secretary of State in the cabinet of President Monroe.

Later Career.—As secretary of State, Adams played the leading part in the acquisition of Florida and the promulgation of the Monroe Doctrine. Ever since the acquisition of Louisiana successive administrations had sought to include a part at least of Florida in that purchase. In 1819, after long negotiations, Adams succeeded in bringing the Spanish minister to the point of signing a treaty in which the Spaniards abandoned all claims to territory east of the Mississippi, and the United States relinquished all claim to what is now known as Texas. Before the Spanish Government ratified the treaty in 1820, Mexico, including Texas, had thrown off allegiance to the mother country, and the United States had occupied Florida by force of arms. The Monroe Doctrine (*q.v.*) rightly bears the name of the president who in 1823 assumed the responsibility for its promulgation; but it was primarily the work of John Quincy Adams. The eight years of Monroe's presidency (1817–25) are known as the “Era of Good Feeling.” As his second term drew to a close, there was a great lack of good feeling among his official advisers, three of whom—Adams, secretary of State, Calhoun, secretary of War, and Crawford, secretary of the Treasury—aspired to succeed him in his high office. In addition Henry Clay and Andrew Jackson were also candidates. Calhoun was nominated for the vice-presidency. Of the other four, Jackson received 99 electoral votes, Adams 84, Crawford 41, and Clay 37; as no one had a majority, the decision was made by the House of Representatives, which was confined in its choice to the three candidates who had received the largest number of votes. Clay, who was speaker of the House of Representatives, and had for years assumed a censorious attitude toward Jackson, cast his influence for Adams and thereby secured his election on the first ballot. A few days later Adams offered Clay the secretaryship of State, which was accepted. The wholly unjust and baseless charge of “bargain and corruption” followed, and the feud thus created between Adams and Jackson greatly influenced the history of the United States.

Up to this point Adams's career had been almost uniformly successful, but his presidency (1825–29) was in most respects a failure, owing to the virulent opposition of the Jacksonians; in 1828 Jackson was elected president over Adams. It was during his administration that irreconcilable differences developed between the followers of Adams and the followers of Jackson, the former becoming known as the National Republicans, who with the Anti-Masons were the precursors of the Whigs. In 1829 Adams retired to private life in the town of Quincy; but only for a brief period, for in 1830, largely by Anti-Masonic votes, he was elected a member of the national House of Representatives. On its being suggested to him that his acceptance of this position would degrade an ex-president, Adams replied that no person could be degraded by serving the people as a representative in Congress or, he added, as a selectman of his town. His service in Congress from 1831

until his death is, in some respects, the most noteworthy part of his career.

Throughout he was conspicuous as an opponent of the extension of slavery, though he was never technically an abolitionist, and in particular he was the champion in the House of Representatives of the right of petition at a time when, through the influence of the Southern members, this right was, in practice, denied by that body. His prolonged fight for the repeal of the so-called "gag laws" is one of the most dramatic contests in the history of Congress. The agitation for the abolition of slavery, which really began in earnest with the establishment of the *Liberator* by William Lloyd Garrison in 1831, soon led to the sending of innumerable petitions to Congress for the abolition of slavery in the District of Columbia, over which the Federal Government had jurisdiction, and for other action by Congress with respect to that institution. These petitions were generally sent to Adams for presentation. They aroused the anger of the pro-slavery members of Congress, who, in 1836, brought about the passage of the first "gag rule," the Pinckney resolution, presented by Henry L. Pinckney, of South Carolina. It provided that all petitions relating to slavery should be laid on the table without being referred to committee or printed; and, in substance, this resolution was readopted at the beginning of each of the immediately succeeding sessions of Congress, the Patton resolution being adopted in 1837, the Atherton resolution, or "Atherton gag," in 1838, and the Twenty-first rule in 1840 and subsequently until repealed. Adams contended that these "gag rules" were a direct violation of the First amendment to the Federal Constitution, and refused to be silenced on the question, fighting for repeal with indomitable courage, in spite of the bitter denunciation of his opponents. Each year the number of anti-slavery petitions received and presented by him increased; perhaps the climax was in 1837, when Adams presented a petition from 22 slaves, and, when threatened by his opponents with censure, defended himself with remarkable keenness and ability. At each session, also, the majority against him decreased until in 1844 his motion to repeal the Twenty-first rule was carried by a vote of 108 to 80 and his battle was won. On Feb. 21, 1848, after having suffered a previous stroke of apoplexy, he fell insensible on the floor of the Representatives' chamber, and two days later died. Few men in American public life have possessed more intrinsic worth, more independence, more public spirit and more ability than Adams; but throughout his political career he was handicapped by a certain reserve, a certain austerity and coolness of manner, and by his consequent inability to appeal to the imaginations and affections of the people as a whole. He had few intimate friends, and few men in American history have, during their lifetime, been regarded with so much hostility and attacked with so much rancour by their political opponents. Adams was married in 1797 to Louisa Catherine Johnson (1775-1852).

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ADAMS, MAUDE (1872-), American actress, was born in Salt Lake City, Utah, on Nov. 11, 1872. The family name was Kiskadden, but she adopted the maiden name, Adams, of her mother, an actress. From an early age she played juvenile parts, and at the age of 16 went to New York. From her appearance in Hoyt's *A Midnight Bell*, in 1889, her popularity grew steadily. In 1897 Charles Frohman gave her her first leading part as Lady Babbie in *The Little Minister*; and in *Peter Pan* she achieved a great success. She introduced Rostand to the American stage, taking the title-rôle in *L'Aiglon* in 1901, and in *Chantecler* in 1911. Other plays in her repertory were *Romeo and Juliet*, *The Pretty Sister of José*, *The Jester* and *As You Like It*.

ADAMS, OSCAR FAY (1855-1919), American author and editor, was born in Worcester, Mass., in 1855. He was educated in the New Jersey State Normal school. He became a teacher of English literature and a frequent contributor to periodicals. In 1886 he edited *Through the Year with the Poets*, in 12 volumes.

His published writings include *The Story of Jane Austen's Life* (1891, 2nd ed. 1897); *The Archbishop's Unguarded Moment and Other Stories* (1899); *A Brief Handbook of English Authors* (1884, 7th ed. 1893); *Dear Old Story Tellers* (1889, new ed. 1911); *A Dictionary of American Authors* (1897, 5th ed. 1905); and *A Motley Jest—Shakespearean Diversions* (1909). He was also American editor for *The Henry Irving Shakespeare*. He died in North Truro, Mass., April 30, 1919.

ADAMS, ROBERT (1791-1875), Irish clinician noted for his accounts of essential heart block and rheumatic gout. His name is associated with that of his colleague, William Stokes, in the Stokes-Adams syndrome, a condition of the heart characterized by slowed pulse and giddiness.

See *Biographisches Lexicon*, vol. 1 (1929).

(F. L. A.)

ADAMS, ROGER (1889-), U.S. chemist, was born in Boston, Mass., on Jan. 2, 1889. He was educated at Harvard university, from which he graduated in 1909 and received the degree of Ph.D. in 1912. Following two years' study at the University of Berlin and the Kaiser Wilhelm institute, 1912-13, he returned to Harvard, where he was instructor in organic chemistry for three years. In 1916 he was made assistant professor, in 1919 professor and in 1926 head of the department of organic chemistry, in the University of Illinois. He made important researches on catalysts, local anaesthetics, platinum oxide, alkali-insoluble phenols, chaulmoogric acid derivatives and other organic compounds, receiving numerous awards including the Joseph Priestley medal (1946).

His writings include *Organic Syntheses* (1921) and many articles on chemical subjects.

ADAMS, SAMUEL (1722-1803), U.S. statesman, born in Boston, Mass., on Sept. 27, 1722, a second cousin to the elder John Adams. He graduated from Harvard college in 1740 and began the study of law. Though he repeatedly failed in business and was sued because of his easy methods as tax collector, he became so influential in local politics as to be called the "Man of the Town Meeting."

He first came into wider prominence at the beginning of the Stamp act episode, when as author of Boston's instructions to its representatives in the general court of Massachusetts he urged strenuous opposition to taxation by act of parliament. At about the same time he was elected to the lower house of the general court, in which he served until 1774, after 1766 as clerk. As



HOUSE AT LEXINGTON, MASS., FROM WHICH ADAMS AND HANCOCK ESCAPED WHEN AROUSED BY PAUL REVERE

James Otis's vigour and influence declined, Adams took a more prominent position in the revolutionary councils, in which he advised against any form of compromise. Many of the Massachusetts revolutionary documents, including the famous "Massachusetts Resolves" and the circular letter to the legislatures of the other colonies, are from his pen. Indeed, there can be no question that he was one of the first American political leaders to deny the legislative power of parliament and to desire and advocate separation from the mother country.

To promote the ends he had in view Adams suggested non-importation, instituted the Boston committees of correspondence, urged that a Continental Congress be called, and wrote a vast number of articles for the newspapers, especially the *Boston Gazette*, over a multitude of signatures. He was, in fact, one of the most voluminous and influential political writers of his time. His style is clear, vigorous and epigrammatic; his arguments are characterized by strength of logic and appeals to passion, and are based not so much on precedent and documentary authority as on "natural right."

Although he lacked oratorical fluency, his short speeches, like his writings, were forceful; and he was an eminently successful manager of men, shrewd, wily, adroit, an adept in all the arts of the politician. He is considered to have done more than any other

one man, in the years immediately preceding the War of Independence, to mould and direct public opinion in his community; and by his contemporaries he was credited with equally successful management of the delegates to the first Continental Congress.

During the intense excitement which followed the "Boston Massacre," Adams skilfully secured the removal of the soldiers from the town to a fort in the harbour. He also managed the proceedings of the "Boston Tea Party," and later he was leader in the opposition to the Boston Port bill. One of the objects of the expedition sent by the governor, Gen. Thomas Gage, to Lexington, Mass., (*q.v.*) and Concord, N.H., on April 18-19, 1775, was the capture of Adams and John Hancock, temporarily staying in Lexington, and when Gage issued his proclamation of pardon on June 12 he excepted these two, whose offenses, he said, were "of too flagitious a nature to admit of any other consideration than that of condign punishment."

As a delegate to the Continental Congress, from 1774 to 1781, Adams vigorously opposed any concession to the British government, strove for harmony among the several colonies in the common cause, served on the committee to prepare a plan of confederation and signed the Declaration of Independence. His most important service was in organizing the forces of revolution before 1775.

In 1779 he was a member of the convention which framed the constitution of Massachusetts adopted in 1780, and in 1788 a member of the Massachusetts convention to ratify the constitution of the United States. From 1789 to 1794 Adams was lieutenant governor of his state, and from 1794 to 1797 governor. After the formation of parties he became allied with the Democratic-Republicans rather than with the Federalists. He died in Boston on Oct. 2, 1803.

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ADAMS, SAMUEL HOPKINS (1871-), U.S. author, was born in Dunkirk, N.Y., on Jan. 26, 1871. He graduated from Hamilton college, Clinton, N.Y., in 1891 and entered journalism. From 1891 to 1900 he was engaged as a reporter and special writer for the *New York Sun*. He was managing editor of McClure's syndicate in 1900-01, advertising manager of McClure, Phillips and Company in 1901-02, and from 1903 to 1905 member of the editorial staff of *McClure's Magazine*.

In 1905 he contributed to *Collier's Weekly* a noteworthy series of articles exposing fraudulent quack medicines, and in 1915-16, in the *New York Tribune*, he similarly exposed dishonourable practices in advertising.

Among his published writings are: *The Mystery*, with Stewart Edward White (1905); *The Great American Fraud* (1906); *The Flying Death* (1906); *Average Jones* (1911); *The Secret of Lonesome Cove* (1913); *The Health Master* (1913); *The Clarion* (1914); *Little Miss Grouch* (1915); *The Unspeakable Perk* (1916); *Our Square and the People in It* (1917); *Common Cause* (1918); *Wanted, a Husband* (1919); *Revelry* (1926); *The Gorgeous Hussy* (1934); *Maiden Effort* (1937); and *A. Woolcott: His Life and His Works* (1946).

ADAMS, SARAH FLOWER (1805-1848), English poet, was born at Great Harlow, Essex, Feb. 22, 1805. She was the daughter of Benjamin Flower and in 1834 married William Bridges Adams, inventor and pamphleteer. She was a Unitarian and her writings are chiefly religious. Her longest work, *Vivia Perpetua* (1841), a dramatic poem having for its subject the life of the early Christians, contains impressive passages. Besides various other poems, she wrote several beautiful hymns, the best known of which is "Nearer, My God, to Thee" (1840). She died in Aug. 1848.

ADAMS, WALTER SYDNEY (1876-), U.S. astronomer, was born in Antioch, northern Syria, on Dec. 20, 1876. He graduated from Dartmouth college, Hanover, N.H., in 1898,

studied at The University of Chicago in 1899-1900 and at the University of Munich in 1901. For the ensuing three years he was an assistant and instructor in the Yerkes observatory at Lake Geneva, Wis. He was assistant astronomer at the Mt. Wilson observatory of the Carnegie institution, Pasadena, Calif., from 1904 to 1909, when he was made astronomer. He served also as acting or assistant director of the observatory from 1910 until 1923, and then as director from 1923 to 1946. His writings include a memoir on the rotation of the sun and papers on stellar motions, solar and stellar spectroscopy.

In 1935 he received the Janssen medal of the Paris Academy of Sciences.

ADAMS, WILLIAM (d. 1620), English navigator, the first Englishman in Japan, was born at Gillingham, near Chatham, England. When 12 years old he was apprenticed in the mercantile marine, afterward entering the British navy, and later serving the company of Barbary merchants as master and pilot. Attracted by the Dutch trade with India, he shipped as pilot major with a little fleet of five ships dispatched from the Texel in 1598 by a company of Rotterdam merchants. The vessels, boats ranging from 75 to 250 tons and crowded with men, were driven to the coast of Guinea, where the adventurers attacked the island of Annabon for supplies, and finally reached the straits of Magellan. Scattered by stress of weather the following spring, the "Charity," with Adams on board, and the "Hope" met at length off the coast of Chile, where the captains of both vessels lost their lives in an encounter with the Indians. In fear of the Spaniards, the remaining crews determined to sail across the Pacific. On this voyage the "Hope" was lost, but in April 1600 the "Charity," with a crew of sick and dying men, was brought to anchor off the island of Kiushiu, Japan.

Adams was summoned to Osaka and there examined by Iyeyasu, the guardian of the young son of Taiko Sama, the ruler, who had just died. His knowledge of ships and shipbuilding, and his nautical smattering of mathematics, raised him in the estimation of the shogun, and he was presented with an estate at Hemi near Yokosuka; but was refused permission to return to England. In 1611 news came to him of an English settlement in Bantam, and he wrote asking for help. In 1613 Capt. John Saris arrived at Hirado in the ship "Clove" with the object of establishing a trading factory for the East India company; and after obtaining the necessary concessions from the shogun, Adams postponed his voyage home (permission for which had now been given him) in order to take a leading part, under Richard Cocks, in the organization of this new English settlement.

He had already married a Japanese woman, by whom he had a family, and the latter part of his life was spent in the service of the English trading company, for which he undertook a number of voyages to Siam in 1616, and Cochinchina in 1617 and 1618. He died May 16, 1620, some three years before the dissolution of the English factory. His Japanese title was Anjin Sama, and his memory was preserved in the naming of a street in Yedo, Anjin Cho (Pilot street), and by an annual celebration on June 15 in his honour.

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ADAMS, WILLIAM TAYLOR (1822-1897), U.S. juvenile writer, popularly known under the pseudonym of "Oliver Optic," was born in Medway, Mass., on July 30, 1822. For 20 years he was a teacher in the public schools of Boston, and he served for a term in the state legislature. He wrote more than 100 books, chiefly juvenile fiction, which appeared in several series. In large part these were contributed to *Oliver Optic's*

Magazine, of which he was founder and editor. Among the best known are "Boat Club" series (1854), "Riverdale Story Books" (1858), "Woodville Stories" (1863-67), "Army and Navy" series (1865-1894), "Starry Flag" series (1867-69), "Young America Abroad" series (1867-69), "Great Western" series (1875-82), "Yacht Club" series (1900-03). He wrote also two novels, *The Way of the World* (1867) and *Living Too Fast* (1876). He died in Boston on March 27, 1897.

ADAMS, a town of Berkshire county, Mass., U.S., near the northwest corner of the state, including part of the valley of the Hoosac river, and extending from the Hoosac mountains on the east to Mt. Williams (3,040 ft.) and Mt. Greylock (3,491 ft.) on the west. Area 23 sq.mi.; pop. (1950) 12,027; (1940) 12,608, of whom 2,480 were foreign-born whites. Adams is on a branch of the Boston and Albany railroad, and is the nearest railway station for an ascent of Mt. Greylock. It is an industrial centre, with textile printing, cotton mills, paper mills and lime quarries. The town (originally East Hoosuck) was surveyed in 1749 and incorporated in 1778. It was named after Samuel Adams, the revolutionary leader. North Adams was made a separate township in 1895.

ADAM'S APPLE, the prominence in the middle of the front of the neck which moves up and down with swallowing. It is more noticeable in men than in women. It is formed by the thyroid cartilage of the larynx, which is commonly known as the voice box. It is sensitive to pressure and blows and is vulnerable to attack in systems of personal combat.

ADAM'S BRIDGE or **RAMA'S BRIDGE**, a chain of sandbanks between the Island of Manaar, near the north-west coast of Ceylon and the Island of Rameswaram, off the Indian coast, and lying between the Gulf of Manaar on the south-west and Palk Strait on the north-east. More than 30m. long, it seriously hinders navigation. Some of the sandbanks are dry, and no part of the shoal has a greater depth than 3ft. or 4ft. at high water. Though dredging operations were begun as early as 1838 they never succeeded in maintaining a channel for any save vessels of light draught and have now been abandoned. Geological evidence shows that this gap was once bridged by a continuous isthmus, which, according to temple records, was breached by storm in 1480. These banks and shoals are traditionally supposed to be the remains of a huge causeway constructed by Rama, the hero of the *Ramayana*, to facilitate passage of his army from India to Ceylon for the rescue of his abducted wife Sita.

ADAM SCOTUS (c. 1180), theological writer, sometimes called Adam Anglicus or Anglo-Scotus, was born in the south of Scotland in the first half of the 12th century. About 1150 he was a Premonstratensian canon at St. Andrews, and about 20 years later was perhaps abbot and bishop of Candida Casa (Whithorn) in Galloway. He gained a European reputation for his writings, which are of mystico-ascetic type, and include an account of the Premonstratensian order, a collection of festival sermons, and a *Soliloquia de instructione discipuli*, formerly attributed to his contemporary, Adam of St. Victor.

ADAMSEN, AMANDUS HEINRICH (1855-1929), Estonian sculptor, studied in St. Petersburg (Leningrad). In 1887 he produced a portrait in relief of Tsar Alexander III.; he then went to Paris, where he lived for several years. In 1891 he returned to his native land and lived alternately in Port Baltic and St. Petersburg.

Adamsen's technique in marble and wood was moulded on classical lines. His small wood carvings are incomparable. His most important works are an allegory, shown at the Paris Exhibition in 1889, entitled "Liebe, Tod und Wissenschaft"; "Die Welle," and "Hunger"; also "Befreiter Genius" and "Sieg der Arbeit," which were executed for the Nijni-Novgorod Exhibition.

ADAMSON, PATRICK (1537-92), Scottish divine, Archbishop of St. Andrews, was born at Perth and educated at St. Andrews. He then spent some years in Paris, and was in hiding for seven months after the massacre of St. Bartholomew. He returned to Scotland in 1572, and in 1576 was appointed Archbishop of St. Andrews. He came into acute conflict with the General Assembly, and was twice excommunicated, though in each case

the sentence was remitted. The last years of his life were spent in poverty. His collected works, which include Latin verse translations of the books of Job and Revelation, were printed in 1614.

ADAMSON, ROBERT (1852-1902), Scottish philosopher, was born in Edinburgh on Jan. 19, 1852. After a distinguished career at Edinburgh university he spent some time at Heidelberg (1871), where he began his study of German philosophy. He then returned to Edinburgh as assistant, first to Henry Calderwood and later to A. Campbell Fraser; he joined the staff of the *Encyclopædia Britannica* (9th ed.) (1874). In 1876 he succeeded W. S. Jevons in the chair of logic and philosophy at Owens college, Manchester. In 1893 he went to Aberdeen, and finally, in 1895, to the chair of logic at Glasgow, which he held till his death on Feb. 5, 1902. At Glasgow university he accomplished a great deal of useful administrative work and left a substantial impress on its constitution.

In 1903, under the title *The Development of Modern Philosophy and Other Essays*, his more important lectures were published with a short biographical introduction by Prof. W. R. Sorley of Cambridge university (see *Mind*, xiii. p. 73 seq.) (1904). Most of the matter is taken verbatim from the notebook of one of his students. Under the same editorship there appeared, three years later, his *Development of Greek Philosophy*.

Throughout his lectures Adamson pursued the critical and historical method without formulating a constructive theory of his own. He felt that any philosophical advance must be based on the Kantian methods. As he grew older his metaphysical optimism waned. He felt that the increase of knowledge must come in the domains of physical science. Adamson represented an empiricism which, so far from refuting, was actually based on, idealism, and yet was alert to expose the fallacies of a particular idealist construction (see his essay in *Ethical Democracy*, edited by Dr. Stanton Coit).

ADAM'S PEAK, a mountain in Ceylon, about 45 mi. E. of Colombo, in 6° 55' N., 80° 30' E. It rises steeply to a height of 7,360 ft. and commands a magnificent prospect. Its conical summit terminates in an oblong platform, 74 ft. by 24, on which there is a hollow, resembling the form of a human foot, 5 ft. 4 in. by 2 ft. 6 in. It is held in veneration by Buddhists, Mohammedans and Hindus alike, and by them is respectively ascribed to Gautama, to



ADAM'S PEAK, CEYLON, AS SEEN FROM GALLE FACE, COLOMBO, VENERATED BY THE SINHALESE. PILGRIMS ASCEND TO THE SACRED SPOT

Adam and to Siva. It is in charge of Buddhist monks, and is the resort of large numbers of pilgrims. At dawn the peak frequently casts a very well-defined shadow upon the clouds. It can be reached from Hatton on the railway or from Ratnapura.

ADANA. (1) A vilayet in S.E. Asia Minor, Turkey, including the ancient Cilicia. Pop. (1950) 509,600. Land area, 6,663 sq.mi. The mountain districts are rich in unexploited mineral wealth, and the fertile coast-plain, watered by streams from the Taurus, produces cotton, rice, cereals, sugar and much fruit, and affords abundant pasturage. Imports and exports pass through Mersina (q.v.). (2) The chief town of the vilayet, in the alluvial plain about 30 mi. from the sea in 37° 1' N., 35° 18' E., on the right bank of the Seihan (Sihun, anc. Sarus), navigable by small craft as far as the town. Adana is connected with Tarsus and Mersina

by a railway built in 1887, and has a magnificent stone bridge, carrying the road to Missis and the east, and dating in parts from the time of Justinian, but restored first in A.D. 743 and called Jisr al-Walid after the Omayyad caliph of that name, and again in 840 by Caliph Mutasim. There are, also, a ruined castle founded by Harun al-Rashid in 782, fine fountains, good buildings, river-side quays and cotton mills. Adana was a station on the Roman military road to the east and was largely rebuilt by Mansur in 758. Its position, commanding the passage of the mountains to the north of Syria, led to many vicissitudes. In the contest between Egyptians and Turks in 1832, after the defeat of the Turkish army at Konia, it was granted to Ibrahim Pasha, and though the firman named him only *muhassil*, or collector of the crown revenue, it continued to be held by the Egyptians till the treaty of July 1840 restored it to the Porte. The chief productions of the province are cotton, corn, sesame and wool, which are largely exported. Pop. (1950) 117,799. The vilayet and city have been renamed Seyhan.

ADANSON, MICHEL (1727–1806), French naturalist of Scottish descent, was born at Aix-en-Provence. He travelled in Senegal and published an *Histoire naturelle du Sénégal* (Paris, 1757). Adanson's chief work was done as a botanist. In his *Familles naturelles des plantes* (1763) he opened the way for the natural classification of plants developed later by A. L. de Jussieu in his *Genera Plantarum* (1780). He also left a vast unfinished encyclopaedia on all known beings and substances, which has never been published.

ADAPA, MYTH OF. Adapa was a legendary sage, a citizen of Eridu, a city of Babylonia. Endowed with vast intelligence by the God Ea, he became the hero of the Eridu myth of the Fall of Man. Adapa, in spite of his possession of all wisdom was denied immortality; and one day, while fishing, the south wind blew so violently that he was thrown into the sea. In his rage he broke the wings of the south wind which then ceased to blow. Anu, the god of heaven, summoned him before his gates to receive punishment, but jealous Ea (god of wisdom) cautioned him not to touch the bread and water which would be offered him. When Adapa came before Anu, Tammuz and Gishzida interceded for him and explained to the god of heaven that as Adapa had been endowed with omniscience he needed only immortality to become a god; Anu then offered Adapa the bread and water of eternal life, which he refused to take. Thus mankind became mortal. (See *The Cambridge Ancient History*, vol. i [1924].)

ADAPTATION, a process of fitting, or modifying, a thing to other uses and so altering its form or original purpose. In literature there may be; e.g., an adaptation of a novel for a drama, or in music an arrangement of a piece for two hands into one for four, etc. In biology, adaptation plays a prominent part as the process by which an organism or species becomes modified to suit the conditions of its life. Every change in a living organism involves adaptation; for in all cases life consists in a continuous adjustment of internal to external relations. Some adaptations are produced afresh in each generation, others are transmitted by heredity, having been probably fixed by natural selection. (See *EVOLUTION, ORGANIC; SELECTION; VARIATION.*)

ADDA (anc. *Addua*), a river of north Italy. It rises in small lakes of the Fraele glen and unites with several smaller streams near Bormio, in the Rhaetian Alps. Thence it flows southwest and west through the fertile Valtellina (*q.v.*) passing Tirano; the Poschiavino joins it at Tirano and the Malero at Sondrio. It falls into the northern end of the Lake of Como. On issuing from the southeast or Lecco arm, it crosses the plain of Lombardy, and, after about 150 mi., joins the Po 8 mi. above Cremona. The lower Adda once bounded the territories of Venice and Milan. At Trezzo, 20 mi. N.E. of Milan, there is a hydroelectric power plant.

ADDAMS, JANE (1860–1935), U.S. social reformer, was born at Cedarville, Ill., Sept. 6, 1860. After graduating from Rockford college, Rockford, Ill. (A.B., 1882), she entered the Woman's Medical college of Philadelphia, Pa., but her health failed, and after two years of invalidism she travelled extensively in Europe, where she visited Toynbee hall, London, Eng. After her return she founded Hull house, a pioneer social settlement in the old Hull mansion on Chicago's west side, where well-known social

reformers lived as residents. In this large settlement she worked with labour and other reform groups for many pioneer welfare laws such as the first juvenile court law and the first "mother's pension" law, tenement house regulation, an eight-hour law for women, factory inspection and workmen's compensation. She was also an able supporter of woman suffrage. A well-known pacifist, she was chairman of the International Congress of Women at The Hague, Neth., in 1915, following which the Women's International League for Peace and Freedom, of which she became president, was established. She was cowerinner of the Nobel peace prize in 1931. She was the first woman president of the National Conference of Social Work (1910) and took an active part in the Progressive campaign with Theodore Roosevelt in 1912. Author of many books and articles, she used her influence for social justice for the immigrant, for the Negro, for labour and for the rights of women and children. She died in Chicago on May 21, 1935. (E. At.)

ADDAX, a genus of antelopes, with one species (*A. nasomaculatus*) from North Africa and Arabia. It is 3 ft. high, yellowish white in colour, with a brown mane and fringe on the throat. Both sexes carry horns, which are ringed and form an open spiral. The addax is a desert antelope, living in regions where it seldom rains and getting its necessary moisture from the desert plants.

ADDER, a name for the common viper (*Vipera berus*) of Europe and Asia. The puff-adder (*Bitis arietans*), widespread in Africa, and the death-adder (*Acanthophis antarcticus*), of Australia, are very poisonous. In North America the original meaning of "any snake" tends to be preserved, as for the harmless hog-nose snake (*Heterodon contortrix*), which hisses loudly and is called the puffing adder or spreading adder. See *HOGNOSE; VIPER.*

ADDICT, DRUG: see *DRUG ADDICTION.*

ADDING MACHINE: see *OFFICE APPLIANCES.*

ADDIS ABABA (the new flower), capital of Ethiopia since 1896, about 8,000 ft. above sea level on the southern slopes of the Entoto Mts. in 9° 1' N., 38° 56' E. It is the centre of trade and is linked by a single railway line (486.5 mi.) with Jibuti in French Somaliland on the Gulf of Aden and by roads, built for the most part by the Italians, to Asmara, Assab, Jimma, etc. After the completion of the railway in 1918 Addis Ababa underwent much change. It is embowered in woods of eucalyptus planted by Emperor Menelek and is watered by small tributaries of the Awash river, notably the Akaki and the Kabana. The normal population is about 150,000, but at least times thousands of followers of the chiefs and provincial governors attend court. The foreign legations are quartered in well built houses in large grounds on the outskirts of the town. After the visit of Emperor Haile Selassie to Europe in 1924 motor cars were imported into the town. The central market place is the daily rendezvous of immense numbers of peasants and traders dealing in local and imported cotton and other goods. The city suffered somewhat from bombs dropped during the Italian war on Ethiopia in 1935–36. Numerous buildings, including government offices and hospitals, were erected during the Italian occupation. The Ethiopian government has embarked on a program of modernization for the city. Electric and water facilities exist. Radio and telephone communications are to be extended, as are commercial air routes. Most of the few industries of Ethiopia are in or near the city: flour mills, cotton processing plants, ice, carbonated water and beer plants, machine shops, etc. The city was captured by the Italians, May 5, 1936, and soon after became the capital of Italian East Africa. It was taken by British and Ethiopian troops, April 5, 1941. The emperor returned May 5, 1941. (P. W. I.)

ADDISON, JOSEPH (1672–1719), English essayist, poet and man of letters, eldest son of Lancelot Addison, later Dean of Lichfield, was born at his father's rectory of Milston in Wiltshire, on May 1, 1672. After having attended several schools, the last Charterhouse, he was entered a commoner of Queen's college, Oxford, at the age of 15; but after two years was elected to a demyship of Magdalen college for his skill in Latin versification. He took his master's degree in 1693 and subsequently obtained a fellowship which he held until 1711. Much of his early Latin verse is preserved in the *Musae Anglicanae* (1691–99). A

poem in the third volume of Dryden's *Miscellanies* followed in the next series by a translation of the fourth *Georgic*, brought about his introduction to Tonson the bookseller, and (probably through Tonson) to Lord Somers and Charles Montagu. To both of these persons he commended himself by *An Account of the Greatest English Poets* (1694), *An Address to King William* (1695), after Namur, and a Latin poem entitled *Pax Gulielmi* (1697), on the Peace of Ryswick, with the result that in 1699 he obtained a pension of £300 a year to enable him (as he afterwards said in a memorial addressed to the Crown) "to travel and qualify himself to serve his Majesty." In the summer of 1699 he crossed into France, where, chiefly for the purpose of learning the language, he remained till the end of 1700; and after that he spent a year in Italy. In Switzerland, on his way home, he was stopped by receiving notice that he was to attend the army under Prince Eugene, then engaged in the war in Italy, as secretary from the King. But in March 1702 the death of King William at once drove his Whig friends from power and Addison's pension ceased. He was able, however, to visit a great part of Germany, and did not reach Holland till the spring of 1703. In the autumn of the same year Addison returned to England.



AFTER THE STATUE IN WESTMINSTER ABBEY

ADDISON WHO, WITH STEELE, DELIGHTED THE TOWN WITH THE "SPECTATOR"

During his residence abroad he wrote the rhymed *Letter from Italy* to Charles Montagu, the *Dialogues on the Usefulness of Medals*, not published until after his death, and the *Remarks on several parts of Italy*, printed in 1705. After his return to England he was asked by Lord Halifax to write a poem celebrating Marlborough's victory at Blenheim. This, *The Campaign* (1704), won for its author a post in the excise, which was practically a sinecure. The next ten years of his life were spent in government service as an under-secretary of State, secretary to Lord Halifax on a mission to the Elector of Hanover (1708), and secretary to Lord Wharton, the lord lieutenant of Ireland (1708-10). His commissionership in the excise he retained all his life, and he sat in Parliament, a silent member, from 1708 onwards, first for Lostwithiel and then for Malmesbury. During this period he wrote an anonymous pamphlet in defence of the Government entitled *The Present State of the War* (1707), and an opera libretto, *Rosamond*, complimenting the Duke of Marlborough, which was a failure at the time, but was afterwards set to music by Dr. Arne with great success. In 1711 he purchased for £10,000 the estate of Bilton near Rugby.

Soon after the fall of the ministry, he started the *Whig Examiner* in opposition to the *Tory Examiner*, then conducted by Prior, and afterwards the vehicle of Swift's most vehement invectives against the party to which he had once belonged. These are, certainly the most ill-natured of Addison's writings; but they are neither lively nor vigorous, and the paper died after five numbers (Sept. 14 to Oct. 12 1710). There is more spirit in his allegorical pamphlet, *The Trial and Conviction of Count Tariff*. But meanwhile Addison found his real vocation as one of the greatest of English essayists. Richard Steele, who had been Addison's schoolfellow at the Charterhouse, remained on intimate terms with him and belonged to the same political party. Addison was in Dublin when, in April 1709, Steele published the first number of the "Tatler." He is said to have detected his friend's authorship only by recognizing in the sixth number a critical remark on Virgil, which he remembered having himself communicated to Steele. He began to furnish hints and suggestions, assisted occasionally and finally wrote regularly. According to Aitken (*Life of Steele*, i. 248), he contributed 42 out of the total of 271 numbers, and was part-author of 36 more. With the advent of Addison as a contributor the character of the "Tatler" changed. The essay began to preponderate, and the news ele-

ment almost disappeared. The paper was discontinued from Jan. 2, 1711, perhaps because its semi-political character made Steele's position difficult under the Tory administration. But after a very short time it had a successor in the "Spectator," in which Addison played the leading part. The paper was to be non-political, and was to "bring philosophy out of the closets and libraries, schools and colleges, to dwell in clubs and assemblies; at tea-tables and in coffee-houses" (*Spectator* No. 10).

The first number appeared on March 1, 1711; the paper was issued daily until Dec. 6, 1712. In the "Tatler" the papers on different subjects had been dated from various clubs; in the "Spectator" the framework is supplied by an imaginary club grouped round the "Spectator." Mr. Spectator himself, whose character is portrayed in the first number, represents a new and more sober England, very different from the court circles of the time. He is learned, thoughtful, serious, yet with a pleasant humour; he frequents the coffee-houses, and his observant eye notes the new spirit growing up under the older forms of society. His fellow club members represent different types. Sir Roger de Coverley is the old English country gentleman; Sir Andrew Freeport represents the great London merchant class; Captain Sentry is the good-humoured soldier discharged in civil life; Will Honeycomb the man of fashion, while the Templar stands for learning and wit, and so on.

For nearly two years the "Spectator" delighted the town. The "Spectator" stood for reason and moderation in an age of bitter party strife, for clean living in an age when the English upper classes had not yet recovered from the licence of the Restoration, and in criticism for the best standards of its time. Addison and Steele were for a reconciliation of the harsh austerities of Puritanism with the careless profligacy of the Restoration. They were, in fact, great moralists. Samuel Johnson, whose political sympathies did not make him too friendly to Addison, paid his tribute to the lucidity and purity of his English style. "Whoever wishes to attain an English style," he said, "must give his days and nights to the volumes of Addison." And Macaulay speaks justly of Addison as the "consummate painter of life and manners," and of "the great satirist who alone knew how to use ridicule without abusing it; who, without inflicting a wound, effected a great social reform, and who reconciled wit and virtue, after a long and disastrous separation, during which wit had been led astray by profligacy and virtue by fanaticism." The "Spectator" includes the famous Saturday papers on Milton in which Addison applied the principles of Aristotelian criticism to Milton's work. However excessive his praise of Milton may seem (he placed him above Homer and Virgil), these papers had a great influence on criticism for a long period, and were translated into French and German.

Of the 555 papers in the "Spectator" Addison's numbered 274 against 236 written by Steele. W. J. Courthope estimated the circulation of the "Spectator" at 10,000—a very large number for those days—and the bound annual volumes had a further sale of 9,000. After the "Spectator," Steele projected the "Guardian," which was also to be non-political, but did not maintain its aloofness. Addison also contributed a few papers.

It is astonishing to some readers that Addison's tragedy of *Cato*, produced on April 13, 1713, should have been counted one of his best achievements. But the artificiality and frigidity of the piece, and its glaring faults even after the emendations of Pope and others, counted for very little against the political interest imported into the play. It was dedicated to the Duchess of Marlborough, and the liberal sentiments put into the mouths of Roman orators were taken as a glorification of Whig sentiments. It was interpreted as a defence of the Whigs and Marlborough against the Tories, who were suspected of trying to undo the Act of Settlement. *Cato* ran for 35 nights. It was translated into French and German, and Addison was praised by Voltaire as "the first Englishman who composed a regular tragedy and infused a spirit of elegance into every part of it." Voltaire's praise was partly due to Addison's strict adherence to the unity of place which his English contemporaries found unnatural and artificial.

From the cessation of the "Spectator" onwards, Addison's life, though outwardly increasingly prosperous, was clouded by various misunderstandings and quarrels. The rights and wrongs of Pope's quarrel with him (*see* POPE, ALEXANDER) are difficult to disentangle, and cannot be dealt with here. But Addison, who had established Button in a coffee-house in Covent Garden, held a little literary court there of which Budgell, Tickell, Carey and Phillips were members. Pope was not a member of the coterie, though it appears that he made a brief appearance there. In any case there was a complete breach. Pope wrote the famous lines on Atticus in the *Epistle to Dr. Arbuthnot* in which Addison is mercilessly attacked as "willing to wound, and yet afraid to strike," who "like Cato, gives his little senate laws, and sits attentive to his own applause." The *Epistle* was not published until after Addison's death, though he must have seen the lines.

On the accession of George I., Addison was appointed secretary to the lords justices entrusted provisionally with the conduct of the Government until the new King's arrival. He then became once more chief secretary for Ireland. He defended the Hanoverian succession against the Jacobite partisans in a new paper called the "Freeholder" which appeared bi-weekly between Dec. 23, 1715 and June 9, 1716. Probably in return for this service he was made one of the commissioners for trade and the colonies. In Aug. 1716 he married Charlotte, Countess dowager of Warwick, who brought her husband the occupancy of Holland House, Kensington. The common report that the marriage was a very unhappy one is based mainly on the evidence of Addison's enemies. The allegations that he was incompetent in the public service are derived from similar sources; but as one of the secretaries of State in the Sunderland cabinet (1717) he seems to have been a failure. He resigned on the plea of failing health in March 1718. In the same month he found himself ranged as a pamphleteer against his old friend Dick Steele. The contest was still proceeding when Addison died of dropsy, June 17, 1719. Steele's real love for his friend was shown in the letter to Congreve prefixed to Addison's anonymous comedy *The Drummer*, acted in 1716.

Addison's life was written in 1843 by Lucy Aikin. This was reviewed by Macaulay in July of the same year. A more modern study is that in the "Men of Letters" series by W. J. Courthope (1884). The *Spectator* (seven vols. 1712-13, the 8th being added in 1715), was frequently reprinted. There is a good modern edition, in eight vols. (1897-98) by G. Gregory Smith. Of the *Taller* there is an edition by G. A. Aitken in eight vols. (1898). A complete edition of Addison's works (based upon Hurd) is included in Bohn's *British Classics*; Bonamy Dobree, *Essays in Biography* (1925).

ADDISON'S DISEASE, a morbid state first described by Thomas Addison in 1855, has as prominent features of its syndrome asthenia, marked weakness, low blood pressure, loss of weight, irritability of the gastrointestinal tract and, usually, pigmentation. The cause of the symptoms is deficiency of adrenal cortical function, but there is more than one reason for failure of the cortical tissue.

The most common lesion is caseation associated with tuberculosis. Atrophy of the gland without infection is found in 20% or more of the cases.

Life in the presence of Addison's disease has been difficult and precarious. Any condition which resulted in loss of sodium and chloride, as excessive perspiration or a diet with high content of potassium and low sodium, could cause prostration or death. Physical exertion, strain from a surgical operation or administration of an anaesthetic alone, has been sufficient to precipitate a critical condition.

Diagnosis of Addison's disease in its severe form is not difficult, but demonstration of limitation of adrenal cortical function requires objective laboratory tests. Under closely controlled conditions, determination of the ability of the kidney to retain sodium and chloride or to excrete water furnishes reliable information concerning adrenal cortical activity. Patients with Addison's disease have survived without adequate treatment for months or a few years, but before recognition of the relation of sodium potassium and chloride to the severity of the symptoms a fatal termination was almost certain.

Robert Loeb in 1932 discovered that if the loss of sodium chloride was stopped by the daily administration of large amounts of this salt, clinical improvement was often marked and sustained. The unfavourable effect of potassium was shown in 1937, and a rational treatment of Addison's disease based on the control of mineral metabolism provided relief but not a satisfactory solution of the problem. In 1930 an extract of the adrenal cortex was made available for patients in a critical condition but this material remained scarce, not always reliable and very expensive. The availability of desoxycorticosterone in 1937 made it possible to control mineral metabolism.

However, since desoxycorticosterone tended to increase the concentration of sodium and decrease that of potassium in the blood when large amounts of this compound were used, it was necessary to limit the intake of sodium and increase potassium in the diet. Many patients have been greatly benefited by this treatment, but few of them were restored to a state of well-being and some patients died even though the electrolytes in the blood were within normal limits. It became evident that something more than control of mineral metabolism was essential. Cortisone, a hormone of the adrenal cortex which influences organic metabolism and many diverse physiologic processes, was not available until this compound was prepared on a commercial scale in 1948. In 1949 it was shown that a daily dose of about 15 mg. of cortisone and 1 to 5 mg. of desoxycorticosterone restored strength and a sense of well-being to patients who had Addison's disease. Treatment with cortisone alone was not satisfactory because sodium and chloride were rapidly lost from the body; but when the mineral metabolism was controlled with desoxycorticosterone and at the same time cortisone was administered, the patient was able to resist fatigue and to enjoy an almost normal state of health.

BIBLIOGRAPHY.—George W. Thorn, *Diagnosis and Treatment of Adrenal Insufficiency* (1948); *Proceedings of the National Academy of Sciences*, vol. 38, p. 73 (1952). (E. C. KL.)

"ADDLED PARLIAMENT," the name usually given to the English parliament which met on April 6, 1614, sat for two months of violent debate, and was finally dissolved by James I. without having passed a single bill. Seven years passed before another parliament was summoned.

"ADDRESS, THE," an English parliamentary term for the reply of the Houses of Parliament (and particularly of the House of Commons) to the speech of the sovereign at the opening of a new parliament or session. There are certain formalities which distinguish this stage of parliamentary proceedings. The "King's Speech" itself is divided into three sections: the first, addressed to "My Lords and Gentlemen," touches on foreign affairs; the second, to the "Gentlemen of the House of Commons," has reference to the estimates; the third, to "My Lords and Gentlemen," outlines the proposed legislation for the session. Should the sovereign in person open parliament, he does so in the House of Lords in full state, and the Speaker and members of the House of Commons are summoned there into the royal presence. The sovereign then reads his speech. If the sovereign is not present in person, the speech is read by commission. The Commons then return to their House, and an address in answer is moved in both Houses. But before this motion a bill is read *pro forma*, a survival of an ancient claim of the Commons to assert their right of deliberation on subjects other than the Crown's immediate cause of summons. The Government of the day selects two of its supporters in each House to move and second the address, and when carrying out this honourable task they appear in levee dress. Previous to the session of 1890-91, the royal speech was answered paragraph by paragraph, but "the address" is now moved in the form of a single resolution, thanking the sovereign for his most gracious speech. The debate on the address is used as a means of ranging over the whole Government policy, amendments being introduced by the Opposition. A defeat on an amendment to the address is generally regarded by the Government as a vote of no-confidence. After the address is agreed to it is ordered to be presented to the sovereign. The thanks of the sovereign for the address are then conveyed to the Lords by the lord steward of the household and to the Commons by the comptroller of the household.

ADDRESSING MACHINE: see OFFICE APPLIANCES.

ADE, GEORGE (1866–1944), U.S. author, was born at Kentland, Ind., on Feb. 9, 1866. After graduating from Purdue University in 1887, he took up newspaper work in Lafayette, Ind., and Chicago (1887–1900). Although he belonged to the school of American vernacular humorists, he was definitely an urban product. Many of his early books, such as *Artie* (1896) and *Doc' Horne* (1899) were designated as stories "of the streets and town" and were adapted from his newspaper contributions. His best-known book, *Fables in Slang* (1899), is clever and sophisticated. Ade wrote a number of musical comedy librettos, film scenarios, including *Back Home and Broke* (1922), and plays, the best known of which were *The County Chairman* (1903), *The College Widow* (1904) and *Father and the Boys* (1908). He died May 16, 1944.

ADELA (1062?–1137), daughter of William the Conqueror and mother of Stephen, king of England, whose right to the throne derived through her. She was married to Stephen, earl of Meaux and Brie in 1080 at Breteuil. Upon the death of his father in 1090, her husband succeeded to the earldom of Blois and Chartres. She took an active interest in civil and ecclesiastical affairs and was instrumental in rebuilding the cathedral of Chartres in stone. In 1095 she became regent when her husband, at her urging, took part in the first crusade to the Holy Land. He returned in 1099, but left to join the second crusade in 1101 and was killed in battle at Ramula. Adela continued as regent during the minority of her sons and was increasingly active in public life. Anselm, her guest and teacher in 1097, was often entertained by her during 1103 and 1105 and she affected a temporary reconciliation between him and her brother, Henry I. In 1107 Adela entertained Pope Pascal during Easter and in the following year was hostess to Boemund of Antioch. She made her son Theobald successor to her rule in 1109 and entered a convent in the diocese of Autun, continuing to wield an important influence in public and clerical affairs. She persuaded Theobald to join with her brother Henry I against France in 1117 and was a benevolent patroness of churches and monasteries. She died in 1137 and was buried at Caen.

ADELAER or **ADELER**, the surname given to KURT SIVERTSEN (1622–75), Norwegian-Danish sailor. Born at Brevig, in Norway, he entered the Dutch navy and then the Venetian service, where he was known as Curzio Suffrido Adelborst (*i.e.*, Dutch for "naval cadet"). He commanded the Venetian squadron at the battle of the Dardanelles (May 13, 1654) when his ship alone sank 15 Turkish galleys and burned others. Next day he compelled the surrender of the Turks at Tenedos. In 1660 he became admiral-lieutenant in the Venetian service, but in 1662 he was induced to take command of the Danish fleet. Under Christian V he took command of the combined Danish fleets against Sweden, but he died before the expedition.

ADELAIDE (ADELHEID) (931–999), queen of Italy and empress, was the daughter of Rudolph II of Burgundy, and married, in 947, Lothair, who succeeded his father Hugh as king of Italy. Lothair died in 950 and Adelaide was imprisoned at Cpmo by his successor, Berengar II, marquis of Ivrea, who wished to compel her to marry his son Adalbert. After four months (August 951) she escaped and took refuge at Canossa with Atto, count of Modena-Reggio. Meanwhile Otto I, the German king, whose English wife, Edgitha, had died in 946, came to Italy. Adelaide met him at Pavia, and at the close of the year the marriage took place. On Feb. 2, 962, she was crowned empress at Rome by Pope John XII immediately after her husband, and she accompanied Otto in 966 on his third expedition to Italy, where she remained with him for six years.

After Otto I's death (May 7, 973), Adelaide exercised for some years a controlling influence over her son, the new emperor, Otto II. The causes of their subsequent estrangement are obscure, but it was possibly due to the empress' lavish expenditure in charity and church building, which was a serious drain on the imperial finances. In 978 she left the court and lived partly in Italy, partly with her brother Conrad, king of Burgundy, by whose mediation she was ultimately reconciled to her son. In

983, shortly before his death, she was appointed his viceroy in Italy, and, in concert with the Empress Theophano, widow of Otto II, and Archbishop Willigis of Mainz, defended the right of her infant grandson, Otto III, to the German crown against the pretensions of Henry the Quarrelsome, duke of Bavaria.

In June 984 the infant king was handed over by Henry to the care of the two empresses; but the masterful will of Theophano soon obtained the upper hand, and until the death of the Greek empress, on June 15, 991, Adelaide had no voice in German affairs. She assumed the regency, in concert with Archbishop Willigis and a council of princes of the empire, and held it until in 995 Otto was declared of age. In 996 the young king went to Italy to receive the imperial crown; and from this date Adelaide devoted herself to pious exercises, to correspondence with the abbots Majolus and Odilo of Cluny, and to the foundation of churches and religious houses.

She died on Dec. 17, 999, and was buried in the convent of Saints Peter and Paul, her favourite foundation, at Salz in Alsace.

By the emperor Otto I she had four children: Otto II (d. 983); Mathilda, abbess of Quedlinburg (d. 999); Adelheid (Adelaide), abbess of Essen (d. 974); and Liutgard.

BIBLIOGRAPHY.—Adelaide's life (*Vita* or *Epitaphium Adalheidae imperatricis*) was written by St. Odilo of Cluny. It is valuable only for her later years, the rest of her life being merely outlined, though her adventures in escaping from Berengar are treated in more detail. The best edition is in André Duchesne, *Bibliotheca Cluniacensis*, pp. 353–362. See Giov. Batt. Semeria, *Vita politico-religiosa di s. Adelaide, etc.* (Turin, 1842); Jul. Bentzinger, *Das Leben der Kaiserin Adelheid . . . während der Regierung Ottos III.*, Inaug. Dissertation (Breslau, 1883); J. J. Dey, *Hist. de s. Adelaide, etc.* (Geneva, 1862); F. P. Wimmer, *Kaiserin Adelheid, Gemahlin Ottos I des Grossen* (Regensburg, 1889); W. Wattenbach, *Deutschlands Geschichtsquellen* (Stuttgart and Berlin, 1904). See Ulysse Chevalier, *Répertoire des sources historiques* (1903).

ADELAIDE, capital of South Australia, in the county to which it gives its name, is situated near the middle of the eastern side of St. Vincent gulf where the coast line curves farthest inland (eastward). The genius of Charles Sturt, and then of William Light, the first surveyor-general, selected (1836) a site upon fertile plains which swept up very gently from the coast to a curving line of hills some 9 mi. inland. (Mt. Lofty, *c.* 7 mi. [air line] E.S.E. of Adelaide, 2,333 ft.) Light chose, not without opposition, a spot on rising ground, close to the Torrens stream, the chief early source of water supply, and within easy reach of a fair open roadstead (Holdfast bay, *c.* 6 mi.). Within 8 mi. also was the only considerable sheltered inlet along this recently elevated coast, the Port Adelaide "river," a deflected tidal estuary. This water—shallow, muddy, but improved by dredging—became the site of Adelaide's port until the construction of the outer harbour provided a more accessible anchorage for larger vessels near the mouth of the estuary and facing the open gulf. Southward the hills close in upon the plain and meet the coast line, but northward the lowlands stretch, broadening, up to and beyond the head of the gulf. Easy movement was possible also by various gaps and saddles to the Murray lowlands in the east and southeast, and Adelaide thus soon became an important nodal point for lines of movement by land and sea. The fertility of the plains—deep alluvium washed down from the torrent-scarred hills—the presence of minerals (though in relatively small quantities) in the hills, and the genial climate formed the basis of Adelaide's prosperity. A fairly regular rainfall of *c.* 21 in. falling largely in the winter months (April–November); temperatures hot in summer (Jan. mean: 73°; highest recorded [shade] maximum 116°, with fairly frequent heat spells); but cool and bracing in winter (June mean: 52° with occasional frosts); land and sea breezes along the coast and much sunshine make up a typical Mediterranean climate. The town was laid out by Light in the form of a square, divided into rectangular blocks with gardens and parks at the points of intersection. Around the square a mile-broad belt of park land was reserved, and beyond these stretch the suburbs. The park lands have been to some extent encroached upon for public buildings, but the remainder form the great playground and "lungs" of the city which claims to have no slums. The

cotton piece goods, grain, hides, coal, sugar and tobacco. The exports are, in the main, the same as the imports. Aden itself produces salt and cigarettes. The trade is largely one of transshipment.

Imports for 1949 amounted to Rs. 42,63,00,879¹; exports to Rs. 18,76,73,189. In that year 3,600 merchant ships of 15,924,948 tons (net) entered the port of Aden, besides 2,500 local craft.

The submarine cables of Cable and Wireless, Ltd., diverge there: on the one hand to India, the far east and Australia; on the other, to Zanzibar and the Cape of Good Hope. There are no railways in the colony, and communications between the townships are by road.

By mid-20th century there were several regular air services between Aden and Cairo (via Jibuti, Asmara and Khartoum, or via Jidda and Port Sudan); to Addis Ababa; and to Nairobi via Hargeisa and Mogadishu; and to Mukalla in the eastern Aden protectorate during the summer monsoon. The population of the Aden colony at the 1946 census was 80,876, of which 365 were of European and allied races.

Boundaries and Administration.—After the kingdom of the Yemen (*q.v.*) became independent of the Ottoman empire it refused to recognize the boundary between itself and the western Aden protectorate which was determined by the Anglo-Ottoman convention of 1905. The matter was left open by the Anglo-Yemeni treaty of Feb. 11, 1934, but it was agreed in Jan. 1951 to form a joint commission to demarcate frontiers and settle the disputes which had occurred from time to time. As a result of disputes concerning the border with Yemen, Great Britain and Yemen broke diplomatic relations in 1949; however, in March 1951 they were resumed.

On April 1, 1937, Aden passed from the control of the India office to the colonial office; its currency became the East African shilling in place of the rupee in June 1951. In Jan. 1947 a legislative council was inaugurated, consisting of the governor, four ex-officio members, not more than four official members and not more than eight unofficial members representing the various communities.

The Aden protectorates, eastern and western, have an area of about 110,000 sq.mi. with an estimated population of 650,000 in 1950, organized into about 30 sultanates, sheikhdoms and other tribal units in treaty relations with the British government. The principal of these are the Qu'aiti state of Shihr and Mukalla and the Kathiri state of Sai'un, both in the eastern protectorate; and the 'Abdali sultanate of Lahaj in the western.

BIBLIOGRAPHY.—Colonial Office, London, *Annual Reports on Aden*, with further bibliography; the Master of Belhaven, *The Kingdom of Melchior* (London, 1949); Doreen Ingrams, *A Survey of Social and Economic Conditions in the Aden Protectorate* (Eritrea, 1949). (G. E. K.)

ADENÈS, **ADENEZ** or **ADANS**, surnamed *Le Roi*, French trouvère, was born in Brabant about 1240. He owed his education to the kindness of Henry III, duke of Brabant, and he remained in favour at court for some time after the death (1261) of his patron.

In 1269 he entered the service of Guy de Dampierre, afterward count of Flanders, probably as *roi des ménestrels*, and followed him in the next year on the abortive crusade in Tunis. The expedition returned by way of Sicily and Italy, and Adenès left in his poems some very exact descriptions of the places through which he passed.

The poems written by Adenès are four: the *Enfances Ogier*, *Berte aus grans piés*, *Bueves de Comarchis* and a long *roman d'aventures*, *Cléomadès*, borrowed from Spanish and Moorish traditions brought into France by Blanche, daughter of Louis IX. Adenès probably died before the end of the 13th century.

BIBLIOGRAPHY.—The romances of Adenès were edited for the Académie royale de Belgique (*Cléomadès* by A. van Hasselt, 1865-66; *Berte*, *Les Enfances Ogier*, *Bueves de Comarchis* by A. Scheler, 1874); *Berte* was rendered into modern French by G. Hecq (1897) and by K. Périé (1900); *Cléomadès*, by Le Chevalier de Chatelain (1859). See also the edition of *Berte* by Gaston Paris (1832); Léon Gautier, *Les épopées françaises*, vol. iii, etc.

¹ 100,000 rupees is written as Rs. 1,00,000; 10,000,000 is written 1,00,00,000.

ADENOIDS. A condition, commonly found in children, produced by excessive growth of the pharyngeal tonsil or adenoid (*see* PHARYNX). The enlargement may block the nasal passages or the eustachian tube and produce disturbances in breathing and in hearing.

If severe, the child may assume a characteristic vacant, stupid expression accompanied by mouth breathing. The presence of these growths may handicap the child in his physical and mental development. The removal is a relatively simple operative procedure. (F. L. A.)

ADEODATUS, pope and saint (?-676), became bishop of Rome on April 11, 672, and died on June 16, 676.

Little is known of his life before 672 except that he was a monk in the Roman monastery of St. Erasmus, whose quarters he later helped to enlarge.

During his pontificate the Monothelite controversy (*q.v.*) over the unity or duality of Christ's will was still active between the sees of Rome and Constantinople. To Adeodatus, during this controversy, was ascribed the rejection of the *Synodikon* tendered by Constantine I of Constantinople, and the repression of the Monothelite heresy.

Also ascribed to him is the work of restoring the basilica of St. Peter at Campo di Merlo near Rome. Beyond these few works little else is known of his reign as pontiff. Of his writings, only letters of his to the abbots of St. Peter of Canterbury and St. Martin of Tours are extant, both relating to the granting of privileges to these churches. Occasionally he is referred to as Adeodatus II, Adeodatus I being the alternative name of an earlier pope Deusdedit (*q.v.*).

ADEPT (if used as a substantive pronounced *adept*, if as an adjective *adept*; Lat. *adeptus*, "one who has attained"), completely and fully acquainted with one's subject; an expert.

The word implies a natural inborn aptitude, more than acquired proficiency. In olden times an adept was one versed in magic, an alchemist.

ADERNÒ (ADRANO), town of the province of Catania, Sicily, 22 mi. by rail N.W. of the town of that name. Pop. (1936) 24,307 (town), 24,515 (commune). Anciently Adranon (the original Siculan settlement was perhaps about 5 mi. away), it took its name from Adranos, an indigenous deity, in Roman times identified with Vulcan, to whom was dedicated a temple guarded by 1,000 huge dogs. Substructures of the temple may persist outside the town. The town, founded by Dionysius I (c. 400 B.C.), has fine remains of its walls (*see* P. Orsi in *Not. Scavi*, p. 227 [1915]).

For a time it was the headquarters of Timoleon, and it was the first town taken by the Romans in the First Punic War (263 B.C.). In the centre of the modern town rises the castle built by Roger I.

ADES, nonalcoholic beverages made from the juice of lemons, oranges or limes, powdered sugar or syrup and plain, mineral or carbonated water. Usually a maraschino cherry and cracked ice, and a straw through which to sip the drink, are added.

Ades are sold in the United States chiefly at soda fountains and drugstores. "Orange drinks" are also served at street stands and corner shops, as are drinks made from the juice of pineapple, grapefruit, etc.

The juice of the fruit is ordinarily extracted through electrical machines installed at soda fountains.

The advantage in this method lies in the fact that the customer sees with his own eyes the fresh fruit and the resulting unadulterated juice.

ADHAN: *see* AZĀN.

ADHEMAR DE CHABANNES (c. 988-1034), mediaeval historian, was born at Chabannes, Fr. He was a monk of the monastery of St. Cybard, Angoulême, and died at Jerusalem.

Adhémar's principal work, *Chronicon Aquitanicum et Francicum*, or *Historia Francorum*, is in three books and deals with Frankish history from the fabulous reign of Pharamond, king of the Franks, to A.D. 1028.

The two earlier books are scarcely more than a copy of the *Gesta regum Francorum*, but the third, dealing with the period from 814 to 1028, is of considerable historical importance, and

is published in the *Monumenta Germaniae historica, Scriptores*, iv (Hanover and Berlin, 1841).

A critical edition of the entire *Chronicon*, prepared by Jules Chavanon (1897), is in the *Collection de textes pour servir à l'étude et à l'enseignement de l'histoire*. Other writings of Adhémar's are published by J. P. Migne in the *Patrologia Latina*, tome cxli (Paris, 1844-55).

See F. Arbellot, *Étude historique et littéraire sur Adémar de Chabannes* (Limoges, 1873).

ADHEMAR (ADEMAR, AIMAR, AELARZ) **DE MONTEIL** (d. 1098), crusader, became bishop of Puy-en-Velay after the deposition of his predecessor by Gregory VII in 1077. He made a pilgrimage, possibly to Jerusalem, in 1086-87.

It was from Puy that Urban II, on Aug. 15, 1095, convened the council that met at Clermont in the following November; there he began the preaching of the first crusade. Adhémar, the first of his audience to take the Cross, was appointed by Urban to lead the crusade as his legate.

He travelled to Constantinople with Raymund IV of Toulouse and the Provençal contingent. During the crossing of Asia Minor and the siege of Antioch (May 1097 to June 1098) there was no supreme commander of the crusade, but Adhémar played a leading part in the counsels and activities of its leaders. He was prominent in military operations and in the situation which developed during the siege of Antioch when Peter Bartholomew claimed to have discovered the Holy Lance. He organized the mass religious devotions at times of crisis, and he began to establish friendly relations with the eastern Christians.

He appears to have commanded universal respect and affection and so restrained the quarrels that arose from the conflicting ambitions of the lay leaders. This was his greatest service to the expedition.

After Adhémar's death of the plague in Antioch (Aug. 1, 1098), division within the army became so acute that the crusade almost foundered.

See L. Bréhier, "Adhémar de Monteil," *Dictionnaire de biographie française*, ed. J. Balteau et al., vol. 1, col. 590-598 (Paris, 1933); also S. Runciman, *History of the Crusades*, vol. 1 (Cambridge, 1951).

(R. C. SMA.)

ADHESIVE CEMENTS; see CEMENT: *Adhesive Cements*.

ADIABATIC CHANGE, a change in the physical state of a body, whether this change be one of volume, strain, electric charge, etc., which involves no passage of heat to or from the body.

(See THERMODYNAMICS.)

ADIABATIC PROCESSES IN ATMOSPHERE. Because of the large volumes of air involved and the relatively small temperature differences between adjacent air parcels, it is common to assume that no heat is added to or withdrawn from the air (adiabatic process) during atmospheric processes.

This assumption appears to be justified for air which is not in contact with the ground and for processes which are completed in from a few hours to a day. When air ascends or descends it expands and contracts as a result of the change in pressure. If no condensation or evaporation of water occurs the air will cool about 1° C. per 100 metres rise (5.4° F. per 1,000 ft.), which is called the dry adiabatic lapse rate.

When moist air is lifted it will cool at the dry adiabatic rate (the presence of moisture has a negligible effect until saturation is reached) until it becomes saturated. Further lifting will result in the condensation of water vapour or cloud formation. The latent heat of condensation is added to the air and as a result it cools less rapidly, at the so-called moist or saturated adiabatic lapse rate.

The value of the moist adiabatic lapse rate depends on the temperature and pressure being about 0.44° C. per 100 metres at 20° C. and 1,000 mb. and 0.80° C. per 100 metres at -20° C. and 600 mb. If saturated air descends it follows the moist adiabatic lapse rate only as long as it contains liquid water in suspension which can evaporate; otherwise it follows the dry adiabatic lapse rate. If an air parcel of absolute temperature T_0 and pressure p_0 is dry-adiabatically compressed or expanded to a pressure p , its temperature T is given by $T = T_0(p/p_0)^{.288}$.

(See METEOROLOGY; LAPSE RATE OF TEMPERATURE; THERMODYNAMICS; UPPER AIR SOUNDINGS.)

(H. G. HN.)

ADIAPHORISTS, the name of a party in the religious controversies of the 16th century in Germany. The Adiaphorist controversy among Lutherans was an issue of the provisional scheme of compromise between religious parties, drawn up by Charles V, sanctioned at the Diet of Augsburg, May 1548, and known as the Augsburg Interim. It satisfied neither Catholics nor Protestants. As head of the Protestant party the young elector Maurice of Saxony negotiated with Melancthon and others, and at Leipzig, Dec. 1548, secured their acceptance of the Interim as regards *adiaphora* (things indifferent), points neither enjoined nor forbidden in Scripture. This sanctioned jurisdiction of Roman Catholic bishops and observance of certain rites, while all were to accept justification by faith (relegating the words, "by faith alone" to the *adiaphora*). Passionate opposition was led by Melancthon's colleague, Matthias Flacius, on the grounds that the imperial power was not the judge of *adiaphora*, and that the measure was a trick to bring back popery. From Wittenberg he fled, April 1549, to Magdeburg, making it the headquarters of rigid Lutheranism. Practically, the controversy was concluded by the religious peace ratified at Augsburg (Sept. 1555), which left princes a free choice between the rival confessions with the right to impose either on their subjects; but much bitter internal strife was kept up by Protestants on the theoretical question of *adiaphora*; to appease this was one object of the Formula Concordiae, 1577. Another *Adiaphorist* controversy between Pietists and their opponents, respecting the lawfulness of amusements, arose in 1681, when Anton Reiser (1628-86) denounced the opera as anti-Christian.

See J. Herzog and A. Hauck, *Realencyklopädie* (3rd ed.); and F. Hastings, *Encyclopaedia of Religion and Ethics*, art. "Adiaphorism," where the connection of this historic question with the fundamental question of what is vital or essential is shown. For an earlier study, on 'rigourist lines, see E. Schmid, *Adiaphora, wissenschaftlich u. historisch untersucht* (1809).

ADIGE, river, north Italy. The Adige rises in small lakes on the Resia (Reschen Scheideck) pass (4,944 ft.), and near Gloreza is joined by tributaries where roads over the Ofen and Stelvio passes fall in. It flows E. to Merano, and S.E. to Bolzano, where it receives the Isarco (6 ft.), and becomes navigable. Turning S.W., and receiving the Noce (right) and the Avisio (left), it enters Lombardy, 13 mi. S. of Rovereto. It falls into the Adriatic at Porto Fossone, a few miles N. of the Po. The most considerable towns on its banks (south of Bolzano) are Trento, Rovereto, Verona and Legnago. It is very rapid, with sudden floods which do great damage. In Lombardy it is 200 yds. wide, and 10 to 16 ft. deep, but the strong current impedes navigation. The Adige is 220 mi. long and, after the Po, the most important river in Italy. In Roman times its lower course lay much farther north than now, along the base of the Euganean hills, and it entered the sea at Brondolo. In A.D. 587 the river broke its banks and took its present course, but new streams opened repeatedly to the south, until now the Adige and Po form one delta.

ADIGEI (ADYGEI), autonomous region in the north Caucasian area of the R.S.F.S.R., created July 1922. It is a narrow strip of territory lying north and south of lat. 45° and curving south at about long. 41° E., forming an autonomous island in the north Caucasian area, mainly along the south banks of the Kuban river and Laba river, from west of Krasnodar to south of Labinsk. It was formerly part of the Kuban province. The Kuban river is navigable to its confluence with the Laba river but is malarial and swampy and frequently floods its banks. The population (1939) 241,773 is entirely rural and is administered from Krasnodar, for which purpose it is divided into the following sections:—Dzhidzhikhabsk, Natrybovsk, Preobrazhensk, Takhtamykavsk, Khakyrino-Khabalsk. The Adigei or Adygei (their own name) or Cherkess (their Russian name) are Circassians who formerly occupied the mountain valleys but were compelled by Russia in 1861 either to settle on the flat land or to emigrate (200,000 settled in Turkey, as the Bashi-Bazouks). They are mainly Alpine in physical type and speak a language of the

Abkhazo-Adigean group of the "Spirant" branch of the Japhetite languages. Their religion was Mohammedan, mingled with old heathen and modern Christian rites. Cattle and sheep rearing were their chief occupations, and great respect to seniority and hospitality, and fierce vendettas, were characteristic. Their present habitat is on the southern limit of the black-earth steppe region where it merges into the broad-leaved, deciduous forest. They are now mainly an agricultural people, with wheat, maize and sunflower seed as the chief crops; consequently, their old customs are rapidly dying out.

ADIPOCERE, a substance into which animal matter is sometimes converted (from the Lat. *adepts*, "fat," and *cera*, "wax"), and so named by A. F. Fourcroy, from its resemblance to both fat and wax. When the Cimetière des Innocents at Paris was moved in 1786-87, great masses of this substance were found where the coffins containing the dead bodies had been placed very closely together. Chemically, adipocere consists principally of a mixture of palmitic, margaric and oxymargaric acids combined with a little ammonia; glycerine appears to be absent (*see also under OILS, FATS AND WAXES*).

Lime, derived from the tissues, is present with other substances as an inorganic residue. It appears that it is not formed from protein, but from the body fats which collect together and undergo decomposition.

ADIPOSE TISSUE is composed of specialized connective tissue cells which contain large globules of fat. The chief chemical constituents of this fat are the neutral glycerol esters of stearic, oleic and palmitic acids. The fat stored in these cells comes in part directly from the fats eaten, and in part is manufactured within the body from fats and carbohydrates in the food and sometimes from protein. The main reservoir of fat in the body is the adipose tissue beneath the skin, called the *panniculus adiposus*. There are also deposits of fat between the muscles, among the intestines and in their mesentery, around the heart and elsewhere.

Besides acting as a fuel reserve against times of starvation or great exertion adipose tissue helps conserve the heat of the body and forms soft and elastic pads between the various organs.

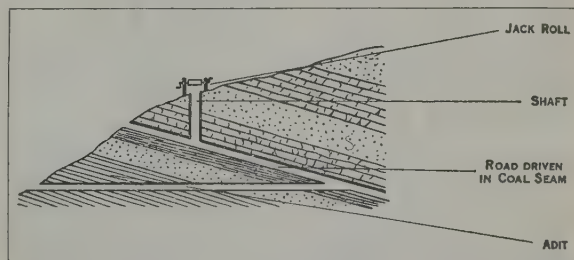
ADIRONDACKS, a group of mountains in northeastern New York, U.S., in Clinton, Essex, Franklin and Hamilton counties, often included by geographers in the Appalachian system, but pertaining geologically to the Laurentian highlands of Canada. Unlike the Appalachians, the Adirondacks do not form a connected range, but consist of many summits, isolated or in groups, arranged with little appearance of system. There are about 100 peaks, ranging from 1,200 to more than 5,000 ft. in height, and 42 more than 4,000 ft.; the highest peak, Mt. Marcy (called by the Indians Tahawus, or "cloud-splitter"), is near the eastern part of the group and attains an elevation of 5,344 ft. Other high peaks are McIntyre, 5,112 ft.; Skylight, 4,920; Haystack, 4,918; and Whiteface, 4,872. These mountains, consisting of various sorts of gneiss, intrusive granite and gabbro, have been formed partly by faulting but mainly by erosion, the lines of which have been determined by the presence of faults or the presence of relatively soft rocks. The mountains form the water parting between the Hudson and the St. Lawrence rivers. On the south and southwest the waters flow either directly into the Hudson, which rises in the centre of the group, or else reach it through the Mohawk. On the north and east the waters reach the St. Lawrence by way of Lakes George and Champlain, and on the west they flow directly into that stream or reach it through Lake Ontario. The most important rivers within the area are the Hudson, Black, Oswegatchie, Grass, Raquette, Saranac and Ausable. Among the larger lakes are the Upper and Lower Saranac, Big and Little Tupper, Schroon, Placid, Long, Raquette and Blue Mountain. The surface of most of the lakes lies at an elevation of more than 1,500 ft. above the sea; their shores are usually rocky and irregular, and the wild scenery within their vicinity has made them very attractive to the tourist.

The region known as the Adirondack Wilderness, or the Great North Woods, embraces between 5,000 and 6,000 sq.mi. of mountain, lake, plateau and forest, which for scenic grandeur is almost unequalled in any other part of the United States. Railways and highways penetrate the heart of the region and small boats ply upon the larger lakes. Well-marked trails lead to the crests of the better-known peaks. The mountains are easily reached from Plattsburg, Port Kent, Herkimer, Malone and Saratoga Springs. Every year thousands spend the summer months in the wilderness, where cabins, hunting lodges, villas and hotels are numerous. The resorts most frequented are in the vicinity

of the Saranac and St. Regis lakes and Lake Placid.

In the Adirondacks are some of the best hunting and fishing grounds in the eastern U.S. At the head of Lake Placid stands Whiteface mountain, from whose summit one of the finest views of the Adirondacks may be obtained. Two miles southeast of that lake, at North Elba, is the old farm of the abolitionist John Brown, which contains his grave and is much frequented by visitors. Lake Placid is the principal source of the Ausable river, which for a part of its course flows through a rocky chasm from 100 to 175 ft. deep and rarely more than 30 ft. wide. At the head of the Ausable chasm are the Rainbow falls. Another impressive feature of the Adirondacks is Indian pass, a gorge about 11 mi. long, between Mt. McIntyre and Wallace mountain, a majestic cliff rising vertically from the pass to a height of 1,300 ft. Keene valley, in the centre of Essex county, is another picturesque region, presenting a pleasing combination of peaceful valley and rugged hills. Though the climate during the winter months is very severe—the temperature sometimes falling as low as -42° —it is beneficial to persons suffering from pulmonary troubles and a number of sanatoria have been established. The region is heavily wooded with spruce, hemlock, pine and hardwood trees. Lumbering has been much restricted by the creation of a state forest preserve, containing in 1927, 1,884,643 ac., and by the purchase of large tracts for game preserves and recreation grounds by private clubs. The so-called Adirondack park, containing more than 3,000,000 ac., includes most of the state preserve and large areas held in private ownership.

ADIT. An adit is the name given to a horizontal working made from the surface to strike a seam of coal or a mineral vein. Other names for an adit are "day drift," "day hole" surf (forest of Dean), "sough" (lead mines of Derbyshire), "water-gates" (north of England), "sorre" (Yorkshire), "aridod" and "audit" as well as adit. Mining by means of adits is very ancient, and was practised in hilly country where the seams were cut by valleys. It was perhaps the earliest method of mining. The adits were driven at such a level as to drain off the water from the workings. The figure shows a seam coal outcropping on the side of a hill with ventilating shaft and adit level. In modern times a number of adit tunnels were driven at much lower levels for the purpose of draining off the water in old earlier workings, in metal mines in the western part of Canada, the United States and Mexico. Inclines are sometimes called adits.



THE LOWER TUNNEL, WHICH IS HORIZONTAL, REPRESENTS AN ADIT CUT ACROSS THE STRATA, TO "WIN" AND DRAIN A COAL SEAM

Sometimes the coal was carried up the shaft on the backs of men or women climbing ladders, or by means of a jack roll worked by manual labour. The coal was worked by means of narrow passages driven in the coal, small pillars being left for the support of the roof. The extent to which working was possible was limited by three factors: lack of ventilation, crush of pillars and water difficulties. Mechanical ventilation was not practised. A fire was placed in the shaft to heat the air and so increase the air current. The pillars were made very small with a view to getting as much coal as possible, and as the area worked extended, a point was reached at which the support offered by the pillars of coal became insufficient and a crush of the superincumbent strata supervened, inducing a "creep" or heaving-up of the floor, if the floor were a soft fireclay. If the floor was hard, a "thrust" took place and the pillars were crushed. The methods of raising the water from the dip workings to the water level or adit being by means of pumps worked by manual labour, it was not possible to proceed far to the dip from beyond the point where the adit struck the seam of coal or, as it was termed, beyond "the line of free drainage."

Where the ground was flat, working by adits was not possible, so that it was usual, in very early times, to get the coal by means of bell pits (*q.v.*) sunk near the outcrop. (R. R.)

ADJECTIVE, a word used chiefly in its grammatical sense of limiting or defining the noun to which it refers (Lat. *ad-jacio*, "to throw to"). Grammarians used to speak of a noun and its adjective together as a noun-adjective. In the art of dyeing,

adjective colours are those which require mixing with some basis to render them permanent.

ADJECTIVE LAW. This term means the law of procedure and distinguishes it from the substantive law, which it is designed to enforce, the former being viewed as the machinery by means of which the latter is brought into operation.

ADJOURNMENT, the act of postponing a meeting of any private or public body, particularly of parliament, or any business, until another time, or indefinitely (in which case it is an adjournment *sine die*). The word applies also to the period during which the meeting or business stands adjourned.

ADJUDICATION, generally the determination of an issue by the exercise of judicial power; the entry of a decree or judgment by a court. In bankruptcy proceedings an adjudication is an order of court declaring a debtor to be bankrupt. (See BANKRUPTCY.)

ADJUNCT, that which is joined on to another, not an essential part, and inferior to it in mind or function, but nevertheless amplifying or modifying it. (Lat. *ad*, "to," *jungere*, "to join.") Adverbs and adjectives are adjuncts to the words they qualify. Twelve members of the Royal Academy of Sciences in Paris are called "adjuncts."

ADJUSTMENT (IN LAW): see AVERAGE.

ADJUSTMENT (IN PSYCHOLOGY) is the process of behaviour by which men, and other animals as well, maintain an equilibrium between their needs and the demands and obstacles of their environments. In its simplest form, a sequence of adjustment begins when some need is felt and ends when that need is satisfied. For example, a hungry dog is stimulated by his physiological state to engage in varied activities such as searching, begging and barking. When one of these responses brings him food, he eats and thereby reduces or removes the stimulus that set the activity sequence in motion. He is then adjusted to this particular need.

In general, the adjustment process involves four parts: (1) a motive or need in the form of a strong persistent stimulus; (2) the thwarting or nonfulfilment of this need; (3) varied activity, or trial-and-error behaviour, leading eventually to (4) some response that removes the initiating stimulus and completes the adjustment.

Some of the motives that stimulate adjustive behaviour are simple physiological needs such as hunger and thirst. Certain other strong motives combine physiological elements and cultural or learned factors, as illustrated by the sex motives. Of great importance in complex human adjustments are the social motives involved in interactions with other persons, including needs for security, approval, recognition, achievement, mastery and the like. These motives are not inborn, but are strongly inculcated by learning processes that begin early in life. To a great extent, they are determined by social standards and differ from one culture to another. Thus, typical persons in the European-American culture have a strong motivation to succeed and excel which is markedly lacking in persons who live in some so-called primitive cultures.

Two main kinds of thwarting may be distinguished—frustration and conflict. A frustration is an external circumstance or an act of another person that prevents the fulfilment of an aroused motive. An adolescent may want to use the family automobile to drive to a dance, but be frustrated because the automobile is out of order or because his father forbids him to use it. A conflict is the arousal of two or more strong motives that cannot be satisfied together. A youngster may want to go to a dance to feel that he belongs to a group and does what his friends do. For an adolescent in our culture, that is a strong motive. But the youth may be a clumsy dancer and sensitive to the real or imagined ridicule of his fellows. Therefore, he also has a motive to avoid the dance to escape humiliation. He is in a dilemma; whether he goes or stays away he will experience distress. Psychologically, a conflict exists when the reduction of one motivating stimulus involves the increase of another, so that a new adjustment is demanded.

The psychological criterion of the solution of an adjustment is the elimination or reduction of the stimulation that was the source of the activity. In the total behaviour of a human being, however, adjustments rarely occur in isolation, but many have to be made simultaneously. Satisfactory adjustment therefore requires unified and integrated behaviour, in which all motives are reasonably satisfied with due regard to their functioning as an interrelated system.

Substitute Adjustments.—Adjustments to simple physiological needs such as hunger or thirst can be made only by direct solutions. The organism must eat and drink or it will die. Adjustments to social motivations, however, permit a variety of solutions, some of which are more direct and more satisfying than others. Suppose, for example, that a university student fails his examinations. This is a situation demanding adjustment, for it thwarts not only his educational

and vocational plans, but also his strong social needs for security, approval and achievement. The student may adjust by finding and remedying the cause of his difficulties, by increasing his effort or by changing his plans in a rational manner, all of which are direct and constructive solutions. He may also adjust by blaming others for his failure, by claiming that the examinations were unfair, by emphasizing his attainments in other than academic tasks (such as athletics), by daydreaming of imaginary successes or by developing an apparent illness that excuses his failure. All of these are adjustments of a sort, for they are in some degree satisfying to the social needs for success and approval.

A number of the more common varieties of substitute adjustments have been named and defined, and are usually known as adjustment mechanisms.

Adjusting by overemphasizing a trait in order to conceal a weakness is known as *compensation*. Thus, a boy who fears his own lack of strength in competition with his equals may adjust by becoming a bully of younger children; a man sensitive to his own lack of education may affect the use of long words; or an unattractive girl may call attention to her intellectual or vocational accomplishments. Compensations are somewhat satisfying because they are rather close substitutes for the thwarted achievement, and because they divert attention from the deficiency that the person feels. The mechanism of *rationalization* is somewhat similar. In rationalizing, the individual convinces himself, and attempts to convince others, that there are socially acceptable reasons for conduct that is determined by quite different motives. Selfishly based behaviour is defended as socially acceptable, or as no worse than that of other persons.

In *projection*, individuals attribute to others the traits and motives that are the subject of their own conflicts. The student resisting a strong temptation to cheat may be unusually sensitive to this evil and think that he sees dishonesty in many acts of others. Rationalization and projection are the psychological bases of delusions found in some persons suffering from severe mental disorders. Blaming their failures on others gives rise to delusions of persecution, while delusions of grandeur serve to support a sense of importance and to explain why they were selected for persecution.

In other instances, persons will adjust to social difficulties by withdrawing from contacts with other people and developing phantasies of imaginary achievements. The mechanism of *repression* consists of learning to forget or ignore distressing thoughts, and is common in both mild and serious maladjustments. It is illustrated by the "blind spots" that normal people have with respect to their own shortcomings and, at the extreme, by the almost complete forgetting of a person's past life which may be his reaction to catastrophic conflicts. *Regression* is a reversion to an adjustment satisfying at an earlier period of life, as when an older child competes for the attention of his parents by reverting to infantile habits. Persons may also adjust by becoming ill, which excuses their failures and permits them to escape from unbearable situations. Illnesses as adjustments are mainly examples of *hysterical* mechanisms which, like most other types, vary greatly in severity. The reluctant schoolchild's nine-o'clock headache expresses his distaste for academic tasks; a soldier's paralyzed arm may resolve the conflict between his pride and his guilt or fear.

If a person with serious frustrations or conflicts cannot find a reasonably satisfactory direct or substitute solution, he remains in a nonadjustive state. He is activated by motivating stimuli that he cannot reduce, and therefore is tense, overactive and susceptible to emotional reactions. Common evidences of nonadjustment are anxiety, worry and so-called "nervousness."

It must be emphasized that substitute adjustments are usually unconscious in the descriptive sense of this term. The person who employs them does not deliberately attempt to deceive others. Instead, he hits upon a type of behaviour that reduces his motivations and gives him a vague sense of relief from tension. He does not understand the source or meaning of his reactions, and often is anxious to improve his adjustments but does not know how to do so.

Substitute adjustment mechanisms are used by all people and are not abnormalities in themselves. The difference between quite normal people who display many of these mechanisms, and people who are severely maladjusted or psychoneurotic, is one of degree rather than of kind of behaviour.

Readjustment.—Persons who suffer from difficulties of psychological adjustment can be helped by psychotherapy, a process of treatment carried out by psychiatrists, clinical psychologists or psychiatric social workers, or by clinics in which these qualified specialists work as a team. They recognize that advice, persuasion or punishment are not effective means for accomplishing readjustment.

Psychotherapy is a series of conferences between the therapist and the client. The therapist listens to the client's story, accepts his motivations, conflicts and inadequate behaviour without reproach or praise, and makes responses that acknowledge and clarify the client's attitudes and feelings. In the permissive and supportive atmosphere provided by the therapist, the client becomes able to recall and to piece together significant aspects of his past experiences and present attitudes that hitherto he was unable to face. The client learns, at his own pace and through his own thinking, to react to his conflicts more calmly, and constructively. Improvement in his everyday behaviour may follow. (See PSYCHIATRY; PSYCHOLOGY.)

BIBLIOGRAPHY.—N. Cameron and A. Magaret, *Behavior Pathology* (1951); J. Dollard and N. E. Miller, *Personality and Psychotherapy* (1950); L. F. Shaffer, *The Psychology of Adjustment* (1936).

(L. F. Sr.)

ADJUTANT, a helper, or junior in command, one who assists his superior, especially an officer who acts as an assistant to the officer commanding a battalion or unit of similar scale. In the British army the appointment of adjutant is usually held by a captain or lieutenant. The adjutant acts as staff officer to the commanding officer, issues his orders, superintends the work of the orderly room and the general administration of the corps and is responsible for the training of recruits. Regular officers are appointed as adjutants to units of the territorial army. In the French army, however, the title is given to senior underofficers of superior grade to sergeant. On the European continent the word is not restricted to the lower units of organization; for example, in Germany the *Adjutantur* includes all "routine" as distinct from "general" staff officers in the higher units, and the aides-de-camp of royal persons and of the higher commanders are also styled adjutants general, *Flügel-adjutanten*, etc.

ADJUTANT BIRD, the name given to large storks (*q.v.*), of the genus *Leptoptilos*, distinguished by their dull plumage, black scabrous head and enormous pouch, of doubtful function, connected with the respiratory system. The largest is *L. dubius* of India. It feeds on offal, frogs and fish, and is a most efficient scavenger, for which reason it is usually protected. Other species are *L. javanicus* of southeast Asia and *L. crumeniferus*, the marabou stork of Africa; the "marabou" feathers of commerce were originally the undertail coverts of this bird, but the name is now applied to a large number of kinds of downy feathers.

ADJUTANT GENERAL, an army official, originally (as indicated by the word) the chief assistant (Lat. *adjuvare*) staff officer to a general in command, but now a distinct high functionary at the head of a special office in the British and U.S. war departments. In England the second military member of the army council is styled adjutant general to the forces. He is a general officer and at the head of his department of the war office, which is charged with all duties relative to personnel. The adjutant general of the U.S. army is one of the principal officers in the war department, the head of the bureau for army correspondence, with the charge of the records, recruiting, issue of commissions, etc. Individual U.S. states also have their own adjutant general, with cognate duties regarding the state militia. In many countries the term has retained its original meaning of an officer on the personal staff, and is the designation of personal aides-de-camp to the sovereign.

ADLER, FELIX (1851–1933), U.S. educationalist, was born at Alzey, Ger., Aug. 13, 1851. His father, a Jewish rabbi, emigrated to the United States in 1857, and the son graduated at Columbia college in 1870. After completing his studies at Berlin and Heidelberg, he became professor of Hebrew and oriental literature at Cornell university, Ithaca, N.Y. (1874–1876). In 1876 he established in New York city the Society for Ethical Culture. In 1902 he became professor of political and social ethics at Columbia university. Adler took a prominent part in philanthropic and social reform movements, such as the erection of model tenement houses and the abolition of child labour. He published *Creed and Deed* (1877), *The Moral Instruction of Children* (1892), *Marriage and Divorce* (1905), *The Religion of Duty* (1905), *The World Crisis and Its Meaning* (1915), *An Ethical Philosophy of Life* (1918) and *The Reconstruction of the Spiritual Ideal* (Hibbert lectures at Oxford, 1923). He died April 24, 1933.

ADLER, HERMANN (1839–1911), British chief rabbi, born at Hanover, Ger., on May 30, 1839, the son of N. M. Adler, was educated at University College school and University college, London, and then at Prague under Rapoport. After receiving the rabbinical diploma at Prague, he returned to England to become temporary principal of the Jewish Theological college in London for two years. With this college he was associated in one capacity or another all his life. He began his ministry at the Bayswater synagogue in 1864, and continued to preach there until 1891,

when he became chief rabbi on the death of his father. Adler was a prominent figure in English public life, and served on many Mansion House committees and on various bodies concerned with the improvement of social conditions in London. He died on July 18, 1911. A collection of his sermons, entitled *Anglo-Jewish Memories and Other Sermons*, was published in 1909.

His daughter, NETTY, sat on the London county council for Central Hackney from 1910–25 and was deputy chairman of the council in 1922–23. She served on many committees in connection with social questions, but her principal work was done in education. She began her social work as a school manager under the local school board, was then co-opted a member of the London education committee 1905–10, and in the county council was closely connected with the administration of the schools. Apart from education, she was interested in the welfare of children from all points of view, having been for many years joint honorary secretary on the committee for the protection of wage-earning children, and a member of the London Advisory Council for Juvenile Employment.

ADLER, NATHAN MARCUS (1803–1890), British chief rabbi, was born at Hanover, Ger., Jan. 15, 1803, and died at Brighton, Eng., on Jan. 21, 1890. He took his degree of Ph.D. at Erlangen in 1828. He was ordained in the same year, was chief rabbi of Oldenburg (1829) and of Hanover in 1830, and on Oct. 13, 1844, was elected chief rabbi in London. There he originated and carried out his scheme for a Jews' college for the training of teachers, which was founded in London on Nov. 11, 1855, with himself as its first president. In 1860 Adler suggested the establishment of a United Synagogue which should bring all the British congregations under one central administration; this idea was realized in 1870, when the United Synagogue bill was passed in parliament. Adler's writings include sermons and commentaries on Hebrew texts, the best known of which is *Nethinah la-ger*, a commentary on the Aramaic paraphrase of Onkelos on the Pentateuch (1874).

ADLER, VIKTOR (1852–1918), Austrian politician, was born at Prague, June 24, 1852. He began to occupy himself early with political and social questions. In 1883 he went to study in Switzerland and in London, where he came into close touch with F. Engels. On his return to Vienna, however, he turned entirely to politics. The Workmen's party had sunk into political insignificance and Adler's task was to restore unity in the ranks of labour. In 1886 appeared his paper *Gleichheit*, eventually succeeded by *Die Arbeiterzeitung*, the principal organ of the Social Democratic party, which Adler continued to conduct till his death. In July 1889 he appeared at the first congress of the Second International, of which he became an official, as the representative of the united Austrian Labour party. From that time he was the acknowledged leader of the party.

Adler regarded it as his first task to secure for the workers representation in parliament, but it was not until 1907 that he was able to secure universal and equal suffrage. The Social Democratic party increased their representation from 11 deputies to 87. Adler himself entered the diet of Lower Austria in 1902, and in 1905 was elected to the *reichsrat*, where, until his death, he played an important part.

In the congress and in the secretariat of the International, Adler, with A. Jaurès and A. Bebel, played the most prominent part, whether as leader, adviser or mediator. After the collapse of Austria in 1918 at the constituent session of the provisional German-Austrian national assembly, he read the declaration of the Social Democrats, in which they expressed their willingness, in association with the other German-Austrian parties, to build the new state on the basis of democracy and self-determination, without prejudice to a possible association with the German empire. He held for a few days the office of foreign minister, but he broke down and died Nov. 12, 1918, the day on which the state council had decided to proclaim German Austria a democratic republic, and an integral part of the German reich.

BIBLIOGRAPHY.—His works include articles scattered in various newspapers, in the *Neue Zeit*; *Kampf*; *Deutsche Worte* (Vienna), in addition to those in the *Arbeiterzeitung*; pamphlets, among which are *Die Fabrikinspektion, insbesondere in England und der Schweiz* (1884); *Die Arbeiterkammern und die Arbeiter* (1886); *Die Gleichheit vor dem Ausnahmegericht* (1889); *Das allgemeine, gleiche und direkte Wahlrecht und das Wahlrecht in Oesterreich* (1893); *Schwurgerichtsprozess gegen Doktor Viktor Adler wegen Verbrechens der Störung der öffentlichen Ruhe* (1894); *Alcoholismus und Gewerkschaft* (many editions) (1907).

AD LIBITUM (Lat., "at pleasure"), in music, a direction signifying that the performance of the passage in question is left to the unfettered discretion of the performer; also that a given portion of a composition, such as the accompaniment of a choral piece, may be omitted if desired.

ADMETUS, in Greek legend, son of Pheres, king of Pherae,

in Thessaly. By the aid of Apollo, who served him as a slave—either as a punishment for having slain the Cyclopes, or out of affection for his mortal master—he won the hand of Alcestis, the most beautiful of the daughters of Pelias, king of Iolcus. Finding that Admetus was soon to die, Apollo persuaded the Fates to prolong his life, provided any one could be found to die in his place. His parents refused, but Alcestis consented. She was rescued by Heracles, who wrestled with Death and made him give her back.

BIBLIOGRAPHY.—See A. Lesky, *Alkestis: der Mythos und das Drama* (Vienna, 1925); W. Roscher's *Lexikon*, arts. Admetos, Alkestis.

ADMINISTRATION, the performance or management of affairs, a term specifically used in law for the administration or disposal of the estate of a deceased person. (See WILL or TESTAMENT.) It is also used generally for "government," and specifically for "the government" or the executive ministry, and in such connections as the administration (administering or tendering) of the sacraments, justice, oaths, medicines, etc.

Letters of Administration.—Upon the death of a person intestate or leaving a will to which no executors are appointed, or when the executors appointed by the will cannot or will not act, the probate division of the high court is obliged to appoint an administrator who performs the duties of an executor. This is done by the court granting letters of administration to the person entitled. Grants of administration may be either general or limited. A general grant is made where the deceased has died intestate. Formerly, on the death of the owner of realty and personalty intestate, the realty vested in the deceased's heir and the personalty in the court of probate until administrators were appointed. Now, since the rights of heirs as such are abolished by the Administration of Estates Act 1925, all the property, real and personal, vests in the court. Moreover, formerly the right to be appointed administrator was more or less defined. Now by the same act the court is given an absolute discretion as to whom it shall appoint, subject to these limitations: that where there is no special reason to the contrary some person interested in the residuary estate should be appointed, and that where the estate passing on the deceased's death includes land settled otherwise than by his will the trustees of the settlement should be appointed (s. 10). Not more than four persons are to be appointed administrators (Judicature Act 1925, s. 160); and separate administrators may be appointed to the real and to the personal estate of the deceased (Administration of Estates Act 1925, s. 13). In the absence of statutory next-of-kin the crown, on the death intestate of an owner of land and personalty, is now entitled to both as *bona vacantia*, escheat both to the intermediate lord and to the crown being abolished. If a creditor claims and obtains a grant he is compelled by the court to enter into a bond with two sureties that he will not prefer his own debt to those of other creditors.

The more important cases of grants of special letters of administration are the following:—

Administration *cum testamento annexo*, where the deceased has left a will but has appointed no executor, or the executor appointed has died or refuses to act. In this case the court will make the grant to the person with the largest beneficial interest.

Administration *de bonis non administratis*: this occurs in two cases: (1) where the executor dies intestate after probate without having completely administered the estate; (2) where an administrator dies. In the first case the principle of administration *cum testamento* is followed, in the second that of general grants in the selection of the person to whom letters are granted.

Administration *durante minore ætate*, when the person nominated by the will as executor is under age.

Administration *pendente lite*, where there is a dispute as to the person entitled to probate or a general grant of letters the court appoints an administrator till the question has been decided.

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ADMINISTRATIVE COMMISSION is the name applied in the United States to a governmental agency headed by a group

of persons rather than by an individual and charged with the enforcement or execution of a law or laws. In Great Britain such agencies are more often known as administrative boards, such as the Local Government board (1871-1919); however, the civil service commission (1855-) offers an example of a different practice in nomenclature. There also have been numerous royal commissions consisting of prominent citizens designated by the government of the day to study troublesome public questions and offer suggestions for needed legislation. These bodies, however, do not have administrative functions.

In the United States, administrative commissions first appear among national governmental agencies with the creation of the civil service commission under the Pendleton act of 1883. This was followed, in 1887, by the Interstate Commerce commission, in 1914 by the Federal Trade commission, in 1916 by the United States tariff commission and the United States employees' compensation commission, in 1920 by the Federal Power commission, in 1934 by the Federal Communications commission and the Securities and Exchange commission, and in 1936 by the United States Maritime commission which, in turn, was successor to the United States Shipping board, created in 1916. While the name commission is the most common among such administrative agencies in the national government of the United States, it is not universal. Functions similar to those performed by the agencies just enumerated are entrusted to the National Mediation board, created in 1934 to take the place of the earlier United States Board of Mediation (1926-34), the Railroad Retirement board (1935-), and the National Labor Relations board (1935-).

It is necessary, in the United States as well as in Great Britain, to distinguish between administrative commissions and government corporations. Examples of the latter include, in Great Britain, the British Broadcasting corporation and in the United States, the Tennessee Valley authority. While such agencies normally have plural heads and are charged with governmental administrative functions, their legal status differs from that of the administrative commission. They are usually provided with capital by the government, but are free to operate within the scope of their charters without bureaucratic intervention in administrative details. Ex-officio and advisory bodies are not properly included among administrative commissions, since they have no continuing responsibility for the execution of law.

Administrative commissions in the United States vary in size from 3 to 11. They are appointed by the president with the advice and consent of the senate, but they are not represented in the president's cabinet. In most cases the law establishing the agency provides that no more than a simple majority of the members may belong to the same political party.

Such agencies are found not only in the national government of the United States, but also in the several state governments and occasionally in city government. The most common state agencies of this type include industrial commissions, boards of health, boards of education, boards of public welfare and unemployment compensation commissions. In local government they appear mainly in the fields of health and education.

Administrative commissions are commonly used where quasi-legislative and quasi-judicial as well as executive functions are to be discharged. Thus these agencies offer a means of escape from a rigorous application of the separation of powers doctrine in government. Legislators, in establishing new commissions, show an increasing tendency to delegate to them broad powers of subordinate legislation. Judges and lawyers deprecate the tendency to confide judicial powers to administrative tribunals, but the expense and delay of proceedings in the regular courts make supplementation inevitable. While boards are not as well suited to the performance of administrative duties as are single-headed departments, they do provide continuity of policy through long overlapping terms of office, insulate the execution of the law from partisan political interference and permit the representation of interest groups concerned with the administration of legislation.

See Frederick F. Blachly and Miriam E. Oatman, *Administrative Legislation and Adjudication* (1934); Avery Leiserson, *Administrative Regulation* (1942); Walter Gellhorn, *Federal Administrative Proceed-*

ings (1941); Joseph P. Chamberlain, Noel T. Dowling, Paul R. Hays, *The Judicial Function in Federal Administrative Agencies* (1942); Robert E. Cushman, *The Independent Regulatory Commissions* (1947). (H.A. W.)

ADMINISTRATIVE LAW. Administrative law consists of all those principles and rules of law which together furnish the legal matrix of public administration. This description, it will be noted, differentiates administrative law from the rest of the law solely in terms of its subject matter. Indeed, in Anglo-American jurisprudence there exists no separate body of law which deals with this subject matter. Instead, the pertinent principles and rules find their sources scattered through constitutions, statutes, judicial decisions, and even administrative regulations and orders. The factor, however, which gives them a significant unity is their common bearing upon the organization and functioning of the administrative authorities of the modern state (see *AUTHORITY, ADMINISTRATIVE*).

Scope of Administrative Law.—It follows from the definition of administrative law that its scope corresponds exactly with that of public administration. The administrative system exists primarily to render public services and exercise public controls of persons or property. To this end the law must establish appropriate administrative agencies, vest in them certain powers, prescribe the scope and limits of such powers, provide means of enforcing the administrative decisions made in the exercise of such powers, and furnish the private parties who may be affected with remedies or safeguards against administrative action which is arbitrary, discriminatory or unauthorized.

Of the powers delegated to administrative authorities by modern regulatory statutes, four types may be mentioned: (1) the *rule-making power*, or the power to issue general rules and regulations having the force of law for the purpose of filling up the details of statutory policy; (2) the *licensing power*, or the power to grant or refuse, to renew, and to revoke licences or permits which may be required by statute for the pursuit of such professions as law and medicine and the conduct of certain forms of business; (3) the *investigatory power*, or the power to require witnesses to testify and produce books, papers and records for the purpose of acquiring the information needed for effective regulation; and (4) the *directing power*, or the power to issue, usually after notice and an opportunity to be heard, administrative orders by which the private party is required, in conformity with the governing statute, to do or refrain from doing specified things.

Whatever the public service and control functions of the administrative system may be, however, their performance depends upon its also conducting auxiliary operations which relate to its organization as a going concern, provision for its personnel and matériel, and the financing, planning and over-all administrative management of its varied activities. Accordingly, the law must also establish rules to authorize and govern these auxiliary and managerial operations and the relations which the administrative system is to bear with respect to them to other parts of the government.

In the United States early efforts at systematic treatment of these aspects of the law consisted mainly of bringing together the pertinent principles of judge-made law under the heading, "the law of public officers." Around the turn of the century, however, Frank Johnson Goodnow made, against the background of the systems of continental Europe, the first comprehensive study of U. S. "administrative law" conceived as the legal framework of public administration. In this new perspective many common law principles considered under the older heading found their appropriate place.

Purposes of Administrative Law.—Only by bringing together from all sources the relevant legal principles is it possible to acquire that over-all view of the legal mould of public administration which clarifies its purposes and gives intelligent guidance to its development. In the broadest sense, the problem of administrative law is an aspect of the central problem of political theory: the reconciliation of authority and liberty. More specifically, the purposes of legal control of public administration are: (1) to establish administrative authorities and enable them

to carry out public policies designed to protect the public interest, and (2) to safeguard private interests against administrative arbitrariness or excess of power.

It is important to remember, however, that in the larger view each of these interests includes the other as a factor. The public interest includes the welfare of all members of the community, those who are regulated no less than those for whose protection regulation is undertaken. Accordingly, the public interest itself suffers if those who are regulated become victims of administrative oppression. Yet it is equally true that the private interest of those who are regulated includes in the long run the public interest. They may profit in the short run if the law renders ineffective administrative efforts to prevent their exploitation of the public; but by the same token it may render ineffective their protection against forms of exploitation indulged in by others. The aim of administrative law is thus to attain a synthesis of public and private interests in terms of the social and economic circumstances and ideals of the age.

Droit Administratif versus the Rule of Law.—Some form of judicial control of administrative action is so necessary to the protection of private interests against administrative abuse as to have come in the western world to be considered a characteristic feature of free government. In broad outline, however, this judicial control has for historical reasons taken two different forms, the continental European and the Anglo-American.

Of the former the French system of *droit administratif* is perhaps typical. That system provides for a high degree of administrative centralization, and exempts the administrative authorities from control by the ordinary tribunals. This does not mean, however, that these authorities are free from all forms of judicial control. For in France there are two separate systems of courts, the ordinary and the administrative. The former try cases under the civil and criminal codes, while the latter try cases involving official action. The highest administrative court, the judicial branch of the council of state, has developed a body of case law which has given satisfaction at home and received high praise from many foreign observers.

In England, on the other hand, there developed a decentralized administrative system, with central control exercised by the king's judges as a part of their common law jurisdiction. In the long struggle with the Stuarts the foundations of the modern system were completed. Chief Justice Sir Edward Coke exalted the common law as a sort of embodiment of natural justice and symbolized its supremacy as against the high prerogative claims of James I. The long parliament abolished the star chamber and other extraordinary courts, which had threatened to become engines of Stuart tyranny. The "Glorious Revolution of 1688" marked the final establishment of the legislative supremacy of parliament; and the Act of Settlement gave the judges tenure during good behaviour. Thereafter, even the servants of the crown were amenable to the ordinary law of the land, which meant the law administered by the independent judges of the common law and chancery courts on the basis of judicial precedents or acts of a sovereign parliament.

From the beginning of the 18th century, therefore, there has been in England, and in every country which derived its jurisprudence from England, but a single hierarchy of courts, the ordinary judicial tribunals, which hear cases involving official action as an incident of their common law or statutory jurisdiction, and which apply to such cases no separate body of law, but the law of the land in the form of the common law, equity, statutes and (where they exist) written constitutions. Under the name of the "rule of law" this system was idealized in 1885 by A. V. Dicey in his *Law of the Constitution*; and in countries in which the rule of law in this special sense prevails, administrative law is an appropriate name for those general and special principles and remedies of the law of the land by which the ordinary courts control administrative action.

Those accustomed to one of these two systems run the risk of judging the other in terms of their own. The basis of a practical comparison would be topic by topic in terms of attainment of the purposes of administrative law. Dicey's volume became a classic

of English-speaking legal literature; but his comparison of the rule of law with *droit administratif* has been subjected to searching criticism. He described the rule of law, for example, as excluding the existence of "wide discretionary authority on the part of the government"; but the growth in England of administrative discretion caused even Dicey to admit in his eighth edition of 1920 that this development had "some features which faintly recall" French administrative law.

Dicey further declared that the rule of law means the "equal subjection" of official and citizen to "the ordinary law of the land administered by the ordinary Law Courts"; but what matters in practice is not whether there are two bodies of law and two kinds of courts or only one, but whether the balance struck between public and private interest is comparable under the two systems. Even the common law treats cases involving official action differently in some instances from those in which this factor is absent; and if the injured citizen may hold the government responsible in place of the officer, it is certainly not obvious that there is any practical virtue in holding the officer personally responsible merely in order to subject him to the same law that governs the citizen. The peculiar virtue which the rule of law possesses in this respect is that it symbolizes the Anglo-American distaste for the idea that officialdom is a class apart, to which special deference is due. The subtlety of this virtue, however, goes beyond all practical considerations.

French administrative litigation is far less expensive and burdened with technicalities than that in U.S. courts. Though the members of the judicial branch of the French council of state do not have formal independence of the administration, of which they are technically a part, it is said that they enjoy practical independence. The fact that they bring to their task either administrative experience or training in administrative law or both might even tend to make their judgment more balanced than that of judges trained only in the common law and private practice.

Whatever the respective merits, however, of these two great systems, the French and the Anglo-American, each is so deeply rooted in historical experience and tradition that, though they may still further approach each other in results, this is likely to take place through gradual modification rather than wholesale importation.

The Extraordinary Remedies.—In England, judicial control of administrative action was first systematically worked out through use of the prerogative writs. These ancient writs were originally granted only to the king for the control of local officers, but in time came to be available to private parties as against the central administration, and still play an important part in the administrative jurisprudence of both Great Britain and the U.S. In the latter country they are known as the extraordinary remedies. Five of them are products of the common law, while the sixth, the injunction, is a product of equity. Since an understanding of their nature is a first step in the study of Anglo-American administrative law, they will be briefly described in turn.

*Quo warrant*o may be used to try the legal title of one assuming to exercise a public office. At common law the action may be brought only in the name of the state by the attorney general, who may proceed *ex officio* or on the petition of another. The latter is known as the relator, while the one whose title to the office is to be tried is known as the respondent. It is no defense for the respondent to show that he is the officer *de facto*; if he fails to show that he is presently the officer *de jure*, the state is entitled to judgment of ouster. This involves removal of the respondent; and thereafter all pretended official acts done by him are void for all purposes. If the relator claims to be the lawful officer, the court may incidentally pass upon his claim of title.

By the writ of *mandamus* the court orders a public officer to perform a particular nondiscretionary act which it is his legal duty to perform and the legal right of the petitioner to have performed. The writ is issued only if there is no other adequate remedy. It is not used to control official discretion, but it may order an officer to exercise a discretion which it is his legal duty

to exercise. It is also used in effect to correct gross abuse of discretion, as when the officer admits facts which show that his only reason for noncompliance is an arbitrary one. The writ is not available to compel a general course of action in law enforcement; for this would make the court in effect the supervisor of an executive function.

Described as the strong arm of equity, the *injunction* is issued by a court exercising equitable jurisdiction to compel the defendant, who may be a public officer, to do or refrain from doing a particular thing. If the writ orders him to do something, it is called a mandatory injunction; while if it orders him to refrain from doing something, it is called a preventive injunction. The latter is the more usual form, and is sought by one party against threatened infringement of his rights at the hands of another. The court may issue a temporary or interlocutory injunction to preserve the *status quo* until a full hearing can be had. The permanent injunction is the final order of the court. It is to be granted only if there is no adequate remedy at law; that is, only if the threatened injury could not be adequately redressed by money damages. In U.S. administrative law, however, injunctions have been so freely granted as to give rise to severe criticism. An injunction against a public officer to restrain him from proceeding under an unconstitutional statute or in excess of his statutory authority is not considered a suit against the government, and hence does not require statutory consent.

By the writ of *certiorari* the court may order up from a lower court or administrative agency the record of proceedings of a judicial nature for the purpose of quashing or affirming the same. An early U.S. view that the scope of judicial review on common law *certiorari* is confined to the correction of jurisdictional errors was later shown to have been based upon a misconception of the English cases. The New York court of appeals long ago abandoned this view, and held that this writ was available, not indeed to reweigh the evidence, but to correct errors of law and to examine the case upon the whole of the evidence in order to determine whether, as a matter of law, there was any evidence which could warrant the decision. On the other hand, since in the federal courts injunction furnishes an adequate remedy, *certiorari* plays no important part in federal administrative law.

The writ of *habeas corpus* has well been described as the palladium of personal liberty. Upon proper application it is directed to the party, be he a private person or a public officer, who is exercising restraint upon the personal liberty of another, and orders him to produce the body of the person detained and show legal cause for the detention. Upon his return to the writ a summary hearing is held. If legal cause or justification is shown, the body is remanded to the custody of the officer or other party. Otherwise, the court or judge will discharge the prisoner. The writ is available against administrative authorities in quarantine, extradition, and alien cases, and to test the jurisdiction of the military authorities over one who denies such jurisdiction.

The writ of *prohibition* runs to an inferior court or other tribunal exercising judicial power to restrain it from proceeding in excess of its jurisdiction. It is not issued when there is an adequate remedy by appeal. If the inferior tribunal is found to be exceeding its jurisdiction, judgment involves prohibiting it from entertaining any further proceedings in the matter. In U.S. administrative law the utility of the writ is restricted by the fact that it may be denied to the petitioner on the ground that the licensing or other administrative agency is exercising administrative rather than judicial power.

The Scope of Judicial Control.—The scope of judicial control of administrative action depends upon such variable factors as the nature of the governmental function involved, the type of administrative power which is being exercised, the wording of the particular statute in question, and the technical features of the form of relief which may be available in the courts. U.S. courts have worked out certain general principles governing the extent to which they will, in reviewing administrative determinations, regard them as conclusive or as liable to reversal; but

these principles are subject to qualification in diverse types of situation. The courts tend to require that all available and adequate administrative remedies, such as appeal from an inferior to a superior administrative officer, be exhausted before resort may be had to judicial relief; and they do not ordinarily interfere with administrative discretion. They regularly re-examine administrative determinations of questions of law, but give great weight to the interpretations of statutes made by those charged with their administration, and in case of doubt accept them as binding. Findings of fact, if supported by substantial evidence, are ordinarily accepted as conclusive; but this is a controversial subject, with a division of opinion between those who emphasize the importance of protecting private interests and those who emphasize the importance of strengthening administrative effectiveness in the public interest.

Notice and Hearing.—Another safeguard of private interest is notice and hearing as a part of administrative adjudication. For the administrative exercise of so-called quasi-judicial powers, or those which are regarded as analogous in character to judicial power as exercised by the courts, *audi alteram partem* (that the other side be heard) is a requirement of the common law. In the U.S. notice and an opportunity to be heard are in such cases generally a requirement also of constitutional due process of law. While administrative tribunals are not bound in such hearings by all the technical rules of evidence which prevail in judicial trials, they are held to deny due process of law if they fail to apply "the rudimentary requirements of fair play."

In the making of administrative rules and regulations, an analogous safeguard is prior consultation of the private groups concerned. This is not constitutionally necessary; but good practice calls for informal consultation, and the governing statute may make formal consultation a prerequisite of issuance.

The Enforcement of Administrative Decisions.—Further protection of private interests is afforded by the fact that, in the U.S., due process of law generally requires that, for the enforcement of administrative decisions, resort must be had to the courts. In this connection mention may be made of some of the more common means of enforcement which are provided by modern regulatory statutes. The statute may make it a misdemeanor to violate administrative rules and regulations or administrative orders or to practise a profession without a licence. It may specify a statutory appeal to court, by the administrative authority concerned, for judicial enforcement of its order which has been disobeyed. It may provide that an administrative order become final if no appeal is taken by the private party affected within a specified time, and that violation thereafter subjects the offender to a civil penalty recoverable by governmental suit in the proper court. In each of these illustrations judicial enforcement is preceded by an opportunity for judicial review to determine the validity of the administrative decision.

In an exceptional class of situations, however, due process of law is not violated by authorizing administrative authorities to execute their own decisions. An example of common law origin is summary abatement of public nuisances which endanger the public health or safety. The property of a delinquent taxpayer may also be summarily seized and sold for satisfaction of the tax. There are even some examples of administratively imposed fines. It is to be noted, however, that even summary action is subject to some form and degree of later judicial review.

Government Liability in Tort.—In an important class of cases the French *droit administratif* gives the private citizen more effective remedies than are furnished by Anglo-American administrative law. This is in cases in which private parties are wrongfully injured by official action. In considering such injuries French jurisprudence distinguishes between those caused by fault of service (*faute de service*) and those caused by the personal fault (*faute personnelle*) of the official. For his personal faults the French functionary is liable before the ordinary courts; but for faults of service the council of state holds the government itself liable. Indeed, by holding the government responsible for damages in situations where there was in fact no fault of either sort, the council of state has seemed to some observers to be

approaching something like a doctrine of risk liability by which the state insures the citizen against all exceptional injuries caused by the functioning of the public services.

In Anglo-American law wrongs other than breaches of contract are called torts. But in England the doctrine that the king can do no wrong relieves the crown, or in other words the government, of legal responsibility for torts committed by its servants and places that responsibility solely upon those servants personally, though the government may see fit to come to their relief. In the U.S. the national and state governments are not amenable to suit without their consent given by statute; though municipal corporations are held liable for the torts committed by their agents in connection with their proprietary or business as distinguished from their strictly governmental functions. While congress, for example, has given its general consent for the national government to be sued on its contracts, it has not done so in cases involving torts. It has, however, given governmental corporations like the Reconstruction Finance corporation the general capacity to sue and be sued.

Now this personal liability of the officer is often unsatisfactory for the officer himself, for the injured party and for the public interest. This may be seen from cases in which it has been held by U.S. courts that, if the owner cannot get a hearing before his property is summarily destroyed for the protection of the public health, he is entitled to his hearing afterward in a tort action against the officer. In such a situation, the officer may be held personally liable for money damages if a jury disagrees with his determination that a horse now destroyed had the glanders and hence constituted a public nuisance. The owner may get a personal judgment against the officer, only to find that he has nothing with which to pay it. The knowledge on the part of the officer that he may be held personally responsible if a jury of 12 laymen later disagrees with his expert judgment may cause him to hesitate to act at his own peril in the public interest.

The inadequacies of such a solution become increasingly evident as the operations of modern government are expanded. For the public interest demands on the one hand that these operations be effectively carried out, while on the other hand their expansion enhances the likelihood of their causing injury to the private citizen. At the same time, however, faults of service are after all faults of officials; and it is not sufficient to give the citizen an effective remedy against the government if, by relieving officials of personal liability, the responsibility with which they act is so dulled as to produce an increase of avoidable injuries and an unnecessary burden upon the public treasury.

Problems Resulting from the 20th Century Growth of Administrative Authority.—In the first half of the 20th century both England and the U.S. witnessed a broadening of governmental functions and a corresponding growth of administrative authority. Parliament, congress, and state legislatures vested more and more powers of a quasi-legislative and quasi-judicial nature in administrative agencies. This development was a direct and inevitable result of the economic and social changes wrought by the industrial-technological revolution which swept over the western world. At the same time, however, it posed new problems in administrative law. In broad terms, these problems centre around the question: how shall this new "administrative justice" be reconciled with the traditional "rule of law?"

The growth of administrative discretion, inconsistent as it is with the traditional conception of the rule of law, seems to be a permanent feature of modern government. In terms of the rule of law, then, the crucial question is the extent to which this administrative discretion is subject to control by the courts. Otherwise, the problem shifts to that of providing an administrative personnel and administrative procedures which will tend to cause this discretion to be exercised with fairness.

Controversy and Appraisal.—This growth of administrative justice has been the object of vigorous attack in both England and the U.S. In the former, criticism was brought to a head by the publication in 1929 of Lord Hewart's *The New Despotism*. In his opinion the situation in England was characterized by

"administrative lawlessness" rather than "administrative law." For him the new despot was the bureaucratic despot. In consequence of this denunciation, the lord high chancellor appointed a committee on ministers' powers, whose *Report* in 1932 took a middle view. It regarded quasi-legislative and quasi-judicial powers as inevitable, but proposed various limits and safeguards.

This report also mentioned a subject which is much discussed in the U.S., when it declared (p. 78) that "bias from strong and sincere conviction as to public policy may operate as a more serious disqualification than pecuniary interest." In the U.S. various regulatory boards and commissions initiate complaints of violation of legal standards and then hear their own complaints and render decision. Critics say that this arrangement makes the agency both prosecutor and judge and gives it such an interest in deciding that its charges are true that it becomes judge in its own cause. They object further because, on judicial review, the case comes to the court with the facts already found and with the findings of fact conclusive upon the court if supported by substantial evidence.

In response to this criticism the proposals have been various. At one time there was considerable discussion of the advisability of creating a central administrative court empowered to review administrative adjudications and in so doing to reweigh the evidence. In 1937 the president's committee on administrative management proposed complete separation of the two functions by vesting that of prosecution in an administrative section under the control of the appropriate executive department and that of making decisions in a judicial section which would be independent of the department except in matters of "housekeeping." In 1941 the U.S. attorney general's committee on administrative procedure advocated preservation of the unified over-all responsibility of the board or commission at the same time that its staff is provided with independent hearing commissioners empowered to conduct hearings and to make decisions appealable to it.

In the U.S. criticism culminated in specific efforts to "curb" administrative authority by general legislation intended to extend the scope of judicial review or to impose procedural safeguards. Outstanding among such efforts were a proposal made in 1938 by a New York state constitutional convention and the Logan-Walter bill passed in 1940 by the U.S. congress; but the former measure was rejected by the New York electorate, and the latter was vetoed by the president.

The problem is a real one, and goes to the heart of the purposes of administrative law. Unfortunately, however, the discussion is too often conducted by partisans who forget the ideal of the golden mean. Apologists for untrammelled administrative authority think only of the need for effective enforcement of policies intended to protect the general welfare by the regulation of private economic power, and forget that fairness to those regulated is a factor in the general welfare. Critics of administrative adjudication think only of the traditional safeguards of the rule of law, and forget that without modification these safeguards would hamstring modern government in its necessary effort to maintain the public interest by defending all the other major private groups against the abuse of power by any one of them.

Thus some of the traditionalists tend to assume an analogy between the modern bureaucrat and James I or between the modern administrative tribunal and the star chamber. The analogy, however, is misleading. The task of the Stuart period in English constitutional history was to render arbitrary political power responsible to the nation; while the task of the 20th century is to employ responsible political power for the purpose of imposing responsibility to the community upon the arbitrary economic power which the industrial-technological revolution has centred in various special groups. This new and different task calls for new tools which are more flexible than detailed legislation enforced by the judicial process. The modern bureaucrat is one of these indispensable tools.

This does not mean, however, that the modern bureaucrat is to be treated as a philosopher-king to whose wisdom and benevolence may be assigned the government of mankind. The bureaucrat can no more safely be entrusted with irresponsible power than an

hereditary monarch or an independent judge. It follows that questions of executive accountability and bureaucratic responsibility, which are always with us, have become more pressing than ever before.

The industrial revolution created a new situation; and in all new situations the intelligent approach is neither to scrap traditional methods nor blindly to adhere to their outmoded forms. The problem is partly one of readaptation. Judicial review is an historic safeguard which should be reinterpreted in terms which are meaningful under modern conditions; but this reinterpretation should preserve as much of the old as is compatible with the effectiveness of administrative action in the public interest. The problem is also partly one of invention. New safeguards must be invented to take the place of those particular features of the rule of law which are no longer workable. One avenue for creative thought leads in the direction of improvement of administrative personnel; but the future may hold new answers of which nobody has yet dreamed. Such an approach calls for careful appraisal in contradistinction to both negative criticism and uncritical acceptance of the administrative function.

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(J. Ht.)

ADMINISTRATIVE REGULATION can best be defined by contrasting it with legislative regulation. The latter consists in the detailed determination of rights and duties by statute and their enforcement, either at the instance of private parties or on the government's initiative, by means of the regular law enforcement machinery. Administrative regulation, by contrast, leaves much more to the discretion of government officials, generally members of specialized administrative agencies which normally possess considerable independence from the cabinet or chief executive. This power may be exercised by issuing general rules elaborating broad statutory grants of authority, by granting, denying, or revoking licences or permits, or by issuing mandatory orders.

Discretionary administrative power is in no sense a new phenomenon. The licensing power in particular has long been used, especially for the protection of the public health and safety. Restaurants, for example, commonly are not permitted to operate without a licence, which can be secured only by meeting certain standards of sanitation. But the term "administrative regulation" usually refers to the application of the administrative method to the regulation of business for what may be broadly termed economic objectives. In this sense administrative regulation is a comparatively recent development.

In England the establishment of a Railway commission in 1873 may be taken as the starting point. This semi-administrative tribunal was little more than a specialized court, but its weakness led to the creation later of agencies with more power. The Railway Rates tribunal, which was set up in 1921, still is more of a court than an administrative regulatory agency; however, it does

possess extensive discretionary authority, although it still has no power to initiate proceedings. The Electricity commissioners, established in 1919 for the licensing of electricity suppliers, have quite broad regulatory powers. They have complete control over who shall produce electricity and under what conditions and at what prices. After 1930, public service passenger vehicles using streets and highways have, like railways, been subject to extensive control. In this case, moreover, the law is administered by authorities (the Area Traffic commissioners) who possess wide discretionary powers and do not follow a rigid, legalistic procedure. Similar but more limited regulation was extended to goods transport (trucking) in 1933. In a slightly different category are the various boards set up by authority of the Agricultural Marketing acts of 1931 and 1933. Producers of a given commodity may secure the permission of the minister of agriculture for the establishment of a board whose members they elect and who possess extensive powers over the marketing activities of the group. The trend after 1936 has been away from producer-controlled regulatory authorities and several acts have provided boards or commissions for particular industries with members appointed by the appropriate minister. The Cotton Industry board, established in 1939, exemplifies this trend and also is significant for its extension of administrative control into a new field.

Administrative regulation has found wider use and been more fully developed in the United States than in England. It was the need for controlling the discriminatory practices and other abuses of the railroads which led, in the United States, as in England, to the first resort to administrative regulation in the modern sense. The Interstate Commerce commission was created in 1887 for this purpose. Reinforced by the Hepburn act of 1906 and subsequent amendments to the Interstate Commerce act, it became the archetype of American regulatory commissions, combining quasi-legislative, quasi-judicial and purely administrative powers. Chief among the commissions which followed in the wake of the Interstate Commerce commission are the Federal Trade commission (1914), the Federal Power commission (1920), the Federal Communications commission (1927, 1934), the Securities and Exchange commission (1934), the National Labor Relations board (1935), the United States Maritime commission (1916, 1936), and the Civil Aeronautics board (1938, 1940). (Where two dates are given the earlier applies to a predecessor agency with a different title.) In some cases broad regulatory powers are given to a department head, as to the secretary of agriculture by the Packers and Stockyards act of 1921 and by the Agricultural Adjustment act of 1938. A similar development has taken place in the states.

Some conception of the powers wielded by these agencies may be had from an enumeration of legislative standards which they apply. These include "reasonable rates," "public convenience and necessity," "unreasonable discrimination," and "unfair labour practices [which] interfere with, restrain, or coerce employes [or] dominate or interfere with any labour organization."

The increasing reliance upon governmental regulation of economic activities, the mounting complexities of those activities themselves and the trend toward substituting prevention for punishment comprise the major causes of the growing use of the administrative method. This method enables the legislature to leave to others the elaboration of detailed regulations for which it has neither the time nor the competence. It also provides expert agencies far better fitted than the courts for the application of regulatory legislation. Without the flexibility of this form of regulation, legislatures would be at a loss to cope with many of the problems confronting them by a dynamic industrialized society.

Like every new form of power, administrative regulation involves its own peculiar dangers and abuses, for which it has been severely criticized. Because of the broad discretion commonly delegated to regulatory authorities, it is complained that a cardinal principle of the "rule of law," that rights and duties should be clearly stated in advance of action by the government, is violated. Discretion also opens the door to arbitrary action. The

fact that it is common practice to grant these agencies a considerable amount of autonomy leads to the objection that they are undemocratic. Finally, the fact that a single agency makes investigations and findings of fact, brings charges, hears the replies to the charges, and renders decisions, is alleged to violate the principle that the same person should not be both prosecutor and judge—and also, in the United States, the doctrine of the separation of powers.

In practice, adequate safeguards against these abuses have been developed and are generally applied. They include numerous procedural devices, such as, opportunity for hearings, the requirement that all decisions affecting private rights be accompanied by a published statement of reasons, and the separation of the prosecuting and the adjudicating functions within the agencies' staffs. Although administrative agencies are not rigidly bound by precedent, they find it to their own great advantage to develop standards for their guidance and to adhere to consistent policies. Nor are they by any means unchecked from without. On the contrary, they operate within legislative grants of authority, by means of annual appropriations, and frequently are subject to legislatively prescribed procedure. They are also liable to control by the judiciary, at least to the extent that the courts will determine whether they have acted within the authority of and subject to, the restrictions laid down by the legislature, and, in the United States, whether they have complied with the requirements of "due process of law." Finally, they are responsible in varying degrees to the executive branch of the government.

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ADMINISTRATOR: see WILL OR TESTAMENT.

ADMIRABLE CRICHTON: see CRICHTON, JAMES.

ADMIRAL, the rank and title of the naval officer who commands a fleet or subdivision of a fleet. In the United States navy there are four grades of admiral, i.e., admiral of the fleet, admiral, vice-admiral, rear admiral, in descending order of seniority. The first was created, 1899, for Admiral George Dewey. The second and third, corresponding to general and lieutenant general in the army, were created in 1866. In the British navy there are four corresponding grades: admiral of the fleet, admiral, vice-admiral and rear admiral. These titles superseded those of admiral of the blue, red and white.

The rank of admiral essentially applies to flag officers of the military branch who have commanded, or who have qualified to command, a fleet or squadron at sea. In the U.S. navy, certain officers of the nonmilitary branches are given the rank of: rear admiral, medical corps; rear admiral, supply corps; rear admiral, construction corps; rear admiral, civil engineer corps. They are not flag officers.

The corresponding ranks in the United States services are:

NAVY	ARMY
Admiral of the fleet.....	General of the army
Admiral	General
Vice-admiral	Lieutenant general
Rear admiral	Major general
Commodore	Brigadier general

The rank of commodore, after being abandoned for a long period, was re-established in 1943.

The corresponding ranks in the British services are:

NAVY	ARMY	AIR FORCE
Admiral of the fleet....	Field marshal	Marshal of the royal air force
Admiral	General	Air chief marshal
Vice-admiral	Lieut. general	Air marshal
Rear admiral	Major general....	Air vice-marshal

In the United States the ranks of admiral and vice-admiral are temporarily conferred (ex officio) upon the following commanders:

ADMIRAL	VICE-ADMIRAL
Chief of naval operations.....	Commander scouting force
Commander in chief, U.S. fleet.....	Commander battleships
Commander in chief, Atlantic fleet.....	Commander aircraft
Commander in chief, Pacific fleet	
Commander battle force	

The chiefs of bureau in the U.S. navy rank as rear admirals.

It is exceptional for an admiral of the fleet to fly his flag at sea in peacetime. Commanders in chief of the main British fleet and of the premier home ports—Portsmouth and Plymouth—are generally full admirals, and the lesser independent commands and second-in-command are vice-admirals or rear admirals. The political and administrative head of the British navy up to the year 1546 was known as the lord high admiral, which office is now executed by the lords commissioners of the admiralty. There still remain the honorary titles of vice- and rear admiral of Great Britain, in compliment to selected senior flag officers. (W. B. Cx.)

ADMIRALTY. The department of state that advises the British government and takes the necessary executive action on all questions relating to the interests and territories of the British empire by sea is the admiralty. It is also responsible for building, manning, maintaining and administering the royal navy.

The board of admiralty consists of lords commissioners who were originally appointed by royal letters patent to execute the office of lord high admiral, the powers of which office were statutorily vested in commissioners by the Admiralty act of 1690, although the system whereby responsibility centred in a single high officer—the lord high admiral of the United Kingdom—was virtually terminated in the reign of Henry VIII.

• From time to time after that date, the sovereign exercised the royal prerogative to revive the office of lord high admiral, as, for example, when Charles II conferred it on his brother, James, duke of York (afterward James II); but after the reign of Queen Anne only one such appointment was made, that of the duke of Clarence (afterward William IV), who held the office of lord high admiral in 1827–28.

For nearly three centuries before the Admiralty act of 1832, administration of the service was the responsibility of a separate body known as the navy board. The constitution of this board varied, but it was nearly always riddled with political influence and frequently with corruption and inefficiency. Under that act, the board of admiralty was invested with all the powers and duties of the navy board and also of a third organization, the victualling board. Yet another organization, originally instituted specially for the navy, was the ordnance committee, but this passed into military hands and was long a byword for sloth and inefficiency. It became a joint concern in 1881 and, under the title of ordnance board, came to deal with design and trials of ordnance for all three services.

The constitution of the board of admiralty under the act of 1832 provided for superintending lords of the various departments but for no organization for war planning or the conduct of operations, with the result that the system broke down badly when it was put to the test by the Crimean War. Various attempts at reform were made, notably by H. C. E. Childers on becoming first lord in 1868 and then by G. J. Goschen who succeeded him in 1871. But no proper naval staff existed until Winston Churchill was appointed to that office in 1911; even then it was not properly constituted nor given the necessary standing to prevent several naval disasters and the miscarriage of the Dardanelles campaign in the early part of World War I.

As that war developed, it became evident that the departmental lords were too fully occupied with administration and supplies to be able to take an effective part in that joint responsibility for the operational side of the naval war which constitutionally they were expected to do. In the autumn of 1917, after Adm. John R. (later Earl) Jellicoe had become first sea lord, the naval staff system was put on an altogether sounder basis. In effect, there became two separate though closely co-operating bodies within the admiralty, one dealing with the operations and the other with the maintenance of the navy. Although there were modifications in detail, this remained the governing principle in the organization of the admiralty.

At mid-20th century the constitution of the board of admiralty, as laid down by Order in Council of May 21, 1947, was as follows:

The first lord; the first sea lord and chief of naval staff; the second sea lord and chief of naval personnel; the third sea lord and controller of the navy; the fourth sea lord and chief of supplies and transport; the fifth sea lord and deputy chief of naval staff (air); the vice-chief of naval staff; the assistant chief of naval staff; the parliamentary and financial secretary; the civil lord; and the permanent secretary.

The first lord is responsible to the king and to parliament for all the business of the admiralty; in the exercise of this over-all responsibility he may assign to the other members of the board such duties and responsibilities as he may think fit. The following is a brief statement of the duties and responsibilities so exercised by other members of the board, subject to the overriding responsibility of the first lord and to the reservation that the first sea lord in his personal capacity remains responsible to parliament for professional advice on naval affairs generally.

The first sea lord is the chief naval professional adviser to the government and the first lord. He is also chief of the naval staff and as such is assisted by the vice-chief of naval staff, the deputy chief of naval staff (air) and the assistant chief of naval staff, who are all members of the board. The naval staff, under the chief of the naval staff and his supporting lords commissioners, is responsible for the formulation of strategical policy, including strategical planning, formulation of tactical doctrine, disposition of the fleet and the statement of the broad requirements both as regards quantities and specifications of H.M. ships and their fighting equipment.

The second sea lord is responsible for the recruitment and entry of officers and men of the royal navy and royal marines and for their training, discipline, welfare, education and the general administration of admiralty establishments connected therewith. He is also responsible for the recruitment, training and administration of the women's royal naval service and naval reserves. The third sea lord is responsible for the construction, equipment and repair of ships and their armaments; for research and development; for the oversight of admiralty establishments connected therewith; and for the supply, distribution and maintenance of all warlike stores. The fourth sea lord is responsible for the provision of naval, victualling and medical stores, and fuel for the fleet, and for the movement of persons and matériel as required for the naval service. He is also concerned with pay, allowances and pensions. The fifth sea lord is responsible for the general direction and co-ordination of policy on all naval air matters. In his capacity as deputy chief of naval staff (air), the fifth sea lord deputizes for the chief and vice-chief of naval staff as necessary.

The parliamentary and financial secretary assists the first lord in his parliamentary duties and in connection with matters relating to the financial policy.

The civil lord assists the first lord in his parliamentary duties and has a general responsibility for works services and for the conditions of service of the admiralty's industrial employees.

The permanent secretary is responsible for general co-ordination of admiralty business on behalf of the board; the interior economy of the admiralty office; the administration of the civil staff; and for navy contracts. As accounting officer for navy votes he is responsible for the control of expenditure and is adviser to the board of admiralty on financial questions. He is responsible for paying, receiving and accounting for all moneys administered by the department.

The only lords who automatically resign when the prime minister resigns are the first lord and the civil lord, both being mem-

bers of parliament.

The naval staff of the admiralty consists essentially of picked naval officers of the rank of commander and above, working under the orders of the chief of naval staff (first sea lord) and his supporting sea lords, with the necessary civilian clerical staff. It is responsible for the collection of intelligence; the formulation of strategical policy, including strategical planning, and of tactical doctrine; it states broad requirements as regards numbers and design of H.M. ships, their weapons and equipment; it studies the changes in naval warfare consequent on scientific and technical developments; it advises on weapon training and on the priorities to govern the effort to be devoted to the various details of armaments.

An ever increasing amount of attention was devoted by the naval staff during the 20th century to naval aviation in all aspects. Indeed, the air branch became the most important one in the service, and was strongly represented in the admiralty. Numerically, however, the greater part of the admiralty was still devoted to the administration, manning, construction, equipment and supplying of the navy at mid-century. Many of the departments concerned with these matters, under their respective superintending sea lords, had a steady flow of naval officers bringing to them up-to-date practical and professional knowledge of sea-going requirements; others of a less essentially naval character were staffed entirely by civil servants. The admiralty had its own scientists, but it also shared scientific research with the other two service departments through the medium of the ministry of defence.

The most spacious part of the admiralty building in London runs across the north side of the Horse Guards parade; adjoining it is the old building with its beautiful frontage in Whitehall. The latter dates from 1723. An ugly excrescence, popularly known as "Lenin's tomb," was built on at the northwest corner during World War II to provide a bombproof retreat in case of damage to the normal accommodation.

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(E. A.)

ADMIRALTY, HIGH COURT OF. The High Court of Admiralty of England was the court of the deputy or lieutenant of the admiral. It is supposed in the *Black Book of the Admiralty* to have been founded in the reign of Edward I; but it would appear, from the learned discussion of R. G. Marsden, that it was established as a civil court by Edward III. in the year 1360; the power of the admiral to determine matters of discipline in the fleet, and possibly questions of piracy and prize, being somewhat earlier. At first there were separate admirals or rear-admirals of the north, south and west, each with deputies and courts. A list of them was collected by Sir H. Spelman. These were merged in or absorbed by one high court early in the 15th century. Sir Thomas Beaufort, afterwards earl of Dorset and duke of Exeter (appointed admiral of the fleet 1407, and admiral of England, Ireland and Aquitaine 1412, which latter office he held till his death in 1426), certainly had a court, with a marshal and other officers, and forms of legal process—mandates, warrants, citations, compulsories, proxies, etc. Complaints of encroachment of jurisdiction by the admiralty courts led to the restraining acts, 13 Ric. II. c. 5 (1389), 15 Ric. II. c. 3 (1391) and 2 Hen. IV. c. 11 (1400).

Jurisdiction.—The original object of the institution of the courts or court seems to have been to prevent or punish piracy and other crimes upon the narrow seas and to deal with questions of prize; but civil jurisdiction soon followed. The jurisdiction in criminal matters was transferred by the Offences at Sea Act, 1536, to the admiral or his deputy and three or four other substantial persons appointed by the lord chancellor, who were to proceed according to the course of the common law. By the Central Criminal Court Act, 1834, cognizance of crimes committed within the jurisdiction of the admiralty was given to the central criminal court. By an act of 1844 it has been also given to the justices of assize; and crimes done within the jurisdiction of the admiralty are now

tried as crimes committed within the body of a county. See also the Criminal Law Consolidation Acts of 1861.

From the time of Henry IV. the only legislation affecting the civil jurisdiction of the High Court of Admiralty till the time of Queen Victoria is to be found in an act of 1540, enabling the admiral or his lieutenant to decide on certain complaints of freighters against shipmasters for delay in sailing, and one of 1562, giving the lord high admiral of England, the lord warden of the Cinque Ports, their lieutenants and judges, co-ordinate power with other judges to enforce forfeitures under that act—a very curious and miscellaneous statute called "An Act for the Maintenance of the Navy."

In an act of 1534, with regard to ecclesiastical appeals from the courts of the archbishops to the Crown, it is provided that the appeal shall be to the king in Chancery, "and that upon every such appeal a commission shall be directed under the great seal to such persons as shall be named by the king's highness, his heirs or successors, like as in cases of appeal from the Admiralty Court." It is only in this incidental recognition that recorded authority for appeals from the admiralty to persons commissioned under the great seal is to be found. The appeal to these "persons," called delegates, continued until it was transferred first to the Privy Council and then to the judicial committee of the Privy Council by acts of 1832 and 1833.

The early jurisdiction of the court appears to have been exercised very much under the same procedure as that used by the courts of common law. Juries are mentioned, sometimes of the county and sometimes of the county and merchants. But the connection with foreign parts led to the gradual introduction of a procedure resembling that coming into use on the Continent and based on the Roman civil law.

Restraining Acts.—The material enactments of the restraining statutes were as follows:—An act of 1389 (13 Ric. II. c. 5) provided that "the admirals and their deputies shall not meddle from henceforth of anything done within the realm, but only of a thing done upon the sea, as it hath been used in the time of the noble prince king Edward, grandfather of our lord the king that now is." The Act of 1391 (15 Ric. II. c. 3) provided that "of all manner of contracts, pleas and quarrels, and other things rising within the bodies of the counties as well by land as by water, and also of wreck of the sea, the admiral's court shall have no manner of cognizance, power, nor jurisdiction; but all such manner of contracts, pleas and quarrels, and all other things rising within the bodies of counties, as well by land as by water, as afore, and also wreck of the sea, shall be tried, determined, discussed and remedied by the laws of the land, and not before nor by the admiral, nor his lieutenant in any wise. Nevertheless, of the death of a man, and of a mayhem done in great ships, being and hovering in the main stream of great rivers, only beneath the (bridges) of the same rivers (nigh) to the sea, and in none other places of the same rivers, the admiral shall have cognizance, and also to arrest ships in the great flotes for the great voyages of the king and of the realm; saving always to the king all manner of forfeitures and profits thereof coming; and he shall have also jurisdiction upon the said flotes, during the said voyage only; saving always to the lords, cities, and boroughs, their liberties and franchises." The statutes of Richard, except the enabling part of the second, were repealed by the Civil Procedure Acts Repeal Act, 1879. The formation of a High Court of Justice rendered them obsolete.

In the reign of James I. the chronic controversies between the courts of common law and the admiralty court as to the limits of their respective jurisdictions reached an acute stage. We find the records of it in the second volume of Marsden's *Select Pleas in the Court of Admiralty*, and in Lord Coke's writings: *Reports*, part xiii. 51; *Institutes*, part iv. chap. 22. In this latter passage Lord Coke records how, notwithstanding an agreement asserted to have been made in 1575 between the justices of the King's Bench and the judge of the admiralty, the judges of the common law courts successfully maintained their right to prohibit suits in admiralty upon contracts made on shore, or within havens, or creeks, or tidal rivers, if the waters were within the body of

any county, wheresoever such contracts were broken, for torts committed within the body of a county, whether on land or water, and for contracts made in parts beyond the seas. It is due to the memory of the judges of Lord Coke's time to say that, at any rate as regards contracts made in *partibus transmarinis*, the same rule appears to have been applied at least as early as 1544, the judges then holding that "for actions transitory abroad, action may lie at common law."

Judge's Patent.—All the while, however, the patents of the admiralty judge purported to confer on him a far ampler jurisdiction than the jealousy of the other courts would concede to him. The patent of the last judge of the court, Sir Robert Joseph Phillimore, dated Aug. 23, 1867, styles him "Lieut. Offl Princl and Commissary Genl and Special in our High Court of Admiralty of Eng. and President and Judge of the same," and gives to him power to take cognizance of "all causes, civil and maritime, also all contracts, complaints, offences or suspected offences, crimes, pleas, debts, exchanges, accounts, policies of assurance, loading of ships, and all other matters and contracts which relate to freight due for the use of ships, transportation, money or bottomry; also all suits civil and maritime between merchants or between proprietors of ships and other vessels for matters in, upon, or by the sea, or public streams, or fresh-water ports, rivers, nooks and places overflowed whatsoever within the ebbing and flowing of the sea, and high-water mark, or upon any of the shores or banks adjacent from any of the first bridges towards the sea through England and Ireland and the dominions thereof, or elsewhere beyond the seas." Power is also given to hear appeals from vice-admirals; also "to arrest . . . according to the civil laws and ancient customs of our high court . . . all ships, persons, things, goods, wares and merchandise"; also "to enquire by the oaths of honest and lawful men . . . of all . . . things which . . . ought to be enquired after, and to mulct, arrest, punish, chastise, and reform"; also "to preserve the public streams of our admiralty as well for the preservation of our royal navy, and of the fleets and vessels of our kingdom . . . as of whatsoever fishes increasing in the rivers"; also "to reform nets too straight and other unlawful engines and instruments whatsoever for the catching of fishes"; also to take cognizance "of the wreck of the sea . . . and of the death, drowning and view of dead bodies," and the conservation of the statutes concerning wreck of the sea and the office of coroner (1276), and concerning pillages (1353), and "the cognizance of mayhem" within the ebb and flow of the tide; all in as ample manner and form as they were enjoyed by Dr. David Lewis (judge from 1558 to 1584), Sir Julius Caesar, and the other judges in order (22 in all) before Sir Robert Phillimore. This form of patent differs in but few respects from the earlier Latin patents—*tempore* Henry VIII.—except that they have a clause *non obstantibus statutis*.

Modern Progress.—As has been said, however, the contention of the common law judges prevailed, and the admiralty court (except for a temporary revival under Cromwell) sank into comparative insignificance during the 17th century. The great maritime wars of the 18th century gave scope to the exercise of its prize jurisdiction; and its international importance as a prize court in the latter half of the 18th and the first part of the 19th centuries is a matter of common historical knowledge. There were upwards of 1,000 prize causes each year between 1803 and 1811, in some years upwards of 2,000.

There were other great judges; but Sir William Scott, afterwards Lord Stowell, is the most famous. Before his time there were no reports of admiralty cases, except Hay and Marriott's prize decisions. But from his time onwards there has been a continuous stream of admiralty reports, and we begin to find important cases decided on the instance as well as on the prize side.

In the reign of Queen Victoria, two enabling statutes, 1840 and 1861, were passed and greatly enlarged the jurisdiction of the court. The manner in which these statutes were administered by Dr. Stephen Lushington and Sir R. J. Phillimore, whose tenure of office covered the whole period of the queen's reign till the creation of the High Court of Justice, the valuable assistance rendered by the nautical assessors from the Trinity House, the

great increase of shipping, especially of steam shipping, and the number and gravity of cases of collision, salvage and damage to cargo, restored the activity of the court and made it one of the most important tribunals of the country. In 1875, by the operation of the Judicature Acts of 1873 and 1875, the High Court of Admiralty was with the other great courts of England formed into the High Court of Justice. The principal officers of the court in subordination to the judge were the registrar (an office which always points to a connection with canon or civil law), and the marshal, who acted as the maritime sheriff, having for his baton of office a silver oar. The assistance of the Trinity Masters, which has been already mentioned, was provided for in the charter of incorporation of the Trinity House. These officers and their assistance have been preserved in the High Court of Justice.

Practitioners in the Court.—Till the year 1859 the practitioners in the High Court of Admiralty were the same as those in the ecclesiastical courts and distinct from those who practised in the ordinary courts. Advocates took the place of barristers, and proctors of solicitors. The place of the attorney-general was taken by the king's or queen's advocate-general, and that of the treasury solicitor by the king's or queen's procurator or proctor. There were also an admiralty advocate and an admiralty proctor.

In an act of 1859 the practice was thrown open to barristers and to attorneys and solicitors.

Upon the next vacancy after the courts were thrown open, the Crown altered the precedence and placed the queen's advocate after the attorney- and solicitor-general. There were two holders of the office under these conditions, Sir R. J. Phillimore and Sir Travers Twiss. The office was not filled up after the resignation of the latter, nor was the office of admiralty advocate filled up when next it became vacant.

Ireland.—The High Court of Admiralty of Ireland, being formed on the same pattern as the High Court in England, sat in the Four Courts, Dublin, having a judge, a registrar, a marshal and a king's or queen's advocate. In peace time and war time alike it exercised only an instance jurisdiction, though in 1793 it claimed to exercise prize jurisdiction (*see ADMIRALTY JURISDICTION*). No prize commission ever issued to it. By the Irish Judicature Act of 1877 it was directed that it should be amalgamated with the Irish High Court of Justice upon the next vacancy in the office of judge, and this subsequently took place. There was no separate lord high admiral for Ireland.

Scotland.—At the Union, while the national functions of the lord high admiral were merged in the English office it was provided by the Act of Union that the Court of Admiralty in Scotland should be continued "for determination of all maritime cases relating to private rights in Scotland competent to the jurisdiction of the Admiralty Court." This court continued till 1831, when its civil jurisdiction was given to the Court of Session and the Sheriffs' Courts (*see ADMIRALTY JURISDICTION*).

See J. Godolphin, View of the Admiralty Jurisdiction (1661); Sir Travers Twiss, *Black Book of the Admiralty*, Rolls' series (1871); R. G. Marsden, *Select Pleas in the Court of Admiralty*, published by the Selden Society (1894).

ADMIRALTY ISLANDS, a group of about 40 islands in the Bismarck archipelago, north of New Guinea, between 1° and 3° S. and 146° and 148° E. The largest of the islands is Manus, sometimes called Great Admiralty island; its principal town is Lorengau, on the northeastern coast of Manus. The estimated native population in 1940 was 13,450 and there were 37 non-native inhabitants. The principal economic activities of the islands are coco-nut plantations (10,457 hectares under cultivation in 1940) and pearl and other shell fisheries. Manus has hills running up to 3,000 ft.; the other islands are mostly low and of coral formation. The Admiralty islands were formerly part of the German protectorate, which also included eastern New Guinea, from 1885 until 1914. They were then occupied by Australian troops and were assigned to Australian administration as part of the League of Nations mandate for eastern New Guinea, which included adjacent islands. They were invaded by the Japanese in Jan. 1942, during the southward sweep that brought them to the northern coast of New Guinea and to the Solomons. The natives are Papuans, with a variety of local dialects, addicted to cannibalism and not hospitable to strangers, although they were tamed to some extent under the man-

datory administration. The islands were discovered by Dutch navigators in 1616 and were visited by Philip Carteret in 1767. The first landing, however, was from the "Challenger" in 1875.

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ADMIRALTY JURISDICTION. The courts by which, as far as we know, admiralty jurisdiction in civil matters was first exercised were the following. In and throughout England the courts of the several admirals soon combined into one High Court of Admiralty (*see ADMIRALTY, HIGH COURT OF*). Within the territories of the Cinque Ports the Court of Admiralty of the Cinque Ports exercised a co-ordinate jurisdiction. In certain towns and places there were local courts of vice-admiralty. In Scotland there existed the Scottish High Court of Admiralty, in Ireland the Irish High Court of Admiralty. Of these courts that of the Cinque Ports alone remains untouched. The Scottish Court was abolished, and its civil jurisdiction given to the Court of Session and to the courts of the sheriffs by the Court of Session Act, 1830—not, however, till a decision given by it and the appeal therefrom to the House of Lords had established a remarkable rule of admiralty law in cases of collision (*Hay v. le Neve*, 1824, 2 Shaw, Sc. App. Cas. 395). The act states that the Court of Justiciary held cumulative jurisdiction with the Court of Admiralty in criminal matters. The local vice-admiralty courts in England had ceased to do much work when they were abolished by the Municipal Corporations Act, 1835. The High Court became, with the other superior courts, a component part of the High Court of Justice by virtue of the Judicature Acts, 1873 and 1875. And the Irish Court in like manner became a part of the High Court of Justice in Ireland by virtue of the Judicature Act passed in 1877.

Vice-Admiralty Courts.—As England first, and Great Britain afterwards, acquired colonies and possessions beyond seas, vice-admiralty courts were established. The earliest known was that in Jamaica, established in the year 1662. Some vice-admiralty courts created for prize purposes in the eighteenth century were suffered to expire after 1815. In the year 1863, when the act regulating the vice-admiralty courts was passed, there were vice-admiralty courts established in 45 several portions of the King's dominions; to which by an act of 1867 one for the Straits Settlements was added. These courts have been regulated from time to time by the following statutes: 2 and 3 Will. IV. c. 51, 26 and 27 Vict. c. 24 (Vice-Admiralty Courts Act, 1863), already cited, and 30 and 31 Vict. c. 45 (Vice-Admiralty Courts Act Amendment Act, 1867); and by the slave trade acts, of which the last and consolidating act was that of 1873.

In 1890 the Colonial Courts of Admiralty Act provided that, except in the colonies of New South Wales, Victoria, St. Helena and British Honduras, vice-admiralty courts should be abolished and colonial courts of admiralty substituted. There is power, however, reserved to the Crown to erect through the admiralty in any British possession any vice-admiralty court, except in India or any British possession having a representative legislature. No vice-admiralty court so established can exercise any jurisdiction except for some purpose relating to prize, the royal navy, the slave trade, foreign enlistment, Pacific Islanders' protection, and questions relating to treaties or conventions on international law.

Colonial Courts of Admiralty.—By the Colonial Courts of Admiralty Act, 1890, already referred to, every court of law in a British possession which is declared by its legislature to be such, or if there be no such declaration, which has original unlimited civil jurisdiction, shall be a court of admiralty.

There used to be vice-admiralty courts for Calcutta, Madras and Bombay; but by the India High Courts Act, 1861, s. 9, the admiralty jurisdiction was given to the High Courts of these places.

Consular Courts.—Admiralty jurisdiction was given to the consular courts in China, Japan and Turkey (those in Japan and Turkey have disappeared with the capitulations), and by s. 12 of the Colonial Admiralty Courts Act any court established by H.M. for the exercise of jurisdiction in any place outside H.M.'s dominion may have admiralty jurisdiction granted to it.

Australia.—By the Commonwealth of Australia Constitution Act, 1900, a federal supreme court, to be called the High Court of Australia, is created, and the parliament of the Commonwealth may make laws conferring original jurisdiction on the High Court in matters of admiralty and maritime jurisdiction.

Isle of Man.—There is a court of admiralty in the Isle of Man of which the water-bailiff is judge. He is also styled admiral. It is said to have jurisdiction in salvage and over other maritime matters occurring within three leagues from the shore.

County and Local Courts.—Modern statutes have given admiralty jurisdiction to the City of London Court, Court of Passage and to county courts in the following matters: Salvage, where the value of the salvaged property does not exceed £1,000, or the claim for reward £300; towage, necessities and wages, where the claim does not exceed £150; claims for damage to cargo, or by collision, up to £300 (and for sums above these prescribed limits by agreement between the parties); and claims arising out of breaches of charter parties and other contracts for carriage of goods in foreign ships, or torts in respect thereof, up to £300. This jurisdiction is restricted to subjects over which jurisdiction was possessed by the High Court of Admiralty at the time when the first of these acts was passed, except as regards the last branch of it (*the Aline*, 1880, 5 Ex. Div. 227; *R. v. Judge of City of London Court* [1892] 1 Q.B. 272). In analogy with the county court admiralty jurisdiction created in England, a limited admiralty jurisdiction was given in Ireland to the recorders of certain boroughs and the chairmen of certain quarter sessions; in salvage cases, where a county court in England would have jurisdiction, magistrates, recorders and chairmen of quarter sessions may have jurisdiction as official arbitrators (Merchant Shipping Act, 1894, s. 547). In Scotland, admiralty suits in cases not exceeding the value of £25 are exclusively tried in the sheriff's court; while over that limit the sheriff's court and the court of session have concurrent jurisdiction. The sheriff has also criminal admiralty jurisdiction, but only as to crimes which he would be competent to try if committed on land (*The Court of Session Act*, 1830, ss. 21 and 22).

By an act of 1821 an arbitral jurisdiction in cases of salvage was given to certain commissioners of the Cinque Ports.

The appeal from county courts and commissioners is to the High Court of Justice, and is exercised by a divisional court of the Probate, Divorce and Admiralty Division. In cases arising within the Cinque Ports there is an optional appeal to the Admiralty Court of the Cinque Ports. The appeal from the High Court of Justice is in ordinary admiralty matters, as in others, to the Court of Appeal, and from thence to the House of Lords.

Civil Jurisdiction.—In the high courts, whether in England, Scotland or Ireland, it is not now necessary to distinguish their civil admiralty jurisdiction, from their ordinary civil jurisdiction, except for the purpose of seeing whether there can or cannot be process *in rem*. Not that every admiralty action can of right be brought *in rem*, but that no process *in rem* lies at the suit of a subject unless it be for a matter of admiralty jurisdiction—one, for instance, that could in England have been tried in the High Court of Admiralty. Now these matters of admiralty jurisdiction with process *in rem* range themselves under four primary and four supplementary heads. The four primary are damage, salvage, bottomry, wages; and the four supplementary are extensions due to one or other of the statutes of 1840 (Admiralty Court) and 1861 (Admiralty Court Act). They are damage to cargo carried in a ship, necessities supplied to a ship, mortgage of ship, and master's claim for wages and disbursements on account of a ship. In all these cases, primary and secondary, the process of which a plaintiff can avail himself for redress, may be either *in personam* as in other civil suits, or by arrest of the ship, and, in cases of salvage and bottomry, the cargo. Whenever, also, the ship can be arrested, any freight due can also be attached, by arrest of the cargo to the extent only of the freight which it has to pay. For the purpose of ascertaining whether or not process *in rem* would lie, there have been distinctions as nice, and the line of admiralty jurisdiction has been drawn as carefully, as in the cases of the admiralty jurisdiction of the county courts (the

Theta, [1894] P. 280; the *Gas Float Whitton* [1897] App. Cas. 337). Similar questions have been raised in the U.S., from *De Lovio v. Boit* (1815, 2 Gall. 398), and *Ramsay v. Allegre* (1827, 12 Wheat. 611), down to the more modern cases which are quoted in the arguments and judgments in the *Gas Float Whitton*. The disciplinary jurisdiction once exercised by the Admiralty Court, over the royal navy and merchant vessels, may be said to be obsolete in time of peace, the last remnant of it being suits against merchantmen for flying flags appropriate to men-of-war (the *Minerva*, 1800 3, C. Rob. 34), a matter now more effectively provided against by the Merchant Shipping Act, 1894. In time of war, however, it was exercised in some instances as long as the Admiralty Court lasted, and is now in consequence exercisable by the High Court of Justice (see PRIZE COURTS AND PRIZE LAW). It was, perhaps, in consequence of its ancient disciplinary jurisdiction that the Admiralty Court was made the court to enforce certain portions of the Foreign Enlistment Act, 1870.

Finally, appeals from decisions of courts of inquiry, under the Merchant Shipping Act, cancelling or suspending the certificates of officers in the merchant service, may be made to the Probate, Divorce and Admiralty Division of the High Court of Justice.

Criminal Cases.—The Admiralty jurisdiction in criminal matters extends over all crimes committed on board British ships at sea or in tidal waters, even though such tidal waters be well within foreign territory (*R. v. Anderson*, 1868, L.R. 1 C.C.R. 161), but not over crimes committed on board foreign vessels upon the high seas (*R. v. Serva*, 1845, 1 Denison C.C. 104). Whether it extended over crimes committed on foreign ships within territorial waters of the United Kingdom, and whether a zone of three miles round the shores of the United Kingdom was for such purpose territorial water, were the great questions raised in *R. v. Keyn* (the *Franconia*, L.R. 2 Ex. Div. 126), and decided in the negative by the majority of the judges. Since then, however, the legislature has brought these waters within the jurisdiction of the admiralty by the Territorial Waters Jurisdiction Act, 1878. Section 2 runs as follows: "An offence committed by a person, whether he is or is not a British subject, on the open sea within the territorial waters of British dominions, is an offence within the jurisdiction of the admiral, although it may have been committed on board or by means of a foreign ship." By s. 7 the "jurisdiction of the admiral" is defined as "including the jurisdiction of the admiralty of England or Ireland, or either of such jurisdictions as used in any act of parliament" (see WATERS, TERRITORIAL).

Where portions of the sea and tidal waters, by reason of their partially land-locked positions, are deemed to be in the body of a county, there is no admiralty jurisdiction. Crimes are tried as if they were committed on land within the same county.

Pirates, whatever flag they pretended to fly, were, from 1360, wherever their crimes were committed, subject to admiralty jurisdiction. The criminal jurisdiction of the admiralty was first exercised by the High Court of Admiralty; and then, by the Offences at Sea Act, 1536, transferred to commissioners appointed under the great seal, among whom were to be the admiral or admirals, his or their deputies. Admiralty sessions were held for this purpose till 1834. Admiralty criminal jurisdiction is now, by virtue of the series of statutes, the Offences at Sea Act, 1799, the Central Criminal Court Act, 1834, Offences at Sea Act, 1844, and the criminal law consolidation acts passed in 1861, exercised by the Central Criminal Court and by the ordinary courts of assize. Special provision for trial in the colonies of offences committed at sea was made by William III (1698-99), in the Offences at Sea Act, 1806, and the Admiralty Offences (Colonial) Act, 1849. (P.)

See Clunet, *Journal du droit international privé*; E. C. Benedict, *Law of American Admiralty* (1940); E. S. Roscoe, *The Admiralty Jurisdiction and Practice of the High Court of Justice*, 5th ed. (London, 1931), *Studies in the History of the Admiralty and Prize Courts* (London, 1932).

UNITED STATES

Admiralty jurisdiction was exercised in the American colonies by vice-admiralty courts until the year 1776, then by the State

admiralty courts until 1789. The Constitution, Art. III., s. 2, provides that the judicial power of the United States "shall extend to all cases of admiralty and maritime jurisdiction."

The Judiciary Act of 1789 (1 U.S.S.L. 76) granted original jurisdiction to United States district courts. The circuit courts were given concurrent original jurisdiction over seizures for slave trading, condemnations of property used by persons in insurrection (R.S. 629, 2nd ed.), and in the coolie trade (R.S. 2159, 2nd ed.). The supreme court of the District of Columbia was given the same jurisdiction as that of the United States district courts in 1901 (31 U.S.S.L. 1199). Formerly the Judiciary Act authorized appeals from the district court to the circuit court and thence to the Supreme Court. This practice was abolished in 1891, and nine circuit courts of appeals were created (Judicial Code, s. 116). These were the final courts of appeal in admiralty, except that there was the right of a direct appeal to the Supreme Court on questions of jurisdiction (Judicial Code, s. 238), and that the Supreme Court might in its discretion review the judgments of the circuit court of appeals by writs of certiorari (Judicial Code, s. 240).

The circuit courts were abolished in 1911 (Judicial Code, s. 289). Direct appeals to the Supreme Court were abolished in 1925 (43 U.S.S.L. 938). Since then the district courts alone have original jurisdiction in all admiralty cases. Appeals lie to the circuit courts of appeal which may certify questions to the Supreme Court for opinion, and the Supreme Court may review the judgments of the circuit courts of appeal on writs of certiorari.

The district courts have jurisdiction in admiralty of suits against the United States in contract and in tort arising out of the operation of merchant vessels (41 U.S.S.L. 525), in tort, towage and salvage arising out of the operation of public vessels (43 U.S.S.L. 1112), and in certain cases concurrent jurisdiction with the court of claims in contract cases (24 U.S.S.L. 505; *Cornell S. S. Co. v. U.S.*, 202 U.S. 184). The district courts have jurisdiction over crimes and offences committed upon vessels of the United States wherever they may be afloat upon navigable waters, but they are tried according to common law criminal procedure (*U.S. v. Rodgers*, 150 U.S. 249; *Hamilton v. U.S.*, 268 Fed. 15).

Actions in admiralty may be either *in rem* with the arrest of the ship, or other maritime property, to enforce a maritime lien (a *ius in re*) or *in personam* against a person. Actions *in rem* are limited to courts of admiralty. Under s. 24 of the Judicial Code, "saving to suitors the right of a common law remedy where the common law is competent to give it," a right *in personam* may be enforced in a common law court, but the substantive rights of the parties are determined by the maritime law (*Southern Pacific v. Jensen*, 244 U.S. 205; *Knickerbocker Ice Co. v. Stewart*, 253 U.S. 149). Admiralty jurisdiction extends to all navigable waters, including rivers, lakes and canals connected with the sea (*The Hine*, 4 Wall. 555; *Robert W. Parson*, 191 U.S. 17). Admiralty jurisdiction extends to prize cases (*Jecker v. Montgomery*, 13 How. 498), to possessory and petitory suits (*The Schooner Tilton*, Fed. Cas. No. 14054; *Ward v. Peck*, 18 How. 267), to maritime contracts and torts. Maritime contracts are determined by their subject matter and in general they relate to ships as such, or to transportation of goods or passengers. They include charter-parties, contracts of affreightment, bills of lading, bottomry and respondentia bonds, salvage, towage, pilotage, stevedoring, supplies and repairs, advances, marine insurance policies, wages, preferred mortgages (41 U.S.S.L. 988, 1000; *ex parte Easton*, 95 U.S. 68). A contract to build a ship or furnish material for its completion is non-maritime (*Peoples Ferry Co. v. Beers*, 20 How. 393; *the Thames Co. v. Francis McDonald*, 254 U.S. 242). A tort is maritime if the injury is inflicted on navigable waters (*Atlantic Transport Co. v. Imbrovek*, 234 U.S. 52). If a vessel collides with a pier the damage to the pier is a non-maritime tort because the injury occurs on land (*Cleveland Terminal & Valley R.R. Co. v. Cleveland S.S. Co.*, 208 U.S. 316), but the damage to the vessel is a maritime tort because that injury occurs on navigable waters (*P.W. & B.R.R. Co. v. Phila. etc. S.S. Co.*, 23 How. 209; *Hill v. Board of Freeholders*, 45 Fed. 260). (A. M. B.)

ADMISSION: see EVIDENCE, also ESTOPPEL.

ADMITTANCE, in alternating current electricity, the reciprocal of the reactance. (See **ELECTRICITY**.)

ADO (d. 874), archbishop of Vienne in Lotharingia, belonged to a famous Frankish house, and spent much of his middle life in Italy. He held his archiepiscopal see from 859 until his death on Dec. 16, 874. Several of his letters are extant and reveal their writer as an energetic man of wide sympathies and considerable influence.

Ado's principal works are a *Martyrologium* (printed *inter al.* in Migne, *Patrolog. lat.*, cxxiii, pp. 181-420; append., pp. 419-436), and chronicle, *Chronicon sive Breviarium chronicorum de sex mundi aetatibus de Adamo usque ad ann. 869* (in Migne, cxxiii, pp. 20-138 and Pertz, *Monumenta Germ.*, ii, pp. 315-323, etc.).

Ado's chronicle is based on that of Bede, with which he combines extracts from the ordinary sources, forming the whole into a consecutive narrative founded on the conception of the unity of the Roman empire, which he traces in the succession of the emperors, Charlemagne and his heirs following immediately after Constantine and Irene. "It is," says Wattenbach, "history from the point of view of authority and preconceived opinion, which exclude any independent judgment of events."

Ado also wrote a book on the miracles (*Miracula*) of St. Bernard, archbishop of Vienne (9th century), published in the Bollandist *Acta Sanctorum*; a life or *Martyrium* of St. Desiderius, bishop of Vienne (d. 608), written about 870 and published in Migne, cxxiii, pp. 435-442; and a life of St. Theudericus, abbot of Vienne (563), published in Mabillon, *Acta Sanct.*, i, pp. 678-681, Migne, cxxiii, pp. 443-450, and revised in Bollandist *Acta Sanct.*, xii, pp. 840-843.

See W. Wattenbach, *Deutschlands Geschichtsquellen*, vol. i (Stuttgart, 1904).

ADOBE (ă-dō'bē), a Spanish-American word (often corrupted to *dobie*) for the sun-dried clay used for building by the Indians in the arid regions of the southwestern United States and northern Mexico (from Spanish *adobar*, to plaster). The use of such building material is said to have been anciently introduced into Spain from northern Africa. Soon after the discovery of America the method was imported into Peru, Mexico and other dry countries of the new world by the Spanish conquerors, who brought it as early as the 16th century to the Indians of New Mexico and Arizona. Most of the buildings connected with the Spanish missions in California, established in 1770-1823, were constructed of adobe. In Mexico and the southwestern United States the name is not only applied to the bricks but also to the clay from which they are made, and, likewise, to structures built of this material. The usual method of making adobe is very simple. It consists of wetting a quantity of suitable clay, adding a small amount of chopped straw, hay, grass roots or other fibrous litter, mixing the materials with a hoe or a similar implement, and then trampling the mass with the bare feet. When brought to the proper consistency, the adobe is shaped with simple wooden moulds into bricks. These vary greatly in size, in accordance with intended use, ranging from small forms about 8 in. square and 2 in. thick to large slabs 1 or 2 yd. long, 1 ft. wide and 6 to 8 in. thick. A common form for structural use is about 12 in. wide, 16 in. long and from 4 to 8 in. thick. After being properly dried, adobes are laid in walls, like ordinary bricks, and joined with a mortar of the same material. Often the walls are smoothly finished inside and out with this mortar and given an outer coating of lime wash, which is frequently tinted with yellow or other colours.

In regions of scant rainfall adobe is serviceable in structures of one story, or other low buildings, having well-drained foundations and nonleaking roofs with wide cornices and eaves. When

protected against the action of water, adobe walls will endure for many decades and sometimes for centuries. As adobe is a very poor conductor of heat and as walls made of it do not become frosty in cold weather or damp in a short rainy season, adobe structures are warm in winter and cool in summer, the interior temperature of the walls remaining remarkably constant. After 1900 there was a revival of adobe construction in the southwestern United States, particularly in California. In a modified form adobe is utilized also in Colorado and other states of the Rocky Mountain plateau, where, instead of being first made into bricks, the adobe is moulded directly into the wall, being applied and dried in successive layers.

In the plateau region adobe is used chiefly for walls of stables, cattle sheds and chicken houses. In southern California substantial city homes have been constructed with adobe walls, made from materials available on the premises, and finished with waterproof plaster or stucco, thus making it possible, when so desired, to dispense with the wide cornices and eaves otherwise required in adobe structures.

Scientific researches have shown that seeds that have been embedded with the barnyard refuse used in making adobe are preserved indefinitely. Consequently, by dissolving out seeds contained in adobes from the walls of old buildings whose date of erection is known, the approximate date of introduction of various cultivated plants in the region may be ascertained.

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ADOBE SOIL, a term used in the western United States, particularly in California, to designate the structural quality of various clay soils, referring usually to the characteristic breakage of such soil material into small angular blocks when it dries. These soils are very heavy in texture, being composed of extremely fine-grained material, a large part of which is colloidal. Sands and loose sandy loams, for example, never display an adobe soil structure.

By many, however, adobe soils are thought of as constituting the material from which adobe or sun-dried bricks are made; but, as in the case of ordinary brick, adobe building materials are derived from a great variety of clayey soils. Under proper conditions of moisture soils of adobe structure are readily worked, but when too dry their hardness and coherence make tillage extremely difficult. When placed under irrigation, soils of this type usually display great fertility.

ADOLESCENCE, the period of human development between childhood and maturity. For the psychological aspects of adolescence, see **PSYCHOLOGY**, especially the sections *Clinical Psychology* and *Educational Psychology*. See also **SECONDARY EDUCATION**, for the relation between adolescence and education, and **AGE**, for the legal aspects of this period, particularly in relation to rights and responsibilities.

ADOLPH OF NASSAU (c. 1255-1298), German king, son of Walram, count of Nassau. He appears to have received a good education, and inherited his father's lands around Wiesbaden in 1276.

Adolph won considerable fame as a mercenary in many of the feuds of the time, and on May 5, 1292, was chosen German king, in succession to Rudolph I, an election which was due rather to the political conditions of the time than to his personal qualities. He made large promises to his supporters, and was crowned on July 1 at Aix-la-Chapelle. Princes and towns did homage to him, but his position was unstable, and the allegiance of many of the princes, among them Albert I, duke of Austria, son of the former king Rudolph, was merely nominal.

Seeking at once to strengthen the royal position, he claimed Meissen as a vacant fief of the empire, and in 1294 allied himself with Edward I, king of England, against France. Edward granted him a subsidy, but because of a variety of reasons Adolph did not take the field against France, but turned his arms against Thuringia, which he had purchased from the landgrave Albert II.



MEXICAN PEONS MOULDING AND DRYING ADOBE, A COMMON BUILDING MATERIAL IN ARID PARTS OF MEXICO AND THE SOUTHWEST U.S.

This bargain was resisted by the sons of Albert, and from 1294 to 1296 Adolph was campaigning in Meissen and Thuringia, and his relations with Albert of Austria were becoming more strained.

He had been unable to fulfil the promises made at his election, and the princes began to look with suspicion upon his designs. Wenceslaus II, king of Bohemia, fell away from his allegiance, and his deposition was decided on, and was carried out at Mainz, on May 23, 1298, when Albert of Austria was elected his successor. The forces of the rival kings met at Gölheim on July 2, 1298, where Adolph was killed, it is said by the hand of Albert. He was buried at Rosenthal, and in 1309 his remains were removed to Spire.

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ADOLPHUS, JOHN LEYCESTER (1795–1862), English lawyer and author, was the son of John Adolphus (1768–1845), a well-known London barrister who wrote a *History of England to 1783* (1802), a *History of France from 1790* (1803) and other works. He was educated at Merchant Taylors' school and at St. John's college, Oxford.

In 1821 he published *Letters to Richard Heber, Esq.*, in which he discussed the authorship of the then anonymous Waverley novels, and fixed it upon Sir Walter Scott. This conclusion was based on the resemblance of the novels in general style and method to the poems acknowledged by Scott. Scott thought at first that the letters were written by Reginald Heber, afterward bishop of Calcutta, and the discovery of J. L. Adolphus' identity led to a warm friendship. Adolphus was called to the bar in 1822, and his *Circuiteers*, an *Eclogue*, is a parody of the style of two of his colleagues on the northern circuit.

He became judge of the Marylebone County court in 1852, and was a bencher of the Inner Temple. He was the author of *Letters from Spain in 1856 and 1857* (1858), and at the time of his death on Dec. 24, 1862, was engaged in completing his father's *History of England*, a book still valuable for the history of the first part of the reign of George III.

ADOLPHUS FREDERICK (1710–1771), king of Sweden, was born at Gottorp on May 14, 1710. His father was Christian Augustus (1673–1726), duke of Schleswig-Holstein-Gottorp, bishop of Lübeck, and administrator, during the war of 1700–21, of the duchies of Holstein-Gottorp for his nephew Charles Frederick; his mother was Albertina Frederica of Baden-Durlach. From 1727 to 1750 he was bishop of Lübeck, and administrator of Holstein-Kiel during the minority of Duke Charles Peter Ulrich, afterward Peter III of Russia.

In 1743 he was elected heir to the throne of Sweden by the "Hat" faction in order that they might obtain better conditions of peace from the empress Elizabeth, whose fondness for the house of Holstein was notorious.

During his whole reign (1751–71) Adolphus Frederick was little more than a state decoration, the real power being lodged in the hands of an omnipotent *riksdag*, distracted by fierce party strife. Twice he endeavoured to free himself from the intolerable tutelage of the estates.

The first occasion was in 1756 when, stimulated by his imperious consort Louisa Ulrica, sister of Frederick the Great, he tried to regain a portion of the attenuated prerogative, and nearly lost his throne in consequence. On the second occasion, under the guidance of his eldest son, the crown prince Gustavus, afterward Gustavus III, he succeeded in overthrowing the tyrannous "Cap" senate, but was unable to make any use of his victory. He died at Stockholm on Feb. 12, 1771.

See R. Nisbet Bain, *Gustavus III and his Contemporaries*, vol. i (London, 1895).

ADONI, a town of former British India, in the Bellary district of Madras, 307 mi. from Madras by rail. Pop. (1941) 35,431. It has manufactures of carpets, silk and cotton goods, factories for ginning and pressing cotton and a considerable trade in cotton. The hill fort above, now in ruins, was a seat of government frequently mentioned in 18th-century wars.

ADONIJAH (Heb. *Adoniyah* or *Adoniyahu*, "Yah is Lord"), a name borne by several persons in the Old Testament, of whom the most noteworthy was the fourth son of David. He was born to Haggith at Hebron (II Sam. iii, 4; I Ch. iii, 2). Adonijah was the natural heir to the throne. On the death of Absalom, and shortly before the death of David, he made preparations to seize his birthright, in which he received the support of Joab and Abiathar the priest; he also made arrangements for his coronation (I Kings i, 5 *et seq.*).

However, Bathsheba, David's favourite wife, organized a counterintrigue in favour of her son Solomon. With the help of Bathsheba and of Nathan the prophet, and apparently with the consent of David, Solomon ascended the throne. Hearing this, Adonijah fled for safety to the horns of the altar. Solomon spared him on this occasion (I Kings i, 50 *et seq.*), but later he commanded Benaiah to slay Adonijah (ii, 13 *et seq.*) on the ground that he wished, with the approval of Bathsheba, to marry David's former concubine, Abishag, and thus seemed to be aiming at the crown (I Kings i, *et seq.*).

ADONIS, in classical mythology, a youth of remarkable beauty, the favourite of Aphrodite. According to the story in Apollodorus (iii, 14, 4), he was the son of the Syrian king Theias by his daughter Smyrna (Myrrha), who had been inspired by Aphrodite with unnatural love. When Theias discovered the truth he would have slain his daughter, but the gods in pity changed her into a tree of the same name. After ten months the tree burst asunder and from it came forth Adonis. Aphrodite, charmed by his beauty, hid the infant in a box and handed him over to the care of Persephone, who afterward refused to give him up. On an appeal being made to Zeus, he decided that Adonis should spend a third of the year with Persephone and a third with Aphrodite, the remaining third being at his own disposal.

There are many variations in the later forms of the story, notably the version given by Ovid (*Metam.*, x, 298) which is also the one used by Shakespeare. In this version, Adonis was killed by a boar. Apollodorus (iii, 185) clumsily combines the two. The name is generally supposed to be of Phœnician origin (from *adon*, "lord"), Adonis himself being identified with Tammuz (but see F. Dümmler in Pauly-Wissowa's *Real-encyclopædie*, who does not admit a Semitic origin for either name or cult). The name Abobas, by which he was known at Perga in Pamphylia, certainly seems connected with *abub* (a Semitic word for "flute"; cf. "ambubaiarum collegia" in Horace, *Satires*, i, 2, I). (See also ATTIS.)

Annual festivals, called Adonia, were held in his honour at Byblus, and also, from the 5th century B.C. onward, at different places in Greece. Although there were variations in the ceremony itself and in its date, the central idea was the death and resurrection of Adonis, mourning for Adonis who was generally represented by an effigy which was afterward thrown into the water. A vivid description of the very elaborate festival at Alexandria (for which Bion probably wrote his *Dirge of Adonis*) is given by Theocritus in his 15th idyll, the *Adoniazusæ*. On the first day, which celebrated the union of Adonis and Aphrodite, their images were placed side by side on a silver couch, around them all the fruits of the season, "Adonis gardens" in silver baskets, golden boxes of myrrh, cakes of meal, honey and oil, made in the likeness of things that creep and things that fly. On the day following, the image of Adonis was carried down to the shore and cast into the sea by women with dishevelled hair and bared breasts. At the same time a song was sung, in which the god was entreated to be propitious in the coming year.

This festival, like that at Athens, was held late in summer; at Byblus, where the mourning ceremony preceded, it took place in spring.

It later became generally agreed by most authorities that Adonis represents a vegetation spirit, whose death and later return to life represent the decay of nature in winter and its revival in spring. He is born from the myrrh tree, the oil of which is used at his festival. He is connected with Aphrodite in her character of vegetation goddess. A special feature of the Athenian festival was the "Adonis gardens," small pots of seeds forced

to grow artificially, which rapidly faded. The dispute between Aphrodite and Persephone for the possession of Adonis finds a parallel in the story of Tammuz and Ishtar (see APHRODITE). In other words, Aphrodite is the Oriental mother-goddess, Adonis her lover; the details have been influenced by the legend of Demeter (*q.v.*). The ceremony of the Adonia was intended as a charm to promote the growth of vegetation, the throwing of the gardens and images into the water being supposed to procure a supply of rain (for European parallels see Mannhardt). It is suggested (Frazer) that Adonis is not a god of vegetation generally, but specially a corn-spirit, and that the lamentation is not for the decay of vegetation in winter, but for the cruel treatment of the corn by the reaper and miller (*cf.* Robert Burns's *John Barleycorn*).

An important element in the story is the connection of Adonis with the boar; possibly Adonis himself was looked upon as incarnate in the swine. For a god sacrificed to himself as his own enemy, *cf.* the sacrifice of the goat and bull to Dionysus. It has been observed that whenever sacrifices of swine occur in the ritual of Aphrodite there is reference to Adonis. In any case, the conception of Adonis as a swine-god does not contradict the idea of him as a vegetation or corn spirit, which in many parts of Europe appears in the form of a boar or sow.



ADONIS, A YOUTH IN CLASSICAL MYTHOLOGY, BELOVED BY APHRODITE FOR HIS GREAT BEAUTY

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ADONIS, a genus of plants of the crowfoot family (*Ranunculaceae*, *q.v.*) known as pheasant's eye and *Flos Adonis*. They comprise about 20 Eurasian species, cultivated for ornament. They are erect herbs with much-divided leaves and yellow or red flowers. *Adonis vernalis* is a perennial, but *A. aestivalis* and *A. amurensis* are annuals, the latter sometimes naturalized. The name is also given to the Adonis Blue butterfly (*Lysandra bellargus*), occurring in the chalk downs of southern England.

ADOPTION is the act of a person taking upon himself the position of parent to another who is not in fact or is not treated by law as his child, and the person so acting is recognized by the law as having the rights and duties of a parent by nature. The practice prevailed in most civilized or semicivilized nations from the earliest times. In India it is general, based on customs or religious and social ideas which vary in different parts of the country and among different classes. "The probability is that any Hindu who has no son will contemplate adoption," and the effect that every adoption must have on the devolution of property causes endless disputes, so that the courts, including the privy council on appeals from Indian tribunals, are constantly occupied with the litigation of this subject. An elaborate statement with regard to the Indian laws affecting adoption will be found in Z. Mayne's *Commentaries*.

Adoption was also common among the Greeks and Romans. The Roman law was well defined and clearly stated by the jurists and, in this as well as in other subjects, had an important influence on the law of most modern European countries except England. Important changes were made from time to time, but it is to be noticed that from the earliest to the latest times some intervention on the part of the state and official sanction was required to give legal effect to adoptions. This principle has been generally accepted in the legislation and practice of modern

states and is also the basis of the recent change in English law.

By the French code conditions are laid down under which adoption may take place. To give legal effect to it, enquiry must be made by the court (1) whether the conditions have been fulfilled, (2) whether the adopter is of good repute. The act of adoption must be published and registered. The adopted person preserves his rights in his natural family of origin and gains no rights of inheritance as regards the property of the relatives of the adopter, but in the property of the adopter himself has the same rights as a legitimate child. According to the French code, the adoptive parent must be 50 years of age, and on the other hand it is provided that *l'adoption ne pourra en aucun cas avoir lieu avant la majorité de l'adopté*. A subsequent part of the code deals with the appointment of *tuteurs officieux* for protection of the interests of persons who require such oversight or assistance.

In Germany adoption is recognized and plays a most important part in the social life and conditions of the German people. It is regulated by a number of elaborate and carefully drawn provisions which are contained in the civil code. A comprehensive statement of these provisions will be found in an article by Henry Happold, of Berlin, which appeared in the *Law Magazine and Review* for Aug. 1914. It shows how complicated the question is and how many points have to be provided for. As in the French code, confirmation by a competent tribunal is necessary to give legal validity to an adoption. It is also to be noted that though the adopted child acquires the legal position of a legitimate child of the adopter, the adopter acquires no right of inheritance, and the person adopted acquires no rights as regards the relatives of the adopter.

Adoption is also provided for in the legislation of the British dominions. In West Australia, for example, a male may be adopted by a man 18 years his senior, or by a woman 30 years his senior, or a female by a woman 18 years her senior or a man 30 years her senior. An act on the subject has also been passed in South Africa.

In view of this widespread recognition of adoption by law both in ancient and modern states all over the world it seems strange that until 1926 "adoption" in the sense of the transfer of parental rights and duties in respect of a child to another person and their assumption by him was not recognized by the law of England (*see Halsbury's Commentaries*). But a relative or a stranger might put himself *in loco parentis* to a child, and certain legal consequences between the parties might result from that position. Where a parent has neglected a child or it would be injurious to the child to remain in his custody, he could be deprived of it or of the direction of the child's education or of the right to decide in what religion it shall be brought up (*re Newton*, 1896, 1 ch., 748). Under the Children act, 1908, and other statutes the guardianship of children may be taken from parents who have ill-treated and neglected them and entrusted to some other person or institution, but this is not properly a case of adoption.

By the British Adoption of Children act, 1926, for the first time a definite system of legal adoption is introduced. Under that act on application made by a person desirous of being authorized to adopt an infant, the court may make an order authorizing the applicant to adopt that infant. In this procedure English law follows the precedent of Roman law and of most other countries, including the dominions, in requiring the sanction of a judicial or public authority for adoption of children. The welfare of the child is to be the paramount consideration. No payment or reward is to be received by the adoptive parent unless sanctioned by the court for some special reason. The adopted child does not lose rights of succession to the property of the natural parent or gain rights of succession to the adopter, but all rights and duties of parents or guardians as to future custody, maintenance and education are to vest in and be exercisable by and enforceable against the adopter as though the adopted child was born to the adopter in lawful wedlock. The applicant must not be under 25 years of age, must as a rule be 21 years older than the person adopted, and the court must see that the consent of the proper parties has been obtained. Either the high court, the county courts or courts of summary jurisdiction may deal with

applications for adoption, and the effect of the order is registered

Already the act has been used in a very large number of cases, and it is constantly found that between the adoptive parents and the children adopted ties of affection grow up very similar to those which exist between parents and their own children.

In the United States, Louisiana and Texas follow the civil law in relation to adoption, but the other states, where their jurisprudence is based on the common law, have had to enact statutes concerning the same. In many states it is required that adoptions be made only by married couples, but in a few states a single person may do so. Suitable age, financial solvency and substantial compliance with the requirements of the statutes are essential to make adoptions legal. Some states permit adoptions only of minors, and others forbid adoptions of relatives. An adopted child stands in the position of a child by blood in the matter of inheritances if the adoptive parent dies intestate.

See W. Clarke Hall, *Law of Adoption and Guardianship of Infants* (1928). (A. H.)

ADOPTIONISM. As the theological doctrine of the Logos which bulks so largely in the writings of the apologists of the 2nd century came to the front, the trinitarian problem became acute. The necessity of a constant protest against polytheism led to a tenacious insistence on the divine unity, and the task was to reconcile this unity with the deity of Jesus Christ. Some thinkers fell back on the "modalistic" solution which regards "Father" and "Son" as two aspects of the same divine principle; but the "adoptionist" or humanitarian method was a simpler and more popular one. Basing their views on the synoptic Gospels, the adoptionists under Theodotus of Byzantium tried to found a school at Rome c. 185, asserting that Jesus was a man, imbued with the Holy Spirit's inspiration from his baptism, and so attaining such a perfection of holiness that he was adopted by God and exalted to divine dignity. Theodotus was excommunicated by the bishop of Rome, Victor, c. 195, but his followers lived on under a younger teacher, Artemon, while in the east similar views were expounded by Beryllus of Bostra and Paul of Samosata, who undoubtedly influenced Lucian of Antioch and his school, including Arius and, later, Nestorius.

There is thus a traceable historical connection between the early adoption controversy and the struggle in Spain at the end of the 8th century, to which that name is usually given. It was indeed only a renewal, under new conditions, of the conflict between two types of thought, the rational and the mystical, the school of Antioch and that of Alexandria. The writings of Theodotus of Mopsuestia, a typical representative of the Antiochene school, had become well known in the west, and the opposition of Islam also partly determined the form of men's views on the doctrine of Christ's person. About 780 Elipandus (born 718), archbishop of Toledo, revived and vehemently defended the expression, *Christus Filius Dei adoptivus* (Christ the adopted son of God), and was aided by his much more gifted friend Felix, bishop of Urgella. They held that the duality of natures implied a distinction between two modes of sonship in Christ—the natural or proper, and the adoptive. In support of their views they appealed to scripture, and especially to Christ's fraternal relation to Christians—the brother of God's adopted sons. Christ, the firstborn among many brethren, had a natural birth at Bethlehem and also a spiritual birth begun at his baptism and consummated at his resurrection. Thus they did not teach a dual personality, nor the old Antiochene view that Christ's divine exaltation was due to his sinless virtue; they were less concerned with old disputes than with the problem as the Chalcedon decision had left it—the relation of Christ's one personality to his two natures.

Felix introduced adoption views into that part of Spain which belong to the Franks, and Charlemagne thought it necessary to assemble a synod at Regensburg (Ratisbon) in 792, before which the bishop was summoned to explain and justify the new doctrine. He renounced it and confirmed his renunciation by a solemn oath to Pope Adrian, to whom the synod sent him. The recantation was probably insincere, for on returning to his diocese he taught adoptionism as before. Another synod was held at Frankfurt in 794, by which the new doctrine was again formally con-

demned, though neither Felix nor any of his followers appeared.

In this synod Alcuin of York took part. A friendly letter from Alcuin, and a controversial pamphlet, to which Felix replied, were followed by the sending of several commissions of clergy to Spain to endeavour to put down the heresy. Archbishop Leidrad (died 816) of Lyons, being on one of these commissions, persuaded Felix to appear before a synod at Aix-la-Chapelle in 799. There, after six days' disputing with Alcuin, he again recanted his heresy. The rest of his life was spent under the supervision of the Archbishop at Lyons, where he died in 816. Elipandus, secure in his see at Toledo, never swerved from the adoption views, which, however, were almost universally abandoned after the two leaders died. Adoptionism continued to be a source of theological dispute all through the middle ages, but was no longer put forward as a serious interpretation of the person of Christ.

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ADOR, GUSTAVE (1845–1928), Swiss statesman, was born at Geneva, Dec. 23, 1845, of a Vaudois family established there in 1814. He studied law at the academy and in 1868 became an advocate. He served his apprenticeship to politics in the cantonal government and was president of the cantonal executive in 1892 and 1906. From 1889 to 1917 he was a member of the Swiss National council, of which he was president in 1901.

Ador gained an international reputation for the hard and disinterested work he did for the International Red Cross. He had become president of the committee four years before World War I, and when it broke out he founded an association at Geneva for facilitating communications between prisoners of war and their families and for alleviating their condition. A central agency for forwarding parcels and letters was established.

In June 1917, after the enforced resignation of Arthur Hoffmann, Ador became a member of the executive of the Swiss federation with the portfolio of foreign affairs. Toward the end of 1918 he was elected president of the Swiss federation; he retired at the end of his year of office. He headed the Swiss delegation which visited Paris and London in Jan.-Feb. 1920 to secure a reservation of the principle of the neutrality of Switzerland when she joined the League of Nations. He did important work for the League itself, first as president of the Brussels Conference of 1920 and then as president of the Economic and Financial commission. He represented Switzerland at the various assemblies of the League of Nations until 1924, when he retired on the ground of advancing age, although he still continued his Red Cross work. He died at Geneva on March 31, 1928. His funeral was a national ceremony, and was held in Geneva cathedral.

ADORATION, from the phrase (*manum*) *ad os* (*mittere*) which designated the Roman's act of kissing the hand to the statue of the god he wished to honour, has come to denote the act whereby man acknowledges God's supreme perfection and dominion. Such actions are principally sacrifice and the prayer of praise which of their very nature are restricted to the adoration of God. The Greek Christians distinguished carefully between *λατρεία*, the worship of God, and *προσκύνησις*, the veneration given to other sacred persons or objects. Both Greek words were translated into Latin by the one word *adoratio*, and as a result the distinction of concepts was at times obscured. In English this confusion has been avoided by the more common use of *veneration* to designate the reverence paid to Saints and images or relics of Saints. Roman Catholics add a further distinction between such veneration as paid to the Blessed Virgin because of her singular pre-eminence (*hyperdulia*) and as paid to Saints and sacred objects (*dulia*). By a natural transition *adoration* has also been applied to the homage rendered to monarchs by the ceremony of striking the earth with the forehead.

ADORF, a town in the *Land* of Saxony, 3 mi. from the Czechoslovakian frontier, at a height of 1,400 ft. above sea. Pop. (1933) 7,886. Musical instruments, objects in mother of pearl, textiles and carpets are made.

ADOUR, a river of south-west France, rising in the department of Hautes Pyrénées, south of the Pic du Midi de Bigorre, and flowing in a wide curve to the Bay of Biscay. It traverses the beautiful valley of Campan and, after passing Bagnères de Bigorre, enters the plain of Tarbes. Beyond Tarbes numerous canals are drawn from the river for irrigation purposes; the most important is the Canal d'Alaric, which follows the right bank for 36 mi. Within the department of Landes it flows west and later south-west, becoming navigable at St. Sever, beyond which it is joined on the left by the Larcis, Gabas, Louts and Luy, and on the right by the Midouze. After Bayonne the river enters the sea through a dangerous estuary, after a total course of 208 mi. The mouth of the Adour has repeatedly shifted, its old bed being represented by the series of *étangs* and lagoons extending northward as far as the village of Vieux Boucau (22½ mi.), where it debouched in the 14th century. The present channel was constructed by the engineer Louis de Foix in 1579. The area of the basin of the Adour is 6,565 sq.mi.

ADRA (anc. *Abdera*), a seaport of S. Spain, in Almería province. Pop. (1940) 6,907 (mun., 12,443). Adra is the port of shipment for the lead obtained in the Sierra de Gádor near Berja, 10 mi. N.E., and also exports grapes, sugar and esparto grass.

ADRAR (Berber for "uplands"), the name of various districts of the Sahara, northern Africa. Adrar Sutuf is a hilly region in southern Río de Oro (*q.v.*). Adrar el Jebli, otherwise Adghagh, a plateau north-east of Timbuktu, is the headquarters of the Awellimiden Tuareg (see **TUAREG** and **SAHARA**). Adrar n'Ahnnet and Adrar Adhafar are smaller regions in the Ahnet country south of Insalah. Adrar Temur, the best known region of the name, is in the western Sahara, 300 mi. N. by E. of the Senegal and separated on the north-west from Adrar Sutuf by wide valleys and sand dunes. Adrar is within the French sphere of influence. In general barren, the country, which occupies the centre of a plateau scarped steeply westwards, contains several oases, with a total population of about 10,000. The chief centres of population are Atar, Shingeti, Wadan and Ujeft, Shingeti being the chief commercial centre, whence caravans take to St. Louis gold-dust, ostrich feathers and dates. A considerable trade is also done in salt from the sebkha of Ijil, in the north-west.

Adrar or Adgar is also the name sometimes given to the chief settlement in the oasis of Tuat in the Algerian Sahara.

ADRASTUS: see **OEDIPUS**.

ADRENAL GLANDS. These consist of two parts. The inner portion, the medulla, produces epinephrine—also known as adrenaline. The outer portion, the cortex, elaborates cortisone, hydrocortisone and at least one other hormone which is probably a steroid, and is concerned with mineral metabolism. About 25 other steroids are present in the adrenal cortex but they have little or no physiologic activity and are apparently intermediate steps in the elaboration of cortisone and hydrocortisone.

Epinephrine when administered mimics the action produced by stimulation of the sympathetic nervous system and fortifies the body in an emergency—Cannon's theory. Among these effects are a rapid rise in blood pressure, an increase in the concentration of blood sugar and the flow of blood to the muscles, and inhibition of digestion. However, the adrenal medulla is not essential for life. Activity of the medulla is controlled largely by stimulation of sympathetic nerves and by humoral agents such as acetylcholine and insulin.

The physiologic activity of the cortical hormones can be summarized under three aspects. First, mineral metabolism: the maintenance within narrow limits of the concentration in the blood of sodium potassium and chloride is essential for life. The secretions of the adrenal cortex exert an important influence on this phenomenon. The hormone (or hormones) which produces this effect had not been isolated at mid-20th century. Second, organic metabolism: the utilization and distribution of carbohydrates, proteins and fats are modified by cortisone and hydrocortisone. Third, tissue reactions such as hypersensitivity, allergic states and collagen diseases: the beneficial results produced by cortisone and hydrocortisone are manifested in the relief of rheumatoid arthritis and about 20 other diseases. The adrenal cortex does not

appear to be directly involved in the aetiology of any of these diseases, and the manner in which cortisone and hydrocortisone produce their effect is not known. The activity of the adrenal cortex is controlled by the pituitary gland through an agent designated as adrenocorticotrophic hormone or ACTH.

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(E. C. KL.)

ADRENALINE (**EPINEPHRINE**) is one of the active principles of the medulla of the suprarenal gland. It produces effects similar to those resulting from stimulation of the sympathetic nervous system and is thought to be similar to, if not identical with, the substance sympathin liberated at the terminations of the sympathetic nerves. It is used in circulatory emergencies and in treatment of asthmatic paroxysms and anaphylactoid reactions. Added to local anaesthetic solutions, it increases the duration of anaesthesia and decreases systemic toxicity by reducing absorption through local vasoconstriction. (See **ADRENAL GLANDS**).

(F. L. A.)

ADRIA (anc. *Atria*), the form Adria or Hadria is less correct. Atria was a town in Picenum, the modern Atri, town and episcopal see, province of Rovigo, Italy, 15 mi. E. by rail from the town of Rovigo. It is situated between the mouths of the Adige and the Po, about 13½ mi. from the sea and but 13 ft. above it. Pop. (1936), 9,435 (town), 32,762 (commune). It gave its name to the Adriatic and was an important Etruscan harbour. The town was famous in Aristotle's day for a special breed of fowls. Even then river silt rendered access difficult, and the historian Philistus excavated a canal to the sea. This was still open in the imperial period, and the town possessed its own guild of sailors; but its importance gradually decreased. The remains of the ancient town lie 10-20 ft. below the modern level.

ADRIAN or **HADRIAN** (Lat. *Hadrianus*), the name of six popes.

ADRIAN I., pope from 772 to 795, was the son of Theodore, a Roman nobleman. Soon after his accession Adrian found it necessary to invoke the aid of Charlemagne against Desiderius, king of the Lombards. In his contest with the Greek empire and the Lombard princes of Benevento, Adrian remained faithful to the Frankish alliance, and the friendly relations between pope and emperor were not disturbed by the difference which arose between them on the question of veneration of images, to which Charlemagne and the Gallican Church were strongly opposed, while Adrian approved the decree of the council of Nicaea (787), confirming the practice and excommunicating the iconoclasts. The dispute remained unsettled at Adrian's death. Adrian restored the ancient aqueducts of Rome, and governed his little state with a firm and skilful hand.

ADRIAN II., pope from 867 to 872, was a member of a noble Roman family, and became pope in 867, at an advanced age. Like his predecessor, Nicholas, Adrian II. was forced to submit, at least in temporal affairs, to the tutelage of the emperor, Louis II., who placed him under the surveillance of Arsenius, bishop of Orta, his confidential adviser, and Arsenius's son Anastasius, the librarian. Adrian had married in his youth, and his wife and daughter were still living. They were carried off and assassinated by Anastasius's brother, Eleutherius. Adrian died in 872.

ADRIAN III., pope, was born at Rome. He succeeded Martin II. in 884, and died in 885, on a journey to Worms.

ADRIAN IV. (Nicholas Breakspear), pope from 1154 to 1159, the only Englishman who has occupied the papal chair, was born before A.D. 1100 at Langley, near St. Albans, in Hertfordshire. Nicholas went to Paris and became a monk of the cloister of St. Rufus, near Arles. He rose to be prior, and in 1137 was unanimously elected abbot. Eugenius III. created him cardinal bishop of Albano. From 1152 to 1154 Nicholas was in Scandinavia as legate, organizing the affairs of the new Norwegian archbishopric of Trondhjem, and arranging for the recognition of Uppsala as a metropolitan see in 1164. Nicholas was elected pope on Dec. 4, 1154. He at once endeavoured to compass the overthrow of Arnold of Brescia, the leader of anti-papal sentiment in Rome.

Disorders ending with the murder of a cardinal led Adrian, shortly before Palm Sunday 1155, to put Rome under the interdict. The senate thereupon exiled Arnold, and the pope, with the co-operation of Frederick I. Barbarossa, was instrumental in procuring his execution. Adrian crowned the emperor at St. Peter's on June 18, 1155, a ceremony which so incensed the Romans that the pope had to leave the city for some months. At the diet of Besançon in Oct. 1157, the legates presented to Barbarossa a letter from Adrian which alluded to the *beneficia* conferred upon the emperor, and the German chancellor translated this *beneficia* in the feudal sense. In the storm which ensued the legates were glad to escape with their lives, and the incident at length closed with a letter from the pope, declaring that by *beneficium* he meant merely *bonum factum*. The breach subsequently widened, and Adrian was about to excommunicate the emperor when he died at Anagnina on Sept. 1, 1159.

In 1155 Henry II. of England sent an embassy to Adrian to ask for permission to invade and subjugate Ireland, in order to gain absolute ownership of that isle. Unwilling to grant a request counter to the papal claim (based on the forged Donation of Constantine) to dominion over the islands of the sea, Adrian proposed that the king should become hereditary feudal possessor of Ireland while recognizing the pope as overlord. This compromise did not satisfy Henry, so the matter dropped; Henry's subsequent title to Ireland rested on conquest, not on papal concession, and was therefore absolute. The much-discussed bull *Laudabiliter* is, however, not genuine.

See Herzog-Hauck, *Realencyklopädie*, 3rd ed. (excellent bibliography), and Wetzer and Welte, *Kirchenlexikon*, 2nd ed. under "Hadrian IV"; also Oliver J. Thatcher, *Studies concerning Adrian IV* (Chicago, 1903); R. Raby, *Pope Adrian IV; An Historical Sketch* (London, 1849); and A. H. Tarleton, *Life of Nicholas Breakspear* (London, 1896).

ADRIAN V. (Ottobuono de' Fieschi), pope in 1276, was a Genoese who was created cardinal deacon by his uncle Innocent IV. In 1264 he was sent to England to mediate between Henry III. and his barons. He was elected pope to succeed Innocent V. on July 11, 1276, but died at Viterbo on Aug. 18, without having been ordained even to the priesthood.

ADRIAN VI. (Adrian Dedel, not Boyens, probably not Rodenburgh, 1459–1523), pope from 1522 to 1523, was born at Utrecht in March 1459, and became tutor to the seven-year-old Charles V. Charles secured his succession to the see of Tortosa, and on Nov. 14, 1516, commissioned him inquisitor-general of Aragon. During the minority of Charles, Adrian was associated with Cardinal Ximenes in governing Spain. After the death of the latter Adrian was appointed, on March 14, 1518, general of the reunited inquisitions of Castile and Aragon, in which capacity he acted until his departure from Tarragona for Rome on Aug. 4, 1522. When Charles left for the Netherlands in 1520 he made Adrian regent of Spain. In 1517 Leo X. had created him cardinal priest *SS. Ioannis et Pauli*; on Jan. 9, 1522, he was almost unanimously elected pope. Crowned in St. Peter's on Aug. 31, at the age of 63, he entered upon the lonely path of the reformer. His programme was to attack notorious abuses one by one; but in his attempt to improve the system of granting indulgences he was hampered by his cardinals; reduction of the number of matrimonial dispensations was impossible, for the income had been farmed out for years in advance by Leo X. In dealing with the early stages of the Protestant revolt in Germany Adrian did not fully recognize the gravity of the situation. At the diet which opened in Dec. 1522 at Nuremberg he was represented by Chieregati, whose instructions contain the frank admission that the whole disorder of the church had perchance proceeded from the Curia itself, and that there the reform should begin. But Adrian was stoutly opposed to doctrinal changes, and demanded the punishment of Luther for heresy. The statement in one of his works that the pope could err in matters of faith ("*haeresim per suam determinationem aut Decretalem asserendo*") has attracted attention; but as it is a private opinion, not an *ex cathedra* pronouncement, it is held not to prejudice the dogma of papal infallibility. On Sept. 14, 1523, he died, after a pontificate too short to be effective.

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soon after his death. He published *Quaestiones in quantum sententiarum praesertim circa sacramenta* (Paris, 1512, 1516, 1518, 1537; Rome, 1522), and *Quaestiones quodlibeticae XII.* (1st ed. Louvain, 1515). See L. Pastor in *Geschichte der Päpste*, vol. iv. pt. ii.; *Adrian VI. and Klemens VII.* (Freiburg, 1907); also Wetzer and Welte, *Kirchenlexikon*, 2nd ed., and Herzog-Hauck, *Realencyklopädie*, 3rd ed., under "Hadrian VI."; H. Hurter, *Nomenclator literarius recentioris theologiae catholicae*, tom. iv. Innsbruck (1899), 1027; *The Cambridge Modern History*, vol. ii. (1904), 19–21; H. C. Lea, *A History of the Inquisition of Spain*, vol. i. (1906); Janus, *The Pope and the Council*, 2nd ed. (London, 1860), 376. *Biographies*.—A. Lepitre, *Adrien VI.* (Paris, 1880); C. A. C. von Höfler, *Papst Adrian VI.* (Vienna, 1880); L. Casartelli, "The Dutch Pope," in *Miscellaneous Essays* (London, 1906). For Adrian I. to Adrian V. see U. Chevalier, *Bio. Bibliographie* (1905); and *Liber Pontificalis*, ed. Duchesne (2 vols. Paris 1886–92).

ADRIAN, SAINT, one of the praetorian guards of the Emperor Galerius Maximian, who, becoming a convert to Christianity, was martyred at Nicomedia on March 4, 303. His limbs were struck off on an anvil, and he was then beheaded. St. Adrian's festival, with that of his wife, St. Natalia, is kept on Sept. 8. He is specially a patron of soldiers, and is much revered in Flanders, Germany and the north of France.

ADRIAN, a city in southeastern Michigan, U.S., about 32 mi. N.W. of Toledo, on federal highway 223. It is the county seat of Lenawee county, and is served by the New York Central, the Wabash and the Detroit, Toledo and Ironton railways. The population was 18,402 in 1950, 14,230 in 1940 and 13,064 in 1930 (federal census).

The county, a rich farming land, contains beautiful lakes. Adrian's trade in grain, livestock and dairy products is extensive.

Main manufactures include automobile parts, aluminum and brass products, aircraft parts, chrome plating, drills, laboratory and hospital furniture, wood products, machine tools, coil springs, concrete block machinery and milk products.

Educational institutions include Adrian college, a Methodist school established in 1859, and Siena Heights college, a Catholic institution for girls. The State Girls Training school is located in the city.

Adrian was laid out in 1828; incorporated as a village in 1836; became the county seat in 1838; and was chartered as a city in 1853. Tradition says that it was named after the emperor Hadrian.

ADRIANI, GIOVANNI BATTISTA (1513–1579), Italian historian, was born of a patrician family of Florence. At the instance of Cosimo I he wrote *Istoria de' suoi tempi* (1583; modern ed. 1872), covering the years 1536 to 1574.

See G. M. Mazzucchelli, *Gli Scrittori d'Italia*, i, p. 151 (1753); G. Mondaini, *La storia dei suoi tempi di G. B. Adriani* (Torino, 1905).

ADRIANOPLE or EDIRNE, the capital of the vilayet of Adrianople, Turkey, 137 mi. by rail W.N.W. of Constantinople. It occupies both banks of the river Tunja, at its confluence with the Maritsa, which is navigable to this point in spring and winter. The nearest seaport by rail is Dédéagatch, west of the Maritsa; Enos, at the river-mouth, is the nearest by water. Adrianople is on the railway from Belgrade and Sofia to Constantinople and Salonica. In appearance it is thoroughly oriental—a mass of mean, irregular wooden buildings, threaded by narrow tortuous streets, with a few better buildings. Earlier buildings include Eski Serai, a half-ruined palace of the sultans; the bazaar of Ali Pasha; and the fine 16th century mosque of the sultan Selim II., built by Sinan.

The war of 1877–78 impoverished Adrianople, and the creation of a customs cordon between it and Eastern Rumelia (1885) put an end to its commercial headship of Thrace, and parts of Bulgaria and Philippopolis and Burgas took most of its trade. The city manufactures silk, leather, tapestry, woollens, linen, and cotton, and has an active general trade. Besides fruits and agricultural produce, its exports include raw silk, cotton, opium, rose-water, attar of roses, wax, and the dye known as turkey red. The surrounding country is extremely fertile, and its wines are the best produced in Turkey. The city is supplied with fresh water by means of an aqueduct carried by arches over an extensive valley. There is also a fine stone bridge over the Tunja.

Adrianople was originally known as Uskadama or Uskodama, but was renamed and enlarged by the Roman emperor Hadrian

(117-138). In 378 the Romans were here defeated by the Goths. Adrianople was the residence of the Turkish sultans from 1361, when it was captured by Murad I., until 1453, when Constantinople fell. It was occupied by the Russians in 1829 and 1878 (see RUSSO-TURKISH WARS).

During the first Balkan War Adrianople was taken from the Turks by Bulgars, with Serbian assistance, in 1913, after a siege of 155 days. During the second Balkan War, in June, 1913, the Turks retook the town and, by the Treaty of Constantinople, signed on Sept. 29, 1913, it was ceded, together with Karagatch, to Turkey by Bulgaria. After World War I, the Greek army, commissioned to restore order in Thrace (May 1920), entered Adrianople in July, and it was ceded to them (Aug. 10, 1920) by the Treaty of Sévres. During the Graeco-Turkish War of 1923 the Greeks occupied Karagatch, the railway station of which is very important for the traffic of Dédeagatch and had therefore been abandoned by Turkey to Bulgaria in 1915. On leaving it they destroyed many buildings and removed the machinery from the mills. After the close of World War I Adrianople was again restored to Turkey by the Mudania Convention of October 1922, confirmed by the Treaty of Lausanne of July 24, 1923. A protocol subjected the Greek inhabitants of Karagatch to the exchange of populations, compelling them to emigrate six months after the re-establishment of peace.

The population in 1940 was given as only 45,680, as compared with about 80,000 in 1905 and 65,454 in 1911. This diminution was due to the emigration of the population, with the exception of the Jews, after the successive occupations of the city. The south-western portion of the city, burnt down in 1905, was rebuilt with comparatively broad streets. The railway station, which stands among ruins, has been rebuilt.

See *British and Foreign State Papers*, 1914, part 1: vol. cvii., p. 706 (1920); vol. cxiii., p. 652 (1917-23); *Treaty Series*, No. 16 (1923).

Adrianople, Battle of, 378.—This is one of the milestones of military, and, in less degree, of political history, for the Roman Empire's barriers against the barbarians were breached so gravely that temporary repair was effected only by the substitution of the forces of destruction—the Goths and Teutons—for the regular imperial forces, and it also marks the changing relative values of infantry and cavalry.

The Visigoths were allowed in 376 to move inside the Roman border to escape the pressure of the Huns. A year later they revolted, and in 378 the Emperor Valens (*q.v.*) determined to subdue them. When (Aug. 9) the attack was made the main body of the Gothic cavalry was away foraging; Gothic offers of surrender, made to regain time for their recall, failed; the Romans, with the legions in the centre, and the cavalry on the wings as customarily, assaulted the Goths' position around the great wagon-laager, when suddenly the enemy squadrons appeared on the scene and charged "like a thunder-bolt" against their left flank. The Roman cavalry were swept aside, while the Gothic horse drove the left wing infantry in upon the centre and reserve, the pressure forcing the Romans into a disordered mass which was too dense to allow them to use their weapons. Surrounded on all sides and forsaken by their right wing cavalry and foot, the Roman main body was massacred, and only after two-thirds of the army had fallen could the survivors break through and follow the retreat of the right wing.

That evening the sun set for all time on the glory of the legions, the infantry who had been the foundation of Roman world-power, and a thousand years' era of cavalry supremacy was ushered in. Henceforth cavalry became the predominant arm of the Roman army, as reorganized by Theodosius, and 150 years later, during Justinian's revival of Roman power, we find Belisarius risking battle and achieving victory without waiting for his infantry to arrive on the battlefield. (See ROMAN ARMY.)

ADRIATIC SEA (ancient *Adria* or *Hadria*), an arm of the Mediterranean sea separating Italy from the Balkan peninsula, occupying a structural depression between the New Fold mountain systems of the Apennines and the Dinaric Alps. The sea extends from north-west to south-east between lat. 40° and 45° 45'

N., a length of nearly 500 miles. Its average width is *c.* 110 m.; but the Strait of Otranto is only 45 miles. The Italian shore, except where the Apennines fall steeply to a narrow coastal ledge between Rimini and Mt. Gargano, is low, merging in the north-west into the marshes and lagoons about the delta of the Po, the basin of which is structurally a continuation of the Adriatic. The sediment brought by the river has pushed forward the coast-line for several miles within historic times. The east coast is generally rugged, and south of the Istrian peninsula, placed between the Gulf of Trieste and the Strait of Quarnero, is fringed with islands (*e.g.*, Veglia, Cherso, Brazza and Curzola) and with many small islets and rocks which represent submerged parallel deviations of the longitudinal mountain folds. Opposite the islands of the Dalmatian coast the sea is shallow, and in the extreme north rarely exceeds 25 fathoms. But between Sebenico and the Abruzzi a well marked depression occurs, with depths exceeding 100 fathoms. South of this shallower water continues, but beyond Mt. Gargano and south of Ragusa depths of over 500 fathoms are reached, and a small area of this basin falls below 800 fathoms. Opposite this deeper water, at the 100 fathom line, the islands of the Balkan coast disappear. The absence of good harbours on the Italian side contrasts with the excellent inlets of the Dalmatian coast. Here the rocks are mainly cretaceous and have characteristic features of dry barren soil and poor vegetation despite the fairly heavy rainfall. Some of the islands, however, are luxuriant with dark vegetation. The *bora* (north-east wind), and the prevalence of sudden squalls, are dangers to navigation in winter. Tidal movement is slight. (See also MEDITERRANEAN SEA.)

For the "Marriage of the Adriatic," or more properly "of the sea," a ceremony formerly performed by the doge of Venice, see the article BUCENTAUR.

(X.)

Political Question.—Before the World War the Adriatic littoral belonged to four States, Italy, Austria-Hungary, Montenegro and Albania, and in practice to the two first. In negotiating the "secret" Treaty of London of April 26, 1915, the Italian Government aimed at securing, in return for Italy's entrance into the war on the side of the Allies, the conversion of the Adriatic into an Italian lake—*il nostro mare*.

Article 4 of that treaty provided that "all Istria up to the Quarnero and comprising Volosca, just beyond Abbazia and the Istrian islands of Cherso, Lussin . . . and the adjoining islets" with Castua and Mattuglie, the station for Abbazia, should become Italian. Article 5 declared that Italy "shall equally receive the province of Dalmatia . . . comprising Lisarica and Tribanj in the north" to a line as far south as Cape Planca (Ploče), between Sebenico and Traù (Trogir), on the mainland, with "all the islands . . . from Premuda, Selve (Silba) and Pago in the north to Meleda in the south, comprising Lissa, Lesina, Curzola, Lagosta (Lastovo) and Pelagosa, with the solitary exception of Great Zirona (Veli Drvenik) and Small Zirona (Mali Drvenik), Bua (Ciovo), Solta and Brazza." The whole coast from Cape Planca to the "southern root" of the peninsula of Sabbioncello and from a point 10 km. to the south of Ragusa Vecchia (Cavtat) to the river Viosa (north of Valona), except Montenegro, and all the non-Italian islands were to be neutralized. The rest of the Dalmatian coast, besides Fiume and the islands of Veglia and Arbe in the north, were to go to Croatia, Serbia and Montenegro, besides the Albanian roadstead of San Giovanni di Medua (the landing-place for Scutari); but Durazzo was to be Albanian.

Article 6 further conferred upon Italy "the entire sovereignty over Valona, the island of Saseno and a territory sufficiently extended to assure the defence of those points" (from the Viosa . . . approximately to the northern frontier of the district of Chimara). Article 7 neutralized the coast south of the above as far as Cape Stylos opposite Corfu. This treaty violated every principle of nationality; it assigned to Italy provinces overwhelmingly Slav (for the Italian population of Dalmatia was only 3.5%), it dismembered Albania and would have created a new Irredentism far more powerful than that which Italy had fought to cure. The entrance of the United States into the war made the treaty a dead letter, although Baron Sonnino, then Italian Minister of Foreign Affairs, still clung to it, for President Wilson refused

to be bound by it, and even some Italians, notably Bissolati and Prof. Salvemini disapproved of it.

Thus began the wearisome "Adriatic question," which at times threatened war between Italy and the Yugoslavs, and attempts were made by British publicists, notably Messrs. Steed and Seton-Watson, to bring about an agreement, the "Pact of Rome," between the two races. The departure of Sig. Orlando, then the Italian premier, and Baron Sonnino from the Paris Conference was due to this question, which was not regulated till the Treaty of Rapallo between the Italians and the Yugoslavs on Nov. 12, 1920, largely the work of Signor Giolitti and Count Sforza, who had meanwhile become Premier and Minister of Foreign Affairs. In Dalmatia, Italy obtained only Zara—the one overwhelmingly Italian town—with an enclave which included the Albanian settlement of Borgo Erizzo—and the island of Lagosta. Italy kept the whole of Istria (despite its large Slav minority) with the islands of Cherso and Lussin and that of Pelagosa. "All the other islands which belonged to the former Austro-Hungarian Monarchy" were "recognized as forming part of the Kingdom of the Serbs, Croats and Slovenes."

By article 4, both States recognized the full liberty and independence of the State of Fiume (*q.v.*), consisting of the *corpus separatum* (the city) and a corridor south of Castua (which became Yugoslav) connecting it with Volosca and Abbazia. Sig. Giolitti evacuated Albania, where Italy retains only the island of Saseno. Mussolini observed the Rapallo Treaty and subsequently settled the question of Fiume, which is now Italian.

The Adriatic is described at Belgrade, no less than in Rome, as "our sea," but the keys of the mouth of the Adriatic, Brindisi and Saseno, are in Italian hands.

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ADSCRIPT. A *villein* was called an "adscript of the soil" (*adscriptus glebae*) since he could be sold or transferred with it, as in feudal days, and as in Russia until 1861. See **VILLEINAGE**.

ADSORPTION. If a gas or solution is brought into contact with a very finely divided or porous material (e.g., charcoal, kaolin) the pressure of the gas or the concentration of the solution generally decreases, the gas or solute being concentrated on the surface of the solid. This phenomenon is known as adsorption, and the finely divided or porous solid is called the adsorbent. The gas or solid can be easily removed from the surface of the solid by exhaustion, heating or washing. The efficiency of an adsorbent depends largely on its specific surface (*i.e.*, area of surface per unit mass), but as we shall see later it also depends on other factors.

This phenomenon of adsorption is to be distinguished from absorption by the fact that the adsorbed gas or solute is concentrated on the surface of the adsorbent, while in absorption the matter taken up penetrates throughout the mass of the absorbing agent. (See **ELECTRIC LAMPS AND VALVES, MANUFACTURE OF**.)

The Adsorption of Gases.—Wood charcoal is very porous; so that it possesses a large specific surface, and is very efficient as an adsorbent. On exposure to the air it adsorbs the atmospheric gases. In order to demonstrate its adsorbing properties it should first be heated to redness in order to remove the adsorbed gases from its surface. If then it is brought into a vessel containing a gas, an immediate diminution of pressure would be indicated by an attached manometer, reaching eventually a constant value.

This final equilibrium pressure depends on the temperature, the nature of the gas and adsorbent, and also on the specific surface of the latter. Adsorption can also be shown by filling a glass tube with ammonia with the open end of the tube dipping into a trough of mercury. A piece of charcoal (after being heated to redness and allowed to cool) is introduced on to the surface of the mercury in the tube. The mercury rises rapidly in the tube, indicating a rapid diminution in the volume of the gas. The ammonia can be recovered from the charcoal by heat or by exhaustion. Hydrogen burns with a pale blue flame which is non-luminous; if the hydrogen is bubbled through benzene it burns with a smoky luminous flame due to the presence of benzene vapour. If the mixture of hydrogen and benzene vapour is passed over charcoal the benzene is adsorbed, as shown by the non-luminous character of the flame of the gas which passes through.

When an adsorbent remains for some time in contact with a gas, an adsorption equilibrium is established, the amount of gas adsorbed per unit mass of the adsorbent increasing with decreasing temperature and with increasing pressure. By plotting the pressures p as abscissae, and the amount of gas adsorbed per unit mass of the adsorbent as ordinates, curves similar to those shown in figure (Curve 3) are obtained. Such a curve, which represents the amount adsorbed at constant temperature, is termed an "adsorption isothermal." It is seen from the curves that the amount of gas adsorbed is not proportional to the gas pressure, but that it increases much more rapidly at low pressures than at high pressures. The adsorption isothermal can be represented by the equation:

$$x/m = ap^{1/n}$$

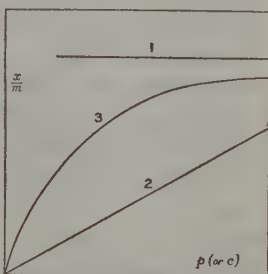
where x is the amount of gas adsorbed by m grams of the adsorbent at gas pressure p ; a and n are arbitrary constants. The value of a depends on the units of measurement, and n is characteristic of the adsorbent and of the gas. Thus, for the adsorption of CO_2 , NH_3 or SO_2 on charcoal, the values of $1/n$ are 0.394, 0.437 and 0.324, respectively, whereas for the same three gases on glass, the values are 0.66, 0.53, 0.28. These constants also vary with the temperature, $1/n$ approaching unity at high temperatures. The temperature at which the unity value is reached depends on the critical temperature of the gas. For hydrogen, which has a very low critical temperature, the value of $1/n$ is unity at ordinary temperatures, but it is less than unity at the temperature of liquid air. In general the value of $1/n$ becomes 1 at temperatures considerably above the critical temperature of the gas.

The logarithmic equation of the isotherm is:

$$\log x/m = \log a + 1/n \log p,$$

which is the equation of a straight line. On plotting experimental values, however, it is found that it only holds at low pressures. As the pressure increases the logarithmic curve ceases to be a straight line, and bends towards the pressure axis. The pressure at which this deflection occurs varies from gas to gas; it is lower the more readily the gas is condensed. Below the critical temperature the equation does not hold for even low pressures. The adsorbability of gases runs more or less parallel with their condensability. The above equations, which are due to Freundlich, imply that an indefinite increase in pressure produces an indefinitely large adsorption. Recent work by Langmuir and others indicates that on increasing the pressure surface saturation is reached. Arrhenius introduced this (s) into his equation for adsorption, viz., $k \cdot dx/dp = (s-x)/x$.

The rate of adsorption is high, equilibrium being reached in a few minutes. The kinetic equation is $dp/dt = k(p_{\infty} - p)$, dp/dt being the rate of diminution of pressure; p_{∞} and p being the pressures at equilibrium and at time t respectively. Since adsorption is decreased by a rise in temperature, it follows that it is accompanied by evolution of heat. This can be readily shown by means of a thermometer immersed in the adsorbent when adsorption takes place. The heat of adsorption can be calculated from the temperature-coefficient of adsorption. If the adsorbent is in contact with several gases at the same time, the adsorption of each is diminished, and at equilibrium the amounts of the several gases adsorbed are in proportion to their respective adsorbabilities. Nothing is definitely known about the influence of the nature of



CURVES OF THREE POSSIBLE TYPES OF RELATION BETWEEN THE PROPORTION OF GAS ADSORBED ON THE SURFACE AND THE PRESSURE OF THE GAS

the adsorbent. Wood or animal charcoal is by far the most efficient. Silica gel is also a very powerful adsorbent. In the adsorption of gases on the surface of solids the adsorbed gas forms a layer one molecule thick on the adsorbent, but in the adsorption of vapours the layer may be several molecules thick.

Adsorption in Solution.—Small drops of a pure liquid, when free from external influences assume a spherical shape. This can be seen with drops of water on a waxy surface—if the drops are large then the effect of gravity is appreciable and the drops become flattened. A liquid suspended in another liquid of the same density and in which it is insoluble also assumes a spherical shape. The second law of thermodynamics states that free energy always tends to become a minimum, and in the case of liquids the free surface energy therefore tends towards a minimum. The free surface energy of a liquid is the product of its surface tension and the area of its surface, so that if there is a diminution in the surface tension or in the superficial area there is a diminution in the free surface energy. A pure liquid cannot change its surface tension, but its surface area is reduced to a minimum if it assumes a spherical shape, for it is characteristic of a sphere that for a given volume it has the minimum surface. If we consider a liquid containing a substance in solution, and having a lower surface tension than the pure liquid, *e.g.*, a solution of one of the fatty acids in water, we find that the lowering of the surface tension results in a lowering of the free surface energy of the liquid; the effect is all the greater the more concentrated the solution. The free surface energy would decrease still further if there were an unequal distribution of the solute in the solution, *i.e.*, if the concentration of the surface layer of the solution were greater than the concentration of the bulk of the solution. This is found to be the case in all solutions where the solute lowers the surface tension of the solvent, and we may state generally that those solutes which decrease the surface tension of the solvent are concentrated at the surface, and, conversely, those solutes which raise the surface tension of the solvent have a lower concentration in the surface layers than in the bulk of the solution. This generalization is known as Gibbs's adsorption theorem. The increase in concentration of the solute at the surface is a case of adsorption of the solute at this surface. Solutions of low surface tension are apt to foam or froth. Conditions favourable to frothing are low surface tension, low volatility and not too high mobility of the liquid. Pure liquids do not froth. A solution of soap in water froths very readily; if this froth is collected it is found to contain a much greater concentration of soap than the bulk of the liquid, *i.e.*, the soap has been adsorbed on the air-liquid surface.

Adsorption of Solutes by Solids.—The adsorption of solvents by solids is explained in exactly the same way as that of solutes at the gas-liquid interface. It is the application of Gibbs's adsorption theorem to the distribution of the solute. Those solutes which lower the surface tension at the liquid-solid interface will be concentrated or adsorbed at that surface and vice versa. When the surface area of the solid is very large (porous or very finely divided solids), the free surface energy assumes very high values, and may be considerably reduced as a result of adsorption. In the case of the gas liquid interface, the surface tension, and consequently the free surface energy, can be readily determined, and thus the results of adsorption interpreted quantitatively. It does not follow that a decrease in the surface tension at the gas-liquid interface involves a decrease in the surface tension at the liquid-solid interface. The measurement of the surface tension in the latter case is extremely difficult, and the results are not trustworthy. If charcoal is shaken with a solution of methylene blue in water, a decrease in the concentration of the solution is indicated by a decrease in the intensity of its colour. A similar result is obtained by shaking charcoal with a solution of the fatty acids, amines, phenols, etc., in water; the solutes are adsorbed by the charcoal, since they lower the surface tension and therefore the free surface energy at the solution-charcoal interface.

In the case of solutes which raise the surface tension of the solvent, the converse holds, *i.e.*, the concentration of the surface

layers will be less than that of the bulk of the solution, and the concentration of the solvent is relatively greater at the solid-liquid surface. We thus have two cases of adsorption; the first, resulting in a diminution in the concentration of the solution, is generally known as positive adsorption, and the second, resulting in an increase in the concentration of the solution, is known as negative adsorption.

It has been suggested that liquids in contact with charcoal are actually compressed on the surface of the solid, and this pressure has been estimated at 10,000 to 60,000 atmospheres. Positive adsorption is utilized largely in industry. Bancroft has determined the efficiencies of the more important decolorizing agents.

Material	Efficiency	Material	Efficiency
Alumina	100	Bone charcoal	17
Fuller's earth	50	Ferric oxide	3
Bauxite	40	Kieselguhr	3

The amount of adsorption generally decreases with increasing temperature, but the rate of adsorption increases with increasing temperature. In adsorption efficiency, specific surface plays a very important part—the higher the specific surface the more efficient the adsorbent. Freundlich's isotherm for adsorption from solution is:

$$x/m = Kc^{1/n};$$

x/m is the amount of solute adsorbed per unit mass of adsorbent; c is the concentration of the solution at equilibrium; K and n are constants, the values of which vary considerably (*e.g.*, n varies between 1 and 5), and depend on the temperature, nature and specific surface of the adsorbent, and also on the solvent.

The adsorption isothermal defines the relationship between concentration in the solution and the quantity adsorbed, as with gases; at small concentrations relatively more is adsorbed than at higher concentrations. This relationship only holds for dilute solutions: at high concentrations a saturation value is reached—in fact, at very high concentrations the amount adsorbed seems to decrease, due to more of the solvent being adsorbed. The adsorption of a salt is an additive property of the cation and the anion; thus, the adsorbability of a series of potassium salts is in the same order as that of sodium salts. The order of adsorbability of cations is as follows: Organic dyes (basic), H^+ , Ag^+ , Hg^+ , Cu^{++} , Al^{+++} , Zn^{++} , Mg^{++} , Ca^{++} , NH_4^+ , K^+ , Na^+ ; and for the anions: Organic dyes (acidic), OH^- , CN^- , S^{--} , I^- , NO_3^- , Br^- , Cl^- , SO_4^{--} . Apart from the organic dyes, hydrogen and hydroxyl ions are the most readily adsorbed. In the case of the metals, the valency and the position of the element in the electrolytic potential series seem to be of importance. This preferential adsorption of H^+ and OH^- gives the adsorbent a positive or negative charge, and explains the origin of the electric charge on colloidal particles. The coagulation of colloidal solutions by electrolytes is also explained by the preferential adsorption on the surface of the colloidal particles of one ion which neutralizes its charge (*see* COLLOIDS).

If we consider the adsorption of methylene blue by kaolin, we find that the adsorbent is very efficient, much more efficient than in the adsorption of the fatty acids, etc. The solute in the case of methylene blue is highly ionized, and it comes into contact with a solid (calcium silicate) whose anion is extremely insoluble, but whose cation readily goes into solution. The calcium ions of the solid therefore change places with the methylene blue cation in solution. This kind of adsorption is known as exchange adsorption and is polar in character.

Theories of Adsorption.—Three theories of adsorption have been advanced: (1) Chemical theory; (2) Solution theory; (3) Surface theory.

Chemical Theory.—If one regards adsorption equilibria as chemical equilibria, then the adsorption isotherm must be a special case of the law of mass action (*see* CHEMICAL ACTION). If one considers the adsorbent and the compound of the adsorbent and adsorbed substance as solid phases of constant composition, one must also assume a phase of variable composition (a solid solution) in order to apply the adsorption isotherm. Then the adsorption equilibrium can be regarded as a chemical equilibrium. The opponents of this theory claim that chemical equilibrium is very

specific, the equilibrium and velocity coefficients vary considerably with the number of reacting molecules (in the adsorption isotherm this is $1/n$). Adsorption equilibrium, on the other hand, is but slightly specific; the constant K (the equilibrium constant in the law of mass action) does not vary much under very different conditions; the same applies to $1/n$. The chemical theory makes it difficult to understand the relation between the adsorbability of a gas and its condensability, or the influence of a solute on the surface tension of a solvent and the readiness with which it is adsorbed. Again, the chemically inactive gases helium and argon are adsorbed.

Solution Theory.—Adsorption as a solution phenomenon has but few adherents. In adsorption, equilibrium is rapidly established, but diffusion in a solid is extremely slow. Again to bring the phenomenon of adsorption into line with Henry's law, one must assume the dissociation of the gas, which is highly improbable in most cases. Some suggest that the gas is liquefied on the surface of the solid; this explains the relationship between adsorption and condensability of gases, but does not assist in the case of adsorption from solution.

Surface Theory.—Many regard adsorption merely as a concentration on the surface of the adsorbent in accordance with the second law of thermodynamics. Assuming the validity of the gas laws and van't Hoff's law for dilute solutions, the following equation can be deduced thermodynamically:

$$u = -c/RT \cdot d\sigma/dc$$

where u = excess of gas or solute in the surface layer; c = concentration of solution (pressure of gas); R = gas constant; and T = absolute temperature.

It is difficult to test this equation in the case of solid surfaces because of the difficulty of determining the value of the surface tension σ . In the case of gas-liquid and liquid-liquid surfaces, the experimental results agree qualitatively, but quantitative results are difficult to obtain on account of the necessity of using very large surfaces.

The laws of chemical combination, solution and adsorption are represented by the curves in figure.

Curve 1: $x = K$ (law of constant composition). Action is due to the attractive forces between the atoms or molecules.

Curve 2: $x/p = K$ (Henry's law of solubility).

Curve 3: $x/p = K^{1/n}$. K is given an exponent between 0 and 1, the values found in the case of chemical combination and solubility respectively. This phenomenon is due to molecular attraction and also to the kinetic motion of the molecules.

Modern research tends to bring together the extreme views (chemical and physical) of adsorption. At one time the phenomenon was regarded as purely physical and non-specific; adsorption is now shown to depend on a variety of factors, many of which are extremely specific and closely related to chemical phenomena. I. Langmuir and N. K. Adam studied the behaviour of oils spread in unimolecular layers on water, and found that the forces operating were not readily distinguishable from chemical forces or affinity.

Applications of Adsorption.—Cocoa-nut charcoal is generally employed at very low temperatures (temperature of liquid air). Adsorption facilitates the separation of the difficultly adsorbed gases hydrogen and helium from the more easily adsorbed, such as nitrogen and oxygen. The effectiveness of gas masks depends on the efficiency of the charcoal which they contain for adsorbing such poisonous gases as chlorine, phosgene, etc. A very active and porous grade of charcoal is also used in an important process for the adsorption of gasoline from natural gas.

Adsorption is of very great importance in chemical reactions, for many of them are accelerated on various solid surfaces, and this has found extensive application in industry. Mention need only be made of the contact process for the manufacture of sulphuric acid ($q.v.$), the synthesis of ammonia ($q.v.$), hydrogenation ($q.v.$) of oils, etc. Catalytic poisoning is also due to adsorption. (See CATALYSIS.) In dyeing, adsorption plays a very prom-

inent part in the fixing of the dye on the material, although the formation of compounds may also play a part in some cases. In the photographic plate the silver bromide is in the colloidal form and adsorbs the sensitiser. In brewing, the gas content and taste of the beer depend largely on adsorption of the colloidal particles. The growth of crystals from solution or from a molten mass is frequently influenced by the presence of other substances in solution; this rate of growth of the crystals in different directions determines their shape.

Adsorption plays a very important part in the agglutination of bacteria, and in the neutralization of a toxin by an anti-toxin. In the field of public health we find adsorption of importance. Aluminium hydroxide and ferric hydroxide, which are present in the soil, are very pronounced adsorbents, and filtration through soil is therefore a very efficient means of freeing sewage and other waste water from colloidal organic particles. This is also of importance to agriculture as the means whereby the soil is able to retain solvents from solutions which percolate through it.

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ADULIS (mod. *Zula*).—An ancient city of Eritrea. According to Pliny, it was founded by slaves who had fled from their Egyptian masters. Excavations have led to the discovery of a considerable amount of prehistoric pottery, and of various buildings, including an altar of the Sun and two Christian churches. The principal periods of its prosperity were the Ptolemaic, Graeco-Roman and Christian. The city, as far as can be ascertained, had neither fortifications nor walls.

See R. Paribeni in *Monumenti dei Lincei*, xviii. (1907) 437 sqq.

ADULLAM, a Canaanite city (Gen. xxxviii. 2), fortified by Rehoboam (2 Chron. xi. 7), and still a place of importance at the time of the Maccabees (2 Mac. xii. 38). Its chief interest lies in its connection with David who took refuge in its stronghold ("Cave" is a scribal error) on two occasions (1 Sam. xxii. 1; 2 Sam. v. 17). A site on the eastern edge of the Shephelah in the neighbourhood of Socoh (Shuweikah) seems to be indicated. Conjectural identifications are (1) Khareitun, south-east of Bethlehem, which has a large cave but nothing else to commend it. (2) Deir ed-Dibban, some 6m. east of Shuweikah, where there are caves and (3) Aid el-Ma', south of Shuweikah and at no great distance from it. The last identification is the one most favoured. The name, which appears to represent an Arabic reconstruction of Adullam, the position and the physical characteristics of the site support it. In modern political history the term "Cave of Adullam" was applied by John Bright to certain Liberals who seceded from their party to oppose the Reform Bill of 1866. But the expression had been used earlier by President Lincoln (1864). From the same usage is derived the shorter political term "Cave" for any body of men who secede from their party on some special subject.

See Clermont Ganneau, *Pal. Expl. Fund Quart. Statement*, 177 (1875); G. A. Smith, *Hist. Geography of the Holy Land*, 229f (1910).

ADULT EDUCATION, a phrase originally meaning education of adults who have not been properly educated as children. As the educational system improved, the need for such education diminished, but as democratic government developed, it brought with it the need, felt by everyone, for education in citizenship. Adult education in this sense has been described as "an inseparable aspect of citizenship" and the new movement, which dates from the beginning of this century, has extended to democratic countries all over the world, including such countries as Germany and the United States. Because these countries had early possessed a comprehensive system of elementary and secondary education, they have not felt the need for adult education in its original sense. (See Adult Education in the United States, page 185.) It is often also distinguished as non-vocational adult education from the vocational education now given to adults in technical and commercial colleges in many parts of the country.

The new movement has taken many forms and is carried on

by many different organizations which held ideals that were at the same time high and practical. Thus in England the Workers' Educational Association, founded by Albert Mansbridge in 1903, originally aimed at bringing together working-class organizations to provide for an education, designed not to take men out of their class or trade, but to equip them, whatever their occupation in life should be, for the work of citizenship. It was to be a highway and not a ladder. The education it desired to bring into being was to be broad, impartial and scholarly, was to aim at a higher university standard and was to enlist the aid of the universities and of public authorities.

The universities were asked to help in maintaining the standard of education, but the choice of subjects and of tutors was to be with the students. It was recognized that adult students bring an experience of life and an understanding of practical problems which are as important a contribution as the more theoretical knowledge of the teachers, and that adult education, therefore, requires a technique and organization in which both students and university trained teachers have their parts to play.

Tutorial Classes.—In 1907 the University of Oxford organized the first tutorial class, the characteristic educational instrument of the new movement. These classes were small, between 20 and 30 persons, meeting once a week in the winter over a period of three years. Each class period consisted of an hour's lecture and an hour's discussion, the students undertaking from the start to attend for the full period of three years and to do written work. The classes were under the control of a joint committee consisting of equal numbers of representatives of the university and of working-class organizations. The quality of work done in these classes was often of a good university standard. All the other universities of England and Wales followed the example of the University of Oxford, and in 1925 there were over 500 tutorial classes with 12,000 students, while the number of affiliated bodies was 2,500 and of independent members 23,000. The Board of Education has supported this work from the beginning and through its inspectors and the reports of its advisory adult education committee done much to further the standard of the teaching given. Most local education authorities now give some support to adult education by grants either to tutorial classes or to the more elementary one-year classes and terminal courses which have greatly increased in numbers.

The total amount of education of this kind given in democratic countries is very considerable and is rapidly increasing. The movement is still young and its future organization is still uncertain. Its great strength in the past was that it has been run by voluntary associations and has in a real sense been a university controlled in the main by its students. It suffers, however, from the weakness of administration and the fluctuating enthusiasm characteristic of all voluntary organizations. Its success in the future will depend on how far it can be connected more closely with public educational institutions on the one hand and organized labour on the other, without losing its voluntary character. The British Institute of Adult Education attempts to survey and co-ordinate by the publication of its journal and other literature, and by the holding of conferences, the work of the various organizations in the country which are concerned with adult education. The World Association of Adult Education is working to spread knowledge of adult education in all parts of the world.

See *Final Report of the Adult Education Committee* (Cmd. 321, 1919) and *Journal of the British Institute*. (A. D. L.)

UNITED STATES

In the United States the term adult education is used to denote an educational movement for men and women, young and old, who no longer are in contact with formalized education and whose primary interest lies in a vocation but who possess a secondary interest in their own educational improvement as a sustained and continuing process. It is sometimes called "continuing education." It interprets graduation from any sort of schooling as a commencement of educational opportunity extending throughout life.

While the movement was not recognized in the United States under the name "adult education" until 1924, its roots were already deeply imbedded in American life. The New England town meeting of the 17th century formed the initial adult education venture of record in the English colonies of North America. It was a logical next step to the formation of the first lyceum in Massachusetts in 1826, a voluntary association of farmers and mechanics "for the purpose of self-culture, community instruction and mutual discussion of common public interests." The town lyceums made rapid growth and in 1839 more than 3,000 were in existence. They assumed an educational leadership with the years, Emerson, Thoreau, Lowell and Holmes among others lending them prestige. It was the example of the lyceum which led Bishop John H. Vincent and his colleagues in 1874 to expand a Sunday school association into a general adult education venture. The Chautauqua Institution (*see* LYCEUMS and CHAUTAUQUAS) resulted and in its train numerous imitators, later to be served by the commercial Chautauqua and lyceum circuits. The last quarter of the 19th century saw the beginnings of the university extension movement and with the 20th century impetus to popular education was given through Andrew Carnegie's large benefactions to public libraries. Meanwhile the tax-supported school system, as the compulsory school age was pushed upward, had instituted a series of vocational extensions, soon accompanied by such non-vocational enterprises for adults as the voluntary evening high school.

The increase in public estimation of these agencies gave rise to many other forms of educational activity for adults. Most of them were based on the American tradition of education at cost, less than cost or no cost to the student. In addition there were devised, to meet the recognized educational needs of large numbers of people, certain commercial organizations known as private correspondence schools (*see* CORRESPONDENCE SCHOOLS) operated for profit under modern salesmanship methods. Almost wholly vocational and technical in nature, these courses attracted such numbers that in 1927 the current enrolment was estimated at more than 2,000,000 persons who were annually expending \$70,000,000 for the instruction offered.

An inquiry into adult education needs and possibilities in England and Scotland, made as a part of the British ministry of reconstruction report of 1919, had resulted in the phenomenal growth of adult classes in those countries. Increasing recognition of the British movement and observance of a considerable American interest in various forms of continuing education led to an inquiry into American conditions, instituted in 1924 by the Carnegie Corporation of New York. Five volumes constituting reports on as many broad phases of the general subject were published, a series of regional and national conferences of teachers and leaders of adults was held and, in March, 1926, there was formed the American Association for Adult Education with headquarters in New York. It serves as a national clearing house for information, sponsors and initiates researches and studies, and supervises and conducts experiments and demonstrations in co-operation with local and national agencies.

Urban and Rural Community Organization for Adult Education.—The initial attempt in the United States to organize an entire community's educational facilities with special reference to the adult and his needs was made in Cleveland in 1924. The Cleveland Conference for Educational Co-operation resulted and later a complementary body, the Adult Education Association of Cleveland. In 1925, Buffalo, organized similarly, conducted a self-survey under the auspices of a co-operative group known as the Buffalo Educational council. The survey has since been published and the recommendations of the council are rapidly becoming effective. The Cleveland and Buffalo examples have brought together like groups in Chicago, Detroit, St. Louis and Brooklyn. Plans for organization have been made in eight other cities. In addition, Dallas, Texas, in its Civic Federation and Institute for social education, founded in 1920, furnishes perhaps the best example in the country of a private educational venture for adults. Representatives of the various community enterprises have formed a national community conference which has affiliated

itself with the National Community Foundation. The latter organization is conducting, on an experimental basis, community organization activities and educational programmes in 60 small cities and towns of the Middle Atlantic States. It co-operates with its related organization, the Swarthmore Chautauqua. Michigan state college is experimenting with continuing education for rural areas in two Michigan counties selected for the purpose. A preliminary survey has been made and responsibility has been assumed by local groups. The California State board of education has likewise initiated a rural county demonstration. A privately supported small town circuit in western New York has been formed, initiating programmes in 16 centres.

Tax-Supported Adult Education.—Approximately 100,000 men and women are enrolled in public evening schools (*see* CONTINUATION SCHOOLS) annually. They are almost exclusively in urban centres of 25,000 population or more. The work offered is either the same as the day school, designed to meet the needs of those who have had to leave school for economic reasons, or technical courses for vocational preparation, or classes for immigrants desiring to learn English. The last group has diminished rapidly since the revision of the immigration laws, although evidence is at hand that the need for such instruction still is large. The continuation school (*see* CONTINUATION SCHOOLS) is newly established and is found in only half the States of the Union and there only in the larger urban communities. It requires from four to 18 hours of student school time each week. The co-operative school, originating at the University of Cincinnati, is still in an experimental stage. It provides for equal division of time between class-room and work in a factory. The usual practice is to alternate weeks. Antioch college, O., is wholly given over to the industrial co-operative idea.

Private Technical, Commercial and Correspondence Schools.—Thousands of business schools (*see* COMMERCIAL EDUCATION), trade schools (*see* TECHNICAL EDUCATION; INDUSTRIAL SCHOOL), and technical institutes, conducted for profit and in a relatively small number of cases, philanthropically endowed, operate in cities of all sizes throughout the country. They vary widely in efficiency and in repute. The schools of this type which utilize the correspondence method of instruction have reached large proportions in the United States. Of the 1,500,000 new students enrolled each year, 95% wish to obtain vocational training and pay from \$10 to \$280 for each course, the average payment being about \$40. Extensive advertising methods are employed, from 30% to 80% of all tuition fees received being devoted to course salesmanship. Efforts are being made by the Federal trade commission, by the Better Business bureau of the National advertising clubs and by the National Home Study council, an association of correspondence schools, to improve business ethics and to create instructional standards.

Schools Operated by Religious Organizations.—Each of the large associations originally organized for religious and social purposes maintains an educational activity as an auxiliary phase. The Young Men's Christian Association (*q.v.*) enrolls about 90,000 young men, mostly in evening classes which are chiefly of a vocational nature but which recently have shown a trend toward the non-vocational. The Young Women's Christian Association (*q.v.*) has an even more widespread educational programme, though of a much more informal nature than that of the Young Men's Christian Association. Its emphasis is definitely on the side of cultural studies. The Knights of Columbus (*q.v.*) and Young Men's and Young Women's Hebrew associations repeat the patterns of the other associations on a smaller scale.

Corporation Schools.—Education for workers is of two general types in the United States: that provided by the workers themselves and that provided by the employers. In the latter group fall some interesting experiments in education for the job-vocational education designed for immediate practical use in the industry which offers it. The larger corporations such as the Standard Oil Company, The Westinghouse Company, the telephone and allied interests, and to a lesser degree the automobile manufacturers, have educational departments which take employes from apprentice courses to the highest technical branches.

Workers' Education.—Although sporadic efforts had been made during the preceding quarter century, it was not until after the World War that an organized educational movement of wage-earners assumed sizable proportions in the United States. In 1921 a group of trade unionists and teachers in New York formed the Workers' Education bureau of America as a national organization to serve as a clearing house for information and to establish study classes. The bureau has since become the agency through which the American Federation of Labor carries on its entire adult education programme for its membership. It has not only increased the number of workers' classes, but has published text-books, syllabi and study outlines. Of the dozen or so labour colleges scattered through the country, the residential Brookwood Labor college at Katonah, N.Y., is the best known. It has a two-year course and also conducts special summer institutes. The International Ladies' Garment Workers' union has the most highly developed educational programme among national unions, although those of the United Mine Workers in Illinois and Pennsylvania are worthy of note. In California, the State Federation of Labor and the University of California Extension Division have embarked upon a joint programme for workers.

Special Summer Schools.—At Bryn Mawr college, a summer session for women workers in industry is held annually for 100 women workers, equally divided between unionized and non-unionized workers. The Bryn Mawr plan has been successfully adopted at the University of Wisconsin, Barnard college of Columbia university, New York, and at Sweetbriar college, Virginia. The National League of Girls' clubs holds an annual summer session on Long Island for mill girls, stenographers and other industrial workers, initially trained in the league's winter classes in New England and Middle Atlantic States. These summer schools are not to be confused with those conducted in great numbers by the universities and colleges throughout the country (*see* SUMMER SCHOOLS) which, while open to adults generally, are chiefly attended by teachers and college students. The California State board of education in 1927 initiated a series of special summer schools of adult education to be held annually. The first session was held at Mills college, Oakland, with an attendance of 250. The Chautauqua Institution of New York conducts a two months' summer session annually attended by about 12,000 people. This course is comparable with a university summer session. In addition winter reading courses are attended by 10,000 persons.

University Extension and Adult Education.—The total enrolment of university extension students in the United States, exclusive of agricultural extension (*see* UNIVERSITY EXTENSION and AGRICULTURAL EDUCATION) may conservatively be estimated at 250,000. The university extension movement (*see* UNIVERSITY EXTENSION), through lectures, visual education media, correspondence courses, exhibits, discussion groups, reading circles, etc., easily reaches five times that number. If the 5,000,000 members of farm families reached by the State agricultural colleges in co-operation with the Federal department of agriculture be added to the general extension total, it will be seen that university and college extension is the most important factor numerically in adult education in the United States.

Libraries and Museums.—Through the activities of the board on the library and adult education of the American Library Association, the 4,000 communities in the United States which have their own public library facilities, together with a number of State and regional organizations, have been acquainted with a new conception of the library as a dynamic agency of education. Many of the larger libraries have instituted readers' advisory services providing individual attention for every serious reader, including the preparation of special reading courses. This association has published a "Reading With a Purpose Series" consisting of more than 40 pamphlets, each of which is a short introduction to a given subject together with a list of half a dozen recommended books in the field. Hundreds of thousands of copies of these pamphlets have been sold and distributed. (*See* LIBRARIES and SCHOOL LIBRARIES.) By means of lectures, gallery talks, guidance for visitors, publications for the layman, loan collections, travelling exhibits, consultation hours for students and manufacturers, and

formal classes, a great educational work has also been done by the museums.

Chautauquas and Lyceums.—The modern chautauqua and lyceum serve towns of less than 2,500 population almost exclusively. With the exception of one circuit, they are conducted for profit. The competition deriving from the radio, motion pictures and cheap transportation has resulted in large financial loss to the chautauqua and lyceum operators of late years and it is questionable whether this form of combination lecture and entertainment bureau will persist in the U.S. The commercial chautauquas are not to be confused with the Chautauqua Institution of New York.

Women's Clubs, Parent Groups and Forums.—Three million women in the United States belong to women's clubs, in towns and cities of all sizes. Study materials are prepared by national and state offices which form the bases of educational programs throughout the year. With the public school as the basic unit, hundreds of thousands of parents, chiefly mothers, are united in parent-teacher associations, child study (*see CHILD STUDY ASSOCIATIONS*), child welfare groups, etc. They are served by several national organizations. Each group is engaged upon an educational program. Certain of the large state universities, notably Iowa, Minnesota and California, have recently assumed responsibilities in relation to the parental education program within their respective areas. Varying greatly in accordance with the communities which they serve, open forums flourish in many parts of the country. They are purely individualistic and autonomous; half of them are conducted by Protestant or Jewish churches.

Individual Enterprises.—Certain individual enterprises reflect the best which the nation has to offer in adult educational thought. Among these should be cited the People's Institute of New York, founded in 1897 as a forum for public discussion. Courses of instruction of a high standard and individual lectures are offered. In its school, the institute conducts experimental classes for adults in various parts of New York city. Similarly, the New School for Social Research of New York city may be considered an adult education enterprise. There are others of less note, including at least three Danish folk school experiments which have not yet demonstrated their adaptability to U.S. life.

(M. A. C.)

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ADULTERATION, the act of debasing a commercial commodity with the object of imitating or counterfeiting a pure or genuine commodity, or of substituting an inferior article for a superior one in order to gain an illegitimate profit. The term adulteration is usually applied to the debasement of foods, drugs or cosmetics; but adulteration may be said to be practised by profiteering contractors who substitute sand for cement in the concrete used for public buildings or by purveyors of woollen goods whose fabric is composed largely of cotton.

Adulteration has been practised by less responsible persons of almost every trade and profession, and its origins are lost in prehistoric times. So widespread and pernicious did this practice become that in ancient and mediaeval times laws were enacted to curb the most flagrant abuses. The common law dealing with fraud is in most cases sufficient to deal with the ordinary forms of adulteration, but all civilized nations found it necessary to enact special legislation to deal with adulteration of foods and drugs.

There are numerous references to adulteration in the classics. Elisha, the biblical prophet, was warned that the herbs of which his pottage was made were poisonous weeds by the cry, "There is death in the pot." Pliny the Elder complained of the "white earth" added to the bread baked in the days before the destruction of Pompeii.

Both Athens and Rome enacted laws to prevent the adulteration of wine with colours and flavouring agents. Because of the

economic importance of spices in the middle ages, the temptation to market sophisticated products was great; and in 1316 the pepperers or spicers of London began to regulate the quality of their produce. During the reign of William the Conqueror, brewers were subject to severe fines for adulterating beer. During the reign of John (1203), the first proclamation regarding the adulteration of bread was made. The first statute specifically prohibiting the adulteration of human food was enacted during the reign of Henry III. In France and Germany, food control statutes were passed in the 13th century. The artificial colouring of butter was prohibited by the *prevost* of Paris in the 14th century.

MODERN LEGISLATION

Both Great Britain and the United States enacted laws from time to time widening the control exercised over foods and drugs. The initial laws dealt principally with adulteration and were designed to prevent specific abuses. Adulteration of food received the earliest legislative attention, partly because the practice was widespread and affected the greatest number of people and partly because the honest purveyors of foodstuffs were placed at an economic disadvantage from which relief could not be obtained otherwise. Increase in legislative control was brought about by technological advances in the food industry such as the development of commercial canning, production of processed foods and the gradual shift of the population from agrarian pursuits to industrial employment with the resultant growth of large cities and the attendant problems of food distribution. This change in character of food production and distribution proceeded most rapidly from about 1865 to 1920 although commercial canning actually began in Europe in 1810, and in 1940 frozen foods were just beginning to become popular in the United States.

British Legislation.—One of the earliest acts of the English parliament dealing with food adulteration was directed at the sophistication of tea. The acts of 1725 and 1730 prescribed penalties for adulteration of this commodity. Similar acts were passed dealing with coffee in 1718 and with cocoa in 1803. The addition of extraneous colouring matters to beer and porter was prohibited in 1816. These laws were penal in nature and served the double purpose of ensuring the integrity of the articles subject to them and of furnishing inland revenue. The enforcement was left in the hands of revenue officers.

Dr. Arthur H. Hassall was one of the first to utilize the microscope to detect adulteration. In 1850 he demonstrated that adulteration of coffee with chicory could be determined by this method, and he was commissioned by Thomas Wakley (1795-1862), owner of the *Lancet*, to extend his examination to other articles of food. Hassall's findings were published as reports of the *Lancet* Analytical Sanitary commission. Adulteration was found to be rampant, and scarcely any common foodstuff was found which was not adulterated. These disclosures and the pressure of public opinion resulted in the appointment of a parliamentary committee in 1855, and in 1860 the first act that dealt directly with the adulteration of food, known as the Adulteration of Food and Drink act, was passed. This act did not provide a clear-cut procedure for its enforcement nor did it provide for a responsible enforcing body. As a result this act, though praiseworthy in intent, was wholly ineffective. The Adulteration of Food and Drugs act (1872) provided for the purchase of samples by inspectors and the analysis of such samples by analysts. Penalties were prescribed: a fine of £50 for the sale of an injurious food and six months' imprisonment at hard labour for a second offense. This act defined an adulterated article as "any article of food or drink or any drug mixed with any other substances, with intent fraudulently to increase its weight or bulk, without declaration of such admixture to any purchaser thereof before delivering the same." In essence this definition is that followed in subsequent acts. Little attention was paid to this act outside of London and a few small towns, but cases which did arise under the act soon revealed weaknesses and defects which occasioned complaints. Among the difficulties complained of were the differences in interpretation of the definition of adulteration by various courts

and by different analysts, and the severity of the penalties imposed for minor deviations from the law.

The Sale of Food and Drugs act, 1875, attempted to correct the defects of the earlier law. This act avoided the term "adulteration" and attempted to define with some precision prohibited practices. It provided for the compulsory appointment of analysts in the City of London, the vestries, county quarter sessions and town councils or boroughs having separate police establishments. Conflicting decisions in the courts, lack of uniform regulations with respect to sampling and analysis led to endless disputes and considerable injustice in its operation. Since dairy products constituted one of the principal classes of food subject to adulteration, the bulk of the early cases under this act dealt with these products. Furthermore, during the decade following the passage of the act, a multitude of butter substitutes made their appearance, and the anguished cries of the dairy industry resulted in the passage of the Margarine act of 1887, which provided for distinctive labelling of butter substitutes.

The need for precise legal standards or definitions for articles of food was apparent in the conflicting decisions of the courts and varied interpretations placed by different analysts on their findings. In 1894 a select committee was appointed to consider the defects of the act of 1875 and recommend remedial measures. Its recommendations resulted in the Sale of Foods and Drugs act of 1899, which, unfortunately, was not comprehensive but merely amended and added to the original statute. Subsequently, various amendments designed to strengthen or clarify the provisions of these various laws were enacted.

The Sale of Food and Drugs act, 1875, was the first comprehensive legislation dealing with adulteration. Many of the older statutes, particularly the Adulteration of Coffee act, 1718, the Adulteration of Tea and Coffee act, 1724, the Adulteration of Tea act, 1730, and the Adulteration of Tea act, 1776, were designed more to protect the revenue than to protect the public from fraud and danger to health. In fact it was not until the Bread act, 1836, that a definite departure was made from revenue protection to the protection of the health of the community.

The multiplicity of acts relating to adulteration and the need for revision of the act of 1875 led to the Food and Drugs act, 1928. This act consolidated and repealed the four principal acts bearing the title Sale of Food and Drugs acts; namely, those of 1875, 1879, 1899 and 1927, and the two Margarine and Butter acts of 1887 and 1907. The 1928 act placed responsibility for administration and enforcement of the law on the local authorities, designated "food and drug authorities," who appointed "sampling officers" and public analysts whose duty was to detect violations and present evidence. The penalties invoked for violation were quasicriminal in nature but did not relieve the offender from his ordinary liabilities at common law or under the law of contract.

Unfortunately, the 1928 act only partially relieved the confusion. Purveyors of foods were still subject to a dozen or more special laws and regulations, some dealing directly with adulteration, others passed as agriculture acts and still others falling in the general category of public health laws. Parliament was again called upon in 1938 to consider additional legislation to consolidate these related laws. In 1938 the Food and Drugs act was passed which consolidated, with certain amendments and additions, a number of miscellaneous acts relating to food and drugs. The acts consolidated were the Food and Drugs (Adulteration) act, 1928; the Knackers acts, 1786 and 1844; the Bread act, 1836; part of the Public Health act, 1875; the Milk and Dairies (Consolidation) act, 1915; the Milk and Dairies (Amendment) act, 1922; the Artificial Cream act, 1929; and part of the Public Health (London) act, 1936.

This act dealt principally with foods and was divided into six parts: part I dealt with the composition of food and drugs, unsound food, measures to prevent the contamination of food, notification of food poisoning and sale of meat from knackers' yards; part II with milk, dairies and artificial cream; part III related to bread, flour, margarine, butter, ice cream, horseflesh and shellfish; part IV to the importation of food; part V dealt with markets, slaughterhouses and cold-air stores and part VI with

administration of the act, legal proceedings and other miscellaneous matters.

The Food and Drugs act, 1938, like its predecessors, did not define adulteration *per se*, but prohibited the addition of substances to foods so as to render the food injurious to health and prohibited the addition of any substance to a drug so as to affect injuriously its quality or potency. The act further prohibited the abstraction of any constituent of a food so as to affect injuriously the nature, substance or quality of the food, except that such altered food could be sold if the purchaser was advised of the alteration and the food complied with pertinent regulations governing food standards. Considerable attention was devoted to prescribing sanitary facilities in food-handling establishments and to prohibiting practices which might result in contamination of the food with filth, spoilage or other changes which might adversely affect its quality. Authority was provided for inspection, sampling and analysis of food; and penalties for violations of the statute and regulations were set forth. Medical practitioners were required to report in detail to the local authorities all cases of suspected food poisoning, and the appropriate local medical officers required to make suitable investigations of all such cases, placing the suspected food under an embargo until the investigation was completed.

Milk and other dairy products were dealt with at length in the act of 1938. The minister of agriculture and fisheries was empowered to promulgate regulations defining adulteration of milk and the councils of counties and county boroughs to enforce the act, except in London where this power was placed in the hands of the food and drug authorities.

The enforcement of the Food and Drugs act, 1938, rested with the various local authorities and food and drug authorities, as defined in section 64. These authorities were, in general, the local county or borough councils. They were required to appoint qualified public analysts and provide facilities for bacteriological and other examinations of samples of food and drugs. Penalties were provided for violations of the act and legal procedure for prosecutions, appeals and other punitive measures were outlined.

Legislation in the United States.—The earliest enactment of the U.S. congress dealing with adulteration was the Flour Inspection Act for the County of Alexandria, in the District of Columbia, passed in 1824. Subsequently, congress enacted other local food and drug laws which applied principally to the District of Columbia and dealt with individual foods or drugs. The first general statute enacted by congress which dealt with adulteration was the Edwards bill of 1848 prohibiting the importation of adulterated drugs. It was not until 1890 that a similar bill, the Edmunds bill, prohibiting the importation of adulterated food, was enacted.

In 1880 a concerted attempt was made to enact legislation regulating interstate traffic in foods and drugs. Between 1880 and 1906 a total of 103 bills were introduced into congress, none of which was passed by both houses; but their various provisions set a pattern for the legislation which culminated in the Food and Drugs act of 1906. The factors responsible for the enactment of this act stemmed from a long series of investigations of adulteration of foods and drugs started by the department of agriculture in 1879. In 1880 Peter Collier, then chief chemist of the division of chemistry of the department of agriculture, recommended the enactment of a national food and drug law. He stated: "A law, carefully framed, is greatly needed in this country, where adulteration and substitution are every day practised." He further observed: "Laws should be made and vigorously enforced making the adulteration of foods and medicines a criminal offense. Where life and health are at stake, no specious arguments should prevent the speedy punishment of those unscrupulous men who are willing, for the sake of gain, to endanger the health of unsuspecting purchasers."

The man whose spectacular investigations so aroused public opinion that legislation was actively considered by congress was Dr. Harvey W. Wiley. Wiley became head of the division of chemistry in 1883 and immediately began a series of investigations on adulteration culminating in a series of reports characterized

by Pres. Grover Cleveland in 1888 as "the most complete treatise on that subject that has ever been published in any country." These investigations included a basic study of the addition of preservatives, colours and other substances to food and a study of methods to analyze foods and determine their adulteration. He organized among members of the bureau of chemistry (formerly the division of chemistry) the "poison squad" to which preservatives and other suspected adulterants were fed in order to determine their dietary value and harmful effects. Wiley also instituted a popular crusade, lecturing and writing for the popular press, organizing national pure food congresses and using every available means to arouse public opinion to promote legislation. So successful were his efforts that the Food and Drugs act was passed by congress by an overwhelming vote and signed by Pres. Theodore Roosevelt on June 30, 1906.

The act of 1906 set forth in rather specific language a statutory definition of adulteration. In the case of drugs recognized in the United States *Pharmacopoeia* or *National Formulary*, the standards set forth in these compendia were made yardsticks whereby the drugs were measured. Unfortunately, the act went on to specify that drugs could differ from these standards and not be deemed adulterated if the standard of strength, quality or purity were plainly stated on the label. Hence, persons ignorant of the significance of the standards could still purchase inferior articles, believing them to be of standard strength or quality. If a drug was not recognized in one of the official compendia, it was deemed to be adulterated if its strength or purity fell below the professed standard or quality under which it was sold. This provision was also open to abuse since it was not illegal to place two, three or more times the stated amounts of the ingredients in a drug preparation. In the case of potent or toxic drugs, serious reactions or poisoning could, and occasionally did, occur.

Confectionery was prohibited from containing terra alba, barytes, talc, chrome yellow or other mineral substances, or poisonous colour, flavour or other ingredients detrimental to health, or any vinous malt, spirituous liquor or compound or narcotic drug. Prior to the enactment of this law, the substances mentioned had been common adulterants of candy, and many children had been harmed or died as a result of consuming adulterated confections.

The adulteration of food was defined to prohibit the addition of substances which might reduce or lower or injuriously affect the quality or strength of the food; prohibit substitution, in whole or in part, of any substance; prohibit the abstraction of valuable constituents; prohibit the use of colour, coatings or other devices designed to conceal damage or inferiority; prohibit the addition of poisonous or deleterious ingredients; and prohibit filth and decomposition in food products.

Although these provisions seemed adequate in 1906, it soon became apparent that unscrupulous manufacturers could circumvent the purpose of the statute. For instance, foods which contained poisons which were natural ones rather than added during the course of production, processing or manufacture were exempt from punitive action. Foods which might become contaminated with dangerous disease organisms could be shipped with impunity if it could be shown that no filth or decomposition were present. One of the most serious loopholes in the law was the so-called "distinctive name" provision which provided that a food not containing an added poisonous or deleterious substance would not be deemed adulterated if sold under its own distinctive name. All an unscrupulous manufacturer needed to do was to adopt a distinctive name for the article; and he could, within limits, formulate any mixture he wished, vary the composition from day to day if he so desired and otherwise defraud the purchaser with impunity. This became a common practice in some quarters of the food industry.

The penalties provided by the statute for violation of its provisions were of two kinds. A criminal provision in section 2 provided a maximum fine of \$200 for a first offense for interstate shipment of an adulterated or misbranded food or drug or the receipt thereof and the delivery or offer of delivery in the original unbroken package for pay, or otherwise of the adulterated or mis-

branded article. Subsequent offenses carried a maximum penalty of \$300 or a year's imprisonment or both.

Section 10 provided for the seizure of interstate shipments of adulterated or misbranded articles by the United States marshal upon court order issued on a writ of monition attested by the United States attorney. This procedure removed the offending articles from the channels of commerce pending litigation of the issues involved. The seizure provisions were directed against the offending goods, and the responsible person or persons could ignore the entire procedure if they so chose. No penalty, other than loss of the goods by condemnation and such unfavourable publicity as might occur, was assessed against the person or firm responsible for the violation. The penalty provided by the criminal statute was nominal in character, and some firms regarded it in the light of a license fee to do an illegal business.

Although the Food and Drugs act was amended several times during the 32 years it was in force, these amendments did not alter materially the provisions dealing with adulteration. The defects already mentioned and others relating to the misbranding provisions of the law became more serious as technological developments in the food industry and the pharmaceutical industry created problems not contemplated by the framers of the original act. The development of a wide variety of packaged, prepared, preserved and canned foods created numerous opportunities for fraudulent practices not covered by the existing laws; and these opportunities were quickly seized upon and exploited by the less scrupulous dealers. New and more potent drugs were discovered and their control required greater technical skill; their potentialities for harm, if improperly prepared, labelled or distributed, increased enormously. The act of 1906 was found to be inadequate to cope with these modern developments.

Beginning about 1933 a series of bills was introduced in congress under the sponsorship of Sen. Royal S. Copeland of New York, providing an entirely new food and drug law. Although considerable support for new legislation was received from consumer groups and the department of agriculture, a powerful lobby prevented the passage of any bill to alter the Food and Drugs act, and it was not until a major tragedy occurred in 1937 that public opinion became sufficiently aroused to force congress to enact remedial legislation.

During Sept. and Oct. 1937 at least 73 persons died after taking a drug known as "Elixir Sulfanilamide." According to the U.S. *Pharmacopoeia*, an elixir is an alcoholic solution, but the product distributed as "Elixir Sulfanilamide" consisted of sulfanilamide dissolved in diethylene glycol, a poison which produces profound kidney and liver damage. The Food and Drugs act contained no provisions prohibiting the distribution of poisonous or dangerous drugs. The definition of adulteration did not encompass the sophistication of this product, and it was only because the manufacturer chose to call this mixture an "elixir" rather than a "solution" that the Food and Drug administration could remove the offending article from the channels of commerce. This tragedy was widely publicized and was one of the important factors in securing enactment of the Federal Food, Drug and Cosmetic act which became law on June 25, 1938.

The Federal Food, Drug and Cosmetic act contained many provisions not found in its predecessor. It prohibited foods dangerous to health; it also prohibited foods, drugs or cosmetics in insanitary containers or contaminated because of insanitary conditions of preparation. Under the old law dangerous foods were prohibited only when the danger came from an added ingredient. Under the new law the food was prohibited if the dangerous ingredient was contained in the food.

Added poisons in food were permitted if addition was necessary in good manufacturing practice, and if the amount added was within tolerances established by the federal security administrator. Metallic trinkets and nonnutritive substances in confectionery were forbidden. The distinctive name and "compound" exemption of the 1906 act were omitted; hence foods with distinctive names were not exempt from adulteration or misbranding provisions of the act. Drugs purporting to be among those officially recognized under standards of the U.S. *Pharmacopoeia*,

Homeopathic Pharmacopoeia or *National Formulary* had to have listed on their labels any differences of strength, quality or purity from the official standards laid down by these compendia. Slack filling of containers was prohibited and deceptive containers were prohibited.

The penalties for violation of the provisions of the new act were substantially increased over the old law and included seizure of the offending article, criminal prosecution of the responsible shipper with maximum penalties of a fine of \$1,000 or a year in jail, or both, for each violation charged; and in the case of intentional fraud or a second offense, a fine as high as \$10,000 or a jail sentence of three years or both could be imposed. In addition, the courts were empowered to issue injunctions restraining persons from further violations of the act.

The enforcement of the Federal Food, Drug and Cosmetic act rested with the administrator of the Federal Security agency. An integral part of this organization is the Food and Drug administration, headed by a commissioner, an associate commissioner and one or more assistant commissioners. In order to detect violations and to enforce the law more effectively, the United States was divided into three inspection districts with offices in New York city, Chicago and San Francisco. These districts were abandoned in 1948 and their administrative functions transferred to Washington. Inspection stations consisting of offices and laboratories with a staff of inspectors, chemists and administrative personnel were set up in Atlanta, Baltimore, Boston, Buffalo, New York, Philadelphia, Chicago, Cincinnati, Kansas City, St. Louis, Minneapolis, New Orleans, Denver, Los Angeles, San Francisco and Seattle. In Washington, D.C., were located the administrative offices and certain technical divisions and their laboratories, comprising the cosmetic division, food division, chemistry division, medical division, microbiological division, division of antibiotics control, division of pharmacology, division of state co-operation and the vitamin division. These divisions were established to supply technical information needed for the enforcement of the law and for the promulgation of regulations.

When a violation of the act is suspected, samples of the offending goods, together with documentary records showing the interstate character of the shipment, are collected by the inspectors and transmitted to the station in the territory in which the shipment originated. Analysis of the sample may be made at the station or by a technical division in Washington. If a violation is detected, a recommendation for appropriate action is forwarded by the station to the administrative headquarters in Washington. If punitive action is warranted, a statement of the facts and a recommendation is forwarded to the appropriate U.S. attorney, whose duty is to prosecute the case in the district court of the United States. Trial by jury may be had upon election by the defendant. Appeal from an adverse decision may be made in appropriate circumstances to the higher courts by either party.

ADULTERANTS

The oldest and most widely used adulterant is water. It is cheap, easily procurable and one of the most difficult substances to detect, particularly in food products whose natural composition is largely water. Milk, in particular, lends itself to adulteration with water; and in most countries local statutes or ordinances have been drafted to prohibit this type of adulteration, usually by providing for a minimum butter-fat content of whole milk.

Preservatives.—The use of preservatives in foods has been practised since time immemorial. Smoking, salting or drying of foodstuffs in order to preserve them was practised by ancient man and is still in use today. The use of chemical preservatives received an impetus during the last quarter of the 19th century when the growth of large cities necessitated the transportation of perishable foods over considerable distances. Modern methods of packing and canning removed the need for preservatives in most foods, but certain foods still require the addition of some substance to retard or prevent natural spoilage.

The use of harmless preservatives to prevent natural decomposition of certain foods may usually be regarded as a legitimate trade practice and does not result in an adulterated product. Neverthe-

less, the use of preservatives has been grossly abused, to the detriment of both the consumer and the legitimate producer. The use of preservatives to conceal damage or inferiority is condemned by most statutes dealing with adulteration. The use of toxic or potentially harmful chemicals as preserving agents is also subject to legal restrictions in most countries. Furthermore, quantities of chemical preservatives in one food may be harmless to the consumer but when added to the quantities found in other foods may lead to serious impairment of health. The presence of a fluorine-containing spray residue on apples may not be injurious if the quantity is less than five milligrams per pound, but if the consumer of the apples lives in an area where the water supply contains one milligram of fluorine in the average daily quantity of water consumed, mottling of the tooth enamel may occur. In this instance drinking the water without consuming the apples would have no deleterious effect.

Good manufacturing practice may still require the use of preservatives. Thus, even the most rigid inspection of tomatoes used for catsup cannot prevent the introduction of mould spores into the product. It is necessary to use a preservative such as sodium benzoate to prevent the development of mouldy decomposition. In most areas of the United States apples and pears cannot be grown successfully without the use of insecticidal sprays. Washing procedures which do not harm the harvested fruit do not remove all of the spray residue. Hence, it was necessary for the federal security administrator to establish maximum tolerances for the presence of certain potentially harmful ingredients of insecticidal sprays on these products.

In considering, therefore, whether the presence of a preservative results in the article's becoming adulterated, one must consider the nature of the preservative, the amount present, whether the use of the preservative could be avoided by good manufacturing practice and the purpose for which the preservative was added.

Boric Acid.—Formerly widely used, boric acid has been largely abandoned as a preservative in both the United States and Great Britain. Its use is deleterious to the consumer, and it has been used in foods for which no preservative was needed if satisfactory manufacturing procedures were followed. Boric acid or borax has been used as a preservative in butter, cream, ham, sausages, potted meats, cured fish and in home-canned fruits and vegetables. It is not an especially effective preservative and will not hide any traces of decomposition which have already taken place. Its use is unnecessary since the foods to which it has been added can be adequately protected from decomposition by careful preparation and adequate processing during manufacture.

Although large single doses of boric acid or borax may be ingested with impunity, smaller doses taken over a long period of time may produce deleterious effects. Amounts of one-half gram of boric acid are harmless, but larger doses, from two to five grams or more, may produce a gastroenteritis, kidney damage and collapse. The continued daily consumption of amounts as low as one-half gram, amounts which could conceivably be ingested during the winter months by a person subsisting on preserved foods, may lead to digestive disturbances, loss of weight and interference with absorption of protein and fat. The action of boric acid is cumulative and the symptoms are insidious. Doubtless many cases of chronic boric acid poisoning have gone undetected because of the vague nature of the symptoms. In persons with gastrointestinal disease or kidney disease, the effects of boric acid are intensified.

Formaldehyde.—Although wholly unsuited for food preservation, formaldehyde was at one time used as a preservative for milk. By mid-20th century, its use had been prohibited in most countries. Although it is an efficient antiseptic, it is quite irritant to mucous membranes and ingestion; even small quantities may lead to severe burning, gastritis and diarrhoea.

Salicylic Acid.—Salicylic acid in a concentration of 1 to 1,000 will inhibit the growth of moulds and yeasts. It has been used mainly in foods and beverages containing sugar and was used more extensively in Great Britain than in the United States, where benzoic acid or sodium benzoate became more popular. In the

quantities usually employed—namely 120 mg. per pound in jams and 0.5 g. per gallon in beverages—deleterious effects were not observed. In large quantities, salicylic acid and its derivatives produce sedation and analgesia; but, unfortunately, nearly 60% of the persons to whom it is administered may show signs of salicylism which consist of tinnitus, deafness, headache, nausea and cardiovascular disturbances. Furthermore, many individuals show an idiosyncrasy to the salicylates which is often manifested by an urticaria and digestive disturbances, even following small amounts. Free salicylic acid may produce a mild gastritis because of its irritant properties.

Benzoic Acid.—Closely related chemically to salicylic acid, benzoic acid, sodium benzoate and organic esters of benzoic acid have been employed extensively in the United States as preservatives. Jams, jellies and catsup are the principal foods in which these preservatives are used. The amounts usually employed are innocuous, and these substances are considerably less harmful than the salicylates.

Propionic Acid.—The discovery that certain fatty acids are effective fungicidal agents led to their employment as mould inhibitors in food products. Because of its occurrence in natural foods and because of its innocuousness, propionic acid and its salt, sodium propionate, have been employed in the baking industry to inhibit mould growth in bread and pastries. Although this preservative is relatively harmless, its use may permit the unscrupulous dealer to sell old bread as fresh. It is principally on economic grounds that the use of propionic acid is frowned upon by regulatory authorities.

Sulphurous Acid.—Sulphurous acid, applied in the form of sulphur dioxide, was formerly used to preserve meat, beer, juices and dried fruits. Except in preserving dried fruits, the use of sulphurous acid or sulphur dioxide was superseded by other more efficient methods of preservation. In large quantities sulphurous acid or the sulphites may produce nephritis, but such quantities would not ordinarily be found in preserved foods and beverages.

Monochloroacetic Acid.—About 1943 the citrus fruit growers of the United States discovered that monochloroacetic acid in relatively small amounts would serve as an efficient preservative and stabilizer for citrus juices. Overripened fruit and fruit otherwise unfit for use could be converted into juice and its inferiority concealed to some extent by the use of preservatives. Monochloroacetic acid was found to be deleterious, and in 1945 an epidemic of vomiting and diarrhoea occurred which was associated with the drinking of an orange-type beverage containing this preservative. Its use in the United States was prohibited by the federal Food and Drug administration.

Thiourea.—Thiourea is an effective antioxidant and has been employed in pharmaceutical preparations, particularly in ampouled solutions of readily oxidizable drugs as a stabilizer. In 1944 and 1945 experiments by the citrus industry showed that dipping the fruit or spraying it with solutions containing 1% or 2% thiourea would prevent deterioration and preserve the vitamin C content. Unfortunately, it was discovered that the thiourea penetrated the skin of the fruit and, since it is a potentially toxic substance which inhibits bodily oxidation processes and decreases the functional activity of the thyroid, its use was proscribed by the Food and Drug administration.

Spray Residues.—The economical production of certain fruits such as apples, pears and peaches requires the use of insecticidal sprays to prevent damage to the crop by insect pests. Under optimum conditions it is not possible to remove all traces of the spray by washing or other means. However, it is possible, by proper procedures, to reduce the quantity of spray residue to levels which will not be injurious to the consumer. The principal substances used as insecticidal sprays are lead and arsenic in the form of lead arsenate, fluorine in the form of cryolite, DDT and other organic compounds such as parathion and benzene hexachloride. All these substances are poisonous if ingested; extraordinary precautions must be taken to keep the concentrations in foods below toxic levels; and, in most cases, none should be present in the finished product. The administrator of the Federal Security agency was empowered under the Federal Food, Drug

and Cosmetic act to establish tolerances for poisonous substances when such substances cannot be avoided by good manufacturing practice. In 1944 an order was issued by the administrator establishing a tolerance for fluorine remaining as a spray residue on apples and pears of seven milligrams per kilogram of fruit.

Informal tolerances for lead and arsenic spray residues were announced by the Food and Drug administration in 1940. The administration stated that it would not take action against products in which the concentration of lead was 0.025 gr. per pound or less and in which the concentration of arsenic was 0.01 gr. per pound or less. In 1945 the Food and Drug administration announced that no action would be taken against products containing DDT as a spray residue, provided the concentration of DDT did not exceed seven milligrams per kilogram of fruit.

Other Adulterants.—Although a wide variety of substances have been used by the unscrupulous to adulterate or debase foods, those employed successfully to any great extent are limited in number because of the ease with which many adulterants may be detected. During World War I and World War II, shortages of many essential foodstuffs developed, particularly sugar, fats and oils. The demand for these substances was met by profiteering manufacturers with a variety of cheap substitutes.

Mineral oil was used to replace vegetable oil in salad dressings and other products in which the consumer would have difficulty in detecting the substitution. Some dealers sought to escape the penalties of the law by offering the products for special dietary use and extolling their virtues as nonfattening or as aids in reducing. The two principal objections to the substitution of mineral oil for vegetable oil are the nonnutritious nature of the mineral oil and the interference with the absorption of fat-soluble vitamins, particularly vitamins A and K, from the digestive tract. The use of mineral oil in foods was banned by the federal Food and Drug administration.

Saccharin or other nonnutritive sweetening agents have been substituted for sugar in beverages, jams and other naturally sweet products. Although there is no evidence that small quantities of saccharin used are harmful, the loss of food value of sugar is of course economically and nutritionally harmful to the consumer.

Coffee became scarce during World War II, and a variety of substances were substituted in whole or in part for this material. Ground chick peas or ground cereals were the most frequent substitutes, often mixed with a little genuine coffee to provide a faint coffee-like aroma. Tea also has been subject to adulteration. In the United States during World War II, green tea was occasionally found to be nothing but dried grass. Other weeds, barks and plants were used to substitute for or "extend" the short supplies of tea. Shortages of chocolate and cocoa resulted in the adulteration of these products with ground cocoa shells and crude fibre. Starch was also used as an extender.

Drugs do not lend themselves readily to the same type of adulteration as does food. The usual complaint against drugs lies in deviations from standards of strength, quality or purity. Substitution of ingredients seldom occurs. However, in 1944 and 1945 it was discovered that a group of manufacturers of female sex hormones in New York city had devised a method of exploiting the premium price paid for natural estrogens. Natural estrogens consist largely of estrone with very small amounts of estradiol. Estradiol has from five to ten times the estrogenic activity of estrone and may be obtained from estrone by chemical reduction. Manufacturers were selling as natural estrogens, estradiol, made by reducing estrone, to which had been added an inert substance, cholesterol, to reduce the potency to that expected for natural estrogens. A given batch of natural estrogens then supplied from five to ten times as much of the adulterated product, and the substitution was extremely difficult to detect because of the close chemical and physiologic similarities of the products. This fraud was discovered and stopped by legal action of the Food and Drug administration.

Colouring Matter.—Artificial colours have both legitimate and illegitimate uses. Harmless colours are frequently used in confections, pastries and ice cream; and if their presence is declared, no deception of the consumer results. However, when an artificial

colour is used to mask inferiority or to imitate a superior and more costly article, the product must be considered adulterated.

Before modern methods of canning and quick freezing, fruits and vegetables were often treated with dyes or similar substances to restore the natural colour lost in processing. Such practices became rare, however, and are usually condemned by the authorities. Milk has been coloured with annatto, tumeric and carrot juice to give it a creamy appearance, but most state laws prohibit this practice.

Vegetable dyes are usually harmless, but their colours are often impermanent and may be altered by processing. Coal tar or aniline dyes are most frequently used for food colouring. Many of these dyes are harmless; but some are potentially toxic, and their use is prohibited by law. Among the toxic dyes may be mentioned the paraphenylene diamine derivatives which may cause oedema of the face, throat and chest as well as severe skin rashes, and certain carcinogenic dyes such as butter yellow which was shown to cause cancer of the liver in experimental animals. In the United States all coal tar dyes must be certified as harmless by the Food and Drug administration before use.

ARTICLES ADULTERATED

Although almost all foods lend themselves to some form of adulteration, certain foods, because of their economic importance, have been subject to this practice to a greater extent than others. A few typical modern examples are mentioned below.

Milk.—Four principal types of adulteration have been practised with respect to milk—addition of water, abstraction of butter fat in the form of cream, addition of a preservative and addition of colouring matter. The composition of whole milk is usually established by local authorities, and these forms of adulteration are universally prohibited. Addition of water and abstraction of butter fat may be readily detected by determinations of butter fat. Most localities require milk to contain at least 3% butter fat, although during certain seasons of the year some cows will give milk of a lower fat content. Large dairies make it a practice to blend milk so that the resultant product always has the same butter-fat content. Thus, rich creamy milk may be added to a milk low in fat to raise it to standard.

Butter.—Butter, like milk, is most often adulterated by abstraction of fat. In the United States, butter is required to have a minimum fat content of 80%. Butter is also subject to adulteration with mould and filth. This occurs when dirty, partially decomposed or otherwise unfit cream is used in making butter. Such adulteration can usually only be detected by microscopic examination.

Fats and Oils.—Lard was subject to widespread adulteration between 1880 and 1890 when U.S. lard imported into England was found to consist largely of a mixture of real lard with cottonseed oil and beef-stearine. Other vegetable fats, such as maize oil, have been used to adulterate lard. Olive oil was frequently found to be adulterated during World War II, and products sold as olive oil often contained nothing but cottonseed or corn oil. Occasionally, even mineral oil was substituted in part for the vegetable oil. Salad dressings and other products composed chiefly of fats and oils have been the subject of fraudulent substitutions, such as the substitution of mineral oil for vegetable oils in these products.

Flour and Bread.—Bread is rarely adulterated in either the United States or England. Flour is often bleached by chemical means, the chief agents used being nitrogen peroxide, benzoyl peroxide, chlorine, bromine, nitrogen trichloride, acid calcium phosphate, acid ammonium phosphate and persulphates. Certain of these agents are objectionable because of the poisonous residues which may be left in the flour and because of their marked destruction of essential nutriment. Chlorine, nitrogen peroxide and benzoyl peroxide are among the bleaching agents to which objection has been made.

Because the production of white flour results in the loss of certain vitamins and minerals, encouragement has been given producers to restore the lost constituents. Under authority of the food standards section of the Federal Food, Drug and Cosmetic

act, the federal security administrator established standards for the enrichment of wheat flour providing for the addition of the following substances in the quantities indicated:

	Milligrams per Pound	
	Minimum	Maximum
Thiamin.....	2.0	2.5
Riboflavin.....	1.2	1.5
Niacin or niacin amide.....	16.0	20.0
Iron.....	13.0	16.5
Calcium.....	500.0	1,500.0

“Enriched” flour must contain these ingredients in the quantities stated; but the addition of other ingredients, not mentioned in the standards, is prohibited even though they may be nutritious.

Tea.—Instances of adulteration of tea have already been cited. In the United States all tea is examined at the time of import and adulterated tea is refused entry. Although common at the turn of the 20th century, adulteration of tea later became rare.

Coffee.—Coffee beans are seldom adulterated, but ground coffee lends itself to the fraudulent addition of extenders, substitutes or other adulterants. Chicory, dried peas, caramel and other substances were used to stretch rationed supplies during World War II.

Cocoa and Chocolate.—Starch in the form of sago flour or arrowroot has been used to adulterate cocoa powder. Red oxide of iron is added to colour the adulterated product and make it appear genuine. Cocoa shells, finely ground or pulverized fibre, are also used to adulterate cocoa.

Beer.—Beer was the subject of a famous instance of adulteration which resulted in important legislation in England. In June 1900 there occurred, mainly in the Midlands but also in other parts of England and Wales, an outbreak of an illness variously described as alcoholism, peripheral neuritis or multiple neuritis. About 6,000 persons were affected, of whom about 70 died. All were beer drinkers; and, after considerable time, Dr. E. S. Reynolds of Manchester discovered dangerous quantities of arsenic in the beer. The brewing sugars used by the affected breweries all came from a single source. This supplier used sulphuric acid made from highly arsenical iron pyrites during the manufacture of the sugar, and the resultant product was often contaminated with as much as four grains of arsenic per pound.

Vinegar.—The principal adulterant of vinegar is acetic acid. Vinegars may be malt or cider vinegars and may be flavoured with herbs such as tarragon. Formerly, much cider vinegar was merely dilute acetic acid, but such forms of adulteration are no longer widely practised.

Baby Foods.—Fruits and vegetables intended for infant feeding are chopped and passed through strainers. This so alters their appearance that adulteration by substitution of an inferior grade of produce is difficult to detect. In the case of string beans, carrots, beets and certain other vegetables, microscopic examination may reveal a high proportion of fibrous material, indicating overripe or inferior grades of produce. Bacteriologic and other tests may occasionally reveal the presence of mould or other contamination. Fortunately, vigilance on the part of food and drug authorities keeps this form of adulteration to a minimum.

Confections.—Candy has been subject to several forms of adulteration. The chocolate of chocolate coatings is frequently adulterated with paraffin, gelatin or some other cheap extender. Beet sugar or corn syrup is frequently substituted for cane sugar. Starch, gelatin and other substances may be added to fillers in excessive quantities.

Although not strictly a confection, popcorn was the subject of a novel form of adulteration in 1945. A brand of popcorn, widely distributed in the middle western United States, was found to have as much as half its weight made up of mineral oil. Seizure of the product and prosecution of the shipper effectively halted this form of adulteration.

Nonalcoholic Beverages.—Soda water, fruit drinks and similar beverages have been the subject of fraudulent adulteration. Grape juice preparations that have never seen a grape, orange drinks that are orange only in colour and beverages in which

saccharin has been substituted for sugar have found their way on the market. Fortunately, however, the instances of such fraudulent acts decreased because of effective law enforcement.

Other Foods.—Maple syrups have frequently been adulterated in two different fashions. Pure maple syrup may contain lead derived from the containers used in processing. Modern methods of preparation have largely overcome this dangerous form of adulteration. On the other hand, not infrequently has a mixture of cane or corn syrup with artificial maple flavouring been passed off as "pure Vermont Maple Syrup."

Spices have been subject to adulteration since ancient times and unfortunately, this practice continued. In 1946, for example, shipments of black pepper were found to contain large quantities of buckwheat, cottonseed hulls and soybean meal. Horse-radish has been found to contain ground parsnips, and cinnamon bark derived from anything but cinnamon trees resembled the genuine article only in appearance. A shortage of Dutch blue poppy seeds in 1945 resulted in the marketing of India white poppy seed artificially coloured to simulate the more valuable article.

Drugs.—Drugs are rarely the subject of deliberate adulteration although prior to the passage of the Food and Drugs act of 1906, the United States was flooded with fraudulent cures for the "dope habit" which contained large quantities of morphine or heroin, and with "liquor cures" which were notable for their high alcoholic content. Most cases of adulteration in modern times result from accident and are infrequent. One or two such accidents may be cited to illustrate the importance of proper manufacturing controls to prevent accidental contamination.

In late 1940 and early 1941 a large pharmaceutical firm in the United States distributed tablets of sulfathiazole which had become contaminated with phenobarbital, a powerful sleeping drug. At least five persons died directly or indirectly as a result of the administration of these tablets. The accident occurred through the accidental introduction of several scoops of phenobarbital, which was being manufactured simultaneously with the sulfathiazole, into the machine compressing the sulfathiazole tablets. As a result of this accident the firm redesigned its manufacturing quarters so that it would be physically impossible for such an accident to reoccur.

In 1943 a large chemical house inadvertently labelled a drum of cadmium chloride, a poisonous chemical, as calcium chloride. This drum was shipped to a bakery which used calcium chloride for enriching bread. Fortunately, this mislabelling was discovered in time to prevent a serious adulteration.

During World War II a serious shortage of quinine developed since most of the world supply had fallen into the hands of the Japanese. Efforts were made to secure cinchona bark from South America. In an effort to capitalize on the demand, unscrupulous South American dealers shipped bark from any tree available, labelling it "cinchona bark." It became necessary for the U.S. government to send analysts to South America to do spot assays on bark submitted for shipment.

Imported crude botanical drugs may be adulterated. Senna, aloes and similar products are sometimes extended by admixture with seeds, straw, fibre, leaves and roots from other plants. Since such shipments are usually inspected and assayed before being passed through customs, the adulteration is detected and entry denied.

For the first time the act of 1938 provided control over adulterated cosmetics. Serious injury to users had occurred in the late 1920s and early 1930s from eyelash dyes containing coal tar dyes. The act of 1938 provided, among other things, that coal tar hair dyes bear a conspicuous statement on the label warning against use in or around the eyes. Poisonous or deleterious ingredients in cosmetics were also prohibited.

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ADULTERY, the sexual intercourse of a married person with another than the offender's husband or wife (from Lat. *adulterium*). Among the Greeks, and in the earlier period of Roman law, it was not adultery unless a married woman was the offender. The foundation of the later Roman law with regard to adultery was the *lex Iulia de adulteriis coercendis* passed by Augustus about 17 B.C. (See *Dig.* 48, 5; *Paull. Rec. Sent.* ii. 26; *Brisson, Ad Leg. Iul. de Adult.*) (See DIVORCE.)

ADUWA (also called Adowa), in the province of Tigré, Ethiopia, 145 mi. northeast of Gondar and 17 mi. east by north of Aksum, the ancient capital of Ethiopia. Aduwa, a hill slope at an elevation of 6,500 ft., in a rich agricultural district, is an important market centre. Pop. 6,500 (est.). On a hill about 2½ mi. northwest of Aduwa are the ruins of Fremona, the headquarters of the Portuguese Jesuits who lived in Ethiopia during the 16th and 17th centuries.



ADUWA, CAPITAL OF TIGRÉ, IS THE CHIEF CENTRE OF TRADE BETWEEN CENTRAL ETHIOPIA AND THE COAST. HERE IS SHOWN THE CHURCH OF THE SAVIOUR OF THE WORLD

An Italian invading force was crushed near Aduwa on March 1, 1896. In Oct. 1935 the Italians evened the score by bombing and then capturing the town. It was recaptured by British and Ethiopian troops in April 1941. (See ITALY: *Hist.*; ABYSSINIA: *Hist.*)

AD VALOREM. The term appropriately used in commerce for a duty which is levied by customs authorities on goods or commodities "according to value." An ad valorem duty is the opposite of a "specific" duty, which is chargeable on the measure or weight of goods. The early English customs tax called "poundage" was an ad valorem duty levied at the rate of one shilling in the pound, or five per cent. In Great Britain in 1927 the duties, commonly called "McKenna Duties," on motor cars, musical instruments, etc., and most of those under the Safeguarding of Industries act, were on an ad valorem basis, and duties of this description were also levied in several British overseas dominions and in the United States of America; in some cases a combined specific and ad valorem duty was leviable, particularly in the United States.

The general practice in the United States is that duty is levied on the foreign export value, *i.e.*, the actual cost at the place of purchase, or the home consumption value in the exporting country, whichever is the greater. It is usual to require at the port of entry the production of an invoice with full particulars of the place where, time when, and the person from whom the goods were purchased, and the actual cost of the goods and any charges on them. Such invoice has to be countersigned by the U.S. consular officer for the district from which the goods are actually destined for the U.S., *i.e.*, place of consignment, not place of shipment. On arrival at the U.S. port of entry the invoice is sworn to by the importer. The definite establishment of the dutiable value is then decided upon by the appraisers at the port of entry, appeal lying to the customs court, formerly the board of general appraisers.

In the British overseas dominions ad valorem duties are usually assessed on the value of the goods in the home trade of the exporting country. In some countries, although nominally ad valorem duties are imposed by the tariff, in practice arbitrary unit values are fixed, either periodically as in the case of Egypt or permanently as in the case of Argentina; the prescribed ad valorem duty is levied on these arbitrary valuations, thus in effect making the duties specific.

It has been argued that, theoretically, an ad valorem duty is preferable to a specific duty, inasmuch as it falls in proper proportion alike on the high-priced and low-priced grades of a commodity, and no matter how the value of any article fluctuates the rate of taxation automatically adjusts itself to the new value. This adjustment has been of particular importance in countries where the currency has been subject to violent fluctuations or where prices have been notably unstable. In practice, however, ad valorem duties may lead to great inequalities and are also difficult to assess equitably; while the relative value of two commodities may remain relatively unchanged under an ad valorem duty, yet owing to the difference in the cost of production, or through the different proportions of fixed and circulating capital employed in their manufacture, an ad valorem tax will be felt much more severely by one commodity than another, from the exporter's point of view. Again, there is always a difficulty in obtaining a true valuation of the exported goods, for values from their very nature are variable.

Ad valorem fees are imposed by some countries (mostly Latin American) on the consular certification of invoices, which are necessary for the clearance of goods through the customs on arrival at the port of destination. These range from 2% to 10%.

The term ad valorem is also used for British stamp duties. By the Stamp Act of 1891, certain classes of instruments, e.g., bills of exchange, conveyances or transfers, leases, mortgages, etc., must be stamped in England with the proper ad valorem duty, that is, the duty chargeable according to the value of the subject-matter of the particular instrument or writing. (See SAFEGUARDING OF INDUSTRY; STAMP DUTY; TARIFFS.)

ADVANCED GUARD, the protective detachment pushed forward in advance of an army, or smaller force, moving towards the enemy. Although protective in purpose, its action is largely offensive in order to fulfil its duties. These are to gain information of the position and strength of the enemy's main forces, to deny similar information to the enemy's reconnoitring troops, to brush aside his advanced detachments and so prevent delay to the march of the main body. When the advanced guard eventually comes to grips with the real strength of the enemy, it should fix him securely in order to allow its own main force to deploy and manoeuvre. Gaining time is then as vital as saving time in the earlier phase, and for this purpose the advanced guard may have to resort to attack, defence, or an alternation of both.

The rôle of an advanced guard may be likened to that of an outstretched arm of a man moving in the dark. Flank guards and rear guards are variations of an advanced guard whose names explain their rôles. Outposts are a protective detachment to a force halted.

ADVANCEMENT, a term used in English law to describe a sum of money or other benefit conferred by a father or a person *in loco parentis* upon a child by blood or adoption for the purpose of establishing such child in life. It may be considered thus:

1. Advancements during a father's life when the father dies intestate. The law as to this is of very ancient origin but is now summed up for our purpose in ss. 47 1 (iii.) and 49 (a) of the Administration of Estates Act 1925. By the former, when a person who dies intestate has during his life paid money or transferred property to a child of his by way of advancement, or has settled money or property on a child of his on such child's marriage, then, if on the parent's death intestate the child is entitled to a share of the parent's estate, the money or property advanced or settled is to be taken *prima facie* as being so paid or settled in and towards the satisfaction of such child's share of the estate as one of the next of kin, and must be taken into account in apportioning the estate among the issue of the intestate. The

value of the advancement is what it is worth at the death of the intestate. By s. 49 (a), where a testator dies partially intestate, any benefits given to the issue of the testator by the will are to be brought into account as if they were advancements in distributing the undisposed of estate among such issue.

2. Double portions. The provisions of s. 49 (a) are really an adaptation of the equitable rule against double portions to cases of partial intestacy. By that rule, where a father or person *in loco parentis* by his will leaves a legacy to a child by blood or adoption and afterwards gives an advancement to such child, then if the advancement was of property of a similar description to that given by the will, the advancement is *prima facie* to be taken as an ademption, total or *pro tanto*, of the legacy. In the same way if the deceased has before he made his will covenanted to advance a certain sum to the child, then if, not having made the advancement during his life, he by his will leaves a legacy to the child, or if he dies intestate and the child is entitled to a share of his estate as next of kin, the legacy or the share of the estate is to be taken into account in total or *pro tanto* satisfaction of the debt due by the covenant.

3. Formerly advancements out of the capital of property held in trust for sale for persons absolutely or contingently entitled could only be made by direction of the court. Now they may be made by the trustees at their absolute discretion, provided that no more than one half part of the *cestui que trust's* actual and prospective share is so advanced, that if the person advanced becomes indefeasibly entitled to a share of the trust property the amount advanced shall be taken into account, and that no interest in the trust property taking precedence of his share shall be prejudiced by such advancement without the owner's consent in writing (See the Trustee Act 1925, s. 32).

ADVANTAGE, that which gives gain or helps forward in any way (Fr. *avant*, before). It is often contracted to "vantage." In some games (e.g., lawn tennis) the term "vantage" is used technically in scoring. A position which gives a better chance of success than its surroundings is called a "vantage ground." The term "point of vantage" is used in sport, also generally, to set forth the occupancy, or attainment, of a favourable position for competitive operations of whatever sort.

ADVANTAGE, MECHANICAL. Mechanical advantage is obtained by using a machine which exerts a *force* greater than the force applied, and is expressed by the ratio $\frac{\text{force obtained}}{\text{force applied}}$.

"Machine" is here used in its widest sense, the simplest form being the lever. (See MECHANICS.)

ADVENT (Lat. *Adventus*, sc. *Redemptoris*, "the coming of the Saviour"), a holy season of the Christian Church, the period of preparation for the celebration of the nativity or Christmas. In the Ethiopic Church it lasts from Nov. 11, in other churches from the Sunday nearest to Nov. 30, till Christmas. It is uncertain at what date the season began to be observed. A council at Saragossa in 380 forbade the faithful to be absent from church from Dec. 17 to Epiphany; but the first unquestionable mention of Advent is at the Council of Tours (567). It has long been recognized in the West as the beginning of the ecclesiastical year. The Roman Catholic Church forbids the solemnization of marriage during Advent. In many countries Advent was marked by diverse popular observances, some of which still survive. In some parts of England poor women used to carry round the "Advent images," two dolls dressed to represent Christ and the Virgin Mary, visiting every household and demanding halfpence. In Normandy the farmers still employ children under 12 to run with torches through the fields and orchards setting fire to bundles of straw to drive out vermin. In Italy the last days of Advent are marked by the entry into Rome of the Calabrian pifferari who play bagpipes before the shrines of the Holy Mother (as the shepherds of Bethlehem are believed to have done before the infant Saviour).

ADVENTISTS, SECOND, members of religious bodies whose distinctive feature is a belief in the imminent physical return of Jesus Christ. (See also ESCHATOLOGY.)

ADVENTITIOUS, coming from outside, in no sense part of the substance or circumstance (Lat. *adventicius*, coming from

abroad). Carlyle called a man's clothes, or condition of life "adventitious wrappings," as being superadded and not a natural part of him. In botany the word means "out of the usual place," as a root or a bud arising at a point not normal for it.

ADVENTURE, a hazardous enterprise. Thus an "adventurer," from meaning one who takes part in some speculative course of action, came to mean one who lived by his wits and a person of no character. The word is also used in certain restricted legal connections. *Joint adventure*, for instance, may be distinguished from partnership (*q.v.*). The *bill of gross adventure* in French maritime law is an instrument making a loan on maritime security. The word was freely used of mercantile enterprises during the colonizing period: hence the title of "Merchant Adventurers." (See **CHARTERED COMPANIES**.)

ADVERB, a part of speech modifying or qualifying an adjective, verb or other adverb. According to their function they are divided into adverbs of time, place, quantity, manner, etc.

ADVERTISING, the process of disseminating information for commercial purposes. Advertisement has existed from early times. Traders made themselves known and called attention to their products by mural inscriptions before the age of printing: a papyrus, discovered at Thebes offering a reward for a runaway slave, is reputed to be 3,000 years old.

The public crier, a civic institution in ancient Greece, is not yet extinct. In the middle ages the spoken word was almost the only mode of publicity in use. The invention of printing ushered in the modern period of advertising. The Bodleian library has a small poster or broadside by William Caxton, 7in. by 5in., advertising a service-book, "The Pyes of Salisbury Use" for sale at the Red Pole in the almonry of Westminster. It was issued in 1480. Printing alone made possible the transition from simple announcement to the system of argument and suggestion which constitutes modern advertising, and the medium of this development was the newspaper. The *Mercuries* or weekly papers sometimes carried a few advertisements, including the first offerings of coffee (1652), chocolate (1657) and tea (1658).

In June 1666 the *London Gazette*, No. 62, announced the first advertisement-supplement, as follows: "An Advertisement—Being daily prest to the publication of Books, Medicines, and other things not properly the business of a Paper of Intelligence. This is to notifie once for all, that we will not charge the *Gazette* with Advertisements, unless they be matter of state; but that a Paper of Advertisements will be forthwith printed apart, and recommended to the Publick by another hand."

In No. 94 of the same journal, published in Oct. 1666, there appeared a suggestion that sufferers from the Great Fire of London should avail themselves of this means of publicity: "Such as have settled in new habitations since the late Fire and desire for the convenience of their correspondence to publish the place of their present abode, or to give Notice of Goods lost or found, may repair to the corner House in Bloomsbury on the East Side of the Great Square, before the House of the Right Honourable of the Lord Treasurer, where there is care taken for the Receipt and Publication of such Advertisements."

Clearly, the restriction of the word "advertisement," which for Shakespeare and the translators of the Authorized Version had meant information of any kind, to a business announcement was in *The Tatler* of Sept. 14, 1710:

"It is my custom, in a dearth of News, to entertain myself with those Collections of Advertisements that appear at the end of all our Publick Prints. . . . Advertisements are of great use to the vulgar. First of all, as they are instruments of ambition. A man that is by no means big enough for the *Gazette* may easily creep into the advertisements. . . . A second use which this sort of writings have been turned to of late Years, has been the management of Controversy. . . . The inventors of *Strops for Razors* have written against one another in this way for several years. The third and last of these writings is to inform the World where they may be furnished with almost everything that is necessary for Life. If a Man has Pains in His head,

Cholic in his Bowels, or spots in his Cloathes, he may here meet with proper Cures and Remedies. If a Man would recover a Wife or a Horse that is stolen or strayed; if he wants new Sermons, Electuaries, Asses' milk, or anything else, either for his Body or his Mind, this is the place to look for them in."

By the middle of the century, advertising began to be complained of, and the stains which the practice of that age left upon its reputation are not yet quite obliterated. In *The Idler* Jan. 20, 1758, Dr. Johnson has:

"Advertisements are now so numerous that they are very negligently perused, and it is therefore become necessary to gain attention by magnificence of promises and by eloquence sometimes sublime and sometimes pathetic. Promise, large promise, is the soul of an advertisement. I remember a washball that had a quality truly wonderful—it gave an *exquisite edge to the razor*! . . . The trade of advertising is now so near to perfection that it is not easy to propose any improvement."

PSYCHOLOGY OF ADVERTISING

The psychology of advertising embraces the application of modern psychology to the problems of advertising. Every effect has a cause: human behaviour is just as susceptible of interpretation in terms of cause and effect as are the movements of the heavenly bodies. To understand behaviour one needs to understand its causes, and to control behaviour one needs to get control of its causes. The control of human behaviour in the purchase of goods is the ultimate aim of the advertiser.

Dynamic Psychology has disclosed the driving forces of the human machine to be motives, desires, needs and wants. Thus, human beings want food and drink, rest and comfort, protection from danger, comradeship with their fellows, superiority over their rivals, etc. The universal presence of these needs or desires guarantees that only relatively slight stimuli need be applied to set the human being into action in order to satisfy them. The advertiser, knowing these facts, attempts not only to engender action by playing upon these motives, but also to show that his own product will satisfy a fundamental need *more effectively* than any other competing product. We find, therefore, that such a commodity as a tooth paste will be offered as a means of satisfying the desire for cleanliness, for beauty, for protection from disease, for prestige, for success in love, or in business. Other things being equal, that commodity which stimulates into action the most powerful motive will win the market. The use of argument and logic plays a minor role in successful present-day advertising in comparison with the direct appeal to desire.

After the proper appeal is chosen the advertiser is faced with the necessity of presenting it to his readers most effectively. At every step in this process psychological problems are encountered. For instance, in order to attract and hold attention the advertisement must be different from its neighbours; it must be *distinctive*. Now, distinction of a given amount may be attained in a variety of ways and at varying cost, for example, by the use of a large space or by associating it with a novel radio program. But when full-page advertisements are too common, and the use of a given radio technique is too nearly universal, both these devices lose their power of grasping the attention. Many other psychological ways of making the appeal effective are known, such as the influence of a pleasant state of mind, however it may be created, upon the memory; the dependence of the comprehension of a message upon the intelligence level of its readers; the dependence of the effectiveness of the trade names and trade marks of commodities, of packages and other containers upon the ability of the reader to discriminate between them and those of competitors and imitators. All these matters of attention value, of aesthetic quality, of ease of comprehension, of freedom from confusion with imitations and many others have been measured by methods developed in the psychological laboratory. For instance, an adaptation of the familiar free association test has been employed to measure the influence of years of advertising upon the familiarity of certain commodities, trade names and slogans in the minds of the public. By presenting a series of commodity names to a sampling of consumers with the request that they report the first thing suggested

by each, it has been possible not only to determine the relative familiarity of products in the minds of people, but to analyze some of the most important factors that determined their status. On the basis of the intelligence surveys that have been made of the population of the U.S., the advertiser can adjust his story so as to be intelligible to any desired proportion of the population. Any advertising message that is to reach as many as three-fourths of the people of the United States must be expressed in the simplest possible words, with short uncomplicated sentences and, if printed, with the use of pictures whenever feasible.

Choice of a Medium and a Product.—The choice of the medium in which the advertisement shall appear, whether it be radio or television, billboard, newspaper, magazine or handbill, and the place where it shall appear in that medium are dependent upon such psychological factors as attitude and interest. Is the hurried reader of a morning newspaper in the attitude favourable to the purchase of an article, or is the television viewer sitting in a comfortable chair at home in the evening in a more appropriate attitude? What is the most appropriate time and place to make a favourable impression upon the professional man, the financier, the merchant or the labourer?

More fundamental than all of these matters of the choice of an appeal and its presentation is the part that psychology may play in determining the nature of the actual product to be sold. It is, indeed, no longer necessary to guess at the popular taste. It may be measured upon a sampling of the buying public. The pleasingness of a proposed brand of coffee, a pattern of linoleum, a musical composition or a perfume, as well as the name that shall be given to it, can be, and occasionally is, determined before it is put upon the market through the simple process of taking a census of preferences.

The technique of measuring such subjective data as preferences, likes and dislikes, as developed in the psychological laboratory, is simple and applicable to an almost unlimited range of practical business problems.

Experimental Studies of Advertising Psychology.—The earliest studies of advertising problems dealt with attention and how to attract it, as this was considered the primary requisite of successful advertising. Such questions as how big an advertisement should be, how frequently it should be repeated, what colours had greatest attention value, and what part of the printed page attracted the most attention were examined in the psychological laboratory (H. Gale, *On the Psychology of Advertising; Psychological Studies*, University of Minnesota, 1900). Problems of the memory value of advertising were then attacked as second only in importance to attention value. For this purpose the laboratory methods for measuring recall, recognition and retention were adopted outright, or in slightly modified form (W. D. Scott, *The Theory of Advertising*, 1903, and H. L. Hollingworth, *Advertising and Selling*, 1913). The application of the "order of merit method" of James Cattell for measuring the value of a whole advertisement introduced a long series of researches of this nature, which have had a profound effect upon the content of the psychology of advertising (E. K. Strong, *The Relative Merit of Advertisements*, 1911).

In later years more complex and less tangible factors affecting advertising success were subjected to experiment. For example, the power of the reader to discriminate among various commodities, advertisements, trade names, etc., was tested with interesting results (R. H. Paynter, *A Psychological Study of Trade-Mark Infringement*, 1920). The feelings and faint emotional states aroused by advertisements and their various components together with the factors that create and strengthen belief, such as positive and negative suggestion, were also measured and evaluated. (See A. T. Poffenberger, *Psychology in Advertising*, 1925.) Radio and television advertising was intensively studied by the above techniques or slight modifications of them. Such problems as the measurement of entertainment value of a program, its effectiveness in making a product known, the measurement of value of special features of a program, and the determination of listening habits were partially solved.

(A. T. P.; X.)

COLOUR IN ADVERTISING

Colour in advertising is as old as the painted signs of inns and shops. Commercial signs and business announcements created by the artist's brush go back several centuries. The lithographed poster for advertising purposes, as used in the modern sense, started with Jules Cheret about 1867. In printing (*q.v.*) the first colour advertisement was for a rug, and was prepared by one of the large mail-order houses. The coloured electric sign followed close on the development of the incandescent lamp about the beginning of the 20th century. The coloured tube lighting (the neon vacuum coloured tube) came into vogue about 1925, and largely revolutionized electrical display signs.

It was the half-tone engraving, when developed into process printing, that made the use of colour practical for periodicals, catalogues, and other forms of printing, but because of mechanical difficulties it was not until about 1910 that the use of colour became common in publication advertising. New iridescent inks that would fuse without blotting out certain tones, highly surfaced papers, and printing presses that would register perfectly, all had to be developed before colour advertising became practical. About 1920 the first rotary printing press was perfected for process coloured productions. Not until 1937 were the mechanical difficulties overcome to such an extent that it was economically practical to print fractional page magazine advertisements in colour. Thereafter it was not unusual to find fully one-half of the advertising space in periodicals printed in colour.

Posters and car and bus (or tram) advertising is more than 90% coloured. Owing to the fact that most poster printing is done by lithography, and that lithography developed colour processing long before it was practical on the letterpress, that form of advertising has practically always been in colour.

The first use of colour in advertising was to attract the attention of the reader, but laboratory tests have indicated that adding colour increases the attention value of a display on a magazine page only 13%. As the extra cost of printing in colour is more than 13%, that was unprofitable.

Colour advertising has been strikingly successful: (1) in portraying goods in their actual colours, (2) in giving various articles a setting of richness and a refined atmosphere, (3) in showing the appearance of the package or container, (4) in reproducing trade marks or other distinguishing features.

Colour in advertising is probably a cause as well as an effect of the greatly increased use of colour in dress, in furnishing and decorating the home, in the variety of tones in which automobiles are painted, and even in the selection of finishing materials by architects. New colours in all these applications were so attractively displayed in advertising that the vogue for colour was sped and spread by their vivid illustrations.

As colour advertising became an important commercial factor, psychologists carried on extensive investigations to determine colour preferences, but without much success, in so far as their researches could be applied to advertising. That cool colours—blues and greens—are more attractive for such displays as window trimming in hot weather than reds, yellows and oranges has been shown. That the reverse is true only to a slight degree is something of an anomaly. This same principle has been successful in advertising for summer and winter resorts.

That women once preferred red and men blue was demonstrated for wearing apparel, but it is probably true that tastes have changed. As many red neckties as blue are sold by haberdashers, and more blue than red hats by milliners.

That there is a physiological as well as a psychological effect of colour, seems to be established by such popular expressions as "feeling blue," a "gray day," "dark hours," "a drab existence." Also there is the acknowledgment adopted by accountants centuries ago of using blue for the debtor side of the ledger and red for the credit side, as those tones were supposed to be symptomatic of the feelings when incurring and discharging debt.

Psychologists have established helpful combinations of colours in producing the maximum luminosity. The two colours which stand at the top for legibility for the greatest distance are black and yellow; the latter as background. Black on white is the next

most luminous combination.

Also the cool colours used for tinting the walls of a room make it look larger than if in white. Red or yellow make it seem smaller than white.

(H. E. A.; X.)

UNITED STATES

In the United States, the first newspaper was entitled *Publick Occurrences both Foreign and Domestick*, published in Boston in 1690. This was succeeded in 1704 by *The Boston News Letter*, a weekly publication. The first issue of *The Boston News Letter*, published April 26, 1704, contained advertisements. It was 40 years before this publication reached a circulation of 300 copies per issue. The early history of advertising, together with numerous sample advertisements of this early period, is well presented in Henry Sampson's *History of Advertising from the Earliest Times* (London, 1875).

The modern period may be dated from about 1850. The reason for putting the dividing point between the early and modern periods at 1850 is the rapid appearance of newspapers and magazines, which made possible the development of modern advertising on a large scale. Advertising was impossible until printing developed and until people generally learned to read. One reason for the rapid increase in the number and distribution of advertising media at this time is probably to be found in the development of transportation systems—railways and waterways. Prior to that time railway lines were limited to restricted areas. There was no national transportation system. To illustrate the difficulties of transportation before that time, and even up to 1870 or 1875, we may quote the following announcement of the *Keno-sha Telegraph* (Wis.) in Rowell's *Directory* in 1869:

The town is renowned for the manufacture of wagons, which find a market all the way to the Rocky Mountains, and even to Oregon, being shipped by way of New York.

This shows how difficult it was to distribute goods generally over the country. It is obvious, then, that without the possibility of transporting goods there was no need of advertising media of wide circulation, and furthermore media could not develop a wide circulation because they could not be distributed conveniently or rapidly. During the middle and latter part of the 19th century the development of a national transportation system made possible the ready distribution of goods and publications. About this time also advertising agencies arose whose primary purpose was to serve as brokers of advertising space. They were rather different in this respect from the modern advertising agency, which, in addition to contracting for space, is, in its best form, an organization giving expert counsel and service regarding marketing and advertising plans and methods.

During this period the number of magazines and newspapers grew very rapidly, so that in 1861 there were 5,203 magazines, papers and periodicals of all kinds in the United States. Yet advertising was relatively limited as compared with the modern day. *Harper's Magazine* had its first advertisement in 1864; *Scribner's* in 1872. Magazine advertising on a large scale did not begin until about 1860 to 1870. It was stated in 1926 that *Harper's Magazine* had approximately as many pages of advertising in one year as it had in its first 24 years. At first it was used chiefly as a medium for advertising the Harper publications. Advertising rates at that time began to assume real proportions. *Harper's Weekly* was receiving \$35 an inch for its back page in the 1860s.

The first advertising agency was established in Philadelphia in about 1840 by Volney B. Palmer. Later, offices were established in Boston and New York. Rates and contracts were not standardized at that time. The agent contracted for a certain amount of space with a publication and then sold it for whatever he could, receiving sometimes as high as 50% of the cost of the space as his commission. Among the better known early advertising agents were V. B. Palmer, S. M. Pettengill and George P. Rowell. In 1948, according to the U.S. census of business, the United States had 3,279 advertising agencies. About 255, including most of the larger ones, were members of the American Association of Advertising Agencies. (See ADVERTISING AGENT or AGENCY.)

Development of Higher Standards.—After 1911 advertising

developed most rapidly as a standardized business. It was in that year that definite organized steps were taken to forward the movement of truth in advertising. In 1911 counsel for *Printers' Ink*, a leading advertising journal in the United States, formulated what became known as "The Printers' Ink Model Statute," which was adopted in a large number of states. This statute made dishonest advertising a misdemeanor.

It (1) placed the responsibility for deception upon the advertiser, (2) dealt with questions of facts about goods rather than opinions, and (3) designated the making of untruthful, deceptive or misleading statements a misdemeanor. By Dec. 1951 this statute had been adopted in 26 states and the District of Columbia in substantially the form in which it was originally prepared by counsel for *Printers' Ink*, and in 17 states in modified form.

The adoption of this statute was a powerful force in bringing deception, misrepresentation and dishonesty in advertising under legal control. The Advertising Federation of America and local advertising clubs and other organizations became active in pushing the adoption of this or similar legislation, which exerted a powerful influence toward the remedying of objectionable practices. In addition to state legislation a number of larger cities adopted ordinances to check certain undesirable advertising practices.

About 1912, the Associated Advertising Clubs of the World at their annual convention adopted the motto "truth in advertising," and established a National Vigilance committee in the United States, later renamed the National Better Business bureau, with the purpose of forwarding higher standards of honesty and reliability in advertising. This committee organized, in connection with the various local clubs throughout the United States, local vigilance committees or Better Business bureaus to eliminate objectionable and untruthful advertising. The purpose of these bureaus has been to carry on locally in each city active efforts, similar to those of the national bureau, toward the elimination of dishonest and objectionable advertising and related business methods. Up to 1952, such bureaus had been established in 85 cities in the United States, including Boston, St. Louis, Cleveland, Indianapolis, Kansas City, Des Moines, Minneapolis, St. Paul, Spokane, Portland, Ore., and New York city. Six cities in Hawaii and Canada had also established bureaus.

An International Advertising conference was held in London in the summer of 1951, at which there was reaffirmed the principle of truth in advertising proclaimed at the first International Advertising conference held at Wembley, Eng., in 1924. The 1951 conference also resolved that advertising must be used increasingly to promote world trade and better international understanding, and that it must "seek its primary justification in service to the consumer by promoting knowledge, helping to reduce the costs of production and distribution, and helping to raise the standards of living."

Facts About Circulations.—In 1914 there was organized the Audit Bureau of Circulations. This became the leading agency for securing reliable information about the circulation and distribution of publications. The work of this bureau came about as the result of several organizations which were interested in the endeavour to develop a generally acceptable means of obtaining reliable, standardized statements of circulation. It was felt that the time was ripe for devising such means, and that the advertiser had a right to know what he was buying when he bought space in publications. It was desirable to know not only the total circulation but also something about the various aspects of this circulation, facts which are as important as the statement of the total amount of the circulation.

About 1870 the only facts generally available regarding circulation were the statements in George P. Rowell's *Directory*; and after that time the *Ayer Directory* was the chief source of information. In order to bring about a somewhat more reliable statement of circulations at that time, Rowell added a gold mark to the name of the publication if the publisher made an affidavit concerning his circulation. This was accompanied by an offer of \$100 to anyone who could disprove the claim made. In general, the audit bureau reports attempt to answer three main questions:

(1) How large is the circulation? (2) Where does it go? and (3) How was it obtained? The bureau operates by requiring from its publisher members a so-called publisher's statement every six months. The bureau itself makes an audited report once a year.

The Audit Bureau of Circulations became of great value to advertising because it made available reliable statements of circulation covering many different phases. In case of error, either intentional or unintentional, the bureau established certain rules. A publisher or advertiser member of the bureau could ask for a reaudit of any publication, if he so desired. If the reaudit proved that the publisher had misrepresented the facts, the expense was to be borne by the publisher. This fact being then bulletined to the other members of the bureau, the publisher became subject to suspension and expulsion from the bureau. By Aug. 1951, 270 general magazines and periodicals, 72 farm publications, 370 business publications and 1,974 newspapers were members of the bureau. In addition to publications, 485 advertisers and 180 advertising agencies were members.

About 1913 there was organized in the United States the Association of National Advertisers, another important influence in the study and development of advertising practices. Likewise, during that period publishers developed a distinct consciousness of censorship of advertising. A considerable number of publishers took a definite stand with regard to the advertising which they would or would not accept. The announced or stated policy might not be fully lived up to in practice in all instances, but the best evidence of actual progress made in this regard lay in a comparison of mid-century issues of leading magazines and newspapers with issues of the early years of the century. The improvement was marked. In addition to the elimination of objectionable and doubtful advertising, a considerable number of media went a step further by guaranteeing their advertising in the sense that they would either themselves make good on any misrepresentation or deception which appeared in connection with an advertisement, or would see that the advertiser in question made good. With most of the high-grade media a policy of guaranteeing is substantially implied, and is almost unnecessary in view of the commendable care which is exercised in rejecting questionable commodities or irresponsible business houses.

In 1917 the American Association of Advertising Agencies was organized. It contributed materially toward the establishment of standards of practices and uniform methods of procedure. In 1925 it inaugurated a department of research for studying fundamental problems of advertising and marketing. Finally, and perhaps most important, an increasing use of research methods developed. Following World War II the association concentrated on four programs: development of better personnel for advertising; promotion of better research; advocacy of better ethics; and the support of better relations between the public and advertising.

SUMMARY OF DEVELOPMENTS AFTER 1850

Considering the period from mid-19th to mid-20th centuries as a whole, the chief developments, in addition to those mentioned, may be designated as follows:

Growth in Quantity.—There was a tremendous growth in the number of firms employing advertising in one form or another. In 1951 there were about 14,000 firms doing some national advertising. A study by *Printers' Ink* in 1951 listed 222 advertisers spending more than \$1,000,000 annually. There was likewise an enormous growth in the number of media. In 1830, it is estimated that there were approximately 800 magazines and newspapers in the United States, of which about 50 were daily publications. Their combined annual circulation was estimated at about 60,000,000 copies, or a circulation of approximately 950,000 copies per issue. In 1830 the total population of the United States was 23,500,000.

In 1861 there were 5,203 papers and magazines for a population of approximately 30,000,000. In 1950 there were 13,492 magazines and newspapers in the United States for a population of about 150,000,000. In other words, there had been an increase of magazines and newspapers since 1861 of approximately 2½ times, whereas the population during the same period of time had

increased approximately 5 times; but since 1830 the population had increased more than 6 times, while the number of magazines and newspapers had increased almost 17 times. A more striking increase took place in the total combined circulation. The estimated combined circulation per issue of 270 magazines was (1951) 150,600,000 copies, and the total combined circulation of the newspapers approximately 114,230,000. Thus since 1830 there had been a growth in total combined circulation of all magazines and newspapers from less than 1,000,000 to approximately 265,000,000 per issue.

During that period, also, there developed entirely new media of advertising, including bus and car cards, posters, direct-mail, motion-pictures and radio and television advertising. Street-car advertising did not come into general use until about 1890, when the change was made from horse-drawn cars to electric cars. The mail-order field developed rapidly. Not only did mail-order houses spring up in large numbers during the period, but also business firms of all kinds developed a very extensive use of direct-mail material in the form of circulars, catalogues, letters and so on. The large mail-order houses commonly sent out twice a year more than 14,000,000 large catalogues, in addition to numerous smaller departmental catalogues issued. Figures obtained in 1951 estimated the total approximate amount spent in direct-mail advertising to be \$878,754,000.

From the time that commercial radio started in the early 1920s it spread until at the beginning of 1952 there were 42,700,000 homes with radio sets. At the same time, there were about 105,700,000 receivers in use in the United States, a figure that included extra sets in homes, those in automobiles, hotels, bars, stores and institutions, and portable sets. Expenditures for time on the four major networks amounted to approximately \$175,000,000 in 1951.

Television had an even more spectacular growth. Sets in use by the public on Jan. 1, 1952, were estimated at 14,500,000, compared with 10,000,000 at the beginning of 1951; 3,950,000 in 1950; 1,000,000 in 1949; 189,000 in 1948, and 16,476 in 1947. From a few television stations on the air in 1947 the number had risen to 108 by the start of 1952. Time charges on the four major television networks were estimated at \$125,000,000 for 1951.

Advance in Quality and Scope.—During the period under consideration there was a distinct improvement in the quality of advertising. Methods of printing, typography, colour printing, art work and the like greatly advanced. Besides the mechanical improvements there were distinct advances in such essential qualities as accuracy of statement and descriptions, reliability and truthfulness. A widening of the scope of advertising developed rapidly. There was a marked increase in the variety of advertising used. Perhaps the dominating types of advertising which flourished originally—that is, about the middle and latter half of the 19th century—were patent-medicine advertising and circus bills and in general much unreliable, dishonest and objectionable advertising. As developed there is hardly a business or type of commodity for which the printed word is not used as a means of selling. Banks and financial institutions of high grade turned to advertising, finding it profitable to employ in a dependable manner the methods which had been found profitable by unreliable financial houses. Advertising suffered because of the objectionable features which were so prominent in its earlier development. For this reason, undoubtedly, high-grade financial houses and to some extent other types of business were slow to take advantage of the possibilities which it offered, but later they adopted the modern techniques of general advertising.

Public service institutions use advertising to place themselves before the public, to secure the co-operation of the community, and to offer their securities to customers and to others. What is termed institutional or good-will advertising is widely used, not only by banking or similar institutions, but by large firms of all kinds, retail stores and manufacturers. Causes of one kind or another—local, national and international—use advertising to secure publicity and to gain adherents. Churches, charitable institutions, schools, educational endowments, public health bureaus, political parties, candidates and even governments find advertis-

ing a suitable and dignified means of publicity. In industrial disputes, employers and employees alike use advertising to influence public opinion and secure sympathy and moral support.

The development of trade-marks was likewise a conspicuous characteristic of the periods mentioned, particularly of the first half of the 20th century. A large proportion of the trade-marks known throughout the United States and all over the world developed during this time. The development of national and international business made trade-marks virtually a necessity; and advertising became an important means, perhaps the chief means, of making them known to the public. The Lanham Trade-mark act of July 5, 1946, effective in July 1947, established important new principles in the federal legal protection of trade-marks.

Volume of Advertising.—Some notion of the immense proportions of advertising may be gained from the amount of money expended and from the amount of space and time used each year for advertising in the United States. It was estimated that in the neighbourhood of \$6,500,000,000 was being spent annually for this purpose at mid-20th century. Approximately \$1,000,000 was spent annually for advertising any one of a score or more of well-known commodities, as high as \$5,000,000 and \$8,000,000 being spent in some cases. Or we may gain a concrete idea of the immensity of advertising from the cost of space for single advertisements in some of the leading media. Thus, for example, a page in a well-known monthly magazine in a single issue may cost \$18,500 and the back outside cover about \$24,000. A page in a well-known weekly publication would run to \$18,800, and the back outside cover \$24,300. A page in the large metropolitan newspapers costs as high as \$4,200. From still another angle the immensity of advertising is indicated by the fact that approximately three-fourths of the cost of maintaining a newspaper or a magazine comes from its advertising space.

The outsider naturally wonders whether advertising with such high rates for space can really be a profitable aid in selling; or whether it may not be an expensive luxury indulged in by large business concerns. The extent to which advertising plays a justifiable role in the distribution of goods is an important and intricate problem which must be dealt with in any important consideration of the subject.

ARGUMENTS FOR AND AGAINST ADVERTISING

There are wastes in advertising, but there are wastes everywhere in production, in distribution, in personal selling. Economy in the distribution side of business has lagged behind, but distinct advances have been made. Probably the chief sources of waste in advertising are:

(1) The lack of proper co-ordination between advertising and the other phases of a business—lack of co-ordination with distribution, personal sales, plans and production—advertising where there is no distribution, and the like.

(2) The use of inefficient methods—weak, unconvincing and ineffective appeals, poor presentation, ineffective technique, the use of too large space or too small space as the result of guessing instead of finding the facts on which to build and plan. It has been estimated that if every advertising message were made 10% more effective it would mean a saving of \$500,000,000 to the business interests of the United States.

(3) The use of advertising for commodities in circumstances in which returns are highly uncertain, or for business ventures which are too hazardous.

(4) The excessive use of advertising in over-keen competition.

(5) The failure to make all advertising literally truthful and dependable. Even if 96% or 97% of advertising were in the main trustworthy and meritorious, the remaining 3% or 4% would weaken the effectiveness of the rest.

(6) The use of advertising for illegitimate business, highly speculative investments, financial frauds or for commodities of doubtful value or actually injurious to mankind.

Improvements are proceeding in all these directions. Fundamentally, these sources of waste are not peculiar to advertising, but are due to the waste and inefficiency in business as a whole. The same sources of waste exist in oral selling—making plans on guesses instead of on facts, not being literally truthful and dependable in every instance, a lack of proper co-ordination with other phases of a business, the waste of time on the part of salesmen, and excessive personal expenditure. Preliminary time studies

show that the average salesman uses only about 15% to 50% of his working time in actual selling. Fundamentally these wastes in oral as well as in printed selling are not to be laid upon these two aspects of business, but are due to conditions in business as a whole, to mistaken judgment, to ignorance and moral weakness.

The Case Against Advertising.—The actual total amount of money spent on advertising is large. The estimated amount spent in the United States in 1951, for example, was approximately \$6,500,000,000.

The questions are: (1) Who pays for it? (2) How far different would be the price of commodities if this expenditure were entirely eliminated? and (3) In what way would the methods of distribution and the cost of distribution be different? The critic assumes that this money is an economic waste and that prices are higher because of it.

A second argument is that advertising considerably increased the demand for, and the purchase of, luxuries and semiluxuries such as cameras, beverages, automobiles, radio and television sets, vacuum cleaners and so on.

A third argument is that advertising was responsible to a considerable extent for the increasing and widespread use of packages, cartons, wrappers and labels for a large variety of products. Advertising was responsible to a very large extent for the development of standardized brands and trade-marked articles. These wrappers and containers cost money which supposedly is not a part of the price paid for commodities bought in bulk. The argument is that all of this expenditure is added to the price of the product.

Relative Cost.—It is found that the amount actually spent for advertising specific commodities differs widely from the amount which the average person thinks is spent. Almost every person who makes a general statement that the prices of commodities are higher because of the advertising, or that the money expended for advertising is wasted, knows little about the actual facts of the relative amount of money expended for advertising a specific commodity. People quite generally have a greatly exaggerated notion of the amount of money spent for printed advertising. An investigation was made to determine the amount which people think is spent for advertising certain commodities. The results of the investigation showed that people generally overestimate from four to five times the amount spent for advertising specific products. For example, the amount spent for advertising a package of a leading food retailing at ten cents was estimated by this representative group of persons as two cents, whereas the actual amount spent by the manufacturer of this food for advertising a single package was three-tenths of a cent, an overestimation of about eight times.

Averages of expenditures for advertising by 119 member companies of the Association of National Advertisers were studied in both 1939 and 1951. The reported advertising expenditures in all industries represented increased substantially between these years, but the increase in sales during the same period was substantially greater. In most cases the proportion of advertising expenditures to sales was small, although in the drugs and cosmetics industry it is traditionally large.

TABLE I.—Advertising Expenditures as Percentages of Sales

Industry classification	1939	1951
Agricultural equipment	2.6	0.9
Alcoholic beverages	6.1	5.2
Automotive	3.4	1.4
Building materials	1.7	1.4
Drugs and cosmetics	28.0	28.0
Electrical appliances	3.0	4.7
Food and groceries	5.0	4.3
Home furnishings	2.9	3.8
Industrial	1.3	0.9
Insurance	0.3	0.2
Office equipment	2.1	2.4
Paper manufacturers	0.9	0.8
Petroleum	1.8	1.0
Textiles and clothing	4.2	3.3
Other industries	4.8	5.0

Source: Association of National Advertisers

The average expenditure for advertising on the part of retailers at mid-20th century was probably less than 3%. Figures showing the average ratio of advertising to sales in small and medium-sized stores for various years between 1943 and 1950 were published by Dun & Bradstreet, Inc., who pointed out that these percentages should not be considered an exact reflection of advertising costs, because of the wide variance among retailers in defining advertising and advertising costs. It is therefore evident

TABLE II.—Average Ratio of Advertising to Sales for Small and Medium-Sized Retailers

Type of store	Percentage
Appliance-radio-television dealers	2.8
Auto accessory and parts stores	1.2
Automobile dealers	1.0
Bakeries (retail)	1.1
Book stores	1.6
Camera and photographic supply stores	1.9
Department stores	1.8
Drug stores	0.6
Dry goods and general merchandise stores	0.8
Farm equipment dealers	0.7
Furniture stores	1.9
Hardware stores	1.1
Meat markets	0.2
Jewelry stores	3.6
Liquor stores (package)	0.3
Men's clothing stores	3.3
Men's furnishings stores	0.6
Paint and wallpaper stores	1.8
Sporting goods stores	2.0
Stationers (commercial)	1.3
Tire dealers	1.4
Variety stores	0.7
Women's accessory and specialty stores	1.0
Women's ready-to-wear stores	3.0

Source: Dun & Bradstreet, Inc.

that while the total expenditure for advertising runs into large figures, the relative expenditure in proportion to the cost of a commodity is small. In other words, if advertising played no part whatever in stimulating the sale of commodities, and if the cost of advertising were therefore directly added to the price of a commodity to the consumer, the price of an article would be almost inappreciably higher. An article selling at \$1.00 would have to be sold at \$1.04 or \$1.05 if advertising were purely a dead expenditure of money. Although the actual expenditure for advertising is relatively small—probably not more than 4% to 5% in the aggregate—even this expenditure would be a serious waste if it produced no economic or social value. The 1% to 3% spent by retailers, or the 2% to 3% spent by manufacturers, would in many instances serve to make the difference between success and failure.

Effects of Advertising.—In 1925 a National Distribution conference was held in Washington, D.C., under the auspices of the Chamber of Commerce of the United States. The report of the committee appointed to investigate "Market Analysis—Advertising and Advertising Mediums" gives some information with regard to the point just brought up. The investigation consisted of a survey of articles which had appeared in publications, giving specific data about the effects of advertising on costs and prices to the ultimate consumer; and in addition of a questionnaire which was sent out to a group of national advertisers, requesting specific data showing the effects of their advertising on their costs and prices. The results were tabulated and summarized in part as follows:

From the data available it is hardly possible to make a non-disputative demonstration. Nevertheless, we believe that it can safely be said that the use of effective advertising by national distributors as a general rule produces one or more of the following results:—

- (1) Decreases the cost of selling.
- (2) Lowers the cost of production on account of increased volume.
- (3) Lowers prices to the consumer and thereby raises the standard of living.

(4) As a by-product, aids in the education of the general public. Data have been obtained from a number of national advertisers to show the effects advertising has had upon the cost of production and the cost of selling, and prices to the consumer. It is realized that changes in business conditions during the past few years and changes in distribution policies within the individual companies make it very

difficult to eliminate the variable factors and to prove the effects of advertising. The data which have been collected, however, seemed to indicate conclusively that the first three results named above are brought about by advertising.

In addition to the four results obtained by advertising which have been mentioned above, advertising often has the following beneficial effects for the manufacturer, dealer or consumer:—

- (1) Advertising aids in stabilizing production.
- (2) Advertising aids in standardization and quality.
- (3) Advertising aids in the simplification of products. (Elimination of unnecessary items in the line.)
- (4) Advertising helps to prevent fluctuation in prices.

Advertising's outstanding contribution consists of its part in promoting a dynamic, expanding economy, it was concluded by Neil H. Borden, professor of advertising in the Harvard Graduate School of Business Administration, in an exhaustive study of *The Economic Effects of Advertising* published in 1942. He said that from a social standpoint advertising's chief task was to encourage the development of new products, and that from the resulting enterprises had come a flow of income that raised the level of material welfare to a point never before known. He maintained that since advertising had been largely associated with the promotion of new and differentiated merchandise, a substantial part of advertising costs should be regarded as growth costs incurred in raising the economy from one level to another.

Summary of Advantages.—A beneficial effect of advertising has been the reduction of seasonal fluctuation in the volume of business. In certain fields of business, the seasonal fluctuation, if not entirely eliminated, was greatly reduced. The two seasons of buying men's clothing were greatly extended, and the sale of toys, formerly largely confined to the holiday season, became more evenly distributed throughout the entire year. The same was true of fountain pens, millinery, oranges and lemons and other products. The result was a reduction in the cost of doing business.

Advertising also aided materially in the standardization of products and quality of goods. This was brought about through the establishment of brand names and trade-marks, which became associated with uniform quantities and qualities in the mind of the public, until the recollection of a brand name of any number of specific products calls up the picture of a certain definite quantity and a certain recognized standard of quality, which the public has been educated to receive when it calls for a product by a specific trade name. Although the establishment of standard packages probably added to the cost of commodities to some extent, it had certain other advantages. It facilitated retailing, requiring less time on the part of assistants in the preparation of products for delivery to the consumer, and it secured a more hygienic handling of goods, particularly foods.

The noteworthy advances made in the general level of living, in public taste, in personal and domestic conveniences, and in the general use of cultural agencies, must be attributed in part to the use of the printed word in the form of advertising. Such products as automobiles, radios, vacuum cleaners, better-fitting clothes, better-constructed and designed houses, better-painted houses, evidence the advance made in the level of living, largely as a result of the insistent and continuous force of advertising. There is no doubt that we should very likely have most if not all of these improvements and conveniences without advertising, but probably not so many people would have had them so soon. Printed publicity and radio and television no doubt helped to educate people to want more and better things in food, clothing, housing, personal comfort and enjoyment.

The almost universal reading of magazines and newspapers was made possible largely, if not solely, through advertising, since more than three-fourths of the income of a periodical is ordinarily derived from its advertising space. In this sense, the newspaper or magazine is practically a by-product of advertising. The comparatively small sum charged for a newspaper or magazine—in comparison with the large sum which such magazine or newspaper would cost if it were not for the advertising which it carries—made some form of reading matter available to even the poorest classes of people. Advertising revenue made possible the large-scale production of newspapers, magazines and periodicals of all kinds, the social and educational value of which is beyond esti-

1865, 1865!
HOT FOR THE GOLD MINES!
THROUGH
BILLS LADING
GIVEN BY THE
MONTANA & IDAHO TRANSPORTATION LINE
Virginia City, Bannock City, Deer Lodge
ALL POINTS IN THE MINING DISTRICTS.

The Steamers of this Line leave St. Louis as follows.



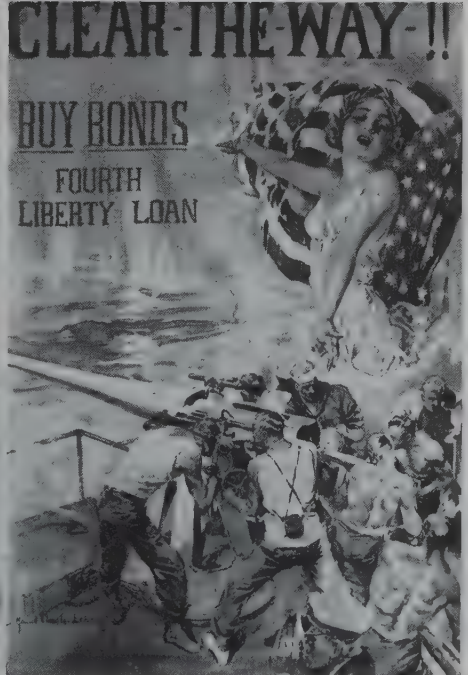
DEER LODGE, Saturday, March 4th.
 BERTRAND, Thursday, March 9th.
 BENTON, Saturday, March 11th.
 YELLOW STONE, Saturday, March 18th.
 FANNY OGDEN, Saturday, April 15th.

For New Business, \$25.00 (50%) and 1 cent per ton for freight between Fort Union and Fort Union, or for the freight of a ton of coal or other goods between Fort Union and Fort Union. We are also prepared to handle Lead Concentration in all of above points and having Teams of our own. Shippers may deposit their goods here or direct to our agents.
 For FREIGHT or PASSENGER apply to
 JOHN G. COPPIN, at DEER LODGE, MONTANA, or to
 JOHN J. BOK & CO., Commercial Street, between 22 and 24 Streets, or
 JOHN McINTIRE, 72 Commercial Street, ST. LOUIS.

J. EAGER,
41 Broad Street, N. Y.



3375 SEARS, ROEBUCK & CO., Cheapest Supply House on Earth, Chicago. CATALOGUE N



BY COURTESY OF (TOP LEFT) NEW-YORK HISTORICAL SOCIETY, NEW YORK CITY, (TOP RIGHT) THE ART INSTITUTE OF CHICAGO, (BOTTOM LEFT) SEARS ROEBUCK & CO., (BOTTOM RIGHT) MUSEUM OF THE CITY OF NEW YORK; PHOTOGRAPH (BOTTOM CENTRE) "TOPICAL" PRESS AGENCY LTD. AND LONDON TRANSPORT EXECUTIVE

ADVERTISING IN THE 19TH AND EARLY 20TH CENTURIES

Top left: Broadside for steamboats going up the Mississippi river carrying cargo and prospectors headed for new gold camps in the western U.S. during the 1860s
 Top right: Poster by Henri de Toulouse-Lautrec advertising the Divan Japonais, a French cabaret (lithograph, 1892)
 Bottom left: Page from the Sears Roebuck & Co. catalogue for 1900, advertising ladies' fur jackets

Bottom centre: Use of advertising space on London bus brought into use in 1910 and generally associated with World War I
 Bottom right: U.S. Liberty Loan poster by Howard Chandler Christy, World War I



BY COURTESY OF (UPPER LEFT) BLAKER ADVERTISING AGENCY, INC., AND ELIZABETH ARDEN SALES CORP., (UPPER RIGHT) CONDE NAST PUBLICATIONS, INC., (BELOW) SEALTEST, INC.

EXAMPLES OF THE USE OF COLOUR IN PUBLICATIONS AND ADVERTISING

Upper left: Water-colour illustration reproduced in a four-colour advertisement

Upper right: Direct colour photograph for a magazine cover

Below: Direct colour photograph of food

mate. The whole cost of radio and television programs is paid for by advertisers.

It seems to have been found from experience that some products may be sold most economically primarily through personal salesmanship, that some products may be sold to certain classes of people most economically primarily through printed salesmanship, but that probably the great majority of products may be distributed most economically by varied proportions of personal and printed selling and the judicious use of radio's spoken word and television's mass demonstrations. So long as competition is believed to be a desirable factor in human welfare, just so long will competitive means be used. Critics of advertising perhaps may neglect the fact that if advertising were eliminated or abolished, other competitive methods would necessarily be substituted for it. If the use of advertising were eliminated, it is quite likely that its place would be taken in most instances by some form of personal selling, with its accompanying expense. The fact that numerous firms which consistently and continuously used advertising over a long period of years survived from early periods of business activity may be taken as some indication that advertising has been found to be a fairly effective agency of business progress.

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GREAT BRITAIN

Advertising's principal function is to assist in the sale of goods and services and, particularly where it is employed by the state, in the inculcation of ideas. To this end, according to the *Statistical Review of Press Advertising*, about £36,913,899 was spent on the purchase of displayed advertising space in Britain's newspapers, magazines and trade publications in 1950; of the total it is estimated that government advertising alone accounted for £1,209,496. These figures took no account of the cost of filling the columns thus acquired. The Select Committee on Estimates in its 1950 report noted that, in the years 1948–51, an average of £15,000,000 annually was expended on the government information services, covering all forms of official advertising, publicity and promotion through such diverse agencies as the central office of information, the foreign office and the British council.

On the basis of test and experience it is possible to forecast what a particular promotional effort is likely to yield in terms of sales. Market research methods employed by advertising men also enable a manufacturer to estimate the limits of his market, so that he may plan his factory's production. The A. C. Nielson method of retail shop auditing provides manufacturers with information about the movement of their own and competitors' goods from the shops. Where in any specific field of manufacture public preference is seen to be moving in the direction of certain brands, rival manufacturers can adjust their advertising, their packaging or the characteristics of their products accordingly. Over an extensive range of consumer goods (notably packaged foods, drugs and toilet products) sales are continually affected by the fickleness of public taste.

The case for advertising by the state rests on different grounds. If it is to intervene regularly in the day-to-day lives of adult citizens in a democracy, a government must employ all the methods of mass communication available to it to secure their co-operation. This is the argument used to justify large-scale advertising by the state to encourage saving, to persuade parents to have their children immunized against diphtheria, to promote road safety and fuel economy, and so on. There have also been drives, aided by modern publicity, to secure recruits for the armed services and for the police and, through the ministry of food, to explain how to make the best use of rationed foodstuffs. Moreover, the nationalized airways, railways and gas and electricity boards in Great Britain continue the use of advertising for selling and informative purposes started under private ownership. Although the need

for advertising by monopolies such as the post office is sometimes questioned it is argued that a monopoly no less than a private organization must create confidence among its clients. The pioneer work of the London Passenger Transport board has been widely commended in this connection. Although there had earlier been a limited amount of "official" advertising, notably on behalf of the post office, the British Industries fair and the old Empire Marketing board, it was World War II that provided the greatest impetus for the large-scale use of advertising for government ends.

As a result of the nationalization of Britain's transport after World War II the state became actively interested in the disposal by hire of advertising sites on railway property, inside railway coaches and in and on buses and trams. In 1949 the British Transport commission's net receipts from the sale of advertising space amounted to £2,207,610, its biggest single source on "noncarrying" revenue.

Agencies and Managers.—The bulk of the commercial advertising in Britain is placed by specialist firms of advertising agents, who are appointed by advertisers to handle their accounts. Normally no fee is paid by the advertiser for this work, the agent receiving a commission (varying from 10% to 15%) on the cost of the advertising from the newspaper or magazine with which it is placed. In practice agencies charge the client directly for special work, and frequently an extra "service fee" of about 2½% is imposed. The service of a first-class advertising agency to its clients includes direct examination of markets and elaborate research; the designing of packages and wrappings for new articles; the invention of selling plans; the formulation of an advertising policy and its embodiment in press advertisements, posters and other forms of advertising; the preparation of window-dressing designs and materials and of showcards; and contracting with newspapers, periodicals and hoarding-owners for the supply of space. The bulk of the agencies are members of the Institute of Incorporated Practitioners in Advertising, which enforces standards of practice designed to eliminate such unprofessional conduct as the active solicitation of other agencies' accounts.

The agency system enables the owners of advertising media to do business conveniently with thousands of advertisers through about 500 offices centred in the big cities. Also, the agent in his own interests must encourage businesses that may not have used advertising to discover how it can be of value to them. The advertiser likewise gains because, through the agency, he has a call on the services of expert teams whom he could not afford to employ on his own staff.

Nevertheless many bigger advertisers and those operating in technical and specialist fields do run advertising departments of their own which, while working in co-operation with the appointed agents, frequently carry out the bulk of the planning and creative work. The large advertising department is the exception rather than the rule, but regular advertisers nearly always appoint one executive, sometimes a director, known as the advertising manager to act as a liaison between the board and the agency. The Incorporated Advertising Managers' association, to which the leading managers belong, works to secure full recognition of its members' importance.

Media.—There are six main methods by which the advertising message can be delivered to the public in Great Britain. These are: the press, which includes newspapers and magazines of all kinds; outdoor advertising, which includes hoardings, *solus* sites, advertising on transport systems, and electric signs; direct mail, which is the professional term for advertising material addressed individually and sent through the post; exhibitions and displays; films and slides in cinemas, theatres and elsewhere; and radio. (In 1951 there was no advertising on the British television service which is controlled by the British Broadcasting corporation. Agitation to secure facilities for advertising programs was being conducted both in parliament and outside.)

Of these the most important is the press. The *Statistical Review of Press Advertising* gives the following figures for the value of space bought in the various departments of newspaper and magazine publishing during 1950: London mornings £10,516,697, London evenings £2,480,810, national Sundays £4,350,572, pro-

vincial dailies £4,810,829, provincial and suburban weeklies £1,417,614, magazines £10,887,276, technical £1,038,719 and trade £1,357,382. In 1950 more than 50 British advertisers spent £75,000 or more apiece on press advertising alone. In some cases individual sums were more than £200,000: for example, Oxydol £299,000, British Railways £240,000, British Electricity authority £225,000, Dreft £213,000 and Wisk Detergent £201,000.

Although the London morning newspapers, sometimes called the "national" dailies, have long been recognized as the major mediums for advertising in Great Britain, they lost something of their pre-eminence after World War II through the vastly extended influence of the mass circulation magazines. In the first place the paper or "newsprint" available to newspapers was more severely rationed than was that supplied to magazine publishers; in the second, the exploitation of new printing techniques, especially colour, enabled the magazines to improve their standing with the public. Whereas it had only 17.18% in 1935, the general magazine press had 34.59% of the annual advertising expenditure recorded for 180 different sorts of product in 1949. In the same period the London mornings' share declined from 36.52% to 23.86%.

It has been alleged that, because of their vast expenditure in the press, advertisers exert an influence on editorial policy. However, the report of the Royal Commission on the Press which sat between 1947 and 1949 stated that although individual advertisers occasionally sought to influence newspaper policy or to obtain the omission or insertion of particular news, such attempts appeared to be infrequent and unsuccessful. The same report pointed out that as long as newspapers were sold for less than what they cost to produce they would need a supplementary income and that the sale of their space to advertisers appeared to be one of the least harmful of the possible sources, but that the publication of advertisements was in any case an essential part of the service which newspapers rendered to the community.

The majority of publishers belong to the Audit Bureau of Circulations, which makes available authenticated half-yearly records of individual newspaper and magazine sales. Some publishers issue their own audited certificates. After World War II considerable attention was paid to "readership." Circulation is a vague term, and one purchased copy of a paper may have several readers. The annual *Hulton Readership Survey* charts the extent to which various newspapers and magazines are seen by other readers than the purchaser of each copy. Hulton's study of "advertisement attention values" was an attempt to show what proportion of the readers of a particular publication read the average advertisements therein.

Outdoor advertising is less amenable to analysis, but valuable work was published by Mills and Rockley's, a big firm of British provincial outdoor advertising contractors, and by the London Transport executive. The latter, in *London's Travelling Public* (1950) gave details of the age-composition and the income levels of those whom advertisements on their properties were likely to reach.

More than any other form of publicity, outdoor advertising has been criticized by the general public and in official quarters. Many charges of disfigurement were undoubtedly true in the past; however, as a result of the enlightenment of owners of regular hoardings and sites and, from 1949, the operations of the Town and Country Planning act, such complaints became considerably less valid. Furthermore, town planning authorities have admitted that outdoor advertising has a legitimate commercial function to perform and can be incorporated within planning programs to the advantage of the community. The way in which the modern, soundly constructed hoarding can even make a contribution to local planning arrangements, was demonstrated in the neighbourhood of the South Bank exhibition during the Festival of Britain (1951): a number of unsightly views exposed by rerouting of roads and other reconstruction work around the site were hidden by judiciously placed advertisement hoardings, in some cases set amid miniature gardens and floodlit.

Whereas advertisements in the press are frequently designed to present long and persuasive arguments on the advertisers' behalf, outdoor media, whether posters or signs, are for the most

part used to drive home what advertisers call "reminder messages." These consist of the name of the product or service being advertised together with a brief and telling slogan. Nicholas Kaldor and Rodney Silverman in *A Statistical Analysis of Advertising Expenditure and of the Revenue of the Press* (1948) estimated that in 1935 approximately £6,500,000 was spent on outdoor publicity.

The poster, by reason of its size and the facilities which it affords for the use of colour, has a powerful effect on the public mind. Announcements can be displayed before more people for a longer time by means of a poster than by the same expenditure of money in the press. If, however, more is desired than an instantaneous impression on the mind, the advertising value of the poster falls sharply.

Large painted signs on gable ends; sky signs on the roofs of houses; a variety of illuminated signs; mobile devices for shop windows; posters on buses, trams and carriers' vans; the rather antiquated expedient of sandwich-sign men; and motor delivery-vans modelled on the shape of the owner's specialty, enormously magnified, are among other forms of outdoor publicity.

A development which, following World War II, added to the attention value of posters of all kinds was the introduction of luminous inks. In electric signs, the continued extension of the neon principle resulted in the remarkable nighttime advertising effects which are such a feature of the entertainment and shopping centres of Britain's big cities, particularly at Piccadilly Circus in London. Equal progress was made in the production of smaller electrical units for use in local shop windows and on counters.

An increasingly popular method of marketing is to advertise for direct orders from the public through the post, and a feature of the popular national newspapers is the space, sometimes as much as a full page, given over to what are called "bargain squares." A typical collection of "bargain squares" will carry offers of clothing and household goods, all of which can be obtained either on the cash-on-delivery principle or by forwarding a cash or postal order for the stated amount to the advertiser, when the line requested will be dispatched to the customer by post. Because this form of trading would lend itself to sharp practice if not strictly supervised, newspapers are at pains to ensure that only reputable dealers are permitted to ply their trade in the paid-for columns.

A variant of the "mail-order" system described above is the unsolicited approach through the post, known as "direct mail." Certain classes of advertising agents specialize in direct mail and devote considerable attention to the compilation of selective mailing lists. In this way an advertiser who wishes to reach certain small groups of people can forward advertising matter direct to any special group, e.g., clergymen, chemists, etc.

Advertising by means of exhibitions and displays called into being a whole range of specialist artists and craftsmen whose talents may be seen at such events as the Motor show and the Radio exhibition or in the windows of the local store. What is known as "point of sale advertising," comprising the window bills, cut-outs, display cards and other forms of promotion supplied by the advertiser to the retailer, may also be included under this heading. The British Display association, representing individuals occupied in the craft of display, and the Display Producers' and Screen Printers' association, representing the majority of the firms engaged in the production of display material, are the moving professional bodies behind this section of the industry.

The possibilities of the newly discovered "magic lantern" as a medium for advertising were recognized at the end of the 19th century when slides were first shown on screens in theatres and music halls. The introduction of the cinematograph led to the production of short moving-pictures, incorporating an advertising message, displayed during the intervals of regular entertainment programs. After the arrival of the sound film this process was further accelerated, and with the increasing use of the portable 16-mm. projector the production of lengthy specialized instructional and documentary films for showing to selected audiences at clubs, canteens and women's institutes—the so-called "non-theatrical" screening—became a favourite weapon in the advertiser's armoury.

At mid-20th century there were approximately 4,800 cinemas in the United Kingdom, with a total seating-capacity of 4,200,000; on an average each seat was being used seven times a week. Of these 4,800 cinemas about 4,300, with a seating-capacity of 3,500,000, were prepared to show advertising films. To speak broadly, there are only two types of advertising films shown on British cinema screens: the individual two-minute film and those which run for 12-18 sec., together with others of the same length. For his share in the latter type of production the advertiser might pay approximately £2,500 and for this would be guaranteed 26 weeks' showing in 100 cinemas.

Advertising by means of radio or television—that is, commercial or sponsored broadcasting—has been the subject of severe limitations in Great Britain because of the setup of the broadcasting arrangements. These preclude both the use of the British Broadcasting corporation's transmitters for the purpose and the establishment of rival broadcasting stations on British soil. In these circumstances before World War II a considerable business had grown up in the use of private broadcasting stations in France, which devoted much of their program time to the transmission of whole sessions recorded in London at British advertisers' expense and intended for listeners in Britain. But all such activity ceased after 1939, and after World War II France abandoned its system of joint state and private enterprise in broadcasting in favour of an official monopoly like the B.B.C.'s. Radio Luxembourg, however, in the grand duchy of Luxembourg, had also carried British sponsored programs up to 1939 and reverted to this system at the end of hostilities: a powerful new transmitter, beamed on Britain, was opened up in 1951 and began to radiate popular entertainment programs interspersed with advertisers' messages for six hours every night. In Nov. 1951 it was calculated that about 15% of the adult population of the United Kingdom were regularly hearing Luxembourg's broadcasts in English. The Broadcasting committee headed by Lord Beveridge, in its report on the future of British radio and television issued in 1951, recommended against the introduction of the sponsoring system in Britain, although Lord Beveridge himself and one other member of the committee thought that there would be no objection to allowing it provided that it was subject to suitable controls.

Usually classified under advertising is the type of activity variously known as press or public relations. In its simpler, earlier form this was undertaken by so-called press agents, generally employed on behalf of entertainment interests, who by means of prearranged stunts sought to get inserted into the non-advertising columns of the press stories and pictures of the activities of film and stage performers—an operation calculated to develop their box-office value. Exploitation of the individual in this fashion continued to go on, but commercial firms, professional organizations and governments also came to use the press, the cinema and the radio to present their views and activities to the world. A public relations officer working for a firm of motor-car manufacturers sees that newspaper motoring correspondents have every facility for reporting on the firm's new models. Similarly the British foreign office through its own press department arranges ministers' press conferences. There is an Institute of Public Relations to which the higher public relations officers belong.

As well as helping to sell goods *en masse* to the consuming public, advertising performs certain less obvious but no less valuable functions. Thus there is a considerable amount of "internal" advertising undertaken by manufacturers and aimed at others in the business, generally the retailers and wholesalers. Examples are to be seen in the extensive trade and specialised press, which serves every section of industry, every occupation and every profession. This advertising is often an important adjunct to the consumer campaign: in creating sales among the public a manufacturer must win the favour of those who are to pass his product "over the counter" to the ultimate buyer.

Organization.—The central professional body of the advertising industry in Great Britain is the Advertising association. It groups together all the interests—advertisers, advertising agencies and media owners. The majority of the other specialist organiza-

tions, such as the Institute of Incorporated Practitioners in Advertising and the Incorporated Advertising Managers' association are affiliated to the Advertising association and thus have a common meeting ground on which to discuss problems. Among the association's objectives are the promotion of public confidence in advertising and advertised goods through the correction or suppression of abuses which undermine that confidence; encouragement of the study of the theory and practice of advertising and the improvement of its technique by the institution of courses of study, holding of examinations and the awarding of diplomas; establishment of the fact that efficient advertising is an essential factor in the marketing of produce and manufactured goods and in the economic life of the country; demonstration of the efficiency of the service that advertising and its associated interests can give to industry and the public; and furtherance of the adoption of standards of practice in the business relations between publishers, agents and advertisers.

One of the most important aspects of the Advertising association's work is to be found in its Advertisement Investigation department, which undertakes to check abuses in the wording and presentation of advertisements. The department regularly issues to the association's members reports on advertising which it considers to be undesirable, and in this way a great many appeals to public cupidity, seemingly innocent to the unpracticed eye but thoroughly disreputable in intent, have been refused admission to the advertisement columns of the serious press.

One instrument whereby the advertising business seeks to keep its house in order is the *British Code of Standards in Relation to the Advertising of Medicine and Treatments*, which has the support of the following organizations: the Newspaper Proprietors Association, Ltd., the Newspaper society, the Periodical Proprietors Association, Ltd., the Proprietary Association of Great Britain, the Advertising association, the Incorporated Society of British Advertisers, Ltd. and the Institute of Incorporated Practitioners in Advertising. The code declares that no advertisement should contain a claim to cure any ailment or symptoms of ill-health and that no advertisement should contain a word or expression used in such form or context as to mean, in the positive sense, the extirpation of any ailment, illness or disease. Treatments or medicines for illnesses which properly require medical attention, misleading or exaggerated claims, appeals to fear, diagnosis or treatment by correspondence, and "money back" offers are all dealt with in the code's recommendations. More specifically the code emphasizes that no advertisement should refer to any medicine, product, appliance or advice in terms calculated to lead to its use for the treatment of a number of specially enumerated illnesses or conditions. These "illnesses or conditions" range from alopecia to varicose veins and include many familiar "conditions" such as baldness, arthritis and obesity. There are nine other codes operated by specialist sections of advertising, including the *Code of Standards* subscribed to by members of the Association of Specialized Film Producers (the trade body of the advertising and documentary film makers) the *Code of Standards of Advertising Practice* of the International Chamber of Commerce and the *Standards of Practice* of the Market Research society. A censorship committee of the British Poster Advertising association and the Solus Outdoor Advertising association—two associations of owners of outdoor advertising sites—is powerful enough to suppress any poster calculated to offend public taste or morality.

Representing exclusively the interests of advertisers as such is the Incorporated Society of British Advertisers, Ltd. which, while not affiliated to the Advertising association, frequently co-operates with it on matters of common concern. The I.S.B.A., founded in 1900, is the oldest body of advertisers (as opposed to publishers) and defends the interest of advertisers when they conflict with those of the agencies and the media owners. The I.S.B.A. works to ensure, among other things, that advertisement charges are not pushed up to uneconomical levels. It was the I.S.B.A. that in 1931 secured the establishment of the Audit Bureau of Circulations.

Indicative of the tendency for advertising to assume professional status is the growing reliance placed on examination in the

selection and promotion of staff. Two sets of examinations are conducted: a broad-based paper set by the Advertising association; and a paper concentrating more on agency practice set by the Institute of Incorporated Practitioners in Advertising. Facilities for study are provided by various commercial colleges and also through some of the 32 local advertising and publicity clubs affiliated to the Advertising association. These clubs, in addition to their social activities, arrange talks and debates on advertising subjects and seek to stimulate a sense of co-operation and unity among advertising people of the same neighbourhood. They are autonomous, but most of them send two delegates to the quarterly meetings of the Advertising association's Club Development committee.

Advertisements in English Law.—Apart from the provisions for formal notification by advertisement in the *London Gazette* and local papers of a large variety of matters of which the public should be informed, acts of parliament relating to advertisements have generally been restrictive. Nevertheless the principle of the spending of public moneys by government departments, local authorities and public corporations finds widespread acceptance.

Legislation affecting advertising is of two types: (1) that which protects the amenities of the countryside and certain urban areas; and (2) that which protects the public from excessive claims in advertisements.

In the first group the most important piece of legislation is the Control of Advertisements regulations, 1948, made under the authority of the Town and Country Planning act, 1947. Legislation in this field, however, began with the Advertisements Regulations act, 1907, which authorized bylaws by local authorities for the regulation and control of hoardings more than 12 ft. in height and for regulating, restricting or preventing the exhibition of advertisements calculated to affect injuriously the amenities of a public park or pleasure promenade or to disfigure the natural beauty of a landscape. In 1925 the powers were extended to include advertisements that would disfigure or injuriously affect the view of rural scenery from a highway or railway or from any public place or water, or the amenities of any village or of any historic public building or monument, or any place frequented by the public chiefly on account of its beauty or historic interest. The home office prepared model forms of bylaws, and by mid-century more than 100 local authorities in Great Britain had exercised their statutory powers.

Subsequently a series of provisions under various town and country planning acts developed further control of outdoor advertising. Then the Town and Country Planning act, 1947, gave the local authorities full control over all outdoor advertising, except minor groups of it, within their territories. In the special areas that appear to the minister to require special protection on grounds of amenity (e.g., rural), express consent from the local planning authority normally has to be obtained before an advertisement site can be located or constructed; but in certain cases—for instance for advertisements on business premises or for functional advertisements by the other local authorities—consent is deemed, that is, not required express. Such advertisements, however, are strictly regulated, both in special areas and in nonspecial areas, and the local planning authority has the right to challenge them. For instance, advertisements on business premises must relate to the business carried on and to the person carrying it on, including advertisements of the goods sold or the services rendered on the premises. In a special area they must not contain letters or figures exceeding 1 ft. in height and may not be more than 12 ft. above ground level. In nonspecial areas they must not be more than 2 ft. 6 in. in height, or more than 15 ft. above ground level.

A further important provision in the regulations is that outdoor advertisements cannot be displayed without the consent of the owner of the land or building on which it is being displayed. This provision has almost stopped "fly-posting," i.e., posting without consideration of the amenities.

In congested areas further restrictions are often imposed for the greater safety or convenience of those using the streets. Thus, under the London Traffic act, 1924, the minister of transport may within the London traffic area restrict the use of sandwich-sign

men and other persons in the street for the purpose of advertisement if they are likely to be a source of danger or to cause obstruction to traffic; and in 1927 the minister, Col. Wilfrid Ashley, forbade the use of displayed vehicles for advertising purposes in certain streets. Within the City of London and the metropolitan police district no person may carry on foot or horseback or any carriage in any thoroughfare or public place any advertisement to the obstruction or annoyance of the inhabitants or passengers (London Hackney Carriage act, 1853); and by the Metropolitan Streets acts, 1867 and 1885, no advertisement, except in such form and manner as may be approved by the commissioner of police having jurisdiction in the area, may, within six miles of Charing cross, be exhibited or distributed in any street by any person on foot or riding in any vehicle or on horseback. In the County of London, by the London Building act, 1894, and in areas in which the Public Health Acts Amendment act, 1907, applies, sky signs as defined by those acts are prohibited. By a bylaw made in 1900 under general statutory powers for the suppression of nuisances, the London County council, in great measure as a result of observation made at coroners' inquests, prohibited advertisement by searchlight or flashlight causing danger to traffic in any street. "Flashlight" is defined as a light which alters suddenly either in intensity, colour or direction. A large number of bylaws for the regulation of advertisements have been passed in different parts of Great Britain.

Other advertisements are prohibited by statute because they are themselves an evil or because they are incidental to evils which the legislature wishes to suppress. Although moneylending is a legitimate trade, it tends to create abuses unless it is severely restricted. In 1892 the sending of an advertisement to any person under legal age inviting him to borrow money was prohibited. Much more drastic restrictions were imposed by the Moneylenders act, 1927. No person might send to any person, except in response to that person's written request, any advertisement containing the name, address or telephone number of a moneylender or inviting him to borrow money from a moneylender or to enter into any transaction involving such borrowing or to apply for information as to such borrowing. A moneylender may, however, advertise in newspapers and at an authorized address by poster or placard, but in each case the act severely limits the contents of the advertisement. Moreover, an advertisement or document sent in response to a written request must show with due prominence the moneylender's authorized name and any other name in which he or a partner was registered under the Moneylenders act, 1900, and must not contain expressions which might reasonably be held to imply that the moneylender carries on a banking business. If the terms of interest are indicated they must be stated at the rate per cent. per annum, or, if otherwise stated, the rate per cent. per annum represented by the interest proposed must also be shown.

By the Larceny act, 1861, advertisements of reward for the return of property stolen or lost must neither indicate that no questions will be asked or inquiries made nor promise to repay the purchaser or pledgee of stolen property. A number of statutes prohibit advertisements relating to betting and lotteries. Prize schemes used for advertising are often illegal, as being lotteries. But if skill contributes to the winning of a prize in a competition, the competition is not a lottery. Indecent and obscene advertisements were penalized by the Indecent Advertisements act, 1889.

The Cancer act, 1939, made it an offense for any person to take part in the publication of an advertisement containing an offer to treat a person for cancer, to prescribe any remedy for it or to give any advice in connection with its treatment. The Pharmacy and Medicines act, 1941, made it an offense to advertise treatments for Bright's disease, cataract, diabetes, epilepsy or fits, glaucoma, locomotor ataxia, paralysis or tuberculosis, or to advertise any article in terms calculated to lead to its use for procuring a miscarriage.

The general law also affects advertisements. False representations, offers to contract, defamatory statements, incitements to crime, contempt of court, breach of copyright and infringement of trade-marks may be contained in advertisements and will be

governed by the ordinary rules relating to deceit, contract, libel, crime and infringement of rights. The courts, however, firmly refused to allow puffing advertisements to become the basis of lawsuits between rival traders and will give a remedy for the disparagement of goods by advertisement only when false statements are made with specific reference to the plaintiff's goods, with intent to injure the plaintiff—and then only when the plaintiff has actually been involved in financial loss.

The law recognizes the value of advertisements to advertisers. Hence for breach of a contract to insert advertisements, damages will be given for the loss of business due to the failure to insert the advertisements. Similarly, where advertisement can be shown to be one of the objects of a contract—as, for instance, where an actor is engaged for a theatre of high repute—loss of publicity may be a substantial element in the damages recoverable for breach of the contract.

A summary of laws and regulations dealing with advertisements in certain other countries is contained in an official return issued by the home office in 1903.

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(A. J. Hy.)

ADVERTISING AGENT or AGENCY, an individual or an organization engaged primarily in the preparation of advertising and also in giving counsel and assistance in the advertising and merchandising of commodities, securities and services.

Although an advertising agency, Reynell and Son, was founded as early as 1812 in London, Eng., the advertising agent first became a recognized factor in business in the United States. The *Boston Chronotype*, Oct. 16, 1846, wrote, "The newspaper advertising agency of Mr. V. B. Palmer we look upon as just the thing. You have only to step into his office with the notice which you wish to have given the whole people of the United States, and it is done." By 1849 Volney B. Palmer, who had been an editorial writer and later member of the advertising department of the *Pottsville Miner's Journal* (Pa.), had opened offices as an advertising agent in Philadelphia, New York, Baltimore and Boston. He acted as the agent for a number of publishers who paid him a commission of 25% for selling space, although he did not assume liability for the credit extended to advertisers. Palmer pioneered advertising on a national scale. His early competitors included S. M. Pettengill, a former clerk for Palmer, and John L. Hooper, who established the precedent of the agent's assuming the responsibility for paying the publisher.

In 1865 George P. Rowell, who had been a bill collector for the *Boston Post*, inaugurated his "list system." Having bought space on contract wholesale from a number of weekly newspapers, he offered space to advertisers in smaller units at retail rates which were below competitors' rates. He advertised "an-inch-of-space-a-month-in-one-hundred-papers-for-one-hundred-dollars." Although the plan proved successful for Rowell and other agents, it did not survive.

As a result of competition among agents and publishers and the flexibility of advertising rates and contracts, the agents became, in effect, expert space traders and brokers.

As late as 1880, the advertising agents relied upon the advertisers to prepare the text of their advertisements; however, in 1914 the Audit Bureau of Circulations was established, and expert and secret knowledge of circulation figures and bargaining for favourable rates were no longer the principal services offered to clients. National advertisers turned to the agencies for assistance in market research, planning of advertising campaigns and preparation of copy. By 1917, when the American Association of Advertising Agencies was founded, agencies had begun to use, in addition to publications, other media such as direct-mail soliciting and outdoor advertising. They later utilized radio and television.

Services which U.S. advertising agents generally undertook included: (1) conducting marketing researches; (2) making sugges-

tions concerning the most saleable form of a product, including the design of the package and determination of price; (3) assisting in the organization and direction of the advertiser's sales force; (4) preparing the advertising, including copy, catalogues, mailing pieces, radio or television programs, etc., and suggesting the amount of money to be expended, the space or broadcasting time required, and the media to be used; (5) making contracts with publishers or purveyors of advertising space or time; and (6) assisting the advertiser to cultivate the good will of the trade and of the public.

As an organization, serving any number of advertisers, the agency (or agent) usually divides itself into departments as follows: (1) executive, which includes the securing of business and its development; (2) research and plans, which conducts marketing inquiries and investigations, and plans the extent and character of an advertising campaign; and (3) production, which provides for the writing and illustration of advertising copy, and the preparation of the engraving cuts and mats necessary to mechanical reproduction and other details. In addition, many agencies became responsible for the production of radio and television programs, which were designed to appeal to a given market for a product, service or, in some cases, idea.

Although U.S. agencies received fees from clients for special services or materials provided, they derived most of their income at mid-20th century from the generally established commission, 15% of the standard rates, which the media voluntarily allowed. Only agencies which met the requirements for "recognition" by various publishers and publishers' associations were awarded the commission by the media owners. Requirements for recognition included agency financial responsibility for obligations to the media owners, which had to be contracted in the name of the agent or agency, and a prohibition against the agency's rebating part of the commission to the advertiser. (See also **ADVERTISING**.)

ADVICE, counsel given after consideration, or information from a distance giving particulars of something prospective (e.g., "advice" of an imminent battle, or of a cargo due). In commerce it is a common word for a formal notice from one person concerned in a transaction to another.

ADVOCATE, a person called in to plead the cause of another; especially one entitled, as having the right of audience, to plead the cause of another in a court of law. In Scotland the word is used particularly to designate a member of the bar of Scotland (see **ADVOCATES**, **FACULTY OF**). The lord advocate is the chief law officer of the crown in Scotland. As chief public prosecutor he appoints six members of the bar to be his deputies in the conduct of criminal prosecutions, and they are termed advocate-deputies.

The lawyers who practised in the English courts of common law were never officially known as advocates, the word being reserved for those who practised in the courts of the civil and canon law (see **DOCTORS' COMMONS**). There was formerly an important official termed his majesty's advocate-general, or more shortly, the king's advocate, who was the principal law officer of the crown in the College of Advocates or Doctors' Commons, and in the admiralty and ecclesiastical courts. He discharged for these courts the duties which correspond to those of the solicitor of the treasury (see **SOLICITOR**). His opinion was taken by the foreign office on international matters, and on high ecclesiastical matters he was also consulted; all orders in council were submitted to him for approval. The office may now be said to be obsolete, for after the resignation of Sir Travers Twiss, the last holder, in 1872, it was not filled. Advocate is also the title still in use in some of the British colonies for the chief law officer of the crown.

In the United States the term advocate has no special significance but is used synonymously with such terms as attorney, counsel or lawyer.

In France, the *avocats*, as a body, were reorganized under the First Empire by a decree of Dec. 15, 1810. There is, however, a distinction between *avocats* and *avoués*. The latter, limited in number, act as procurators or agents, representing the parties before the tribunals, draft and prepare all formal acts and writings, and prepare lawsuits for the oral debates. The office of the *avocat*, on the other hand, consists in giving advice as to the law, and con-

ducting the causes of his clients by written and oral pleadings. The number of *avocats* is not limited.

In Germany the *advocat* no longer forms a distinct class of lawyer. Since 1879, when a sweeping judicature act (*Deutsche Justizgesetzgebung*) reconstituted the judicial system, the *advocat* in his character of adviser, as distinguished from the *procurator*, who formerly represented the client in the courts, has become merged in the *rechtsanwalt*, who has the dual character of counsellor and pleader.

Advocatus Ecclesiae.—In the middle ages the word *advocatus* was used on the continent as the title of the lay lord charged with the protection and representation in secular matters of an abbey. The office is traceable as early as the beginning of the 5th century in the Roman empire, the churches being allowed to choose *defensores* from the body of advocates to represent them in the courts. In the Frankish kingdom, under the Merovingians, these lay representatives of the churches appear as *agentes*, *defensores* and *advocati*; and under the Carolingians it was made obligatory on bishops, abbots and abbesses to appoint such officials in every county where they held property. The office was not hereditary, the *advocatus* being chosen, either by the abbot alone, or by the abbot and bishop concurrently with the count. The same causes that led to the development of the feudal system also affected the *advocatus*. In times of confusion churches and abbeys needed not so much a legal representative as an armed protector, while as feudal immunities were conceded to the ecclesiastical foundations, these required a representative to defend their rights and to fulfil their secular obligations to the state, e.g., to lead the ecclesiastical levies to war. A new class of *advocatus* thus arose, whose office, commonly rewarded by a grant of land, crystallized into a fief which, like other fiefs, had by the beginning of the 11th century become hereditary.

In France the *advocati* (*avoués*) were of two classes—(1) great barons, who held the advocateship of an abbey or abbeys rather as an office than a fief, though they were indemnified for the protection they afforded by a domain and revenues granted by the abbey: thus the duke of Normandy was *advocatus* of nearly all the abbeys in the duchy; (2) petty seigneurs, who held their *avoueries* as hereditary fiefs and often as their sole means of subsistence. The *avoué* of an abbey, of this class, corresponded to the *vidame* (q.v.) of a bishop. Their function was generally to represent the abbot in his capacity as feudal lord; to act as his representative in the courts of his superior lord; to exercise secular justice in the abbot's name in the abbatial court; to lead the retainers of the abbey to battle under the banner of the patron saint.

The *advocatus* played a more important part in the feudal polity of the Empire and of the Low Countries than in France, where his functions, confined to the protection of the interests of religious houses, were superseded from the 13th century onwards by the growth of the central power and the increasing efficiency of the royal administration. They had, indeed, long ceased to be effective for their original purpose; and from the time when their office became a fief they had taken advantage of their position to pillage and suppress those whom it was their function to defend. The mediæval records, not in France only, are full of complaints by abbots of their usurpations, exactions and acts of violence.

In England *advocatus* was never used to denote the representative of an abbot; but in some of the larger abbeys there were hereditary stewards whose functions and privileges were not dissimilar to those of the continental *advocati*. The word *advocatus*, however, was in constant use in England to denote the patron of an ecclesiastical benefice, whose sole right of any importance was an hereditary one of presenting a parson to the bishop for institution. In this way the hereditary right of presentation to a benefice came to be called in English an "advowson" (*advocatio*).

In Germany the title of *advocatus* (*Vogt*) was given not only to the *advocati* of churches and abbeys, but to the officials appointed, early in the middle ages, by the emperor to administer their immediate domains, in contradistinction to the counts, who had become hereditary princes of the empire. The territory so administered was known as *Vogtland* (*terra advocatorum*), a name still sometimes employed to designate the strip of country which

embraces the principalities of Reuss and adjacent portions of Saxony, Prussia and Bavaria. These imperial *advocati* tended in their turn to become hereditary. Sometimes the emperor himself assumed the title of *Vogt* of some particular part of his immediate domain. In the Netherlands as well as in Germany *advocati* were often appointed in the cities, by the overlord or by the emperor, sometimes to take the place of the bailiff (Ger. *Schultheiss*, Dutch *schout*, Lat. *scultetus*), sometimes alongside this official.

See Du Cange, *Glossarium* (ed. 1882-87, Niot), s. "Advocati"; A. Luchaire, *Manuel des institutions françaises* (1892); Herzog-Hauck, *Realencyklopädie* (ed. Leipzig, 1896), s. "Advocatus ecclesiae," where further references will be found.

ADVOCATES, FACULTY OF, the collective term employed to designate the members of the bar of Scotland. The faculty has grown out of the Scots act of 1532, which established the College of Justice, or Court of Session, in Scotland. The advocates had, and still have, the sole right of audience in the Court of Session and High Court of Justiciary. By immemorial custom, they have formed themselves into a self-governing faculty under annually elected office-bearers consisting of the dean of faculty and his council, the vice-dean, the treasurer and the clerk. When properly instructed by a law agent an advocate is, under pain of deprivation of office, bound and entitled to plead in any court in Scotland, civil or criminal, superior or inferior. He is also entitled to plead before the House of Lords, the judicial committee of the privy council and parliamentary committees. The magnificent library collected by the faculty has now been formed into the National Library of Scotland.

ADVOCATUS DIABOLI, devil's advocate, the popular name for the promoter of the Faith (*promotor fidei*), an officer of the Sacred Congregation of Rites at Rome, whose duty is to prepare all possible arguments against the beatification or canonization of an alleged saint. This functionary first occurs in connection with the beatification of St. Lorenzo Giustiniani under Leo X. (1513-21). (See CANONIZATION.)

ADVOWSON, the right of presentation to a vacant ecclesiastical benefice, so called because the patron defends or advocates the claims of the person whom he presents, or because he is the advocate, patron or defender of the church and benefice and is as such given the right to name the priest. At what period the right of advowson arose is uncertain; it was probably the result of gradual growth. The earliest trace of the practice is found in the decree of the council of Orange, A.D. 441, which allowed a bishop, who had built a church in the diocese of another bishop, to nominate the clerk, but not to consecrate the church. The 123rd Novel of Justinian, promulgated about the end of the 5th century, decreed "that if any man should erect an oratory, and desire to present a clerk thereto by himself or his heirs, if they furnish a competency for his livelihood, and nominate to the bishop such as are worthy, they may be ordained." The 57th Novel empowered the bishop to examine them and judge of their qualifications, and, where those were sufficient, obliged him to admit the clerk. In England, for quite two centuries after its conversion, the clergy administered only *pro tempore* in the parochial churches, receiving their maintenance from the cathedral church, all the appointments within the diocese lying with the bishop. But in order to promote the building and endowment of parochial churches, those who had contributed to their erection either by a grant of land, by building or by endowment, became entitled to present a clerk of their own choice to the bishop, who was invested with the revenues derived from such contribution. After the Norman Conquest, it became quite usual for patrons to appoint to livings not only without the consent, but even against the will, of the bishops.

Advowsons are divided into two kinds, *appendant* and *in gross*. The right of presenting, originally given to the person who built or endowed the church, gradually became annexed to the manor in which it was built, and where the right of advowson remains attached to the manor, it is called an advowson *appendant*, and passes with the estate by inheritance or sale without any special conveyance. But where, as is now generally the case, the right of presentation has been sold by itself, and so separated from the

manor, it is called an advowson *in gross*. An advowson may also be partly *appendant*, and partly *in gross*; e.g., if an owner granted to another every second presentment, the advowson would be *appendant* for the grantor's turn and *in gross* for the grantee's.

Advowsons are further distinguished into *presentative* and *collative*. In a *presentative* advowson, the patron presents a clergyman to the bishop, with the petition that he be instituted into the vacant living, and the bishop then, if the presentee be a fit clerk, admits and institutes him. In a *collative* advowson the bishop is himself the patron, either in his own right or in the right of the proper patron, which has lapsed to him through not being exercised within the statutory period of six months after the vacancy occurred. Collation takes the place of presentation, admission and institution. Before 1898 there were also *donative* advowsons, but the Benefices Act, 1898, made all donations with cure of souls *presentative*. In a *donative* advowson, the patron conferred the benefice by a simple letter of gift, without any reference to the bishop.

The Benefices Act of 1898 did not make any substantial change in the legal character of advowsons, which remain practically the same as before the act. Briefly, it prevents the dealing with the right of presentation as a thing apart from the advowson itself; increases the power of the bishops to refuse the presentation of unfit persons, and removes various abuses. An advowson may, still, be sold during a vacancy, but that will not carry the right to present on the vacancy. But under the Benefices Act, advowsons may not be sold by public auction except in conjunction with landed property adjacent to the benefice; transfers of patronage must be registered in the registry of the diocese, and no such transfers can be made within 12 months after the last admission or institution to the benefice. Restrictions have also been imposed on the transfer of patronage of churches built under the Church Building acts and New Parishes acts, and on that of benefices in the gift of the lord chancellor, and sold by him in order to augment others; but agreements may be made as to the patronage of such churches in favour of persons who have contributed to their building or enlargement without being void for simony.

The Benefices Act, 1898 (Amendment) Measure, 1923, provides that after two further vacancies of the benefice subsequent to the passing of the measure, the right of patronage shall become incapable of sale, and that a patron may anticipate the two avoidances by a registered declaration, and declare the patronage shall from the date of declaration be without power of sale. The measure further provides that if a right of patronage becomes after the date of the measure vested in a clergyman or his wife, or in someone on his or her behalf, that clergyman shall not be presented to the living. There is a further provision in the measure, repealing the act called the Clergy Resignation Bonds Act, 1823, which sanctioned the giving by presentees of a bond to a patron that he would resign the benefice in favour of any one named person, or either of two named persons, if both were related to the patron within certain limited degrees.

The right of presentation may be exercised by the owners, whether they be infants, executors, trustees, coparceners (who, if they cannot agree, present in turn in order of age) or mortgagees (who must present the nominee of the mortgagor), or a bankrupt (who, although the advowson belongs to his creditors, yet has the right to present to a vacancy). Certain owners of advowsons are temporarily or permanently disabled from exercising the right, which devolves upon other persons; and the Crown as patron paramount of all benefices can fill all churches not regularly filled by other patrons. It thus presents to all vacancies caused by simoniacal presentations, or by the incumbent having been presented to a bishopric or in benefices belonging to a bishopric when the see is vacant by the bishop's death, translation or deprivation. Where a presentation belongs to a lunatic, the lord chancellor presents for him. Where it belongs to a Roman Catholic the right is exercised in his behalf by the University of Oxford

¹A nomination is to be distinguished from a presentation. The latter is the legal act, which alone will be recognized by the bishop. But if the legal patron be not entitled in equity, the true patron nominates him.

if the benefice be situate south of the River Trent, and by that of Cambridge if it be north of that river. (For the conditions which make a fit clerk see the article BENEFICE.) If the bishop refuses to admit and institute, the patron has his remedy by an action called after the words in the ancient writ *Quare impedit*; that is, the bishop is called upon to show "why he hinders" the patron in the exercise of his right. If the bishop's refusal be due to the fact that there is another claimant to the patronage, that person is also made defendant. If the refusal be because the clerk is alleged to be unfit, the clerk can himself appeal to the court of the metropolitan by a process known as *duplex querela*. The Benefices act also gives to both patron and presentee an alternative mode of appeal against a bishop's refusal to institute or admit, except on a ground of doctrine or ritual, to a court composed of the archbishop of the province and a judge of the high court nominated for that purpose by the lord chancellor, a course which, however, bars resort being had to the ordinary suits of *duplex querela* or action of *quare impedit*.

In case of refusal of one presentee, the patron may present another so long as he does it before lapse.

Upon institution the church is full against everybody except the Crown, and after six months' peaceable possession the clerk is secured in possession of the benefice, even though he may have been presented by a person who is not the proper patron. The true patron can, however, exercise his right to present at the next vacancy, and can recover the advowson from an usurper at any time within three successive incumbencies so created adversely to his right, or within 60 years. Collation, which otherwise corresponds to institution, does not make the church full, and the true patron can dispossess the clerk. Possession of the benefice is completed by induction, which makes the church full against any one, including the Crown. If the proper patron fails to exercise his right within six calendar months from the vacancy, the right devolves or lapses to the next superior patron; e.g., from an ordinary patron to the bishop, and if he makes similar default to the archbishop, and from him on similar default to the Crown. If a bishopric becomes vacant after a lapse has accrued to it, the right goes to the metropolitan; but in case of a vacancy of a benefice during the vacancy of the see the Crown presents. Until the right of presentation so accruing to a bishop or archbishop is exercised, the patron can still effectually present but not if lapse has gone to the Crown. (See also BENEFICE; GLEBE; INCUMBENT; RECTOR; VICAR.)

See J. Mirehouse, *On Advowson* (1824); Phillimore, *Ecclesiastical Law*; J. Bingham, *Origines Ecclesiasticæ, or, the Antiquities of the English Church* (1838-40). (P.)

ADWAN, a Moabite tribe claiming an Arabian origin. They declare that ten generations ago they formed part of a settled population in a fertile district of Arabia and were driven out by invaders much stronger in numbers.

See *The Cambridge Ancient History*, vol. i., 2nd ed. (1924).

ADY, ENDRE (1877-1919), Hungarian poet, was born Nov. 21, 1877, at Ermszent, Transylvania. He was a leader of the modern school and one of the greatest lyrical poets of Hungary. During his youth he became intimate with the publicists and politicians of the Radical and Socialist parties. When he settled down in Budapest he turned his attention towards revolutionary politics and contributed to several Radical papers. He also made prolonged visits to Paris and the Riviera but returned finally to Hungary owing to ill-health, and lived there quietly until his death on Jan. 27, 1919. During the World War he adopted a pacifist attitude, and prophesied the Karolyi revolution of 1918.

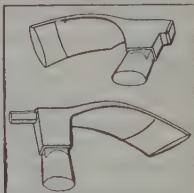
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ADYE, SIR JOHN MILLER (1819-1900), British general, son of Major James P. Aye, was born at Sevenoaks, Kent, on Nov. 1, 1819, and died on Aug. 26, 1900. Sir John Aye served in the Crimean War, in the Indian Mutiny, on the North-West frontier in India in 1863 and subsequently in important commands at home. In 1882 he was chief of staff and second in command of the expedition to Egypt and served throughout the

campaign (G. C. B. and thanks of parliament). He held the government of Gibraltar from 1883 to 1886. Promoted general and colonel commandant of the Royal Artillery in 1884, he retired in 1886. He unsuccessfully contested Bath in the Liberal interest in 1892. He was author of *Recollections of a Military Life* (1895) and other works.

ADYTUM, the most sacred part of a shrine, temple or church such as the Holy of Holies of the Temple at Jerusalem, or the cave of the Oracle of Apollo at Delphi, occasionally used for the chancel (*q.v.*) of a Christian church.

ADZE, a tool used for cutting and planing. It is somewhat like an axe reversed, the edge of the blade curving inward and placed at right angles to the handle. This shape is most suitable for planing uneven timber, as inequalities are "hooked off" by the curved blade. At the same time, each cut of the adze leaves its own facet, giving a peculiarly wrought effect to work so finished. The beams of old houses, or of new ones finished in an old-fashioned way, show most pleasantly the marks of the adze. See TOOL.



CARPENTER'S ADZE. TOOL WITH RAZOR-LIKE EDGE WHICH IS USED FOR CUTTING AND PLANING

ADZHARIA (Georgian *Ach'ara*, Turkish *Ajaristan*), an autonomous socialist soviet republic, a zone under the protection of the Georgian S.S.R. Its boundaries are, on the west, the Black sea, on the south, Turkey, on the north and east, the Georgian S.S.R. Area 1,081.1 sq.mi.; pop. (1933) 153,800: urban 56,365 and rural 97,435. It consists mainly of the former military government of Batum with Ardvin, *i.e.*, the slopes and a portion of the Armenian highlands, drained by the Chorokh river and its tributary, the Acharis-Tsqali, forming deep, picturesque ravines. It is divided for administrative purposes into the following provinces: Adzhar-Tskalsk, pop. 5,524, entirely rural; Kedsk, pop. 10,307, entirely rural; Kobuletsk, pop. 16,996: urban, 1,791, rural, 15,205; Khylosk, pop. 27,172, entirely rural; Chorokh, pop. 59,199: urban, 45,450, rural, 13,749. The climate is "west coast Mediterranean" in type, with southerly and southeasterly rain-bearing winter winds from the low pressure systems over the Black sea. The Caucasus shelters it from north and northeast winds. Rainfall averages 60 in. per annum or more—at Batum 93.3 in. (maximum in November); average temperature January, 43.0° F.; August, 73.8° F. Malaria is prevalent and insect pests, *e.g.*, mosquitoes and locusts, abound. Along the coastal plains from Batum northward are cultivated vine, peach, pomegranate, fig, olive (up to 1,500 ft. above sea level), chestnut, apricot, citrus fruits, apple, pear, plum, cherry, melon and tea, maize (the staple food), wheat (up to 5,000 ft.), potatoes, peas, currants, cotton, rice, colza, tobacco, sunflower seeds and barley. The eucalyptus, mulberry (with silk cultivation), bamboo and ramie are also produced. Much of the republic is forested, the mountain slopes bearing dense forests with a great variety of timber, interspersed with climbing and twining plants and along the plains and lower slopes flowering shrubs bloom, *e.g.*, magnolia, azalea, camellia japonica, begonia. Petroleum exists north of Batum, but is not worked much. Batum (*q.v.*), chief city and port, is linked by rail with Baku (on Caspian) and with Kutais and Poti. Pipes convey petroleum from Baku to Batum. Ach'ara was at first a part of the Georgian duchy (after 1463 sovereign principality) of Guria, under the house of Gurieli. After the 16th century it became a part of the Ottoman, and after 1878 a part of the Russian, empire. In 1921 it became an A.S.S.R. (See GEORGIA.)

A. E.: see RUSSELL, GEORGE WILLIAM.

AEACUS, in Greek legend, was the son of Zeus and of Aegina, daughter of the river-god Asopus. His mother was carried off by Zeus to the island of Oenone, afterwards called by her name. The island having been depopulated by a pestilence, Zeus changed the ants upon it into human beings (Ovid, *Met.*, vii. 520), who were called Myrmidones (*myrmēkes* = ants). Aeacus ruled so impartially that after his death he was made judge of the lower world, together with Minos and Rhadamanth. His successful prayer to Zeus for rain at a time of drought

was commemorated by a temple at Aegina (Pausanias ii. 29), where a festival (*Aiakeia*) was held in his honour.

AECLANUM, an ancient town of Samnium, Italy, 15 mi. E.-S.E. of Beneventum, on the Via Appia (near modern Mirabella). It became the chief town of the Hirpini after Beneventum had become a Roman colony. Sulla captured it in 89 B.C. by setting on fire its wooden breastwork, and new fortifications were erected. Hadrian, who repaired the Via Appia from Beneventum to this point, made it a colony; it has ruins of city walls, aqueduct, baths and amphitheatre; nearly 400 inscriptions have been found. Two different routes to Apulia diverged at this point, one (Via Aurelia Aclanensis) leading through the modern Ariano to Herdonie, the other (the Via Appia of the Empire) passing the Lacus Ampsanctus and going on to Aquilonia and Venusia. See Ashby and Gardner, *Papers of the British School at Rome*, viii. 108 sqq.

AEDESUS (d. A.D. 355), Neoplatonist philosopher, was born of a noble Cappadocian family. He went to Syria, attracted by the lectures of Iamblichus, whose disciple he became. He taught at Pergamum, his chief disciples being Eusebius and Maximus.

See Ritter and Preller, 552; Ritter's *Geschichte der Philosophie*; T. Whittaker, *The Neoplatonists* (1901).

AEDICULA, a small house or temple, especially the Roman household shrine of the Lares and Penates.

AEDILES, the magistrates at Rome who had care of the temples (*aedes*). Created in the same year as the tribunes of the people (494 B.C.), they were plebeians, elected, two in number, by the *Concilium Plebis*. Intended as assistants to the tribunes, they exercised police functions and had power to inflict fines. They also managed the plebeian and Roman games. In 367 B.C. an extra day was added to the Roman games. The patricians offered to bear the expense if admitted to the aedileship. Accordingly two "curule" aediles (see CURULE) were appointed by the *Comitia Tributa*, at first patricians, then patricians and plebeians in turn and lastly from either class. They managed the Roman and Megalesian games, cared for the patrician temples and issued edicts for the markets. The curule aediles ranked higher than the plebeian, but in time their functions became practically identical. These functions fell under three heads: (1) Care of the city—repair, etc., of temples, sewers and aqueducts; traffic regulation and precautions against fire; control of baths and taverns, and general supervision of public morals. (2) Care of provisions—testing of quality and of weights and measures; purchase of corn for disposal in emergencies at a low price. (3) Care of the games—organization of the public games and control of those given by private individuals (*e.g.*, at funerals). These were often used by ambitious persons as a means of gaining popularity. In 44 B.C. Caesar added two patrician aediles, called *Cereales*, for the care of the corn supply. Under Augustus the juridical functions of the office and the care of the games were transferred to the praetor, while its city responsibilities were limited by the appointment of a *praefectus urbi*. In the 3rd century A.D. it disappeared altogether.

See W. E. Heitland, *The Roman Republic* (1923), pp. 157-158; J. E. Sandys, *Companion to Latin Studies* (1921) (useful bibliography), pp. 321, 345, 385; A. H. J. Greenidge, *Roman Public Life* (1901).

AEDUI (i-dōō-ē), HAEDUI or HEDUI, a Gallic people of Gallia Lugdunensis, who inhabited the country between the Arar (Saône) and Liger (Loire). Their territory thus included the greater part of the modern departments of Saône-et-Loire, Côte d'Or and Nièvre. According to Livy (v. 34), they took part in the expedition of Bellovesus into Italy in the 6th century B.C. Before Caesar's time they had attached themselves to the Romans, and were honoured with the title of brothers and kinsmen of the Roman people. When the Sequani (*q.v.*), their neighbours on the other side of the Arar, subjugated them, the Aedui sent Divitiacus, the druid, to Rome to appeal for help, but his mission was unsuccessful. On his arrival in Gaul (58 B.C.), Caesar restored their independence. In spite of this, the Aedui joined the Gallic coalition against Caesar (B.G. vii. 42), but after the surrender of Vercingetorix at Alesia (*q.v.*) were glad to return to their allegiance. Augustus dismantled their native capital Bibracte (*q.v.*) on Mont Beuvray, and substituted a new town with a



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AEGEAN VASES AND BRONZE, METAL AND STONE WORK

1. Vase of 14th and 13th centuries B.C.; In the British School at Athens
2. Bronze statuette of a Minoan goddess; In the museum at Berlin
3. Vase of the 16th century B.C.; In the British School at Athens
4. Vase of 14th and 13th centuries B.C.; In the British School at Athens
5. Bronze daggers inlaid with gold from graves at Mycenae
6. Vase of 16th century B.C.; In the British School at Athens
7. Vase of 16th century B.C.; In the British School at Athens
8. Signets in metal and stone from the royal grave at Dendra, belonging to Professor Persson
9. Vase of 14th and 13th centuries B.C.; In the British School at Athens



BY COURTESY OF (1, 2, 3, 7) THE SOCIETY FOR THE PROMOTION OF HELLENIC STUDIES, (4) THE NATIONAL MUSEUM, ATHENS, (5) THE DIRECTORS OF THE FITZWILLIAM MUSEUM, CAMBRIDGE, (6, 9) THE METROPOLITAN MUSEUM OF ART, NEW YORK, (8) THE BRITISH SCHOOL AT ATHENS, (10) A. W. PERSON

AEGEAN CERAMICS, IVORIES AND GOLD WARE

Figs. 1 and 3. Ivory figures and heads from Knossos, Crete, probably representing athletes or acrobats. 2. A falcon, or coloured and glazed earthenware, relief of a wild goat and her young, taken from the temple repository of the second palace of Knossos. 4. Reconstructed drawing of a terra-cotta figure of the first or second Thessalian period. 5. A terra-cotta head of the first Thessalian period. 6. Reproduction of the so-called Vaphio cups of chased gold, with a design of bull-fighting of octopuses and dolphins

scenes. Mycenaean, of the period 1800-1600 B.C. 7. Birds on a triad of pillars from Knossos, Crete. 8. Jug of monochrome red ware of the first Thessalian period. 9. Reproduction of a sarcophagus from the palace at Hagia Triada, Crete, of the late Minoan period, about 1350 B.C. 10. A king's cup in gold from Dendra, near Medea. The cup, which was found in a tomb of 1350 B.C., is chased with a design



SKETCH MAP OF THE AREA OF AEGEAN CIVILIZATION

The map shows both modern and classical names. The chief centres of Aegean civilization were in Crete and in the Peloponnese, but its influence extended over a much greater area, including the Aegean islands and parts of the coast of Asia Minor. Its middle period may, with some confidence, be placed 2,000 years before Christ, and its duration covered at least 3,000 years.

half-Roman, half-Gaulish name, Augustodunum (mod. Autun). During the reign of Tiberius (A.D. 21), they revolted and seized Augustodunum, but were soon put down (Tacitus, *Ann.* iii. 43-46). The Aedui were the first of the Gauls to receive from the Emperor Claudius the distinction of the *ius honorum*.

See A. E. Desjardins, *Géographie de la Gaule* ii. (1876-93); T. R. Holmes, *Caesar's Conquest of Gaul* (1899).

AEGADIAN ISLANDS (Ital. ISOLE EGADI; anc. AEGATES INSULAE), small mountainous islands off the west coast of Sicily, scene of the defeat of the Carthaginian fleet by G. Lutatius Catulus in 241 B.C., which ended the First Punic War. Favignana (Aegusa), the largest (pop. 6,186 in 1936), lies 10 mi. S.W. of Trapani; Levanzo (Phorbantia) 8 mi. W. (pop. 330); Marettimo, (pop. 1,103), the ancient *ἑρὰ νῆσος*, 15 mi. W. of Trapani, is now reckoned in the group.

AEGEAN CIVILIZATION, the general term for the prehistoric civilization, previously called "Mycenaean" because its existence was first brought to popular notice by Heinrich Schliemann's excavations at Mycenae in 1876, or "Minoan" when Sir Arthur Evans' explorations in Crete from 1899 onwards showed its main source. Subsequent discoveries, however, have made it clear that Crete was its chief centre in its earlier stages, and Mycenae, or the mainland at least, in its later stages; and, accordingly, it is more usual now to adopt a wider geographical title for this culture, which is that of Greece and the Aegean basin in the bronze age.

I. HISTORY OF DISCOVERY AND DISTRIBUTION OF REMAINS

Mycenae and Tiryns are the two principal sites on which evidence of a prehistoric civilization was remarked by the classical Greeks. The Cyclopean walls of the citadel of Mycenae, its gate with heraldic lions, the great "treasury of Atreus" and the galleries of Tiryns had borne silent witness for ages before Schliemann's time; but they were supposed only to speak to the Homeric, or at farthest a rude Heroic beginning of purely Hellenic, civilization. Only when Schliemann exposed the contents of the graves which lay just inside the gate (see MYCENAE), scholars recognized the advanced stage of art to which prehistoric dwellers in the Mycenaean citadel had attained. A good deal of other evidence was available before 1876, but had not been collated and seriously studied. Although it was recognized that certain tributaries, represented, e.g., in the 18th dynasty tomb of Rekhmara at Egyptian Thebes as bearing vases of peculiar forms,

were of some Mediterranean race, neither their precise habitat nor the degree of their civilization could be determined while so few actual prehistoric remains were known in the Mediterranean lands. Nor did the Aegean objects which were lying obscurely in museums in 1870, or thereabouts, provide a sufficient test of the real basis underlying the Hellenic myths of the Argolid, the Troad and Crete, to cause these to be taken seriously. Both at Sévres and Neuchâtel Aegean vases had been exhibited since about 1840, the provenance being in the one case Phylacope in Melos, in the other Cephallonia. Ludwig Ross, by his explorations in the Greek islands from 1835 onwards, called attention to certain early intaglios, since known as "island gems"; but it was not till 1878 that C. T. Newton demonstrated these to be no strayed Phoenician products. In 1866 primitive structures were discovered in the island of Therasia by quarrymen extracting pozzolana for the Suez canal works; and when this discovery was followed up on the neighbouring Santorin (Thera), by representatives of the French school at Athens, much pottery of a class now known to belong to the transition from the middle to the late bronze age, and many stone and metal objects, were found and dated by the geologist Fouqué, somewhat arbitrarily, to 2000 B.C., by consideration of the superincumbent eruptive stratum. Meanwhile, in 1868, tombs at Ialysus in Rhodes had yielded to M. A. Biliotti many fine painted vases of styles which were called later the 3rd and 4th "Mycenaean"; but these, bought by John Ruskin, and presented to the British Museum, were supposed to be of some local Asiatic fabric of uncertain date.

Schliemann's Excavations.—Even H. Schliemann's first excavations at Hissarlik in the Troad did not excite astonishment. But the "Burnt City" of his second stratum, revealed in 1873, with its fortifications and vases, and a hoard of gold, silver and bronze objects, which the discoverer connected with it, began to arouse a curiosity which was destined to spread far. As soon as Schliemann came on the royal "shaft graves" at Mycenae three years later, light poured from all sides on the prehistoric period of Greece. The character of both the fabric and the decoration of the Mycenaean objects was not that of any well-known art. A wide range in space was proved by the identification of the island gems and the Ialysus vases with the new style, and a wide range in time by collation of the earlier Theraean and Hissarlik discoveries. A relation between objects of art described by Homer and the Mycenaean treasures was generally allowed, and a correct opinion prevailed that, while certainly posterior, the civilization

of the *Iliad* was reminiscent of the Mycenaean. Schliemann got to work again at Hissarlik in 1878, and greatly increased our knowledge of the lower strata, but did not recognize the Aegean remains in his "Lydian" city of the 6th stratum, which were not to be fully revealed till Dörpfeld resumed the work at Hissarlik in 1892 after the first explorer's death. But by laying bare in 1884 the upper stratum of remains on the rock of Tiryns (*q.v.*), Schliemann made a contribution to our knowledge of prehistoric domestic life which was amplified two years later by Chr. Tsountas's discovery of a similar palace at Mycenae. Work at Tiryns was not resumed till 1905, when it was proved, as had long been suspected, that earlier strata dating back to the beginning of the bronze age lie below the palace cleared by Schliemann. From 1877 dates the finding of Mycenaean sepulchres outside the Argolid, from which, and from the continuation of Tsountas's exploration of the buildings and lesser graves at Mycenae, a large treasure, independent of Schliemann's princely gift, has been gathered into the National museum at Athens.

Between this date and the end of the century many isolated tombs of the beehive type and cemeteries of rectangular rock-cut chamber tombs were explored in different districts of Greece. Chamber tombs were found in Attica, at Spata, Markopoulo and Alyke, and in Argolis at Nauplia, and near the Argive Heraeum, and some late graves in Salamis. Beehive tombs, already rifled, but retaining some of their furniture, were excavated at Dimeni in Thessaly, Menidi and Thoricus in Attica, Orchomenus in Boeotia, and Kampos in Laconia. The richest tomb of all was cleared at Vaphio in Laconia in 1889, and this produced, in addition to a fine series of engraved gems and miscellaneous goldsmith's work, two splendid golden cups chased with scenes of bull hunting, and fragments of large vases painted in a bold florid style. These latter, with similar fragments from the Argive Heraeum, Thoricus, and Mycenae itself, remained an enigma till the excavation of Cnossus revealed the "Palace" style. The exploration of famous classical sites showed too that many of these, with the notable exception of Olympia, had been important centres of culture in Aegean times. Thus the sanctuary at Delphi, the Heraeum by Argos and the Acropolis of Athens all yielded their quota of what were still called Mycenaean objects and the last site boasts a fortification wall similar in style to those of Mycenae and Tiryns with column bases and foundations of a "palace." A Cyclopean acropolis and "palace" were explored on the island of Goules in Lake Copais, the prehistoric dykes of which were now surveyed. Mycenaean remains came to light in most parts of Greece, but except for Eleusis, Aegina and Thoricus, where little was done, no inhabited sites were touched. At these last three sites pottery of new types was found which we now know to be pre-Mycenaean; but this and the discovery by Wide in 1894 in a barrow at Aphidna of burials containing similar wares remained almost unnoticed. Similarly some early rock-cut tombs with peculiar hand-made pottery found in the American excavations at Corinth in 1896 did not fall into their right context till the discoveries at Korakou, near Corinth, almost 20 years later.

Excavation Outside Greece.—Meanwhile prehistoric research had begun to extend beyond the Greek mainland. Certain central Aegean islands, Antiparos, Ios, Amorgos, Syros and Siphnos, were all found to be singularly rich in evidence of the early Aegean period. The series of Syran-built graves, containing crouching corpses, is the most representative known in the Aegean. Exceptionally rich cemeteries of the same date have been explored in Naxos, and Paros has yielded in addition to early graves some remains of the middle period. Delos too has proved an unexpected source of early Aegean culture. Melos, long marked as a source of early objects, but not systematically excavated till taken in hand by the British school at Athens in 1896, yielded at Phylacope remains of all the Aegean periods, except the Neolithic. Numerous cemeteries with late Aegean pottery have been found in Rhodes. A map of Cyprus in the later Bronze Age (such as is given by J. L. Myres and M. O. Richter in *Catalogue of the Cyprus Museum*) shows more than 25 settlements in and about the Mesaoréa district alone, of which one, that at Enkomi, near the site of Salamis, has yielded the richest Aegean treasure in precious

metal found outside Argolis. E. Gjerstad (*Studies on Prehistoric Cyprus*) has since added to the number of prehistoric sites in the island, the relationship of which to the general Aegean culture is gradually becoming clearer. In Asia Minor a cemetery at Yortan in Mysia and Korte's excavations at Gordium in Phrygia have yielded pottery similar to that from the early strata of Hissarlik. Exploration of south-western Asia Minor has also brought to light remains of the prehistoric age; but though pottery of late Aegean style is found along the coast and ceramic specimens of Aegean appearance have often been brought back from many districts of Anatolia, the connections of Asia Minor and of Hissarlik (Troy) still seem, so far as the early and middle Aegean periods are concerned, to lie outside the Aegean area proper (*see* *TROY*). In Egypt in 1887 W. M. F. Petrie found painted sherds of Cretan style at Kahun in the Fayum, and farther up the Nile, at Tell el-Amarna, chanced on bits of no fewer than 800 Aegean vases in 1889. Much material from subsequent excavations has accumulated to demonstrate that Egypt and the Aegean were in contact from early dynastic times. There have now been recognized in the collections at Cairo, Florence, London, Paris and Bologna several Egyptian imitations of the Aegean style which can be set off against the many debts which the centres of Aegean culture owed to Egypt. Two Aegean vases were found at Sidon in 1885, and many fragments of Aegean and especially Cypriote pottery have been turned up during recent excavations of sites in Philistia and Palestine. Indeed the typical Philistine pottery is derived from the latest Aegean fabric. South-eastern Sicily, ever since P. Orsi excavated the Sicel cemetery near Lentini in 1877, has proved a mine of early remains, among which appear in regular succession Aegean decorative motives from the period of the second stratum at Hissarlik. Vases of the last Aegean period have also been found. Aegean objects too have been reported from Sardinia, although the Aegean influence formerly thought to have been observed in Spain, is now discredited or at least considered much overrated.

One land, however, has eclipsed all others in the Aegean by the wealth of its remains of all the prehistoric ages; viz., Crete, so much so that, for the present, we must regard it as the fountain-head of Aegean civilization, and probably for long its political and social centre. The island first attracted the notice of archaeologists by the remarkable archaic Greek bronzes found in a cave on Mt. Ida in 1885, as well as by epigraphic monuments such as the famous law of Gortyna; but the first undoubted Aegean remains reported from it were a few objects extracted from Cnossus by Minos Kalokairinos of Candia in 1878. These were followed by important discoveries made in the southern plain (Messará) by F. Halbherr. W. J. Stillman and H. Schliemann both made unsuccessful attempts at Cnossus, and A. J. Evans, coming on the scene in 1893, travelled in succeeding years about the island picking up trifles of unconsidered evidence, which gradually convinced him that greater things would eventually be found. He obtained enough to enable him to forecast the discovery of written characters, till then not suspected in Aegean civilization. The revolution of 1897-98 opened the door to wider knowledge, and much exploration has ensued, for which *see* *CRETE*.

Further Mycenaean Investigations.—The success of the excavations in Crete naturally caused fresh attention to be paid to Mycenaean remains on the mainland. At Thebes the ruins of the "House of Cadmus" were found by Keramopoullos and yielded many fragments of brilliant frescoes and a store of inscribed vases of the latest period; while close to the city, chamber tombs, stored with vases and other funeral furniture, were excavated. At Orchomenos the Mycenaean stratum was explored by Furtwängler and the underlying strata, which reach down to the neolithic deposits, began to reveal for the first time the pre-Mycenaean history of the mainland. Wares of the early and middle Aegean periods were unearthed at Aegina and the later continuance of the work there has much enlarged our knowledge and shown that the town was protected by a wall. Imported Cretan ware of the middle period has also come to light. At Tiryns many fragments of frescoes from the palace were found, and in the strata beneath the palace floor, reaching down to bed rock,

remains of the middle and early periods appeared. Further beehive tombs were excavated at Kakovatos at the Messenian Pylos and at Tiryns, but the last had unfortunately been completely plundered at least by Roman times. More evidence for the last period came in from Argos, where the middle period also appeared, Achaea, Aetolia, Locris, and Cephalonia showing that culture all over Greece in the late bronze age had been more or less uniform.

Meanwhile in Thessaly discoveries were being made which were to give a new aspect to the pre-history of Greece. Here rich deposits of painted neolithic pottery were found at Dimini and Sesklo by Tsountas, who cleared some small beehive tombs of the transitional period between the bronze and iron ages at Marmariene. Further systematic excavation of other sites in Thessaly by British archaeologists and researches by Soteriades in Boeotia and Phocis showed that the neolithic pottery of the Greek mainland was totally different from that of Crete and therefore that the underlying basis for the bronze age in these two main spheres of Aegean culture was by no means the same. This was supported by the results obtained by Dörpfeld in Leucas, where he found wares of all three periods (early, middle and late) and neolithic pottery with painted decoration closely akin to the Thessalian. Euboea produced tombs of the early bronze age, showing a striking likeness both to the wares of the Cyclades and to those of the mainland, and more tombs of the late period which indicate that the results obtained in this island coincide with those from elsewhere. Even before the war the American excavators had obtained hints that Corinth was likely to prove fertile in pre-historic remains, but not till 1915 was any great success won. Since that year the Americans under the leadership mainly of Blegen and Miss Walker have rewritten the early history of the mainland. A series of discoveries and excavations has shown that neolithic wares similar to those of Thessaly are to be found in the Peloponnese, where Corinth, Nemea, the Argive Heraeum and Arcadia have all yielded relics of this period. Further, largely as the result of the excavation of Korakou, a prehistoric port on the Gulf of Corinth near Lechaemum, supported by fruitful work at Zygouries (near Cleonae), Nemea and the Argive Heraeum, it has been possible to obtain a clear view of the three stages of the bronze age on the mainland.

The Aegean Area.—Traces of the early and middle bronze ages have also appeared in Laconia, and the German work at Amyclae has yielded many relics of the late period. At Asine, near Nauplia, a Swedish expedition under Persson has achieved brilliant results and recovered remains of all three periods. The same expedition at Dendra, near Midea, has excavated an unplundered beehive tomb which shows the burial ritual and found treasures richer than those of Vaphio. There is a splendid gold cup chased with a design of octopuses and dolphins, a gold and silver cup adorned with bulls' heads, silver cups, weapons of bronze, engraved sealstones of wondrous size, and pottery which dates the tomb to about 1350 B.C., the last period. Nearby is a chamber tomb, with a hoard of 33 bronze vessels, which, though empty of human remains, seems to have been a cenotaph and throws much light on the cult of the dead. At Mycenae the British work directed by Wace has found remains of all three periods of the bronze age, including a rich series of tombs of the last period, and established the history of the shaft graves found by Schliemann. The palace has been re-explored and, with the Lion Gate and walls, been found to date from the latter part of the last period, from 1400 B.C. The beehive tombs, also re-examined, can be dated with some degree of probability, and the finest, such as the Treasury of Atreus are seen to be contemporary with the Lion Gate. These results are confirmed by the renewed work of the Germans at Tiryns under Karo and Kurt Müller, who find that the palace and the walls, with three stages at least, are approximately contemporary with those of Mycenae. The Swedish finds at Dendra and in the beehive tombs of Bodia, in Messenia, agree with these conclusions, which all tend to show that after the fall of Cnossus, about 1400 B.C., Mycenae as the chief stronghold of the mainland succeeded to the Aegean empire and spread Aegean culture far and wide.

Further work in Boeotia at Eutresis and other sites has extended our knowledge of the houses and culture of the two first periods, and on the Acropolis of Athens itself neolithic pottery of the Thessalian type has come to light as well as pottery of the early bronze age. The latest revelation comes from Samos, where bronze age pottery of the middle and late periods, it is said, has been discovered. Thus on the one hand new discoveries have emphasized the uniform and widespread character of the Aegean culture throughout the area, and on the other hand the latest finds on the mainland indicate considerable divergence between it and Crete. The last point is of vital importance in considering the historical and ethnological problems of Greece in the Aegean or pre-historic age. The "Aegean Area" now covers the Archipelago with Crete and Cyprus, the Hellenic peninsula with the Ionian isles, and western Anatolia. Evidence is also coming in from the Macedonian coast. Offshoots are found in the western Mediterranean, in Sicily, Italy, Sardinia, and in the East in Palestine and Egypt. About the Cyrenaica we are still insufficiently informed.

II. GENERAL NATURE OF THE EVIDENCE

For details of monumental evidence the articles on CRETE, MYCENAE, TIRYNS, TROY, CYPRUS, etc., must be consulted. The most representative site explored up to now is Cnossus, which has yielded the most various and the most continuous evidence from the Neolithic age to the twilight of classical civilization. Next in importance are in Crete, Phaestus, Agia Triada, Mochlos, Vasilike, Tylissus, Gournia, Mallia and the tombs of Mesara; on the mainland, after Mycenae, Tiryns, Thebes, Asine, Korakou and the other sites already mentioned, are Agia Marina, Lianokladi and Tsangli; in the islands, Phylacope in Melos, and on the Anatolian littoral Hissarlik (Troy).

A. The *internal* evidence at present available comprises:—

(1) *Structures*.—Ruins of palaces, palatial villas, houses, built dome- or cist-graves and fortifications (Aegean isles, Greek mainland and north-west Anatolia), but not distinct temples; small shrines, however, and *temenê* (religious enclosures, remains of one of which were probably found at Petsofa, near Palaikastro, by J. L. Myres in 1904) are represented on intaglios and frescoes. From like sources and from inlay-work we have also representations of palaces and houses.

(2) *Structural Decoration*.—Architectural features, such as columns, friezes and various mouldings; mural decoration, such as fresco-paintings, coloured reliefs and mosaic inlay.

(3) *Furniture*.—(a) *Domestic*, such as vessels of all sorts and in many materials, from huge store-jars down to tiny unguent pots; culinary and other implements; thrones, seats, tables, etc., these all in stone or plastered terra-cotta; (b) *Sacred*, such as models or actual examples of ritual objects; of these we have also numerous pictorial representations; (c) *Funerary*; e.g., coffins in painted terra-cotta.

(4) *Artistic Fabrics*, e.g., plastic objects, carved in stone or ivory, cast or beaten in metals (gold, silver, copper and bronze), or modelled in clay, faience, paste, etc. No trace has yet been found of large free sculpture, but many examples exist of sculptors' smaller work. Vases of all kinds, carved in marble or other stones, cast or beaten in metals or fashioned in clay, the latter in enormous number and variety, richly ornamented with coloured schemes, and sometimes bearing moulded decoration. Examples of painting on stone, opaque and transparent. Engraved objects in great number; e.g., ring-bezels and gems; and an immense quantity of clay impressions, taken from these.

(5) *Weapons, tools and implements*, in stone, clay and bronze, and at the last iron, sometimes richly ornamented or inlaid. Numerous representations also of the same. No actual body-armour, except such as was ceremonial and buried with the dead, like the gold breastplates in the circle-graves at Mycenae.

(6) *Articles of personal use*, e.g., brooches (*fibulae*), pins, razors, tweezers, etc., often found as dedications to a deity; e.g., in the Dictaeon cavern of Crete. No textiles have survived.

(7) *Written documents*; e.g., clay tablets and discs (so far in Crete only), but nothing of more perishable nature, such as skin, papyrus, etc.; engraved gems and gem impressions; legends writ-

ten with pigment on pottery (rare); characters incised on stone or pottery. These show two main systems of script (*see* CRETE).

(8) *Excavated tombs*, of either the pit or the grotto kind, in which the dead were laid, together with various objects of use and luxury, without cremation, and in either coffins or *loculi* or simple wrappings.

(9) *Public works*, such as paved and stepped roadways, bridges, systems of drainage, etc.

B. There is also a certain amount of *external* evidence to be gathered from:—

(1) Monuments and records of other contemporary civilizations; *e.g.*, representations of alien peoples in Egyptian frescoes; imitation of Aegean fabrics and style in non-Aegean lands; allusions to Mediterranean peoples in Egyptian, Hittite, Semitic or Babylonian records.

(2) Literary traditions of subsequent civilizations, especially the Hellenic, such as, *e.g.*, those embodied in the Homeric poems, the legends concerning Crete, Mycenae, etc.; statements as to the origin of gods, cults and so forth, transmitted to us by Hellenic antiquarians such as Strabo, Pausanias, Diodorus, Siculus, etc.

(3) Traces of customs, creeds, rituals, etc., in the Aegean area at a later time, discordant with the civilization in which they were practised and indicating survival from earlier systems. There are also possible linguistic and even physical survivals to be considered.

III. GENERAL FEATURES OF AEGEAN CIVILIZATION

The leading features of Aegean civilization, as deduced from the evidence must be stated very briefly.

(1) **Political Organization.**—The great Cretan palaces and the fortified citadels of Mycenae, Tiryns and Hissarlik, each containing little more than one great residence, and dominating lower towns of meaner houses, point to monarchy at all periods. Independent local developments of art before the middle of the 2nd millennium B.C. suggest the early existence of independent units in various parts, of which the strongest was the Cnossian. After that date the evidence goes strongly to show that one political dominion was spread for a brief period, or for two brief periods, over almost all the area (*see later*). The great number of tribute tallies found at Cnossus perhaps indicates that the centre of power was there for some time.

(2) **Religion.**—The fact that shrines have so far been found within palaces and not certainly anywhere else indicates that the kings kept religious power in their own hands; perhaps they were themselves high-priests. Religion in the area seems to have been essentially the same everywhere from the earliest period; viz., the cult of divine principles, resident in dominant features of nature (sun, stars, mountains, trees, etc.) and controlling fertility. This cult passed through an aniconic stage, from which fetishes survived to the last, these being rocks or pillars, trees, weapons (*e.g.*, *bipennis*, or double war-axe, shield), etc. When the iconic stage was reached, about 2000 B.C., we find one divine spirit represented as a goddess with a subordinate young god, as in many other eastern Mediterranean lands. The god was probably son and mate of the goddess, and the divine pair represented the genius of reproductive fertility in its relations with humanity. The goddess at times appears, with doves, as uranic, at others with snakes, as chthonic. In the ritual fetishes, often of miniature form, played a great part: all sorts of plants and animals were sacred; sacrifice (not burnt, and human very doubtful), dedication of all sorts of offerings and *simulacra* invocation, etc., were practised. The dead were objects of a sort of hero-worship especially on the mainland. This early nature-cult, explains many anomalous features of Hellenic religion, especially in the cults of Artemis and Aphrodite (*see* CRETE).

(3) **Social Organization.**—There is a possibility that features of a primeval matriarchate long survived; but there is no certain evidence. Of the organization of the people under the monarch we are ignorant. There are so few representations of armed men that it seems doubtful if there can have been any professional military class. Theatrical structures found at Cnossus and Phaestus,

within the precincts of the palaces, were perhaps used for shows or for sittings of a royal assize, rather than for popular assemblies. The Cnossian remains contain evidence of an elaborate system of registration, account-keeping and other secretarial work, which perhaps indicates a considerable body of law. The life of the ruling class was comfortable and even luxurious from early times. Fine stone palaces, richly decorated, with separate sleeping apartments, large halls, ingenious devices for admitting light and air, sanitary conveniences and marvellously modern arrangements, for supply of water and for drainage, attest this fact. Even the smaller houses, after the Neolithic period, seem also to have been of stone, plastered within. After 1600 B.C. the palaces in Crete had more than one storey, fine stairways, bath-chambers, windows, folding and sliding doors, etc. In this later period, the distinctions of blocks of apartments in some palaces has been held to indicate the seclusion of women in *harems*, at least among the ruling caste. Cnossian frescoes show women grouped apart, and they appear alone on gems. Flesh and fish and many kinds of vegetables were evidently eaten, and wine and beer were drunk. Vessels for culinary, table and luxurious uses show an infinite variety of form and purpose. Artificers' implements of many kinds were in use, bronze succeeding obsidian and other hard stones as the material. Seats are found carefully shaped to the human person. There was evidently olive- and vine-culture on a large scale. Chariots were in use in the later period, as is proved by the pictures of them on Cretan tablets and at Mycenae, Tiryns and Vaphio, and therefore the horse was known. Main ways were paved. Sports, probably more or less religious, are often represented; *e.g.*, bull-fighting, dancing, boxing and armed combats.

(4) **Commerce** was practised to some extent in very early times, as is proved by the distribution of Melian obsidian over most of the Aegean area and by the Nilotic influence on early Minoan art. We find Cretan vessels exported to Melos, Egypt and the Greek mainland. Melian vases came in their turn to Crete. After 1600 B.C. there is very close intercourse with Egypt, and Aegean things find their way to all coasts of the Mediterranean (*see below*). No traces of currency have come to light, unless certain axe-heads too slight for practical use, had that character; but standard weights have been found, and representations of ingots. The Aegean written documents have not yet proved (by being found outside the area) epistolary correspondence with other lands. Representations of ships are not common, but several have been observed on Aegean gems, gem-sealings and vases. There are also leaden and clay models of boats. They are vessels of low free-board, with masts. Familiarity with the sea is proved by the free use of marine motives in decoration.

(5) **Treatment of the Dead.**—The dead in the earlier period were laid (so far as we know at present) within cists constructed of upright stones. These were sometimes inside caves and occasionally clay coffins were used. After the burial the cist was covered in with earth. A little later, in Crete, bone pits seem to have come into use, containing the remains of many burials. Possibly the flesh was boiled off the bones at once ("scarification"), or left to rot in separate cists awhile; afterwards the skeletons were collected and the cists re-used. The royal shaft graves at Mycenae are an elaboration of the simple cist grave and the circle surrounding them finds a parallel in the grave rings at Leucas. Chamber tombs built in the early period occur in Crete and rock-cut tombs of the same general type approached by a horizontal or slightly inclined way with the sides converging above are very common on the mainland and in Rhodes in the last period, and are often found in Crete where small clay coffins containing skeletons in a crouching posture are usual. Circular ossuaries which some believe to have been roofed with vaults, occur in Crete in the early period and last into the beginning of the middle period; but the great beehive tombs of Mycenae and the mainland belong to the last period (from about 1500 B.C. onwards) and the finest, such as the treasury of Atreus, to the concluding phase of the bronze age after the fall of Crete about 1400 B.C. Sometimes in Crete at the end of the middle period the dead were trussed up and thrust head foremost into

large jars for burial. On the mainland at a slightly earlier date children are found buried in jars, and sometimes in place of stone cists the dead were surrounded by walls of crude brick or covered with fragments of large store jars. At no period do the Aegean dead seem to have been burned. Weapons, food, water, unguents and various trinkets were laid with the corpse at all periods. In the Mycenae circle an altar seems to have been erected over the graves, and on the mainland at least there are definite traces of the worship of the dead. A painted sarcophagus, found at Hagia Triada, also possibly shows a hero-cult of the dead.

(6) **Artistic Production.**—Ceramic art reached a specially high standard in fabric, form and decoration by the middle of the 3rd millennium B.C. in Crete. The products of that period compare favourably with any potters' work in the world. The same may be said of fresco-painting, and probably of metal work. Modelling in terra-cotta, sculpture in stone and ivory, engraving on gems, were following it closely by the beginning of the 2nd millennium. After 2000 B.C. all these arts revived, and sculpture, as evidenced by relief work, both on a large and on a small scale, carved stone vessels, metallurgy in gold, silver and bronze, advanced farther. This art and those of fresco- and vase-painting and of gem engraving stood higher about the 15th century B.C. than at any subsequent period before the 6th century. The manufacture, modelling and painting of faience objects, and the making of inlays in many materials were also familiar to Aegean craftsmen, who show in all their best work a strong sense of natural form and an appreciation of ideal balance and decorative effect, such as are seen in the best products of later Hellenic art. Architectural ornament was also highly developed. The richness of the Aegean capitals and columns may be judged by those from the "Treasury of Atreus" now set up in the British Museum; and of the friezes we have examples in Mycenaean and Cnossian fragments, and Cnossian paintings. The magnificent gold work of the later period, preserved to us at Mycenae, Dendra and Vaphio, needs only to be mentioned. It should be compared with stone work in Crete, especially the steatite vases with reliefs found at Hagia Triada. On the whole, Aegean art, at its two great periods, in the middle of the 3rd and 2nd millennia respectively, will bear comparison with any contemporary arts.

IV. ORIGIN, NATURE AND HISTORY OF AEGEAN CIVILIZATION

The evidence, summarized above, though very various and voluminous, is not yet sufficient to answer all the questions which may be asked as to the origin, nature and history of this civilization, or to answer any but a few questions with absolute certainty.

A. **Distinctive Features.**—The fact that Aegean civilization is distinguished from all others, prior or contemporary, not only by its geographical area, but by leading organic characteristics, has never been in doubt since its remains came to be studied seriously and impartially. The truth was indeed obscured for a time by persistent prejudices in favour of certain alien Mediterranean races long known to have been in relation with the Aegean area in prehistoric times; e.g., the Egyptians and especially the Phoenicians. Others put forward "Achaean" from the north as its authors. But such claims to the authorship of the Aegean remains grew fainter with every fresh Aegean discovery and every new light thrown on their own proper products; with the Cretan revelations they ceased altogether to be considered except by a few Homeric enthusiasts. Briefly, we now know that the Aegean civilization developed these distinctive features: (1) An *indigenous script* expressed in characters of which only a very small percentage are identical, or even obviously connected, with those of any other scripts. This is equally true both of the pictographic and the linear Aegean systems. Its nearest affinities are with the "Asiatic" scripts, preserved to us by Hittite, Cypriote and south-west Anatolian (Pamphylian, Lycian and Carian) inscriptions. But neither are these affinities close enough to be of any practical aid in deciphering Aegean characters, nor is it by any means certain that there is parentage. The Aegean script may be, and probably is, prior in origin to the "Asiatic"; and it may equally well be

owed to a remote common ancestor, or (the small number of common characters being considered) be an entirely independent evolution from representations of natural objects (*see* CRETE). (2) An *Art*, whose products cannot be confounded with those of any other known art by a trained eye. Its obligations to other contemporary arts are many and obvious, especially in its later stages; but every borrowed form and motive undergoes an essential modification at the hands of the Aegean craftsman, and the product is stamped with a new character. The secret of this character lies evidently in a constant attempt to express an ideal in forms more and more closely approaching to realities. We detect the dawn of that spirit which afterwards animated Hellenic art. The fresco-paintings, ceramic motives, reliefs, free sculpture and toreutic handiwork of Crete have supplied the clearest proof of it, confirming the impression already created by the goldsmiths' and painters' work of the Greek mainland (Mycenae, Thebes, Vaphio, Dendra, Tiryns). (3) *Architectural plans and decoration.* The arrangement of Aegean palaces is of two main types. First (and perhaps earliest in time), the chambers are grouped round a central court, being engaged one with the other in a labyrinthine complexity, and the greater oblongs are entered from a long side and divided longitudinally by pillars. Second, the main chamber is of what is known as the *megaron* type; i.e., it stands free, isolated from the rest of the plan by corridors, is entered from a vestibule on a short side, and has a central hearth, surrounded by pillars and perhaps hypaethral; there is no central court, and other apartments form distinct blocks. In spite of many comparisons made with Egyptian, Babylonian and "Hittite" plans, both these arrangements remain incongruous with any remains of prior or contemporary structures elsewhere. Whether either plan suits the "Homeric" palace does not affect the present question. (4) *A type of tomb*, the dome or "beehive," of which the grandest examples known are at Mycenae. The Cretan "larnax" coffins, also, have no parallels outside the Aegean. There are other infinite singularities of detail; but the above are more than sufficient to establish the point.

B. **Origin and Continuity.**—With the immense expansion of the evidence, due to the Cretan excavations, a question arises how far the Aegean civilization, whose total duration covers at least 3,000 years, can be regarded as one and continuous. The exploration of Cnossus shows that Aegean civilization had its roots in a primitive Neolithic period, of uncertain but very long duration, represented by a stratum which (on that site in particular) is in places nearly 20 ft. thick, and contains stone implements and sherds of hand-made and hand-polished vessels, showing a progressive development in technique from bottom to top. This Cnossian stratum seems to be throughout earlier than the lowest layer at Hissarlik. It closes with the introduction of incised, white-filled decoration on pottery, whose motives are presently found reproduced in monochrome pigment. We are now in the beginning of the bronze age, and the first of Evans's "Minoan" periods. Thereafter, by exact observation of stratification, eight more periods have been distinguished at Cnossus, each marked by some important development in the universal and necessary products of the potter's art, the least destructible and therefore most generally used archaeological criterion. These periods fill the whole bronze age, with whose close, by the introduction of the superior metal, iron, the Aegean age is conventionally held to end. Iron came into general Aegean use about 1000 B.C., and possibly was the means by which a body of northern invaders established their power on the ruins of the earlier dominion. The important point is this, that throughout the nine Cnossian periods, following the Neolithic age (named by Evans, "Minoan I. 1, 2, 3; II. 1, 2, 3; III. 1, 2, 3"; *see* CRETE), there is evidence of a perfectly orderly and continuous evolution in, at any rate, ceramic art. From one stage to another, fabrics, forms and motives of decoration develop gradually; so that, at the close of a span of more than 2,000 years, at the least, influences of the beginning can still be clearly seen and no trace of violent artistic intrusion can be detected. This fact, by itself, would go far to prove that the civilization continued fundamentally and essentially the same throughout. It is, moreover, supported by less abundant remains

of other arts. That of painting in fresco, for instance, shows the same orderly development from at any rate Period II. 2 to the end. About institutions we have less certain knowledge, there being but little evidence for the earlier periods; but in the documents relating to religion, the most significant of all, there is no trace of sharp change. We see evidence of a uniform nature worship passing through all the normal stages down to theanthropism in the latest period. There is no appearance of intrusive deities or cult-ideas. We may take it then (and the fact is not disputed even by those who believe in one thorough racial change, at least, during the bronze age) that the Aegean civilization was indigenous, firmly rooted and strong enough to remain dominant in its own geographical area throughout the bronze age.

This conclusion does not necessarily lead to the corollary that the mass of those who possessed this civilization remained for the most part racially the same throughout the bronze age. This indeed may be true for Crete, but as already indicated there are grave reasons for believing that on the mainland matters were not so simple, and herein lies the crux of Greek ethnology. A solution which would satisfy the archaeological and anthropological problems to be indicated would go far to solving the vexed questions of Hellenic origins, especially as regards Achaeans and Dorians (see DORIANS, ACHAEANS and IONIANS), and the first appearance of Aryans in the peninsula. In the neolithic age the general characteristics of the culture of the mainland and of Crete are quite distinct. On the mainland at the end of the neolithic age a bronze-using culture appears which is undoubtedly akin to that of the islands and Crete. In the middle period, however, about 2000 B.C., a new element comes into the mainland typified for archaeologists by a well marked class of pottery called "Minyan Ware." This occurs as an import into Melos and was even imitated there, but though contemporary Melian wares are recognized in Crete, as in the temple repositories at Cnossus, hardly a sherd of Minyan ware has been found in Crete. Suddenly, just before the beginning of the last period, Cretan influence and culture came in full force to the mainland. Some hold that this betokens a complete conquest of the mainland by Crete, wholesale displacements of population and the institution of Cretan dynasts at Mycenae and elsewhere. Others maintain that this indicates a rapid absorption by a vigorous and progressive folk of a developed culture which they adapted to their own purposes. For the latter view we can urge:—

(1) Distinct differences are observed between the products of the mainland and those of Crete and both, for instance, appear as imports in Melos side by side; (2) the oldest royal grave at Mycenae contains mostly mainland pottery, and throughout the succeeding period, though the superficial culture is Cretan, there are clear signs that its basis is the old element which produced Minyan ware; (3) there is a variation in burial customs between Crete and the mainland pointing to a divergence in belief as regards the dead; (4) the fortified castles of the mainland like Mycenae, Tiryns and Midea are in strong contrast to the undefended palaces of Crete; (5) in the earlier periods Cretan pottery, except in a few cases, has not been found outside, but the adoption of the Cretan phase of Aegean culture by the mainland just precedes the spread of the last phase of that culture far and wide in the Levant, and it is notorious that the remains from Rhodes, Cyprus and Philistia depend on the mainland and not on Crete.

All this suggests that about 1600 B.C. when the last period began some powerful folk (that which introduced Minyan pottery) arose on the mainland and quickly absorbed the mature Aegean culture of Crete, and soon after, when Crete collapsed, about 1400 B.C., the mainlanders became the dominant force and spread their version of Aegean culture abroad. The recent discoveries that the walls and palaces of Tiryns and Mycenae belong to the last phase after 1400 B.C. support this view, as also the other conclusion which places the greatest achievements of Aegean architecture, like the treasury of Atreus, in this the culminating phase of the Aegean culture, which closed perhaps with the great armada led against Troy.

A good deal of anthropometric investigation has been devoted

to human remains of the Aegean epoch, especially to skulls and bones found in Crete in tombs of Period II. The result of this, however, has established the fact that the Aegean races, as a whole, belonged to the dark, long-headed *Homo Mediterraneus*—a fact only valuable in the present connection in so far as it tends to discredit an Asiatic source for Aegean civilization, though there was clearly much affinity between Crete and south-western Asia Minor. From the skull-forms studied, it would appear, that the Aegean race was by no means pure even in the earlier Minoan periods. On the mainland indeed the skulls from Asine show that both the long and the short types were present in the middle period together with one or two examples of an "Armenoid" character. This is by no means in disagreement with archaeology. There is some ground for supposing that the language spoken in Crete before the later Doric was non-Hellenic, though perhaps Indo-European. This inference rests on three inscriptions in Greek characters but non-Greek language found in eastern Crete. The language has some apparent affinities with Phrygian. The inscriptions are post-Aegean by many centuries, but they occur in the part of the island known to Homer as that inhabited by the Eteo-Cretans, or aborigines. Their language may prove to be that of the Linear tablets.

V. HISTORY OF AEGEAN CIVILIZATION

History of an inferential and summary sort only can be derived from monuments in the absence of written records. The latter do, indeed, exist in the case of the Cretan civilization and in great numbers; but they are undeciphered and likely to remain so, except in the improbable event of the discovery of a long bilingual text, partly couched in some familiar script and language. Even in that event, the information which would be derived from the Cnossian tablets would probably make but a small addition to history, since in very large part they are evidently mere inventories of tribute and stores. The engraved gems probably record divine or human names (see CRETE).

(1) **Chronology.**—The first chronological datum is inferred from a close similarity between certain Cretan hand-made and polished vases of Minoan Period I. 1. and others discovered by Petrie at Abydos in Egypt and referred by him to the 1st dynasty. He goes so far as to pronounce the latter to be Cretan importations, their fabric and forms being unlike anything Nilotic. If that be so, the period at which stone implements were beginning to be superseded by bronze in Crete must be dated before 4000 B.C. But below all Evans's "Minoan" strata lies the immensely thick Neolithic deposit. To date the beginning of this earliest record of human production is impossible at present. The Neolithic stratum varies very much in depth, ranging from nearly 20 ft. to 3 ft., but is deepest on the highest part of the hillock. Its variations may be due equally to natural denudation of a stratum once of uniform depth, or to the artificial heaping up of a mound by later builders. Even were certainty as to these alternatives attained, we could only guess at the average rate of accumulation, which proceeds very differently on different sites and under different social and climatic conditions. In later periods at Cnossus accumulation seems to have proceeded at a rate of, roughly, 3 ft. per 1,000 years. Reckoning by that standard we might push the earliest Neolithic remains back behind 10,000 B.C.; but the calculation would be worthy of little credence. Surer chronological links are provided by the close affinity with early dynastic Egyptian products shown by the stone bowls from tombs of the 1st period at Mochlos and in Mesara. At Cnossus actual Egyptian bowls of the earliest dynastic times have been found. These facts, and the parallelism displayed by Cretan seals in ivory and stone from the Mesara ossuaries and by Egyptian seals of the 1st six dynasties, enable us to say that the 1st period began before the middle of the 4th millennium. We reach another fairly certain date in the synchronism of remains belonging to the 12th dynasty (c. 2225 B.C.) with products of Minoan Period II. 2. Characteristic Cretan pottery of this period was found by Petrie in the Fayum and by Garstang at Abydos in conjunction with 12th dynasty remains, and various Cretan products of the period show striking coincidences with 12th dynasty styles, especially

in their adoption of spiraliform ornament. The spiral, however, occurs so often in natural objects (e.g., horns, climbing plants, shavings of wood or metal) that too much stress must not be laid on the mutual parentage of spiraliform ornament in different civilizations. A diorite statuette, referable by its style and inscription to Dynasty 13, was discovered in deposit of Period II. 2. in the central court, and a cartouche of the "Shepherd King," Khyan, was also found at Cnossus. He is usually dated about 1633 B.C. This brings us to the next and most certain synchronism, that of Minoan Periods III. 1, 2, with Dynasty 18 (c. 1600-1400 B.C.). This coincidence has been observed not only at Cnossus, but previously, in connection with discoveries of scarabs and other Egyptian objects made at Mycenae, Ialysus, Enkomi, etc. In Egypt itself Kefti tributaries, bearing vases of Aegean form, and themselves similar in fashion of dress and arrangement of hair to figures on Cretan frescoes and gems of Period III., are depicted under this and the succeeding dynasties (e.g., Rekhmara tomb at Thebes). Actual vases of late Aegean style have been found with remains of Dynasty 18, especially in the town of Amenophis IV.—Akhenaten—at Tell el-Amarna; while in the Aegean area itself we have abundant evidence of a great wave of Egyptian influence beginning with this same dynasty. To this wave were owed in all probability the Nilotic scenes depicted on the Mycenae daggers, on frescoes of Hagia Triada and Cnossus, on pottery of Zakro, on the shell-relief of Phaestus, etc.; and also many forms and fabrics; e.g., certain Cretan coffins, and the faience industry of Cnossus. These serve to date, Periods III. 1-2 in Crete, the shaft-graves in the Mycenae circle, the Vaphio tomb, etc., to the 16th and 15th centuries B.C., and Period III. 3, the walls and palaces of Mycenae and Tiryns, the majority of the 6th stratum at Hissarlik, the Ialysus burials, the upper stratum at Phylacope, etc., to the century immediately succeeding.

The *terminus ad quem* is less certain—iron does not begin to be used for weapons in the Aegean till after Period III. 3, and then not exclusively. If we fix its introduction about 1100 B.C. and make it coincident with the incursion of northern tribes, remembered by the classical Greeks as the Dorian Invasion, we must allow that this incursion did not altogether stamp out Aegean civilization, at least in the southern part of its area. But it finally destroyed the Cnossian palace and initiated the "Geometric" age, with which, for convenience at any rate, we may close the history of Aegean civilization proper.

(2) **Annals.**—From these and other data the outlines of primitive history in the Aegean may be sketched thus. A people, agreeing in its prevailing skull-forms with the Mediterranean race of north Africa, was settled in the Aegean islands from a remote Neolithic antiquity, but, except in Crete, where insular security was combined with great natural fertility, remained in a savage and unproductive condition until far into the 4th millennium B.C. In Crete, however, it had long been in close contact with Egypt and had developed a certain civilization, and at a period more or less contemporary with Dynasties 11 and 12 (2200-2000 B.C.) the scattered communities of the centre of the island coalesced into a strong monarchical state, whose capital was at Cnossus. There the king, probably also high priest of the prevailing nature cult, built a great stone palace, and received the tribute of feudatories, of whom, probably, the prince of Phaestus, who commanded the Messará plain, was chief. The Cnossian monarch had maritime relations with Egypt, and presently sent his wares all over the southern Aegean (e.g., to Melos in the earlier Second City period of Phylacope). A system of pictographic writing came into use early in this Palace period, but only a few documents, made of durable material, have survived. Pictorial art of a purely indigenous character, whether on ceramic material or plaster, made great strides, and from ceramic forms we may legitimately infer also a high skill in metallurgy. The absence of fortifications at Cnossus, Mallia, and Phaestus suggests that at this time Crete was internally peaceful and externally secure. Small settlements in close relation with the capital, were founded in the east of the island to command fertile districts and assist maritime commerce. Gournia and

Palaikastro fulfilled both these ends; Zakro must have had mainly a commercial purpose, as the starting point for the African coast. The acme of this dominion was reached about the end of the 3rd millennium B.C., and thereafter there ensued a certain, though not very serious, decline. The period may be considered to close with a general disaster which overtook the principal Cretan sites at the end of the 17th century B.C. The cause is still to seek; some think it was due to war, others believe that it may have been the result of a terrible earthquake. This would have been caused by the explosion of the volcano of Thera which split that island in two and covered the prehistoric remains which belong to the last phase of the middle period with a deep deposit of pumice.

On the mainland the neolithic population, to judge by its brilliantly painted pottery, seems to have been distinct from that of the islands and to have been related rather to the tribes of the Danubian and Carpathian areas, which some regard as the original home of the Aryans. After the close of the first neolithic period in Thessaly a bronze-using folk, closely akin to the inhabitants of the islands, came to the mainland and advancing from the south-east gradually made themselves masters of the peninsula as far north as Othrys. When this occurred we cannot say, but as the earliest bronze age ware on the mainland is still somewhat primitive it may have taken place well before the end of the 3rd millennium B.C. Once established the bronze age people, together with the remains of the aborigines, developed on a culture parallel to that of the Cyclades, and several prosperous settlements arise as at Tiryns, Mycenae itself, Asine, Nemea, Zygouries and Korakou. If the Cretans and islanders were of non-Hellenic race, the bronze-using incomers may have introduced the non-Hellenic place-names in *-ssos* and *-nthos*. When the second period in Crete had already evolved about the beginning of the 2nd millennium B.C. a new factor entered the mainland. This was accompanied by a new kind of pottery, "Minyan Ware," but whence or how it came we do not yet know. This people seems to have coalesced readily with the pre-existing population which, as we know, already contained two racial elements, and this is reflected in the skull types from Asine. At first, though in communication with islands such as Melos and Paros, they seem to have had no contact with Crete till shortly before the end of the 17th century B.C. Then Aegean culture, as represented by the Cretan culture of the renaissance after the disaster, came into the mainland in full force. This may have been due to a conquest of the mainland by Cretans, or to the hospitable reception of refugees from the disaster in Crete, or to raids conducted by chiefs of the mainland against Crete. Whatever the cause the mainland became saturated with Cretan culture, but it still retained its own individuality, which changed and charged with its own feeling whatever was borrowed from Crete. For instance the evolution of certain mainland vase shapes continues unbroken, but is modified by the influence of Crete. Thus at the beginning of the 3rd period, almost coincident with the rise of the 18th dynasty in Egypt, we have a renaissance in Crete and the establishment of strong centres of culture at Mycenae, Thebes and other mainland sites. In Crete the palaces were rebuilt on a larger scale and with more sumptuous appointments, though there was a distinct tendency towards the baroque. The mainland followed suit, but there is almost the same quality of difference between them as there is between English and American 18th century culture. For two centuries this continued, the mainland becoming stronger and Crete weaker, till just about the time when the 18th dynasty decayed in the nerveless hands of Akhenaten, Crete collapsed and ceased to be the centre of Aegean culture. She still existed, but only as a provincial centre, down to the dawn of the iron age. Her inheritance passed to the mainland which, probably under the leadership of Mycenae, established a great dominion, such as that which Homer depicts under Agamemnon's suzerainty. This is the age of the greatest uniformity of the Aegean culture. Then arose the great Cyclopean fortresses of Tiryns and Mycenae with their palaces, then were built the proudest of the beehive tombs, then Aegean products of mainland style reached distant shores from Sicily to Philistia,

from Macedonia to Egypt. The energy of the mainlanders both in spreading abroad through the Mediterranean the culture which they had adopted as their own and in erecting monumental buildings which testify to amazing architectural skill, demonstrates that they were a people of strong character, capable and original. Were these the Achaeans? Who were the makers of Minyan ware? Were they from Asia Minor like the Tantalids; and were they, so to speak, the forerunners of the Etruscans, who in another land at a later date so quickly absorbed Hellenic culture? These are problems which cannot yet be answered, but it seems possible that Aryans may well have been resident in the peninsula long before the Homeric age and so were not northern invaders as modern criticism has asserted, for Greek tradition regarded the Achaeans as natives. The activities of the mainland folk after 1400 seem to find an echo in the Hittite tablets which record the doings of the Ahhiyava from that century onwards.

Towards the beginning of the 12th century the traditional date for the Trojan War and when Egypt was vexed by the Peoples of the Sea, signs of degeneration again appear and soon after came a final catastrophe, probably about 1100 B.C. Mycenae and Tiryns went up in flames. The palace at Cnossus was once more destroyed, and never rebuilt or re-inhabited. Iron took the place of bronze, and Aegean art, as a living thing, ceased on the Greek mainland and in the Aegean isles, including Crete, together with Aegean writing. In Cyprus, and perhaps on the south-west Anatolian coasts, the cataclysm was less complete, and Aegean art continued to languish, cut off from its fountain-head. Such artistic faculty as survived elsewhere issued in the lifeless geometric style which is reminiscent of the later Aegean, but wholly unworthy of it. Cremation took the place of burial of the dead. This great disaster, which cleared the ground for a further evolution of art, was probably due to an incursion of northern tribes, gradual rather than sudden, who were possessed of superior iron weapons—those tribes which later Greek tradition and Homer knew as the Dorians. They crushed a civilization that had outgrown its strength; and it took two or three centuries for the artistic spirit, instinct in the Aegean area, and probably preserved in suspended animation by the survival of Aegean racial elements, to blossom anew. On this conquest seems to have ensued a long period of unrest and popular movements, known to Greek tradition as the Ionian Migration and the Aeolic or Dorian "colonizations"; and when once more we see the Aegean area clearly, it is dominated by Hellenes, though it has by no means lost all memory of its earlier culture, which was after all the mainspring of the Greek genius. The darkness that shrouds the close of the bronze age was but the prelude to a brighter dawn.

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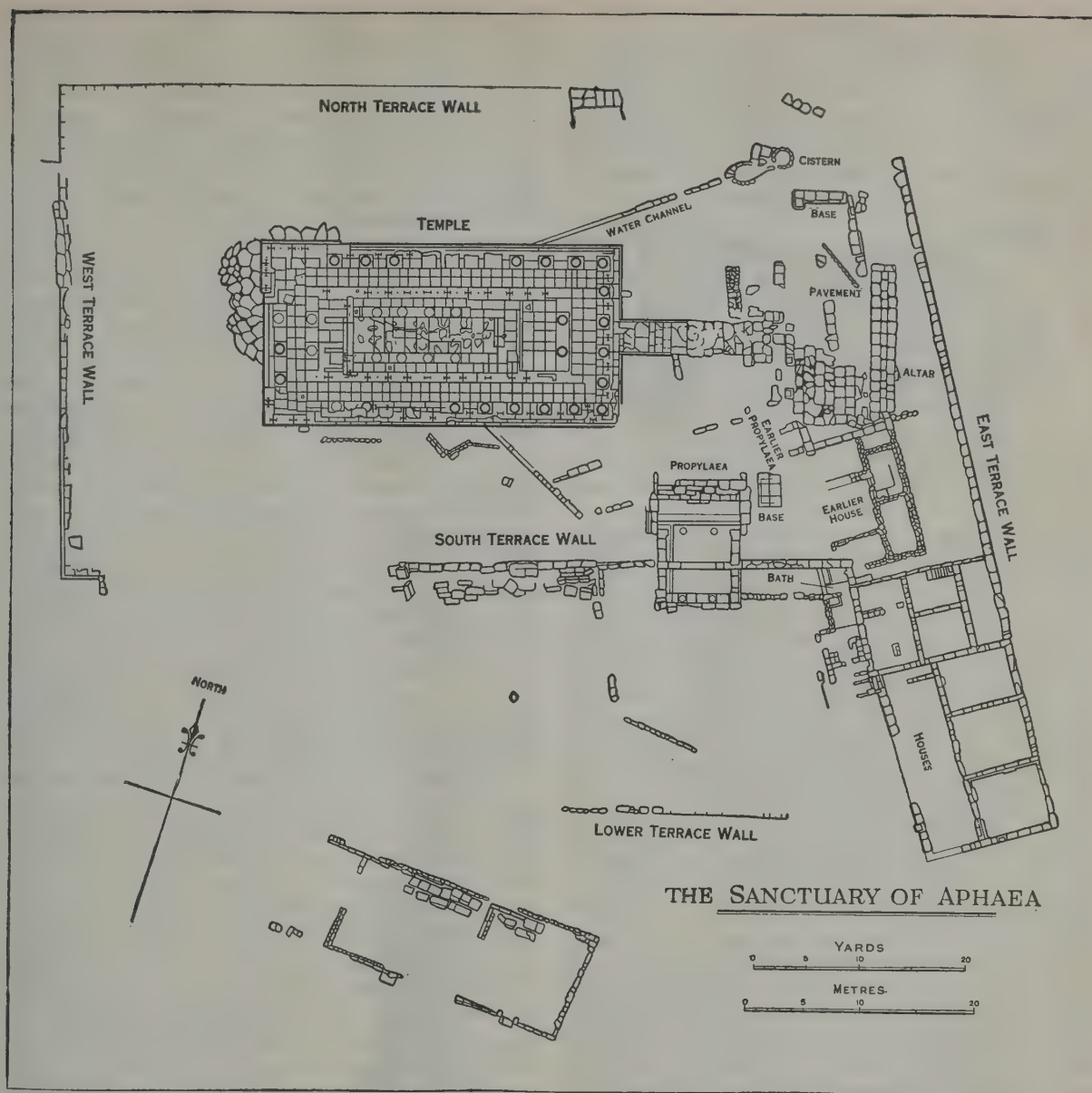
(D. G. H.; A. J. B. W.)

AEGEAN SEA, an arm of the Mediterranean sea, between Greece on the west and Asia Minor on the east, and connected by the Dardanelles with the sea of Marmora, and the Black sea. The name archipelago (*q.v.*) was formerly applied scientifically to this sea. Various derivations suggest origin of "Aegean" from the town of Aegeae, or from Aegea, queen of the Amazons, who perished in this sea; or from Aegeus, father of Theseus, who drowned himself here. Structurally the sea is a much-shattered old land-block almost entirely submerged, outlined by younger fold-mountains (being continuations of ranges of Asia Minor), also partly submerged. Both features have accounted for this island-studded sea with its alternating deeps and shallows. Island chains may be traced through Chios, Psara and Skyros to the North Sporades, through Samos, Nikaria, Mykoni, Tinos, Andros and the south-east promontory of Euboea, and through Rhodes, Scarpanto, Crete and Cerigo to the south-east promontory of the Peloponnese. Between the latter chains are the great group of the Cyclades including Naxos, Paros and Milo. Islands in the northern section of the sea include Thasos, off the Macedonian coast, Samothrace, fronting the Gulf of Saros, and Imbros and Lemnos, in prolongation of the Gallipoli peninsula, while Mitylene lies off the coast of Asia Minor. Important sea basins are those of the Cretan sea with depths of over 1,000 fathoms, and the trough between Thessaly and the gulf of Saros over 600 fathoms. Many islands are of volcanic formation; and a well-defined volcanic group includes Milo, Kimolos, Santorin (Thira) and Thirasia. The larger islands have some fertile and well-watered valleys and plains. The chief productions are wheat, wine, oil, mastic, figs, raisins, honey, wax, cotton and silk. The people fish for coral and sponges, as well as for bream and mullet. Greece owns most of the islands, but a number collectively known as the Dodecanese, including Rhodes, Scarpanto, Kaxo, Astypalaea, Kharki, Symi, Tilos, Nisyros, Kos, Kalymnos, Leros and Patmos and minor ones are in Italian hands. Imbros and Tenedos remain Turkish.

AEGEUS, son of Pandion and grandson of Cecrops, was king of Athens and the father of Theseus (*q.v.*).

AEGINA (*Egina* or *Engia*), a Greek island, in the Saronic gulf, 20m. from the Piraeus. Tradition derives the name from Aegina, the mother of Aeacus, who was born in and ruled the island. In shape Aegina is triangular, 8m. long from north-west to south-east, and 6m. broad, with an area of about 41 sq.m. The western side consists of stony but fertile plains, well cultivated with grain, vines, almonds, figs and some cotton. The rest of the island is rugged. From the conical Mt. Oros at the south end, the Panhellenian ridge stretches north with narrow fertile valleys on either side. From the absence of marshes the climate is the most healthy in Greece. The island forms part of the modern *nomos* of Attica and Boeotia, of which it forms an *eparchy*. The sponge fisheries are important. The chief town is Aegina, at the north-west end of the island, the favourite summer residence of many Athenians.

Antiquities.—The well known temple stands on the ridge near the north corner of the island. In 1811 Baron Haller von Hallerstein and the English architect, C. R. Cockerell, discovered much sculpture from the pediments, which was bought in 1812 by the crown prince Louis of Bavaria and set up in the Glyptothek at Munich. The restoration by B. Thorvaldsen was drastic, ancient parts being cut away to allow of additions treated in imitation of the ancient weathering. The arrangement of the figures has been disputed. Cockerell's inward-facing groups were adopted at Munich till 1901, when Furtwängler's excavation of the site, and fresh



FROM FURTWÄNGLER, "DAS HEILIGTUM DER APHAEA," BY COURTESY OF THE BAYERISCHE AKADEMIE DER WISSENSCHAFTEN

PLAN OF THE TEMPLE OF APHAEA, IN AEGINA

This temple with its famous sculptures was subjected to violent "restoration" at the beginning of last century, but its true character was established by Herr Furtwängler's researches in 1901. Excavations have also shown that the temple belonged not to Zeus or Athena but to a local goddess Aphaea

study of the figures and fragments in Munich, led to a rearrangement which may be regarded as approaching finality. The figures no longer all face towards the centre, but are broken up, as in other early compositions, into a series of groups of two or three figures each. A figure of Athena still occupies the centre of each pediment, but is set farther forward. On each side of this, in the west pediment, is a group of two combatants over a fallen warrior; in the east pediment, a warrior whose opponent is falling into the arms of a supporting figure; other figures also—the bowmen especially—face towards the angles, and so give more variety. The west pediment, which is more conservative in type, represents the earlier expedition of Heracles and Telamon against Troy; the eastern, which is bolder and more advanced, probably refers to episodes in the Trojan war. There are also remains of a third pediment, which may have been produced in competition, but

never placed on the temple. (For the character of the sculptures see GREEK ART.) Inscriptions found by the recent excavations seem to prove that the shrine belonged not to Zeus or Athena as formerly supposed, but to the local goddess, Aphaea, identified by Pausanias with Britomartis and Dictynna. The present temple probably dates from the time of the Persian wars. In the town of Aegina itself are the remains of another temple, dedicated to Aphrodite; one column of this still remains standing, its foundations are fairly preserved, and its votive offerings are important in the early history of Greek vase painting.

AUTHORITIES.—*Antiquities of Ionia* (London, 1797), ii. Pl. ii.-vii.; C. R. Cockerell, *The Temples of Jupiter Panhellenius at Aegina*, etc. (London, 1860); Ch. Garnier, *Le Temple de Jupiter Panhellenien à Égine* (Paris, 1884); Ad. Furtwängler and others, *Aegina, Heiligtum der Aphaia* (Munich, 1906), where earlier authorities are collected and discussed.

HISTORY

Aegina, according to Herodotus (v. 83), was a colony of Epidaurus, to which state it was originally subject. The discovery of gold ornaments belonging to the latest period of Mycenaean art suggests the inference that the Mycenaean culture held its own in Aegina for some generations after the Dorian conquest of Argos and Lacedaemon. It is probable that the island was not Dorized before the 9th century B.C. One of the



FROM PERROT & CHIZEP, "HISTORY OF ART," BY PERMISSION OF CHAPMAN & HALL LTD. THE "HAPPY CUP," A FAMOUS EXAMPLE OF AEGINETAN ART. THE ILLUSTRATION SHOWS PART OF THE UPPER DESIGN

earliest facts known to us in its history is its membership in the League of Calauria, which included, besides Aegina, Athens, the Minyan (Boeotian) Orchomenus, Troezen, Hermione, Nauplia and Prasiae, and was probably an organization for the suppression of piracy. It follows that the maritime importance of the island dates back to pre-Dorian times. Aegina was the first state of European Greece to coin money (see PHEDON). Within 40 years of the invention of coinage by the Lydians (c. 700 B.C.), the Aeginetans introduced the system to the western world. The fact that the Aeginetan scale of coins, weights, etc. was in general use in the Greek world is sufficient evidence of the commercial importance of the island. In the earlier half of the 7th century B.C. it appears to have belonged to the Eretrian league. In the next century Aegina is one of the three principal states, and the only state of European Greece trading at the emporium of Naucratis (Herod. ii. 178). At the beginning of the 5th century it seems to have been an entrepôt of the Pontic grain trade, at a later date an Athenian monopoly (Herod. vii. 147). Unlike the other commercial states of the 7th and 6th centuries B.C., Aegina founded no colonies.

The history of Aegina, as it has come down to us, is almost exclusively a history of its relations with Athens. The account which Herodotus (v. 79-80; vi. 49-51, 73, 85-94) gives of the relations between the two states is to the following effect. Thebes, after the defeat by Athens about 507 B.C., appealed to Aegina for assistance. The Aeginetans at first contented themselves with sending the images of the Aeacidae, the tutelary heroes of their island. Subsequently, however, they entered into an alliance, and ravaged the seaboard of Attica. The Athenians were preparing to make reprisals, in spite of the advice of the Delphic oracle that they should desist from attacking Aegina for 30 years, and content themselves meanwhile with dedicating a precinct to Aeacus, when their projects were interrupted by the Spartan intrigues for the restoration of Hippias. In 491 B.C. Aegina was one of the states which gave the symbols of submission ("earth and water") to Persia. Athens at once appealed to Sparta to punish this act of Medism, and Cleomenes I. (q.v.), one of the Spartan kings, crossed over to the island, to arrest those who were responsible for it. His attempt was at first unsuccessful; but, after the deposition of Demaratus, he visited the island a second time, accompanied by his new colleague Leotychides, seized ten of the leading citizens and deposited them at Athens as hostages. After the death of Cleomenes and the refusal of the Athenians to restore the hostages to Leotychides, the Aeginetans retaliated by seizing a number of Athenians at a festival at Sunium. Thereupon the Athenians concerted a plot with Nicodromus, the leader of the democratic party in the island, for the

betrayal of Aegina. He was to seize the old city, and they were to come to his aid with 70 vessels. The plot failed owing to the late arrival of the Athenian force. An engagement followed in which the Aeginetans were defeated. Subsequently, however, they succeeded in winning a victory over the Athenian fleet. The dates of these incidents are uncertain. It is unlikely that Athens was at war in 498 B.C. as she sent 20 ships to help the Ionians in revolt against Persia, and Herodotus nowhere suggests a peace earlier than 481 B.C. If we may regard the "30 years" of the Delphic oracle as fixed after the event, i.e., after the Athenian victory in 458 B.C. we may assign the dedication of the shrine to Aeacus and the beginning of the war to 488 B.C. This is supported by the building of the great Athenian fleet—"for the war against Aegina"—in 483 B.C. Overtures were unquestionably made by Thebes for an alliance with Aegina, c. 507 B.C., but they came to nothing. The refusal of Aegina was veiled under the diplomatic form of "sending the Aeacidae." The real occasion of the outbreak of the war was the refusal of Athens to restore the hostages some 20 years later. There was but one war, and it lasted from 488 to 481 B.C., when it was suspended owing to the invasion of Xerxes. That Athens had the worst of it in this war is certain. Herodotus had no Athenian victories to record after the initial success, and the fact that Themistocles was able to carry his proposal to devote the surplus funds of the state to the building of so large a fleet seems to imply that the Athenians were themselves convinced that a supreme effort was necessary. It may be noted, in confirmation of this view, that the naval supremacy of Aegina is assigned by the ancient writers on chronology to precisely this period, i.e., the years 490-480 B.C. In the repulse of Xerxes it is possible that the Aeginetans played a larger part than is conceded to them by Herodotus. The Athenian tradition, which he follows in the main, would naturally seek to obscure their services. The destruction of the Persian fleet appears to have been as much the work of the Aeginetan contingent as of the Athenian. It is difficult to credit the number of the vessels that is assigned to them by Herodotus (30 as against 180 Athenian vessels: see GREECE: History; Bibliography).

During the next 20 years the philo-laconian policy of Cimon (q.v.) secured Aegina, as a member of the Spartan league, from attack. The change in Athenian foreign policy, which was consequent upon the ostracism of Cimon in 461 B.C. led to war, in which the brunt of the fighting fell upon Corinth and Aegina. The latter state was forced to surrender to Athens after a siege, and to accept the position of a subject-ally (c. 456 B.C.). The tribute was fixed at 30 talents. By the terms of the Thirty Years' Truce (445 B.C.) Athens covenanted to restore to Aegina her autonomy, but the clause remained a dead letter. In the first winter of the Peloponnesian War (431 B.C.) Athens expelled the Aeginetans, and established a cleruchy in their island. The exiles were settled by Sparta in Thyreatis, on the frontiers of Laconia and Argolis. Even in their new home they were not safe from Athenian rancour. A force landed under Nicias in 424, and put most of them to the sword. At the end of the Peloponnesian War Lysander restored the scattered remnants of the old inhabitants to the island. Its greatness, however, was at an end.

It would be a mistake to attribute the fall of Aegina solely to the development of the Athenian navy. It is probable that the power of Aegina had steadily declined during the 20 years after Salamis, and that it had declined absolutely, as well as relatively to that of Athens. Commerce was the source of Aegina's greatness, and her trade, which appears to have been principally with the Levant, must have suffered seriously from the war with Persia. Her medism in 491 is to be explained by her commercial relations with the Persian Empire. She was forced into patriotism in spite of herself, and the glory won at Salamis was paid for by the loss of her trade and the decay of her marine. The completeness of the ruin of so powerful a state finds an explanation in the economic conditions of the island, the prosperity of which rested upon a basis of slave-labour. It is clear, however, that the number of slaves must have been out of all proportion to that of the free inhabitants. In this respect the history of Aegina does but anticipate the history of Greece as a whole.

The constitutional history of Aegina is unusually simple. So long as the island retained its independence the government was an oligarchy. There is no trace of the heroic monarchy and no tradition of a *tyrannis*. The story of Nicodromus, while it proves the existence of a democratic party, suggests, at the same time, that it could count upon little support.

Modern.—Aegina passed with the rest of Greece under the successive dominations of Macedon, the Aetolians, Attalus of Pergamum and Rome. In 1537 the island, then a prosperous Venetian colony, was overrun and ruined by the pirate Barbarossa (Khair-ed-Din). One of the last Venetian strongholds in the Levant, it was ceded by the treaty of Passarowitz (1718) to the Turks. In 1826–28 the town became for a time the capital of Greece and the centre of a large commercial population which has since diminished considerably.

BIBLIOGRAPHY.—The ancient authorities are Herodotus ii., v., vi., vii. and viii.; also Thucydides i. 105, 108, ii. 27, iv. 56–7. For a criticism of Herodotus' account of the relations of Athens and Aegina, see Wilamowitz, *Aristoteles und Athen*, ii. 280–8; Macan, *Herodotus* iv.–vi.; ii. 102–20. See also G. B. Grundy, *The Great Persian War*, pp. 154 *et seq.*, 202 *et seq.*, 373 *et seq.*

ÆGINETA, PAULUS, a celebrated surgeon of the island of Aegina, whence he derived his name. According to Le Clerc's calculation, he lived in the 4th century of the Christian era; but Abulfaragius (Bar-Hebraeus) places him with more probability in the 7th. The title of his most important work is *Ἐπιτομὴς Ἱατρικῆς Βιβλίας Ἑπτὰ* (*Synopsis of Medicine in Seven Books*); the 6th book, treating of operative surgery, is of interest for surgical history.

The whole work in the original Greek was published at Venice in 1528; another edition appeared at Basle in 1538. Several Latin translations have been published, and an English version, with commentary, by F. Adams (1844–48). Edition by Heiberg (Leipzig, 1912) and German trans. with appendix by I. Berendes (Leyden, 1914).

See M. Neuberger, *History of Medicine*, vol. i (1910).

ÆGIRITE or **ACMITE**: see PYROXENE.

ÆGIS, in Homer, the shield or buckler of Zeus. It was furnished with tassels and bearing the Gorgon's head in the centre. Originally symbolical of the storm-cloud, it probably signifies rapid, violent motion (Gr. *aïssō*). In the later story Zeus is said to have used the skin of the goat Amaltheia (Gr. *aigis* = goat-skin) as a buckler when he went forth to do battle against the giants; in another legend, it is the skin of a monster slain by Athena, who afterwards wore it as a cuirass. Such skin shields were the original form of body protection, afterwards replaced by the solid shield covered with metal. It appears to have been really the goat's skin used as a belt to support the shield. When so used it would generally be fastened on the right shoulder, and would partially envelop the chest as it passed obliquely round in front and behind to be attached to the shield under the left arm. Hence, by transference, it would be employed to denote at times the shield which it supported, and at other times a cuirass. Hence the aegis appears in works of art sometimes as an animal's skin thrown over the shoulders and arms, sometimes as a cuirass, with a border of snakes corresponding to the tassels of Homer, usually with the Gorgon's head in the centre.



RESTORATION OF A STATUE OF ATHENA, WEARING THE ÆGIS, A CUIRASS OF ANIMAL SKIN BORDERED WITH SNAKES AND BEARING THE HEAD OF A GORGON

See L. Preller, *Griechische Mythologie*, i. (1887); Pauly-Wissowa's *Realencyklopädie*; Roscher's *Lexikon der Mythologie*; Daremberg and Saglio's *Dictionnaire des Antiquités*; and Smith's *Dictionary of Greek and Roman Antiquities* (3rd ed., 1890).

ÆGISTHUS, in Greek legend the son of Thyestes by his own daughter Pelopia (Hyginus, *fab.* 88). Having been exposed by his mother, he was found by shepherds and suckled by a goat

(*aîḡ*), whence his name. His uncle Atreus, who had married Pelopia, took him to Mycenae, and brought him up as his own son. For the rest of his story see AGAMEMNON; ATREUS.

ÆGOSPOTAMI, a small creek issuing into the Hellespont, north-east of Sestos, the scene of the decisive battle in 405 B.C. in which Lysander destroyed the last Athenian squadron in the Peloponnesian War (*q.v.*). The existence of a township is attested by coins of the 5th and 4th centuries.

ÆHRENTHAL, ALOYS LEXA VON, COUNT (1854–1912), Austro-Hungarian statesman, was born at Gross-Skal, in Bohemia. He was the son of Baron (Freiherr) Johann Lexa von Aehrenthal and his wife Marie, *née* Countess Thun-Hohenstein, and began his diplomatic career in 1877 as attaché to the Paris embassy under Count Beust. He went in 1878 in the same capacity to St. Petersburg, and from 1883 to 1888 he worked at the Foreign Office in Vienna under Kalnoky, with whom he formed close relations. In 1888 he was sent as councillor of embassy to St. Petersburg, where he exercised considerable influence with the ambassador, Count Wolkenstein. Recalled in 1894 to service in the Foreign Office, he undertook important duties, and in the following year went to Bucharest as ambassador. Here he succeeded in strengthening the relations between the courts of Vienna and Bucharest, the secret alliance which King Charles had concluded in 1883 with the Central European Powers being renewed on Sept. 30. In 1899 he became ambassador in St. Petersburg, where he remained until his appointment as Foreign Minister in Oct. 1906. Aehrenthal at this time thought that Austria-Hungary must, even at the cost of some sacrifice, come to an agreement with Russia. In this sense he endeavoured to continue the negotiations successfully begun by his predecessor, Prince Franz Liechtenstein (1853–1938), for bridging over the difference on Balkan questions between Vienna and St. Petersburg, in order to create a basis for a permanent friendly relation between Austria-Hungary and Russia. He played a principal part in concluding the Münzsteg Agreement of 1903. During the Russo-Japanese War he took a strong line in favour of a benevolent attitude on the part of the Vienna Cabinet towards Russia. When, in Oct. 1906, he succeeded Count Goluchowski as Foreign Minister he at first maintained the views which he had professed as ambassador. He was determined to preserve the interests of Austria-Hungary in the Balkans, but also showed himself prepared to meet the Russian wishes in the Dardanelles question. Accordingly he entered into negotiations, after the outbreak of the Young Turk revolution in the summer of 1908, with Isvolski, arranging with him Sept. 15 at the château of Buchlau, in Moravia, an agreement which aimed at securing for Austria-Hungary the annexation of Bosnia and Hercegovina and for Russia the opening of the Dardanelles to Russian warships.

It was only when Isvolski's proposals were wrecked on the opposition of England, and the Russian minister protested against the annexation of Bosnia and Hercegovina, which had meanwhile been accomplished, and supported the Serbs in their opposition to Austria-Hungary, that Aehrenthal abandoned the idea of a friendly accommodation with the Russian Government. In the sharp struggle during the annexation crisis, not only with Russia and Serbia, but with the Western Powers, he held with tenacious energy to his purpose, and, powerfully supported by Germany, succeeded in carrying out his intentions after excited negotiations which threatened to lead to war. The annexation of Bosnia and Hercegovina was acknowledged by the Powers; an agreement was reached with Turkey; Serbia, after long hesitation, was obliged to submit. For this achievement Aehrenthal was rewarded by his master by elevation to the rank of Count (Aug. 18, 1909), while at the courts of his opponents he was hated but respected.

This was the zenith of his political career. Aehrenthal took the greatest pains to prove in all quarters after the conclusion of the annexation crisis, that Austria-Hungary cherished no far-reaching plans of conquest. In this spirit he offered the most decided opposition to those circles at the court of Vienna which advocated a bloody reckoning with Serbia. He held fast by the Triple Alliance, for he saw in this the surest bulwark of peace.

He sought to form the most intimate relations with the German Empire, but insisted on the independence of the Habsburg Monarchy, and energetically repulsed all efforts on the part of the German chancellery to set limits to that independence. A succession of agreements which he concluded with the Italian Foreign Minister Tittoni, enabled him to maintain correct relations with the Italian Government. Yet, by the maintenance of his peace policy, which had the full approval of the Emperor Francis Joseph, he came into serious conflict with Conrad von Hötzendorf. The battle, carried on with tenacious endurance, ended in 1911 with the victory of Aehrenthal and the resignation of Hötzendorf.

Aehrenthal married in 1902 Pauline, Countess Széchenyi. He died Feb. 17, 1912. During his life the estimate of his policy fluctuated violently. On the one hand it was blamed as provocative, on the other as weak. After the disastrous result of the World War, bringing with it the downfall of the Habsburg Monarchy, it is still more difficult to answer the question whether the path pursued by Aehrenthal in foreign affairs was the right one. It is certain that the Entente Powers were drawn more closely together by the active part played, during his period of office, by Austria-Hungary in Balkan affairs. It is true that the chances of success for the Central Powers in an international struggle were better in the years 1909 and 1911 than in 1914. But the question remains undecided whether, if his activity had been longer continued, Aehrenthal would have been able to maintain the position of Austria-Hungary as a great power without an appeal to the decision of arms. There is no doubt that Aehrenthal was a statesman of considerable mark, a man of wide knowledge and well-ordered intelligence; he was ambitious, but not vain, and an untiring worker. Moreover, in moments of great excitement he was able to maintain outward calmness. He was convinced of his own value, but had no desire to parade it. The Emperor Francis Joseph esteemed him, stood by him in the good and evil hours of his administration of foreign affairs, and repeatedly refused to accept his tendered resignation.

See B. Molden, Alois, *Graf Aehrenthal: Sechs Jahre auswärtiger Politik Österreich-Ungarns* (1917); and the article "Aehrenthal" in the *Deutsche Nekrologien* (vol. xviii, 1917, pp. 230 seq.). (A. F. P.)

AELFRIC, called the "Grammarian" (c. 955–1020), English abbot and author, was educated in the Benedictine monastery at Winchester under Aethelwold, who was bishop there from 963 to 984. Aelfric gained some reputation as a scholar at Winchester, for when, in 987, the abbey of Cernel (Cerne Abbas, Dorsetshire) was finished, he was sent by Bishop Aelfheah (Alphege), Aethelwold's successor, at the request of the chief benefactor of the abbey, the ealdorman Aethelmaer, to teach the Benedictine monks there. He was then in priest's orders. Aethelmaer and his father, Aethelweard, were both enlightened patrons of learning, and became Aelfric's faithful friends.

It was at Cernel, and partly at the desire, it appears, of Aethelweard, that he planned the two series of his English homilies (ed. Benjamin Thorpe, 1844–46, for the Aelfric Society), compiled from the Christian fathers, and dedicated to Sigeric, archbishop of Canterbury (990–94). The Latin preface to the first series enumerates some of Aelfric's authorities, the chief of whom was Gregory the Great. In the preface he regrets that, except for Alfred's translations, Englishmen had no means of learning the true doctrine as expounded by the Latin fathers. The first series of 40 homilies is devoted to plain and direct exposition of the chief events of the Christian year; the second deals more fully with church doctrine and history. Aelfric denied the immaculate birth of the Virgin (*Homilies*, ed. Thorpe, ii. 466), and his teaching on the Eucharist in the *Canons* and in the *Sermo de sacrificio in die pascae* (*ibid.* ii. 262, et seq.) was appealed to by the Reformation writers as a proof that the early English church did not hold the doctrine of transubstantiation.

See *A Testimonie of Antiquitie, shewing the auncient fayth in the Church of England touching the sacrament of the body and bloude of the Lord here publickly preached*, printed by John Day (1567). It was quoted in John Foxe's *Actes and Monuments* (ed. 1610).

His *Latin Grammar and Glossary* (ed. J. Zupitza in *Sammlung englischer Denkmäler*, vol. i., 1880), were written for his pupils

after the two books of homilies. A third series of homilies, the *Lives of the Saints*, dates from 996 to 997. Some of the sermons in the second series had been written in a kind of rhythmical, alliterative prose, and in the *Lives of the Saints* (ed. W. W. Skeat, 1881–1900, for the Early English Text Society) the practice is so regular that most of them are arranged as verse by Prof. Skeat. By the wish of Aethelweard he also began a paraphrase (ed. by Edward Thwaites as *Hepateuchus*, Oxford, 1698) of parts of the Old Testament, but under protest, for the stories related in it were not, he thought, suitable for simple minds. It has been suggested that this part of his life was chiefly spent at Winchester; but his writings for the patrons of Cernel, and the fact that he wrote in 998 his *Canons* as a pastoral letter for Wulfsige, the Bishop of Sherborne, the diocese in which the abbey was situated, afford presumption of continued residence there. He became, in 1005, the first abbot of Eynsham or Ensham, near Oxford, another foundation of Aethelmaer's. After his elevation he wrote an abridgment for his monks of Aethelwold's *De consuetudine monachorum*, adapted to their rudimentary ideas of monastic life; a letter to Wulfgeat of Ylmandun (*i.e.*, Ilmington on the borders of Warwickshire and Gloucestershire); an introduction to the study of the Old and New Testaments (about 1008, ed. William L'Isle in 1623); a Latin life of his master Aethelwold; a pastoral letter for Wulfstan, archbishop of York and bishop of Worcester, in Latin and English; and an English version of Bede's *De Temporibus. The Colloquium*, a Latin dialogue designed to serve his scholars as a manual of Latin conversation, may date from his life at Cernel. It is safe to assume that the original draft of this, afterwards enlarged by his pupil, Aelfric Bata, was by Aelfric, and represents what his own scholar days were like. The last mention of Aelfric Abbot, probably the grammarian, is in a will dating from about 1020.

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AELIA CAPITOLINA. The destruction of Jerusalem and the Temple in A.D. 70 was followed by a second revolt of the Jews. After their defeat Hadrian made the ruined Jerusalem into a Roman colony, Aelia Capitolina, subordinate to Caesarea, the then capital of Palestine (about A.D. 130). Aelia commemorated the emperor's family name; Capitolina is derived from Jupiter Capitolinus to whom a temple was built on the site of the Jewish Temple.

AELIAN (AELIANUS TACTICUS), Greek military writer of the 2nd century A.D., resident at Rome. He is sometimes confused with his namesake Claudius Aelianus (*q.v.*). Aelian's military treatise, *Taktikḗ Ōewplā*, is dedicated to Hadrian, though this is probably a mistake for Trajan, and the date A.D. 106 has been assigned to it. It is a handbook of Greek, *i.e.* Macedonian, drill and tactics as practised by the Hellenistic successors of Alexander the Great. The author claims to have consulted all the best authorities, the chief of which was a lost treatise on the subject by Polybius. Perhaps the chief value of Aelian's work lies in his critical account of preceding works on the art of war and in the fullness of his technical details in matters of drill. Critics of the 18th century thought Aelian greatly inferior to Arrian, but on

the Byzantines, and on the Arabs, who translated the text for their own use, Aelian exercised a great influence. The emperor Leo VI. incorporated much of Aelian's text in his own work on the military art. The Arabic version of Aelian was made about 1350. The copious details to be found in the treatise made it valuable to the army organizers of the 16th century. The Macedonian phalanx of Aelian had many points of resemblance to the solid masses of pikemen and the "squadrons" of cavalry of the Spanish and Dutch systems, and the translations made in the 16th century formed the groundwork of numerous books on drill and tactics. It has been suggested that Aelian was the real author of most of Arrian's *Tactica*, and that the *Τακτική Θεωρία* is a later revision of this original, but the theory is not generally accepted.

BIBLIOGRAPHY.—First edition of Greek text by Robortelli (Venice, 1552); the Elzevier text (Leyden, 1613) has notes. The text in W. Rüstow and H. Köchly's *Griechische Kriegsschriftsteller* (1855) has a translation, notes and reproductions of the original illustrations.

See Baumgärtner's trans. in his *Sammlung aller Kriegsschriftsteller der Griechen* (Mannheim and Frankenthal, 1790), reproduced in 1786 as *Von Schlachtordnungen*, trans. Viscount Dillon (1814). See also R. Förster, *Studien zu den griechischen Taktikern* (Hermes, xii. 1877, pp. 444-49); F. Wüstenfeld, *Das Heerwesen der Muhammedaner und die arabische Uebersetzung der Taktik des Aelianus* (Göttingen, 1880); M. Jähns, *Gesch. der Kriegswissenschaften*, i. 95-97 (Munich, 1889); Rüstow and Köchly, *Gesch. des griechischen Kriegswesens* (1852); A. de Lort-Séguin, *La Phalange* (1880); P. Serre, *Études sur l'histoire militaire et maritime des Grecs et des Romains* (1887); K. K. Müller, in Pauly-Wissowa, *Realencyklopädie* (Stuttgart, 1894).

ÆLIAN (CLAUDIUS ÆLIANUS), Roman author and teacher of rhetoric, born at Praeneste, flourished under Septimius Severus and probably outlived Elagabalus (d. 222). He spoke Greek so perfectly that he was called "honey-tongued" (*μελιγλωσσος*) and wrote in Greek himself. His chief works are: *De natura animalium*, curious stories of animal life, frequently used to convey moral lessons (ed. Schneider, 1784; Jacobs, 1832); *Variae historiae* in 14 books, some of which are fragmentary, consisting mainly of anecdotes of men and customs (ed. Lünemann, 1811). Both works are valuable for the numerous excerpts from older writers. Twenty *Peasants' Letters*, after the manner of Alciphron but inferior, are also attributed to him.

Editio princeps of complete works by Gesner (1556); Hercher (1864-66). English translation of the *Various History* only by Fleming (1876), and Stanley (1665) of the *Letters* by Quillard (French) (1895).

ÆLRED (AILRED, ETHELRED) (1109?-1166), English theologian, historical writer, and abbot of Rievaulx, was born at Hexham about the year 1109. In his youth he was at the court of Scotland as an attendant of Henry, son of David I. He renounced the prospect of a bishopric to enter the Cistercian house of Rievaulx in Yorkshire, founded in 1131 by Walter Espec. He was for a brief period abbot of Revesby, Lincolnshire, but in 1146 returned to Rievaulx as abbot. He led a life of the severest asceticism, and was credited with the power of working miracles. In 1164 he went as a missionary to the Picts of Galloway, where he accomplished a great work of pacification. Two years later he died at Rievaulx in the 57th year of his age. In 1191 he was canonized. His writings are voluminous and have never been completely published. Among them is the tract called *Relatio de Standardo*, an account of the Battle of the Standard (1138), better known than the similar account by Richard of Hexham but less trustworthy.

BIBLIOGRAPHY.—See the *Vita Alredi* in John Tynemouth's *Nova Legenda Anglie* (ed. C. Horstmann, 1901, vol. i. p. 41), whence it was taken by Capgrave. From Capgrave the work passed into the Bollandist *Acta Sanctorum* (Jan. ii. p. 30). This life is anonymous but of an early date. The most complete printed collection of Aelred's works is in Migne's *Patrologia Latina*, vol. cxv.; but this does not include the *Miracula Hagulstaldensis Ecclesiae* which are printed in J. Raine's *Priority of Hexham*, vol. i. (Surtees Society, 1864). A complete list of works attributed to Aelred is given in T. Tanner's *Bibliotheca Britannico-Hibernica* (1748), pp. 247-248. The *Relatio de Standardo* has been critically edited by R. Howlett in *Chronicles, etc.*, of Stephen, Henry II. and Richard I., vol. iii. (Rolls Series, 1886).

ÆMILIA, VIA or **ÆMILIAN WAY**. (1) A high road of Italy, constructed in 187 B.C. by the consul M. Aemilius Lepidus, whence its name; it ran from Ariminum to Placentia, a distance of 176m. almost straight N.W., with the plain of the Po

(Padus) on the right, and the Apennines on the left. The 70th milestone from Ariminum found in the bed of the Rhenus at Bononia records the restoration of the road by Augustus from Ariminum to the river Trebia in 2 B.C. The bridge by which it crossed the Sillaro was restored by Trajan in A.D. 100. The modern high road follows the ancient line, and has some original and some fine modern bridges. After Augustus, the road gave its name to the eighth region of Italy.

(2) A road constructed in 109 B.C. by the censor, M. Aemilius Scaurus, from Vada Volaterrana and Luna to Vada Sabatia and thence over the Apennines to Dertona (Tortona), where it joined the Via Postumia from Genua (Genoa) to Cremona. We must, however, suppose that a coast road from Vada Volaterrana to Genua at least existed before the Via Postumia was built in 148 B.C. According to Polybius the Romans had in his time built the coast road from the Rhone to Carthago Nova; and it is incredible that the coast road in Italy itself should not have been constructed previously.

ÆMILIUS, PAULUS (PAOLO EMILIO) (d. 1529), Italian historian, was born at Verona. He obtained such repute in his own country that he was invited to France in the reign of Charles VIII. in order to write in Latin the history of the kings of France, and was presented to a canonry in Notre Dame. He enjoyed the patronage and support of Louis XII. He died at Paris on May 5, 1529. His *De Rebus gestis Francorum* was translated into French in 1581, and has also been translated into Italian and German.

ÆNEAS, son of Anchises and Aphrodite. In Homer, he is represented as a favourite of the gods, who frequently interpose to save him from danger (*Iliad*, v. 311; xx. 308) as he was destined to rule the surviving Trojans after the war. The story of his emigration is post-Homeric, and is set forth in its fullest development by Virgil in the *Æneid*. Carrying his aged father and household



BY COURTESY OF THE METROPOLITAN MUSEUM OF ART

A MEDIAEVAL ENAMEL ON COPPER OF ABOUT A.D. 1525-30 SHOWING ÆNEAS LEADING THE TROJANS IN THEIR STRUGGLE AGAINST THE GREEKS WHO HAVE ENTERED THE CITY IN THE BELLY OF THE WOODEN HORSE. THE ORIGINAL IS IN RICH SUBDUED COLOURS AND GOLD

gods on his back and leading his little son Ascanius by the hand, he made his way to the coast, his wife Creusa being lost during the confusion of the flight. After a perilous voyage to Thrace, Delos, Crete and Sicily (where his father died), he was cast up by a storm, sent by Juno, on the African coast.

Refusing to remain with Dido, queen of Carthage, who in despair put an end to her life, he sailed from Africa, and seven years after leaving Troy, reached the mouth of the Tiber. He was hospitably received by Latinus, king of Latium, was betrothed to his daughter Lavinia, and founded a city called Lavinium after her. Turnus, king of the Rutuli, a rejected suitor, took up arms against

him and Latinus, but was defeated and slain by Aeneas on the river Numicius. The story of the *Aeneid* ends with the death of Turnus. According to Livy (i. i. 2), Aeneas, after reigning a few years over Latium, was slain by the Rutuli; after the battle, his body could not be found, and he was supposed to have been carried up to heaven. He received divine honours, and was worshipped under the name of *Iuppiter Indiges* (Dionysius Halic. i. 64).

See Schwegler, *Römische Geschichte* (1867); Roscher's *Lexikon*, s.v.

ROMANCES.—The story of Aeneas, as a sequel to the legend of Troy, formed the subject of several epic romances in the middle ages. The *Roman d'Énéas* (c. 1160, or later), of uncertain authorship, the first French poem directly imitated from the *Aeneid*, is a fairly close adaptation of the original, but with the characteristic tone of a mediaeval romance. On this work were founded the *Eneide* or *Eneit* (between 1180 and 1190) of Heinrich von Veldeke, written in Flemish and now only extant in a version in the Thuringian dialect, and the *Eneydos*, written by William Caxton in 1490.

See *Énéas*, ed. J. Salverda de Grave (Halle, 1891); also A. Peij, *Essai sur le romans d'Énéas* (1856); A. Duval in *Hist. littéraire de la France*, xix.; Veldeke's *Eneide*, ed. Ettmüller (Leipzig, 1852) and O. Behaghel (Heilbronn, 1882); *Eneydos*, ed. F. J. Furnivall (1890). For Italian versions see E. G. Parodi in *Studi di filologia romanza* (v. 1887).

AENEAS SILVIUS: see PRUS II.

AENEAS TACTICUS (4th century B.C.), Greek writer. According to Aelianus Tacticus and Polybius, he wrote a number of treatises (*ὑπομνήματα*) on the art of war; the only one extant deals with the defence of fortified cities, and is chiefly valuable as containing a large number of historical illustrations. Aeneas was considered by Casaubon to have been a contemporary of Xenophon and identical with the Arcadian general Aeneas of Stymphalus, whom Xenophon (*Hellenica*, vii. 3) mentions as fighting at the battle of Mantinea (362 B.C.).

Editions in I. Casaubon's (1619), Gronovius' (1670) and Ernesti's (1763) eds. of Polybius; also separately, with the notes by J. C. Orelli (Leipzig, 1818). Other texts are those of W. Rüstow and H. Köchly, *Griechische Kriegsschriftsteller*, vol. i. (Leipzig, 1853), and A. Hug, *Prolegomena Critica ad Aeneas . . . editionem* (Zürich univ. 1874), R. Schoene (Leipzig, 1911). See L. W. Hunter, *Aeneas on Siegescraft* (revised by S. A. Handford, 1927), an edition with translation and introduction, and the bibliography there given.

AENESIDEMUS, Greek philosopher, was born at Cossus, in Crete and taught at Alexandria, probably during the 1st century B.C. He was the leader of what is sometimes known as the third sceptical school and revived to a great extent the doctrine of Pyrrho and Timon. His chief work was the *Pyrrhonian Principles* addressed to Lucius Tubero. His philosophy consisted of four main parts: the reasons for scepticism and doubt, the attack on causality and truth, a physical theory and a theory of morality. The reasons for doubt are given in the form of the ten "tropes": (1) different animals manifest different modes of perception; (2) similar differences are seen among individual men; (3) even for the same man, sense-given data are self-contradictory; (4) vary from time to time with physical changes, and (5) according to local relations; (6) and (7) objects are known only indirectly through the medium of air, moisture, etc., and are in a condition of perpetual change in colour, temperature, size and motion; (8) all perceptions are relative and interact one upon another; (9) our impressions become less deep by repetition and custom; and (10) all men are brought up with different beliefs, under different laws and social conditions. Truth varies infinitely under circumstances whose relative weight cannot be accurately gauged. There is, therefore, no absolute knowledge, for every man has different perceptions, and groups his data in methods peculiar to himself. In attacking causality he adduces almost entirely those considerations which are the basis of modern scepticism. Cause has no existence apart from the mind which perceives; its validity is ideal. The relation between cause and effect is unthinkable. If the two things are different, they are either simultaneous or in succession. If simultaneous, cause is effect and effect cause. If not, cause must precede effect, and there must be an instant when cause is not effective, that is, is not itself. Thus he arrives at the fundamental principle of scepticism, the universal opposition of causes: *πᾶντι λόγῳ λόγος ἀντίκειται* (see SCEPTICISM).

For the immediate successors of Aenesidemus see AGRIPPA.

See also CARNEADES and ARCESILAUS. Of the *πυρρονῶν λόγῳ* nothing remains; we have, however, an analysis in the *Myriobiblion* of Photius.

BIBLIOGRAPHY.—See Zeller's *History of Greek Philosophy*; E. Saisset, *Aenesideme*, Pascal, Kant; Ritter and Preller, sections 364–370; V. Brochard, *Les Sceptiques Grecs*, with bibliography (1923).

AEOLIAN HARP, a stringed musical instrument, played automatically by the wind. It consists of a long narrow sound



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A SPECIMEN OF THE AEOLIAN HARP, WHICH WAS PLAYED AUTOMATICALLY BY THE WIND

box made of deal or pine over which ten or a dozen catgut strings of varying thickness are stretched. The sounds are produced by the play of the wind across the strings causing them to vibrate in aliquot parts, i.e. (the fundamental note not being heard) the half or octave, the third or interval of the twelfth, the second octave, and the third above it, in fact the upper partials of the strings in regular succession.

The principle of the natural vibration of strings by the pressure of the wind was recognized in ancient times. King David, we learn from the Rabbinic records, used to hang his *kinnor* (*kithara*) over his bed at night, when it sounded in the midnight breeze. The same is related of St. Dunstan of Canterbury who was in consequence charged with sorcery. The Chinese at the present day fly kites of various sizes, having strings stretched across apertures in the paper, which produce the effect of an aerial chorus.

AEOLINA, the original and more elegant name of the humble instrument familiarly known as the mouth-organ, another name for it being the mouth-harmonica. It was invented in 1829 by Sir Charles Wheatstone, who also invented the concertina, embodying the same principle, and consists simply of free reeds arranged within a small metal box, so that, each reed having a separate air aperture, it is possible by moving the instrument to right and left against the lips, to produce different notes. The mouth-organ may be regarded as a humble relation not only of the concertina (*q.v.*) and the accordion (*q.v.*) but also of the harmonium (*q.v.*).

AEOLIS (AEOLIA), an ancient district of Asia Minor, colonized at a very early date by Aeolian Greeks. The name was applied to the coast from the river Hermus to the promontory of Lectum, i.e., between Ionia to south and Troas to north. The Aeolians founded twelve cities on the mainland, including Cyme, and numerous towns in Mytilene; they were said also to have settled in the Troad and even within the Hellespont.

AEOLODION (also known as AEOLINE and AEOLODICON), one of several instruments of the harmonium type, invented and developed during the early part of the 19th century, having steel springs instead of the usual reeds. A closely similar instrument, employing wooden reeds instead of steel, was the aeolsklavier, and yet another was the aeolomelodicon or choraleon, in which the reeds were supplemented by brass tubes. The aeolopantalon in turn was in the nature of a combined harmonium and pianoforte designed so that either the one or the other could be used at will. None of these instruments succeeded in establishing itself.

AEOLUS (ἰ-ὀλ-ῶος), in Greek mythology, according to Homer the son of Hippotes, controller of the winds, and ruler of the floating island of Aeolia. In the *Odyssey* (x. 1) he entertains Odysseus, gives him a favourable wind, and a bag in which the unfavourable winds are confined. To see what it contains Odysseus' companions open the bag; the winds escape and drive them back to the island, whence Aeolus dismisses them with

bitter reproaches. He has been identified with Zeus, and his six sons and six daughters with the 12 months. According to Virgil, Aeolus dwells on one of the Aeolian islands to the north of Sicily, Lipara or Strongyle (Stromboli), where he keeps the winds imprisoned in a vast cavern (Virgil, *Aen.* i. 52).

AEON, or EON, a Greek term used to denote an indefinite duration of time; and hence an existence that continues for ever. In the latter sense it was used by the Gnostic sects to denote those eternal beings or manifestations which emanated from the one incomprehensible and ineffable God. (See GNOSTICISM.)

AEPINUS, FRANZ ULRICH THEODOR (1724–1802), German natural philosopher, was born at Rostock, Saxony, on Dec. 13, 1724. In 1757 he settled in St. Petersburg as member of the imperial academy of sciences and professor of physics, and remained there till his retirement in 1798. The rest of his life was spent at Dorpat, where he died on Aug. 10, 1802. Aepinus is best known by his researches, theoretical and experimental, in electricity and magnetism, and his principal work *Tentamen Theoriae Electricitatis et Magnetismi*, published at St. Petersburg in 1759, was the first systematic attempt to apply mathematical reasoning to these subjects. His discussion of the effects of parallax in the transit of a planet over the sun's disc excited great interest, having appeared (in 1764) between the dates of the two transits of Venus that took place in the 18th century.

AEPYORNIS, a genus of large extinct flightless birds, comprising the family Aepyornithidae and the order Aepyornithiformes of the Palaeognathae; they resembled the moas (*q.v.*) in many particulars, and inhabited the southern half of Madagascar up to, possibly, 200 years ago. They are said to have been the origin of the legend of the roc. *Ae. titan* reached a height of 10 ft., and the egg was larger than that of any other bird, measuring more than 13 by 9½ in. and having a capacity of more than 2 gal. (See ORNITHOLOGY.)

AEQUI, an ancient people of Italy, whose name occurs constantly in Livy's first decade as hostile to Rome in the first three centuries of the city's existence. They occupied the upper reaches of the valleys of the Anio, Tolenus and Himella; the last two being mountain streams running northward to join the Nar. They were not finally subdued until the end of the second Samnite War, when they seemed to have received a limited form of franchise. After the Social War the folk of Cliternia and Nersae appear united in a *res publica Aequiculorum* which was a *municipium* (*q.v.*) of the ordinary type. The Latin colonies of Alba Fucens (304 B.C.) and Carsoli (298 B.C.) must have spread the use of Latin (or what passed as such) all over the district; through it lay the chief (and for some time the only) route (via Valeria) to Luceria and the south. At the end of the republican period the Aequi appear, under the name Aequiculi or Aequicoli, organized as a *municipium*, the territory of which seems to have comprised the upper part of the valley of the Salto, still known as Cicolano.

Of the language spoken by the Aequi before the Roman conquest we have no record; but since the Marsi (*q.v.*) who lived farther east, spoke in the 3rd century B.C. a dialect closely akin to Latin, and since the Hernici (*q.v.*) their neighbours to the south-west, did the same, we have no ground for separating any of these tribes from the Latian group.

See the articles MARSI, VOLSCI, and the references there given; R. S. Conway, *The Italic Dialects*, pp. 300 et seq. (1897).

AERARII, a class of Roman citizens subject to a poll-tax arbitrarily fixed by the censor (from Lat. *aes*, in its subsidiary sense of "poll-tax"). They were (1) the inhabitants of conquered towns who possessed the *ius conubii* and *ius commercii*, but no political rights; Caere is said to have been the first example of this (353 B.C.); (2) full citizens subjected to civil degradation (*infamia*) owing to their employment or to conviction for crime; (3) persons branded by the censor. Those who were thus excluded from the tribes and centuries had no vote, were incapable of filling Roman magistracies and could not serve in the army. According to Mommsen, the *aerarii* were originally the non-*assidui* (non-holders of land). The expressions "*tribu movere*" and "*aerarium facere*" are explained by A. H. J. Greenidge—*the first as relegation from a higher to a lower tribe or total exclu-*

sion from the tribes, the second as exclusion from the centuries. Other views of the original *aerarii* are that they were: artisans and freedmen (Niebuhr); inhabitants of towns united with Rome by a *hospitium publicum*, who had become domiciled on Roman territory (Lange); only a class of degraded citizens, including neither the *cives sine suffragio* nor the artisans (Madvig); identical with the *capite censi* of the Serbian constitution (Belot, Greenidge).

BIBLIOGRAPHY.—See A. H. J. Greenidge, *Infamia in Roman Law* (1804), where Mommsen's theory is criticized; A. S. Wilkins in Smith's *Dict. of Greek and Roman Antiquities* (3rd ed., 1891); J. E. Sandys, *Companion to Latin Studies*, with useful bibliography (1921); W. E. Heitland, *The Roman Republic* (1923).

AERARIUM, in ancient Rome the public treasury. The treasury contained the moneys and accounts of the State, the standards of the legions, the public laws, the decrees of the senate, etc. These were deposited in the temple of Saturn and, during the republic, were in charge of the urban quaestors (see *QUAESTOR*), under the control of the senate. In 28 B.C. Augustus transferred the *aerarium* to two *praefecti aerarii*; in 23 B.C. these were replaced by two praetors (*praetores aerarii* or *ad aerarium*), selected by lot during their term of office. In addition to the common treasury, there was a special reserve fund, also in the temple of Saturn, the *aerarium sanctum* (or *sanctius*), originally consisting of the spoils of war, afterwards maintained chiefly by a 5% tax on the value of all manumitted slaves.

This fund was not to be touched except in cases of extreme necessity. Under the emperors the senate continued to have the nominal management of the *aerarium*, while the emperor had a separate exchequer, called *fiscus*, filled largely with the profits from the imperial domains in Egypt and elsewhere. But after a time, as the power of the emperors increased, this distinction virtually ceased. Besides creating the *fiscus*, Augustus also established in A.D. 6 a military treasury (*aerarium militare*), endowed by the emperor himself (see *Monumentum Ancyranum*, iii. 35) and supported by the proceeds of the tax on public sales and the succession duty. Its administration was in the hands of three *praefecti aerarii militaris*, senators of praetorian rank.

The *tribuni aerarii* have been the subject of much discussion. By the *lex Aurelia* (70 B.C.) the list of *iudices* (jurymen) was composed, in addition to senators and equites, of *tribuni aerarii*. Whether these were the successors of the *tribuni aerarii* who in earlier times were paymasters of the troops, etc., or a new order closely connected with the equites, is uncertain. According to Mommsen, they were persons who possessed the equestrian census, but no public horse. They were removed from the list of *iudices* by Caesar, but replaced by Augustus. According to Madvig, the original *tribuni aerarii* were not officials but private individuals of considerable means, who undertook certain financial work connected with their own tribes. The term was subsequently extended to include all those who possessed the property qualification that would have entitled them to serve as *tribuni aerarii*.

BIBLIOGRAPHY.—See Tacitus, *Annals*, xiii. 29, with Furneaux's notes; J. E. Sandys, *Companion to Latin Studies* (1921), useful bibliography. On the *tribuni aerarii*, see A. H. J. Greenidge, *Legal Procedure* (1901); W. E. Heitland, *The Roman Republic*, §957 (1923).

AERATED BREAD. Ordinary bread is leavened by yeast, the vesicular texture being imparted by the consequent fermentation, which produces carbonic acid gas. Dr. Dauglish invented a process by which bread is directly charged with carbonic acid gas, and to bread so lightened the name "aerated" is given. Machinery for the purpose was first devised about 1860. In the aerating process, the carbonic acid gas is supplied to the flour in conjunction with the water, and the lightening is thus performed without any decomposition whatever. For this reason it is claimed that aerated bread will agree with persons who find they cannot digest ordinary bread through the fermenting process continuing after the bread is eaten.

The mixing of aerated bread is performed in a hollow air-tight receptacle by the revolution of iron arms fixed upon a central spindle. Aerated water is pumped into the mixing receptacle at a very high pressure, and when the kneading is finished a valve is opened

at the bottom of the mixer and the dough is forced out by the elasticity of its contained carbonic acid gas. As the dough issues from the machine it is cut off in portions of the required weight and goes forward in tins to the oven. The aerated process is much quicker than the ordinary method of breadmaking with yeast, as with the former an hour and a half serves for the entire conversion of a sack of flour into baked loaves, whereas with the latter process four or five hours are occupied in the formation of the dough and a further period of approximately an hour and a half in the moulding and baking.

Perry and Fitzgerald developed a process for mechanically injecting carbon dioxide into a dough while it is being mixed, and claim a patent was issued on March 9, 1885. Their method differs from the Daughlish process in that the gas is injected directly into the mixer while the dough is being mixed. Bailey and Le Clerc, of the U.S. department of agriculture, published a method in which hydrogen peroxide is used as the aerating agent for leavening bread doughs and the like. Carbon dioxide in the compressed state known as "dry ice" has also been recommended as a means of aerating doughs for bread making purposes.

AERATED WATERS or CARBONATED BEVERAGES. These may be divided into two classes, namely, aerated table waters, and effervescent beverages. The latter are flavoured and are known in the United States as carbonated beverages, also as "soda water," "soda" and "pop," and include ginger ales. Natural and synthetic flavours are used. Natural flavours are from fruits, nuts, roots, herbs, bark and leaves of plants. Synthetic flavours are also made in the laboratory.

Aerated waters are essentially nonalcoholic beverages artificially saturated at the normal temperature with carbon dioxide, the pressure varying according to the type of beverage. Artificially aerated waters had their inception in Priestley's success in 1772 in producing aerated water in imitation of naturally aerated mineral spring water. Large-scale manufacture of aerated water was commenced by Paul at Geneva in 1790 and shortly afterwards by Schweppe in London. In the United States Priestley's experiments interested a Philadelphia physician, Dr. Philip Syng Physick, and he induced a chemist, Townsend Speakman, of the same city, to prepare carbonated water for his patients. Speakman added fruit juice as a flavour and the soft-drink industry in the United States started at that time, 1807. From the original conception of the imitation of natural carbonated water from springs the industry has broadened to include the production of aerated sweetened drinks and substitutes for beverages, such as cider, which are aerated by fermentation. The technique of large-scale aerated-water manufacture and the apparatus employed have undergone very considerable improvement since the beginning of the 20th century. Small-scale production of aerated water has also been rendered much simpler than formerly, when the cumbersome seltzogene apparatus was the only means for small-scale aeration of water.

Raw Materials.—Used in the manufacture of aerated waters are water, carbon dioxide, sugar and certain artificial sweeteners, acidifying materials, fruit juices, artificial fruit essences, essential

oils, vegetable extracts, mineral salts and foam-producing materials.

The water employed must be unexceptionable as regards purity, both from chemical and bacteriological standpoints. To this end it is customary to filter the water through an effective filtering medium, for example, kieselguhr, unglazed porcelain, filter paper or cloth. The water must also be free from objectionable colour, odour and taste. It is sometimes necessary to rectify waters which are either too hard or too soft for the purpose in view, also in some cases manufacturers use distilled water for special purposes.

Carbon dioxide is produced as a by-product in the combustion of coke in burning limestone to quicklime, or from sulphuric acid and carbonates, or recovered as a by-product from fermentation processes. It is either made in a special gas generator in the aerated-water factory or is purchased in a highly compressed or liquefied state in steel cylinders. In either case it must be free from objectionable taste.

Dry ice is also used extensively with the aid of special apparatus by which the evolved gas may be led directly to the carbonator. Carbonation furnishes in the finished beverage a gaseous pressure of from 40 to 80 lb. per sq.in. depending upon the type of product. High-pressure carbonation is used on ginger ales, and is carried on at about 55° and impregnates the beverages with as high as four and one-half volumes of gas. Low pressure is used on fruit drinks, at about 40° to 42° and as low as one volume of gas may be employed.

THE SUGAR CONTENT

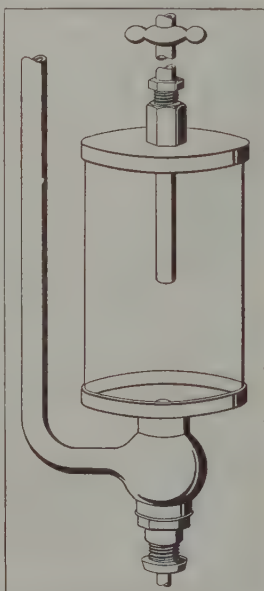
Sugar is specially manufactured for use in aerated-water production. The best grade canners' cane or beet sugar should be used. High grade dextrose and highly refined corn syrup are also used to some extent. The sugar is highly refined by animal charcoal, no blue material having been employed to produce whiteness. Especial care is taken in the refining process to render the sugar free from sediment or scum when made into syrup. Artificial sweeteners, of which saccharin is the chief, are permitted in some countries, and such sweeteners are employed for special purposes, as in cases where sugar is undesirable because of its tendency towards fermentation, or in periods when sugar is expensive or difficult to obtain. Saccharin may be obtained in very high degrees of sweetening power, for example 550 times the sweetening power of sugar. In the United States the use of saccharin is prohibited by the Federal Food, Drug and Cosmetic act and by the laws of many states.

The acidifying materials commonly used in aerated waters are citric acid, tartaric acid, malic acid, phosphoric acid and lactic acid. These acids should be free from metallic and arsenical contamination. They must be of edible grade.

Fruit Juices and Fruit Concentrates used for aerated or carbonated beverages are usually treated to eliminate the albuminous and pectinous matter and finally filtered, so that the finished beverages may be as clear as possible. However, there are also many natural fruit or combination of natural fruit and synthetic flavoured beverages with a cloudy appearance. Concentrated fruit flavours may consist of a blend of fruit juice and fruit oil, *i.e.*, from the peel of citrus fruits, and synthetic fruit esters, or a combination of two or more of these. Essential oils, *e.g.*, lemon, orange, lime, etc., are also employed for flavouring purposes, usually after they have been deprived of their insoluble terpenes and sesquiterpenes by fractional distillation. Vegetable extracts of either aqueous or alcoholic nature are prepared from herbs, roots and seeds for use in the production of ginger and herbal beverages. Mineral salts, *e.g.*, sodium bicarbonate, sodium sulphate, calcium chloride, sodium chloride, etc., are used in the preparation of table waters.

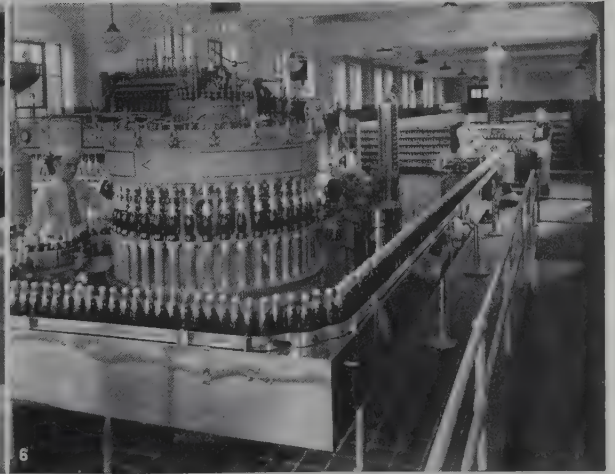
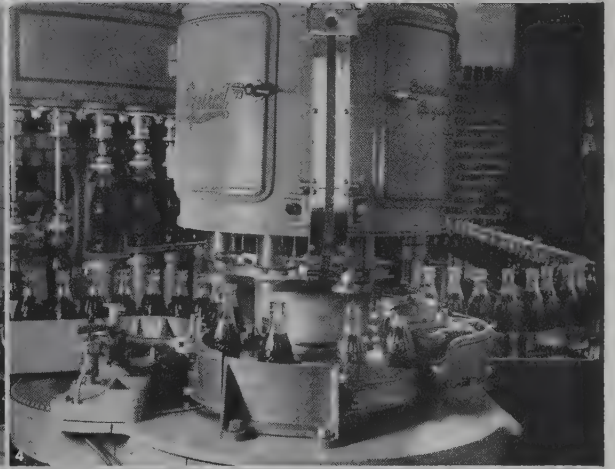
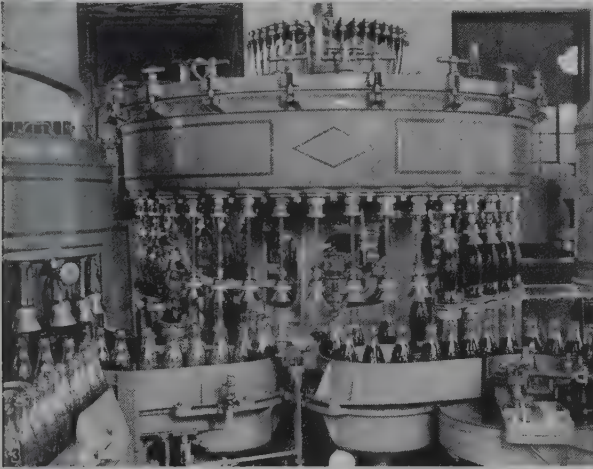
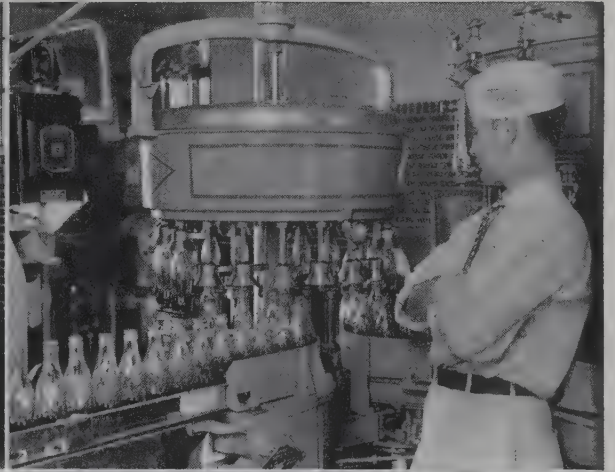
In some countries the use of small quantities of saponin bodies is permitted for the production of foam, such bodies being known as "froth-heading." Other substances which are used for this purpose are liquorice extract, for dark-coloured beverages, and various gums.

Colouring matter is frequently added to aerated beverages. This usually takes the form of burnt sugar or caramel for brown-



A DEVICE FOR MEASURING SYRUP INTO AERATED WATER BOTTLES

The syrup enters from the bottom and ceases to flow when it reaches the air tube. The bottle, pressed against bottom nozzle, cuts off the supply tube and opens the discharge valve. The bottle when removed, closes the discharge valve and opens the supply tube and the syrup again enters.



BY COURTESY OF THE COCA-COLA COMPANY

MODERN MACHINERY FOR THE BOTTLING OF AERATED OR CARBONATED WATERS

1. The large machine is the bottle washer, by means of which the bottles are thoroughly cleaned and sterilized by subjecting them inside and out to a strong hot solution of caustic soda in repeat operations. In the final operations they are thoroughly brushed and rinsed with clear, pure water
2. After leaving the washer, the bottles are carried on an endless belt chain to the first step in the filling operation. In the machine pictured here each bottle receives an exact measured quantity of syrup
3. The second step in filling operation—where an exact measured quantity of carbonated water is placed in each bottle. The bottles proceed to this filling apparatus directly from the machine in which the syrup has been placed in the bottles
4. The third and final step in the filling operation. Here the bottles are sealed by the affixing of a crown. From the time the bottle enters the washing machine until it is sealed, it is not touched by human hands
5. This interesting equipment inverts each bottle several times as it passes around the circle thoroughly mixing the syrup with the carbonated water
6. "On parade." After final inspection, the bottles are automatically conveyed to the end of the line, where they are placed in cases

In picturing this method of bottling, we are using photographs of the bottling of the product, "Coca-Cola." The name "Coca-Cola" is a trade mark.

coloured drinks, and specially pure coal-tar colours for other beverages.

BOTTLING METHODS

The apparatus used in aerated-water bottling is of a highly specialized nature. The bottles are washed by machines of various types, some of the larger being capable of cleansing 1,000 dozen bottles per hour. The bottling units are capable of measuring into each bottle the correct amount of syrup, filling with carbonated water, sealing and labelling. The bottles used for aerated-water bottling are of four main varieties: (1) Codd's bottles, in which the bottle is sealed by means of a glass marble held against an india-rubber ring by the gas pressure; (2) crown cork bottles, which are securely sealed by a cork-lined metal cap clamped on to a shallow boss on the top of the bottle mouth; (3) screw-stoppered bottles, in which a lignum-vitae stopper screws down on to an india-rubber ring; and (4) swing lever stoppered bottles, in which a porcelain stopper is held down on an india-rubber seating by a strong wire lever acting upon the bottle neck. In the United States the use of crown cork bottles is almost universal. Aerated beverages are also largely sold in siphons, the gas pressure serving to discharge the container. Aerated waters are very simply produced on a domestic scale, in protected siphons, the aeration being accomplished by means of carbon dioxide contained in small steel cylinders.

Typical Compositions of various types of both table waters and sweetened aerated waters vary widely, each manufacturer adjusting his product according to his judgment of popular taste and the type of water he is using. The following examples of dosage for the production of table waters are given, taking soft or distilled water as a basis.

Soda Water.—Three and one-half oz. of a mixture of sodium carbonate 15 parts, magnesium chloride $6\frac{1}{2}$ parts, calcium chloride $6\frac{1}{2}$ parts, are dissolved in 10 gal. of water. This is strictly a table water and should not be confused with the term "soda water" used in the United States for flavoured beverages.

German Table Water.—Five and one-half oz. of mixture of sodium carbonate 10 parts, sodium chloride 10 parts, sodium sulphate 1 part, magnesium chloride 8 parts, calcium chloride 5 parts, are dissolved in 10 gal. of water.

The dosage employed in the preparation of aerated imitations of natural mineral waters (*see* MINERAL WATERS) is much heavier than in the preparation of table waters, and many salts are included which have well-marked medicinal properties.

The basis of sweetened aerated waters is the syrup, which contains the acidifying material, flavour and colouring matter in addition to the sugar. Usually the syrup contains about 60% of sugar and is employed in the proportion of 1 to 2 oz. for bottles of from 6–12 oz. of finished beverage. The sugar content of carbonated beverages in the United States is from 6–17%, an average of 11%. This is a food value of approximately 80–100 calories for 8 oz. of beverage. The acidity of the syrup is equivalent to from 0.5% to 1.0% citric acid, depending on the flavour used and on the taste desired in the finished beverage. The colouring matter is varied according to the type of fruit which the drink represents. Most essences employed for flavouring aerated beverages are standardized so that they may be used to the extent of $1\frac{1}{2}$ –2 oz. per gallon of syrup.

Thus in the preparation of a lime-juice syrup the following essence may be used in the proportion of 2 oz. per gallon of syrup: terpeneless West Indian distilled oil of limes 1 part, alcohol 60° O.P. 28 parts, distilled water 16 parts. In the preparation of beverages of an herbal or root-beer type, a smaller proportion of syrup is employed so that the beverages may not be too sweet.

Also, a small proportion of foam-producing material may be employed.

Consumption.—In the United Kingdom, the dominions and other countries where the sale of alcoholic beverages is permitted, consumption of aerated nonalcoholic drinks depends largely on weather conditions and on prices. Taking as example the United Kingdom, the sale of aerated beverages in many years has been

restricted by the succession of wet, cold summers and by the high prices of such drinks consequent upon burdens being placed upon the industry by the government.

Only a small proportion of the total production of table waters was exported. As regards the imports of table waters, these were almost wholly of an unsweetened nature, and they amounted to about 8% of the quantity of similar waters produced in the United Kingdom as shown by the reports of the commissioners of customs and excise.

There has been a tremendous increase in the consumption of "soft drinks" in the United States during recent years as a result of increased capacity for production enabled by inventions and improvements of manufacturing equipment, co-operation of the manufacturers through their trade associations with state and federal authorities to prevent the use of inferior ingredients and to promote highest standards of sanitation in manufacturing and marketing, and to extensive advertising.

According to statistics issued by the American Bottlers of Carbonated Beverages, the national trade association of the manufacturers of "soft drinks," the bottled soft drink industry in the United States consisted in 1943 of more than 6,000 plants, with an estimated total investment of \$500,000,000 to \$600,000,000, employing between 80,000 and 100,000 people, and operating more than 50,000 trucks.

The industry uses more than 250,000 tons of sugar annually, according to a 1943 estimate of the United States department of agriculture, and the association estimates that the annual sales of bottled soft drinks, based on the biennial census of manufactures and other known factors, was for the period 1935–43 as follows:

Year	Value of Production	Year	Value of Production
1935	\$159,939,553	1940	\$411,699,200
1936	211,271,670	1941	553,834,160
1937	278,616,036	1942	502,656,000
1938	325,911,074	1943	444,250,000
1939	361,690,917		

AERIAL, an elevated wire or group of wires forming the principal part of a radio antenna of the open or "condenser" type. (*See* ANTENNA.)

AERIAL LAW (AIR LAW), the law governing use of the airspace and occurrences therein. Although the air is traversed by a variety of objects, such as projectiles and domesticated birds, capable of creating legal problems, the problems arising out of the growing use of aircraft so overshadow all others that in practical effect air law is the law of aircraft. A strict interpretation might exclude legal problems arising out of the contact of aircraft with the ground, or their presence on the ground; but in common practice the phrase is taken to include such problems as well as those arising during actual flight. Thus the major bodies concerned with the study of air law have given attention to such matters as the conditions of use of airports and the liability of the owners of a wrecked aircraft to its salvagers, as well as to the problems engendered during actual flight.

Sovereignty.—The two most fundamental questions of air law are those of national sovereignty in airspace and of private ownership therein. The former, no longer a practical question, had been settled, at least from 1919, by universal recognition that sovereignty in airspace, elsewhere than over the high seas, is held by the sovereign of the underlying territory.

In the early days of air navigation, when pilots of free balloons were unable to control their course but, on the other hand, were not subject to the liability of immediate forced descent as the result of mechanical failure, a considerable body of jurists (mainly of French nationality) maintained an analogy between the upper air and the high seas, both alike being held free of national jurisdiction. The early aeroplanes, however, with their periodic reminders that gravity operated even at the highest levels, and that forced descent held hazards for persons and property on the surface, introduced an element for which the high seas had no analogy. Growing fear of aerial espionage as World War I approached made it increasingly plain that governments would insist

on the prerogatives of national sovereignty in airspace as a condition of national safety. Following that war there was even less likelihood that nations would forego the assertion of sovereign right in the airspace above their territory; and discussions of the public law of the air thereafter invariably proceeded on the assumption that they would not.

Privileges of International Flight.—Although sovereignty has thus been long unchallenged, nations may agree among themselves to restrict the exercise of their sovereignty in any way and to any extent that they find advantageous. In particular, they are able to concede to one another the right for their aircraft to pass through one another's airspace, subject only to such limitations as they may agree to impose. Provisions of that character appeared in two major international conventions on the navigation of the air drawn after World War I: (1) the convention relating to the regulation of aerial navigation, opened for signature at Paris on Oct. 13, 1919; and (2) the convention on international civil aviation, opened for signature at Chicago on Nov. 1, 1944, which superseded the convention of Paris. The two conventions were alike in granting civil aircraft registered in any contracting country the right of free passage through the airspace of other contracting countries, provided that such aircraft were not engaged in the operation of a regular air transport service. Establishment of such regular services, on the other hand, was possible only through supplementary agreements among the nations concerned. The pertinent provisions of the Chicago convention which was in force among 58 nations at the beginning of 1950 follow:

Each contracting State agrees that all aircraft of the other contracting States, being aircraft not engaged in scheduled international air services, shall have the right, subject to the observance of the terms of this Convention, to make flights into or in transit non-stop across its territory and to make stops for non-traffic purposes without the necessity of obtaining prior permission, and subject to the right of the State flown over to require landing. (Art. 5)

No scheduled international air service may be operated over or into the territory of a contracting State, except with the special permission or other authorization of that State, and in accordance with the terms of such permission or authorization. (Art. 6)

The Chicago convention of 1944 was more restrictive than its predecessor of 1919 in respect of aircraft engaged in commercial services other than those of scheduled air transportation (e.g., the carriage of cargo by special contract). Under article 5 such operations were made subject to the right of any country in which commercial loads were to be picked up or discharged "to impose such regulations, conditions or limitations as it may consider desirable." During the first years of operation under the Chicago convention this provision was interpreted by numerous nations to require prior permission for any commercial flight of a foreign aircraft into their territory, and thereby substantially to nullify the benefits of the general declaration of right to fly internationally without securing prior permission, insofar as such aircraft were concerned.

The privilege of freedom of aerial transit and landing was extended to scheduled air transport services by a supplementary agreement, the International Air Services Transit agreement, also drafted at the Chicago conference of Nov. 1944. This agreement did not convey any right to engage in commerce within the territories of the participating nations, but the latter did grant to each other's regular air lines the privileges of flying across their territory without landing, and of landing for refuelling or mechanical attention. It was thus possible to establish a regular air service between the United States and Sweden, for example, merely by agreement between those two countries, and to land the aircraft of such a service at intermediate points for refuelling, since Canada, the United Kingdom (for Newfoundland), Iceland and Norway, as well as the United States and Sweden, had signed the agreement. By the end of 1949 the agreement had been accepted by 40 countries; but a number of countries occupying geographical positions of major importance along the world's air routes, such as France, Brazil, China, Ireland and Portugal, still withheld acceptance.

National Legislation on Air Navigation.—In virtually every nation, legislation had been adopted by 1948 to define the

conditions under which civil aircraft might operate. Such legislation had of course to be in conformity with the terms of any international convention to which the nation was a party, and in many cases was based largely upon the Chicago convention.

All such statutes provided for the registration of aircraft and for the verification of their airworthiness; for the licensing of operating personnel; and for the making of appropriate safety regulations. In some instances, certain of the rules on these subjects were set out in some detail in the legislation itself; but it had become more usual practice for the legislation to empower the executive to adopt appropriate regulations and amend them from time to time without reference to the legislative body.

It became general practice, too, for the national government to establish and operate airports, radio aids to navigation and other facilities for air navigation. In many cases the legislation provided for a measure of economic regulation, or defined the conditions under which private interests might be allowed to engage in air transportation or other commercial activities in the air. Sometimes all these subjects were treated in a single act, but more often they required several pieces of legislation.

The cases of the United Kingdom and the United States may be taken as representative examples. In the United Kingdom the first effective legislation of this character was the Air Navigation act of 1920, drawn to give effect to the terms of the Paris convention of 1919. The supersession of the Paris convention by that of Chicago made new legislation necessary, and the Air Navigation act of 1947 was enacted. The act was a simple one, its principal effect being to permit the executive (i.e., the minister of civil aviation) to issue orders in council for carrying out the Chicago convention and any international standards adopted in accordance therewith, and generally for regulating air navigation. The British act also authorized orders in council to apply customs regulations to the movement of aircraft, to regulate service charges at aerodromes and the conditions of commercial carriage of passengers or goods, and to prohibit the display of any signal or light likely to endanger aircraft. The last point, appearing also in U.S. legislation, was noteworthy as acting, in the interest of the safety of air navigation, to impose obligations or prohibitions upon ground personnel not themselves connected with aeronautics. (For further examples see *The Law of Airports*, below.)

In the United States the introduction of national legislation was complicated by constitutional questions. The first legislation was that of individual states, some of which (Connecticut first) adopted aircraft acts as early as 1914.

The possible extent of the federal government's jurisdiction over civil flight was widely debated in the years immediately following 1918. It came to be generally accepted that interstate operations might be regulated under the interstate commerce clause of the constitution, even though such operations were not explicitly "commercial" in the ordinary sense of the word; and the Air Commerce act of 1926, the first national legislation of the sort, assumed that power. The rules of flight and those affecting aircraft navigation lights and kindred equipment applied under the Air Commerce act to all aircraft operations within the territory of the United States, since a violation of the rules of the air by any aircraft would be an obvious hazard to other aircraft engaged in the interstate operations to which the act directly related. The obligation to prove the airworthiness of aircraft and the competence of the flying personnel and to register the aircraft and secure personnel licences applied under the act only to aircraft and personnel engaged in interstate operations. Those operating within the bounds of a single state were exempt from licensing requirements, except insofar as a number of states adopted legislation to make the holding of federal licences and aircraft registrations a necessary requirement of flight within their territory. Other states set up licensing systems of their own, with a duplication of state and federal authority and of examination and inspection procedure resulting in some cases.

In 1941 the Civil Aeronautics board, to which federal regulatory powers had been transferred from the secretary of commerce,

adopted regulations to require that all aircraft and personnel operating within the United States, even in operations of purely intrastate character, be registered and licensed, on the ground that operation with flight personnel and equipment not meeting fixed and uniform standards would constitute an inherent hazard to interstate operations. Although there was some opposition to that extension of regulatory power, the requirements were upheld (the leading case being *U.S. v. Drumm*, U.S. District court of Nevada, 1944) so that the licensing system became nation-wide. Other federal commonwealths had constitutional difficulties analogous to those in the United States—especially Australia.

The Air Commerce act of 1926 was concerned almost exclusively with air navigation, authorizing the secretary of commerce to make safety regulations, grant licences and registrations and install and operate facilities necessary to safe navigation, such as airway lights and radio stations. Airports were expressly excluded from the authorization, since municipalities and private interests were expected to provide them. The Air Commerce act was superseded in 1938 by the Civil Aeronautics act, which created a new tribunal of five members to exercise most of the powers previously assigned to the secretary of commerce and also to preside over a new system of economic regulation of air lines, determining (among other things) on what routes operations should be permitted by U.S. lines, what line should serve each route, and what compensation the operator should receive from the government for carrying the mail. In 1940 a further change was made and the administrative functions under the act were returned to the department of commerce, but air navigation regulations continued to be adopted by the five-man Civil Aeronautics board.

Private Ownership in Airspace.—In the case of private ownership, the trend was opposite to that in national sovereignty. It was toward freedom of flight, rather than away from it.

The traditional rule, as cited by Sir William Blackstone but recognized long before his time, was that the ownership of the surface of the land conveyed rights extending indefinitely upward and downward, and in particular included all the airspace above the surface property. (For more detailed discussion, see Carl Zollmann, *Law of the Air* [1927]; Harold L. Brown, *Aircraft and the Law* [1933].) The right of real-property owners to make unlimited use of the airspace above their property, with only a few exceptions (see *The Law of Airports*, below) remained valid, but courts were virtually unanimous in holding that ownership conveys no right to forbid, or to receive compensation for, the passage of aircraft through that part of the airspace of which the owner is currently making no effective use. He might erect a tower 1,000 ft. high on his property, if he so desired (subject to zoning regulations) but if the actual structures that he erects are of no more than ordinary building heights, he cannot successfully claim trespass by aircraft which pass over his property, even though at an altitude much less than 1,000 ft. To make his claim good, the property owner must show the area of his actual use to have been invaded.

A decision by the U.S. supreme court (*Causby v. United States*, 1946) reads explicitly on this subject, as follows: "It is ancient doctrine that at common law ownership of the land extended to the periphery of the universe—*Cujus est solum ejus est usque ad coelum*. But that doctrine has no place in the modern world. The air is a public highway, as congress has declared. Were that not true, every transcontinental flight would subject the operator to countless trespass suits. Common sense revolts at the idea. To recognize such private claims to the airspace would clog these highways, seriously interfere with their control and development in the public interest, and transfer into private ownership that to which only the public has a just claim."

In considering whether there has been actual damage to the property holder, indeed, the rights of ownership are irrelevant. Claims have been successfully pressed on grounds of nuisance, of jeopardy to frightened livestock, etc., even when the aircraft alleged to have made the trouble clearly had not passed above the complainant's premises. The reality of nuisance or material damage has been the test.

The Law of Airports.—Actions for aerial annoyance come most frequently from people domiciled near airports where aeroplanes pass constantly along the same course and necessarily at comparatively low altitudes. In a number of cases courts have enjoined the establishment or the continued operation of airports where a strong showing of injury to the neighbours was made. The British Air Navigation act of 1949 met the resultant hazard to airport operation by a provision that no action should lie in respect of nuisance by reason of the noise and vibration caused by aircraft on any aerodrome on which the terms of any order in council regulating such matters had been complied with. The aerodrome management complying with the government's direction thus became immune from legal attack.

The property owner may seek to restrict the airport, but the airport may also restrict the adjacent property owner through appropriate legislation or regulation to prevent his use of his property in a fashion which would handicap or create hazards for air navigation. Numerous cities in the United States have adopted zoning regulations prohibiting the erection of structures of more than a limited height in the neighbourhood of airports—the allowed height usually decreasing as the ends of the airport runways are more nearly approached. Such zoning must of course not be so extreme in character as to work serious hardship on landowners. Where it would do so, as for example if safety of flight required that the structures on a given piece of land be only a few feet in height or even that there be no construction at all, compensation would have to be paid. The acquisition of the owner's rights in the airspace above his property, compensating him for a surrender in perpetuity of the right to occupancy above a stated level, is a possibility where such extreme restrictions are necessary; but airport zoning ordinarily imposes only moderate restrictions, and entails no compensation.

In most countries aerodromes are nationally licensed, and unlicensed places can be used for the landing and taking off of aircraft only under restrictive conditions, if at all. In the United States no such licensing exists, and any attempt to establish it might encounter constitutional difficulties on the ground that an airport is purely an intrastate activity, exempt from national regulation. The federal government's potential powers over airports derive from the attachment of appropriate conditions to the grant of national aid from which most airports have benefited, and from the power to make flight regulations prohibiting aeroplanes from landing and taking off at airports not possessing suitable characteristics. The latter power, however, has been but little used. (For an extensive discussion of the legal problems engendered by airports, see Charles S. Rhyne, *Airports and Courts* [1944].)

Private Air Law.—Private air law relates in general to the commercial relationship existing between the operators of aircraft and other persons. It is distinguished from public air law as represented in the Chicago convention; but the distinction cannot always be drawn with precision. It includes questions of liability for damage, the legal status of mortgages on aircraft, the special legal problems arising out of the insurance of aircraft and their occupants, etc. The extreme mobility of aircraft and the frequency with which they cross international boundaries made it particularly necessary that such matters be the subject of international agreement, to guard against conflict of jurisdiction, escape from obligation by transfer of property across a national boundary, or inequitable variations of practice from one point along a flight path to another. It would be manifestly inequitable, for example, if the amount recoverable by the heirs of the victim of an air transport accident were to be largely dependent upon the particular national territory within which the accident occurred.

Such subjects were for 20 years the care of the Technical Committee of Experts on Air Law (usually known as C.I.T.E.J.A., from the initials of the organization's French name) established on May 17, 1926, and absorbed into the International Civil Aviation organization in 1947. The members of C.I.T.E.J.A. did the preparatory work on the development of private law conventions, which were then formally considered for adoption

and opened to signature at international conferences on private air law. Conferences were held at Paris in 1925 (where C.I.T.-E.J.A. was initiated), at Warsaw in 1929, at Rome in 1933, and at Brussels in 1938. The most important accomplishment resulted from the second conference, and became commonly known as the Warsaw convention. Its primary purpose was to define the liability of air lines to passengers and shippers in case of disaster. It was widely accepted in Europe and to some extent elsewhere, although the 37 countries which had ratified the convention by Jan. 1, 1950 (excluding countries which no longer existed), included only 2 of the 20 Latin American nations. The limits of liability established by the convention were (at the dollar value of gold current in 1950) \$8,290 for each passenger and \$7.50 per pound for cargo. These figures were low as judged by the domestic practice of some nations, notably the United States, but high by the standards of others. Much preparatory work was being done in 1946-50 on the revision of the convention.

The conference at Rome in 1933 produced two conventions, the more significant of which governed the conditions and amount of liability of the operator of an aircraft for damage caused to parties on the ground. It set a maximum operators' liability for a single accident at approximately \$7.50 per pound of gross weight of the aircraft causing the damage, but with the further provision that the total liability could not in any case exceed \$133,000, whatever the size of the aircraft. To secure the benefits of these limits the convention provided that an aircraft operator must maintain a continuous guarantee of his readiness to meet claims, either by having insurance or by keeping a bond posted. The limits set may appear low; but it is obviously impossible for the operator of an aircraft to be bound to pay the full extent of any damage that an accident might cause to property on the surface. A single aircraft overtaken by disaster might cause a fire or explosion resulting in millions of dollars of damage. Even though limits were placed several times as high as those of the Rome convention, it would still be necessary for property owners wishing security to the full extent of possible damage to carry their own insurance against the results of an air disaster.

The Rome convention complemented that of Warsaw. Taken together, they defined substantially the total liability of an aircraft operator.

Another convention prepared at the conference in Rome dealt with the precautionary attachment of aircraft to ensure the satisfaction of claims against the owner, and exempted aircraft used in commercial transportation from such attachment.

Neither of the two Rome conventions had any extensive acceptance by the beginning of 1950. That on liability for damage on the ground had been ratified by only 5 countries, including Belgium and Brazil alone among the major operators of air transportation; and that on precautionary attachment by only 13. A revision of the convention on liability for damage on the ground was being actively developed in I.C.A.O.'s legal committee.

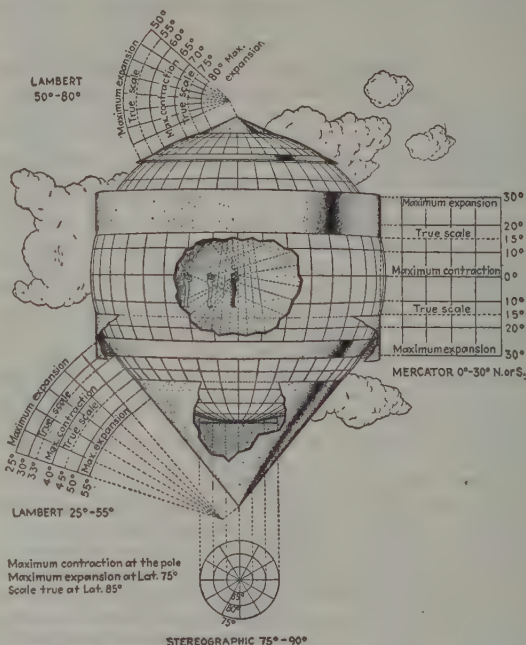
The conference at Brussels in 1938 produced a convention on the legal consequences of assistance and salvage of aircraft (or by aircraft) at sea. It fixed the maximum indemnity payable by operators of shipwrecked aircraft to rescuing vessels or aircraft at a maximum of approximately \$3,300 per person saved, or not in excess of \$33,000 in any instance. Supplementary provisions allowed additional indemnity for the saving of valuable property. Through 1949, the Brussels convention had not been ratified by any nation.

At the end of 1947 the work of developing such conventions had been transferred to the International Civil Aviation organization (I.C.A.O.). The 1948 assembly of I.C.A.O. adopted a convention on the registration of liens and mortgages on aircraft, to safeguard the mortgagee and thus make it easier to place such mortgages. Up to the summer of 1950, only the United States and Mexico had ratified the new convention.

BIBLIOGRAPHY.—C. N. Shawcross and K. M. Beaumont, *Air Law* (1950); John C. Cooper, *The Right to Fly* (1947); U.S. Aviation Reports (1928 *et seq.*) reporting important judicial and administrative decisions and legislation. (Ed. W.)

AERIAL NAVIGATION. Aerial navigation is the science which deals with the methods used to direct an aircraft in flight from one place to another, to determine its position while en route and to predict its time of arrival at some specified point on the route.

The study of air navigation is usually classified into four general methods: (1) pilotage; (2) dead reckoning; (3) radio navigation; and (4) celestial navigation.



FROM P. V. V. WEEMS, "AIR NAVIGATION" (MCGRAW-HILL)

FIG. 1.—ILLUSTRATION OF AERONAUTICAL CHART PROJECTIONS

Pilotage.—Pilotage is the method of directing aircraft from place to place by referring to visible landmarks on the earth's surface, such as church spires, lighthouses, beacons, railroads, rivers, mountains and lakes. In normal flight over land, with a suitable map and good visibility, the pilot guides his plane much as a tourist directs his automobile from a road map, by simple piloting, which is nothing more nor less than comparing objects observed from the plane with objects shown on the map.

Aids to Night Pilotage.—Types of aeronautical lights that are widely used in night pilotage or conditions of low visibility are:

1. Beacon lights, which mark major airways and airports. They consist of a searchlight which throws a beam of white light elevated several degrees above the horizontal and rotates six times per minute. Many of these beacons have auxiliary coloured lights which are used for identification or directional purposes. A green auxiliary light indicates the proximity of a lighted airport.
2. Approach lights, which are used as landing aids to pilots after the completion of instrument approaches. They are of several types and are arranged in several configurations. In general, they extend out from the end of the "instrument" runway and are of high intensity, so as to give the pilot a visual reference to the ground after the radio signals have led him down through the overcast to an altitude of from 200 to 500 ft.

Maps and Charts.—A map or chart is a representation of the earth's surface or a part of it on a flat piece of paper. An accurate chart is probably more important than any other item of equipment. If the destination is not in sight at the start, the navigator's first act is to look at the map to find the direction in which he must go to reach the desired destination. In the course of the flight, as the navigator fixes his position by any or all of the various methods, he plots his fix or determined position on

the chart and checks the direction from this fix to the destination.

Aeronautical charts have been designed and published in several series for use in contact flight, where pilotage is the primary method of navigation. Local charts on a scale of 1:250,000 were published for congested areas around important terminals. Sectional charts were published for the entire United States and for many foreign areas on a scale of 1:500,000, and came into general use for pilotage. By international agreement a world series of uniform charts on a scale of 1:1,000,000 was planned for pilotage on flights of aircraft with moderate to high air speeds.

Chart Projections.—The spherical surface of the earth obviously cannot be represented on a flat piece of paper without some distortion of certain features. In an ideal chart, distances, bearings, shapes and areas would be shown in their true relation, and the shortest distance between two points would be represented by a straight line. It is possible to preserve one of these properties by sacrificing some of the others, and maps are constructed by various methods of projection in order to preserve that feature which will be most useful for the particular purpose the map is to serve.

The principal projections used for aviation charts are the Mercator and Lambert conformal projections. The gnomonic projection is used to determine the great circle (shortest) route between distant terminals, and the stereographic projection is in general use for navigation in polar areas.

The stereographic chart is formed by projecting the earth's surface on a plane with the observer 180° away from the point of tangency of the plane. The stereographic chart is indicated for the south polar area with observer standing at the north pole (see fig. 1).

Theory of Dead Reckoning.—Dead reckoning is the method of determining a position by keeping an account, or reckoning, of the course and distance run from a previously known position called the point of departure.

Dead reckoning requires a knowledge of the direction and the speed of flight. In still air (*i.e.*, in the absence of wind) direction is obtained from the compass reading; the speed is read from the air speed indicator, and the navigator's task is simple. Generally, however, the position of an aircraft on the surface of the earth is the resultant of two distinct motions: the motion of the plane in the direction in which it is headed because of the driving power of the engine; and the motion of the air ocean itself relative to the earth, which is commonly referred to as the wind.

Hence, the navigator needs to keep an estimate of the velocity and direction of the wind at the height at which he is flying and to compute his dead reckoning position accordingly.

Triangle of Velocities.—The speed and direction of an aeroplane flying through the air, which itself is moving bodily in some direction, are given by the triangle of velocities.

Any velocity may be represented by a straight line with an arrow, by making the direction as shown by the arrow represent the direction of the motion, and by making the length of the line proportional to the speed. The resultant of two simultaneous velocities can then be found by starting from any point and drawing a line so that its length and direction represent one of the velocities, and from the end of this line drawing another line to represent the second velocity; the resultant velocity is found by closing the triangle in the reverse direction.

In fig. 2 let the line $E \rightarrow W$ represent a wind of 30 m.p.h. from

the west; and let the line $W \rightarrow P$ represent the heading and air speed of an aeroplane flying southeast through the air at 70 m.p.h. These two velocities form two sides of the triangle $EW P$, starting from E to W for the wind direction and speed and going from W to P for the heading and air speed. The motion resulting from the combination of these two velocities can be represented by the line $E \rightarrow P$, which closes the triangle in the reverse direction; in other words, $E \rightarrow P$ represents the track and ground speed. This triangle of velocities is of the utmost importance in all problems of dead reckoning, and it must be thoroughly understood.

In the chosen lettering: E = earth, W = wind, P = plane.

For example, $E \rightarrow P$ indicates the speed and direction of the plane relative to the earth—in other words, the plane's track and ground speed; $W \rightarrow P$ represents the speed and direction of the plane relative to the wind, which is the heading and air speed.

Radio Navigation.—Radio can be used in various ways as an aid to navigation. The more common of these navigational aids at mid-20th century were: (1) radio direction finders; (2) radio beacons; (3) low-frequency radio range stations; (4) radio location markers; (5) omnirange stations; (6) distance measuring equipment; (7) loran; (8) consol; (9) radar; and (10) instrument approach systems.

A *radio direction finder* is a radio receiver which uses a rotatable loop antenna. Since a loop antenna has directional characteristics, the direction of a transmitting station can be determined by observing the position of the loop when the minimum strength of signal is received. Radio direction finders may be installed at land stations or aboard ships and aircraft.

A *radio beacon* is a radio transmitting station which transmits a specified signal at regular intervals for use by radio direction-finding equipment.

A *low-frequency radio range station* is an installation consisting of two radio transmitters, one of which sends the letter "A" (—) and the other sends the letter "N" (—.). The signals are keyed automatically and so timed that the sequence is interlocking; that is, the dot of the letter "A" fills the interval between the dash and dot of the letter "N," and the dash of the letter "A" fills the interval after the dot of the letter "N." The transmitted signals are controlled in such a manner that in four directions about the station the signal intensities are equal, which results in the reception of a steady tone. This is known as the "on-course" signal. This signal is received in a sector about 3° in width and is commonly known as a radio beam.

Radio location markers are very-high-frequency radio transmitters located at radio range stations and on radio beams as position markers. The signals are transmitted in a narrow vertical pattern, and the markers on radio beams transmit a coded signal to provide identification of the beam. Their purpose is to provide pilots and navigators with positive check points on the airways and on the approaches to air terminals.

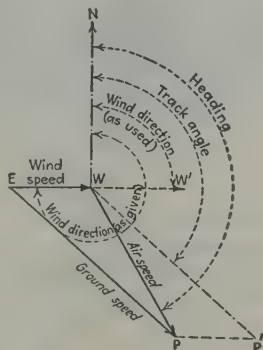
The *omnirange* is a very-high-frequency radio station that transmits a variable phase signal in all directions. With special receivers, a pilot can fly straight toward or away from this range on any of about 120 range legs, each about 3° in width. The low-frequency radio range system in the U.S. was being replaced by omniranges at mid-century.

Distance measuring equipment was developed for use in conjunction with omniranges. It is air-borne, and indicates to the pilot his distance in miles from an omnirange station where the DME transmitter also is located. In tests this equipment measured distances up to 100 mi. with an accuracy of about 98%.

Loran is a long-range navigational aid which was developed during World War II. Its accuracy compares favourably with that of celestial navigation, and its effective range for aircraft over water is about 700 nautical mi. by day and 1,400 nautical mi. by night.

The loran system consists of pairs of ground transmitters, an air-borne receiver-indicator, and specially prepared charts or tables for determining lines of position.

The pairs of loran transmitters are arranged in chains around the world, located primarily to cover heavily travelled ocean routes and coastal waters. Each pair consists of a master station



FROM P. V. H. WEEMS, "AIR NAVIGATION" (MCGRAW-HILL)

FIG. 2.—TRIANGLE OF VELOCITIES SHOWING DEAD-RECKONING TERMS. THE ANGLE NWP IS THE HEADING; ANGLE NWP' , THE TRACK; ANGLE NWW' , THE WIND DIRECTION; ANGLE PWP' , THE DRIFT ANGLE; LINE WP , THE AIR SPEED; LINE EP OR WP' , THE GROUND SPEED; LINE EW OR PP' , THE WIND SPEED

that transmits a pulsed signal which, after a fixed delay, triggers a slave station on exactly the same frequency.

The fundamental principles of loran are as follows: (1) pulsed radio signals are broadcast from a pair of transmitting stations in accurately known positions; (2) these signals are received visually on a specially designed receiver and one signal is superimposed on the other; (3) the difference in the time of arrival of these signals is measured on the indicator component of the receiver; (4) this measured time difference is used to locate the line of position of the observer on the loran chart; (5) the intersection of the lines of position obtained from two pairs of loran transmitters will give a loran fix and determine the position of the observer.

Consol.—Consol is the British name for an improved long-range radio navigational aid developed in Germany during World War II and known as Sonne.

In this system a specially designed transmitting station radiates a series of 60 dots and dashes that are interrupted by an equisignal which is directional to a fraction of a degree, except for two sectors of about 40° each, which are in line with the station antennae towers. These signals can be received with an ordinary low-frequency receiver.

By counting the dots and dashes heard on each side of the equisignal during a complete cycle of transmission, and referring this count to a chart with an overprint of consol lines or to consol tables, 12 lines of bearing will be indicated. The correct bearing can be obtained by applying the dead reckoning position or by taking a rough bearing with a direction finder.

Each station transmits an identifying signal and a steady signal for use by direction finding equipment as a part of each cycle. The time required to complete a cycle was originally two minutes; but the British station at Bushmills, North Ireland, was modified so that it could complete a cycle in 40 sec.

Radar (q.v.) was installed extensively in military aircraft and to a limited extent in commercial aircraft as a method of identifying landmarks at night and when flying in or above clouds. Radar also indicates the distance of an identified object from the observer. Its useful range, however, is limited to the line of sight distance.

Radar beacons were established at many points throughout the world at mid-century. These beacons operated only in conjunction with specially designed radar sets, and by their use the bearing and distance of the observer from the position of the beacon could be obtained.

Instrument Approach Systems.—In the United States the Civil Aeronautics administration developed a system for landing approaches under instrument conditions, commonly known as ILS (instrument landing system). It consists of: (1) a localizer radio beam for guidance to the airport runway; (2) a glide path radio beam for guidance in correct descent; and (3) fan markers to fix position along the approach path.

During World War II another system was developed for instrument approaches. This system used a talk-down technique and became commonly known as GCA (ground controlled approach). Its principle was based on following the path of an aircraft on ground radar equipment; by means of radio communication the pilot is given information regarding his position relative to the desired glide path and is issued instructions for letdown procedures.

Celestial Navigation.—Celestial navigation is the method by which an observer's position on the earth is determined by means of calculations based upon celestial observations. The equipment required consists of a sextant for observing the altitude of celestial bodies, an accurate timepiece, a current air almanac and a set of tables for reducing the observations of time and altitude as required.

Theory of Celestial Navigation.—An observer at any point on the earth's surface, except the poles, sees the altitude of any heavenly body change with time. The altitude can be calculated for any instant of time by methods described below.

The altitude of a heavenly body also changes with a change in the position of the observer. The amount of this change depends on the direction in which the observer moves relative

to the geographical position (G.P.) of the observed body. If he moves one mile directly toward the observed body, the altitude is increased by one minute; while if he moves in any other direction, the altitude is changed by a predictable amount.

The converse is also true; namely, if the altitude of a heavenly body is known, the distance from the geographical position of the body for the instant of observation is known. Celestial navigation is based on the application of this principle. Therefore, we may say that the work of the navigator in celestial navigation consists in finding his geographical co-ordinates of latitude and longitude by locating himself with reference to the geographical position of one or more celestial bodies.

The exact position of a body, in terms of declination and Greenwich hour angle, may be taken from the almanac for any instant of time, and this position may be plotted on a globe or chart as latitude and longitude. A circle with this position as centre, and with a radius equal to the observer's distance from this position as determined by the sextant (*i.e.*, 90° altitude), would be the observer's circle of position; the observer must lie somewhere on this circle called "circle of equal altitude." If two bodies were observed, the intersections of the circles of position would determine the position (or two possible positions) of the observer.

Since the circle of position as determined above would be very large, a small arc of the circle may be considered as a straight line, at some point on which is the observer's position. If it were possible to lay off on a chart with sufficient accuracy the distance of the observer from the geographical position of the body, celestial navigation would be easy. The observer would doubtless use a sextant graduated to read zenith distance (instead of altitude) in minutes, or nautical miles, and this distance would simply be used as the radius of an arc to be laid off on a chart from the plotted position of the body. Unfortunately, the great distances—up to 5,400 mi.—to be plotted make this simple and obvious method impracticable, but the desired effect is secured by the means about to be described.

The Line of Position.—It is not usual to include the whole earth on any one chart; only that part of immediate interest to the navigator is shown. Hence, the whole circumference of circles of equal altitude would not appear; since the radius of the circle is usually large, the small, slightly curved arc in which the navigator is interested may be replaced by a straight line without appreciable error. This line is called a line of position, or position line, or Sumner line after Capt. Thomas H. Sumner, a U.S. shipmaster, who discovered it in 1837.

Plotting a Position Line on a Chart.—To lay down a line of position on a chart by the method of Marq St. Hilaire, it is

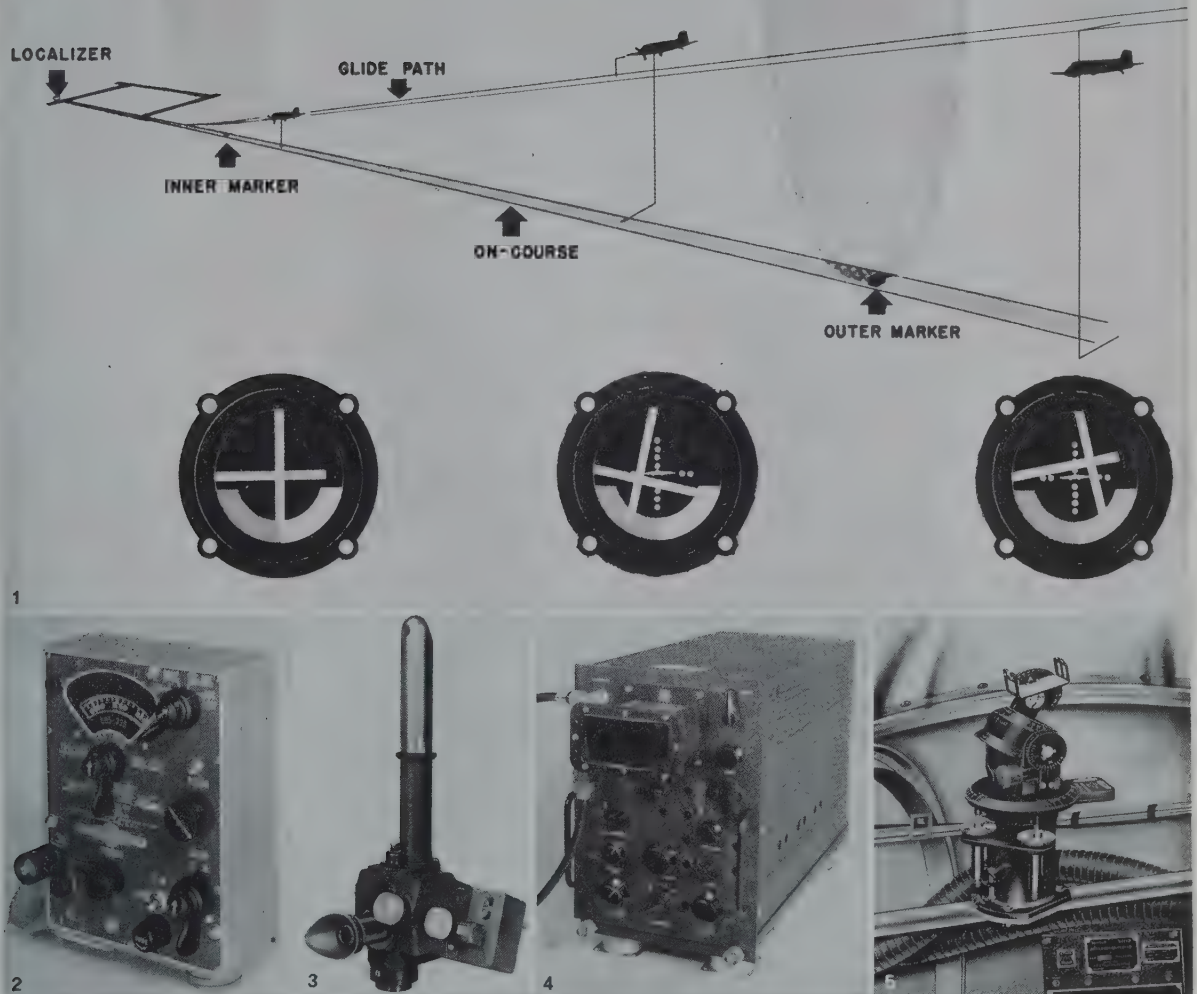
necessary to take the dead reckoning position, or some convenient point close to it, and to compute for this assumed position the altitude and azimuth of the observed body at the time at which the observation was made. If the altitude observed with the sextant agrees exactly with the computed altitude, the altitude difference is zero. Then it is necessary only to draw from the assumed position A (fig. 3) a line of bearing AB along the computed azimuth of the body and a line CAD at right angles to this; then CAD is the required line of position.

If, however, the observed altitude is greater than the computed altitude, say by 15 min. which equals 15 nautical mi. on the earth's surface, the observer is nearer to the geographical position of the heavenly body than the assumed dead reckoning position would indicate. In this case, the position line must be moved closer to the geographical position of the heavenly body by the amount of the altitude difference. Hence, the intercept AE is



FIG. 3.—PLOTING ALTITUDE DIFFERENCE AND LINE OF POSITION

FROM P. V. H. WEEMS, "AIR NAVIGATION" (MCGRAW-HILL)



BY COURTESY OF (1) CIVIL AERONAUTICS ADMINISTRATION, (2) BENDIX AVIATION CORP., (3) KOLLSMAN INSTRUMENT DIVISION OF SQUARE D COMPANY, (4) RADIO CORPORATION OF AMERICA, (5) T. C. LYON (FROM "PRACTICAL AIR NAVIGATION")

INSTRUMENTS USED IN AERIAL NAVIGATION

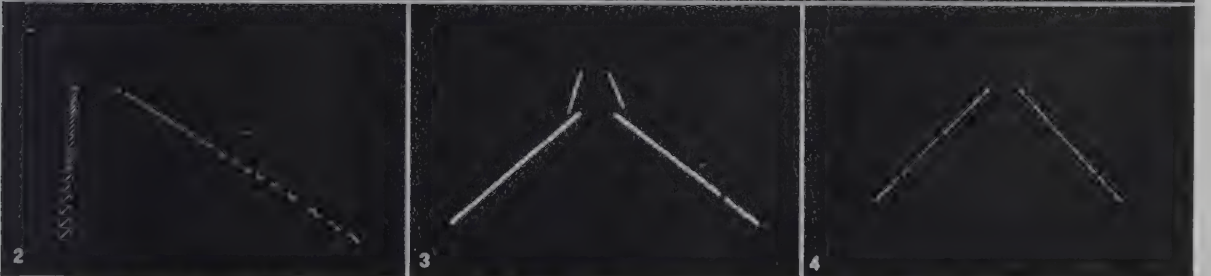
1. Instrument landing system showing the indications received on the aircraft instrument panel when the aircraft is off-course to right or left, and when above or below the glide line
2. Remote control unit of radio direction finder
3. Periscopic sextant with pendulous mirror, used in celestial navigation
4. Loran (Long Range Navigation) receiver for determining aircraft position by pulsed radio signals from land-based stations
5. Astro compass

AERIAL NAVIGATION



1. The globe represented by a series of Mercator and Lambert projections
2. Transatlantic navigator aboard a Lockheed Constellation. Spread on the table is a North Atlantic air map; on it (foreground) is an upper air chart on which lies a drift angle computer; right of the upper air chart is a dead-reckoning computer; between the upper air chart

and the air manuals lies a navigational plotter; on the manuals rests an aircraft octant; above the octant, on the panel, are: a sensitive altimeter, an air speed indicator, a free air temperature thermometer and a calibration card; right of the panel is a Loran receiver



BY COURTESY OF CIVIL AERONAUTICS ADMINISTRATION

LIGHTING USED IN AERIAL NAVIGATION

1. Elevated air beacon, used mainly to identify airports
 2.-4. Slope-line approach lights with runway lights in background:
 (2) pilot to the left and high, so that all lines point toward the

right; (3) pilot on good approach course but too low; (4) pilot
 at right height



BY COURTESY OF (1-3, 5) CIVIL AERONAUTICS ADMINISTRATION; PHOTO, (4) WIDE WORLD

AIRFIELDS IN THE UNITED STATES AND EUROPE

1. Washington National airport terminal building, Washington, D.C.
2. Lakefront Municipal airport, Cleveland, O.
3. A typical class 1 turf field

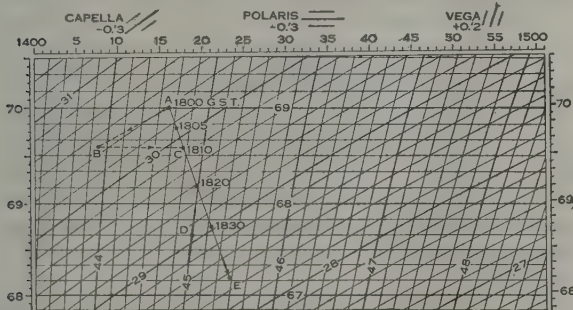
4. Tempelhof airport, Berlin
5. Aerial view of the terminal area at Washington National airport

laid off 15 nautical mi. toward the body along the computed azimuth, and the position line FEG is drawn, as before, at right angles to the azimuth line AB.

Summary.—Briefly, celestial navigation consists in finding and plotting on a chart one or more lines of position. One line of position gives the navigator certain useful information. Two or more lines of position determine by their intersection a definite position or fix. To determine a line of position, the navigator must take the following principal steps: (1) observe the sextant altitude of a known heavenly body; (2) note the exact time of the above observation; (3) take the declination and Greenwich hour angle of the observed body from the almanac for the G.C.T. of observation; (4) apply the assumed longitude to the Greenwich hour angle to find the local hour angle; (5) compute the altitude, using an assumed position, by solving the spherical triangle formed by the earth's pole, the geographical position of the observed body and the observer's assumed position; (6) compute the azimuth, using the same assumed position; (7) compare the computed and observed altitudes to obtain the altitude difference; (8) set off the altitude difference along the computed azimuth and draw the line of position at right angles to it.

Star Altitude Curves.—Using the principles for computing a line of position previously described, altitude curves for so-called "fixed" stars may be plotted against the co-ordinates latitude and sidereal time. Sidereal time is similar to civil time except it is based on the motion of the fixed stars, which causes it to differ from civil time by 3 min. 57 sec. daily.

Actually, the stars move by a small amount in various directions, which, when referred to the earth, causes a displacement of stars from zero to about eight-tenths of a mile annually and this correction must be made in the use of the curves. A portion of a page of the curves is shown in fig. 4 with a plotted example showing how they may be used.



FROM P. V. H. WEEMS, "AIR NAVIGATION" (MCGRAW-HILL)

FIG. 4.—SAMPLE STAR ALTITUDE CURVES SHOWING METHOD OF USE

Suppose a plane making 300 m.p.h. on course 240° true is at A, lat. 70° N., long. 56° W., at 1800 G.S.T., or 1416 L.S.T. (1800 less 3 hr. 44 min. for 56° W. longitude). In 10 min. the plane would travel 50 mi. on 240° and, with a page of the curves used as a Mercator chart, as shown in fig. 4, would arrive at point B, in lat. $68^\circ 36'$ N. Because of the distance travelled in 10 min., the altitude of Vega would change from $44^\circ 36'$ at A to $43^\circ 55'$ at B. In the elapsed 10 min. Vega's altitude increases at point B from $43^\circ 55'$ to $44^\circ 48'$ at C. The combined effect of change of position and 10 min. of elapsed time would change Vega's altitude from $44^\circ 36'$ to $44^\circ 48'$. If Vega's altitude at 1800 G.S.T. is $44^\circ 36'$ and at 1810 G.S.T. is $44^\circ 48'$, then for 1805 G.S.T. Vega's altitude is shown at once to be $44^\circ 42'$. In other words, the line AE is the loci of simultaneous altitudes of Vega, Capella and Polaris, provided the plane remains on its schedule. If at 1830 G.S.T. Vega's altitude is $45^\circ 00'$, the plane is at some point D about 12 mi. off course to right. If an observation of Polaris gives an altitude of $67^\circ 40'$ at 1830, the intersection with Vega gives D as the definite fix and the plane is shown to be 13 mi. 247° true from the scheduled 1830 position.

The only limitation to the star altitude curves is that observa-

tions are restricted to stars for which the curves have been plotted. An accurate solution may be made in about two minutes without the use of an almanac, without plotting lines of position and without knowing the latitude, declination or hour angle of the body. Simply find the intersection of the altitude of two or more stars, refer this to the latitude scale direct for latitude and to the time scale for the local time. This, subtracted from the Greenwich time, gives the longitude.

Comparison of Marine and Air Navigation.—High-speed ships are very little affected by the wind, and the current is much less important in its relative effect on the ship's motion than is true for the old sailing ships and slower ships. Accurate gyrocompasses and speed indicators give excellent account of the motion of the ship itself in the direction in which it is headed.

The aviator on the other hand is concerned with an entirely different "ocean." His aircraft sails in the atmosphere above the surface of the earth. The position of his plane with respect to the surface of the earth is the resultant of two distinct motions: the motion of the plane in the direction in which it is headed because of the driving power of the engine, and the motion of the air itself which is commonly referred to as the wind. The aviator's compass and his air-speed meter give him a fairly good account of the motion of the plane in the direction in which it is headed. But at mid-20th century his compass was still somewhat crude compared to the mariner's gyrocompass, and his air-speed meter was not so accurate as the patent log. The winds are far harder to predict than the ocean currents and their velocity is many times greater.

It is seldom that a current of four nautical miles per hour is encountered, but the speed of the winds may range to 100 m.p.h. or even more.

Thus, the motions which combine to cause the change of position of an aircraft are many times greater in amount and are less accurately known than those affecting a ship. Therefore, the dead reckoning position of an aircraft is more liable to be in error and the error far larger in amount. The aviator should check and correct this position whenever he can by reference to known objects on the surface of the earth, which is known as piloting; by radio bearings; and by observations of heavenly bodies.

Celestial navigation cannot be practised with the same degree of accuracy aboard aircraft as aboard ocean vessels. If a celestial fix obtained in marine navigation is considered to lie within one mile of the actual position, a comparable accuracy for air navigation would be five miles. This difference can be attributed to the higher degree of precision found in marine sextants and the steadier horizon used in marine navigation when taking celestial observations. The marine navigator uses the sea horizon, which is steady, while the air navigator must use a liquid or pendulous horizon, which is subject to movement because of aircraft accelerations.

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AERODROME or AIRPORT. Areas are set aside in every country of the world to serve as take-off and landing points for aircraft. Aerodromes or airports are commonly known by other names such as air terminals, air parks and airfields.

Airports around the world constitute one of the basic and most important segments of aviation.

In the United States alone on Jan. 1, 1950, there were 6,484 airports of all types and classes listed with the U.S. Civil Aeronautics administration. Included in the total were 2,200 municipal airports, 2,585 commercial airports, 353 military airports and 1,346 in other categories.

For statistical and identification purposes the Civil Aeronautics

Recommended minimum standards	Class 1	Class 2	Class 3	Class 4
Length* of landing strips (in feet)	1,800 to 2,700	2,700 to 3,700	3,700 to 4,700	4,700 and more
Width of usable landing strips (in feet)	300	500	500	500
Length of runways (in feet)	None	2,700 to 3,700	3,700 to 4,700	4,700 and more
Width of runways (in feet)	None	150 (Night operations) 100 (Day operations only)	200 (Instrument) 150 (Night operations) 100 (Day operations only)	200 (Instrument) 150 (Night operations) 100 (Day operations only)
Number† of landing strips and runways determined by percentage of winds, including calms‡, covered by landing strip and runway alignment	75%	80%	90%	95%
Facilities	Drainage Fencing Marking Wind-direction indicator	Drainage Fencing Marking Wind-direction indicator Lighting Hangar and shop Fuelling Weather information Office space	Drainage Fencing Marking Wind-direction indicator Lighting Hangar and shop Fuelling Weather bureau Administration building Two-way radio Visual traffic control Instrument approach system, when required	Drainage Fencing Marking Wind-direction indicator Lighting Hangar and shop Fuelling Weather bureau Administration building Two-way radio Visual traffic control Instrument approach system, when required

*All of the above landing-strip and runway lengths are based on sea-level conditions; for higher altitudes increases are necessary. One surfaced runway is recommended for the effective length of each landing strip for airports in classes 2, 3, and 4.

†Landing strips and runways should be sufficient in number to permit take-offs and landings to be made within 22½° of the true wind direction for the percentage shown above of winds four miles per hour and higher, based on at least a ten-year weather bureau wind record where possible.

‡Calms: negligible wind conditions of three miles per hour and lower.

administration classifies airports in the United States with the length of the longest runway or landing area, at sea level, as the major consideration, as follows:

Class	Runway length
Sub 1	Less than 1,800 ft.
1	1,800-2,700
2	2,700-3,700
3	3,700-4,700
4	4,700-5,700
5	5,700-6,700
6	6,700-7,700
7	7,700-8,700
8	8,700-9,700
9	9,700 and up

These lengths should be increased by 7% for each 1,000 ft. of elevation above sea level and further increased by .5% for each degree that the mean temperature of the hottest month of the year, averaged over a period of years, exceeds the standard temperature.

Broken down by class the total of 6,484 airports in the United States on Jan. 1, 1950, was as follows:

Class	Airports
Sub 1 and 1	4,100
2	1,027
3	576
4	447
5	185
6 and up	149

All runway lengths referred to in the classifications below and set forth in the accompanying table apply to airports located at sea level. For those appreciably above sea level, the minimum length of landing strip for each class must be increased enough to compensate for the decrease of density with altitudes. Thus, an airport 6,000 ft. above sea level needs in general a runway length almost 50% greater than would be needed for a field of the same class near to sea level.

Class 1 Airport.—Small communities having a population up to 5,000 which are not located either on the present or proposed air-carrier system should provide airports which can safely accommodate aircraft of the small private-owner type. It is recommended that under sea-level conditions the airport should be equipped with landing strips having a minimum length of 1,800 ft. to 2,700 ft. together with "clear approaches." (For additional data see the table.)

Class 2 Airport.—In larger communities having a general population range of from 5,000 to 25,000, located on present or proposed feeder lines where considerable aeronautical activity is present, the airport should safely accommodate the larger-

sized, private-owner-type planes and small-sized transport planes. For such airports it is recommended that under sea-level conditions they provide landing strips of at least 2,700 ft. to 3,700 ft. in length, together with "clear approaches." (For additional data see the table.)

Class 3 Airport.—Important cities having a general population range of from 25,000 to several hundred thousand, located on feeder lines or serving as intermediate points on main-line routes, should provide airports which can safely accommodate the present-day transport planes. To do this such airports under sea-level conditions should provide landing strips 3,700 ft. to 4,700 ft. in length together with clear and unobstructed approaches. (For additional data see the table.)

Class 4 Airport.—Cities representing the major industrial centres of the nation and serving as the most important junction points or terminals on the airway system should provide airports which can safely accommodate the largest aircraft in use and those planned for the immediate future. Such airports under sea-level conditions should provide landing strips 4,700 ft. and more, together with clear approaches. (For additional data see the table.)

The Civil Aeronautics administration estimated in Sept. 1945 that a total of \$1,027,159,417 had been expended on civil airports through July 1, 1945. Of this total, \$740,705,171 was in federal funds, \$10,155,266 in state funds, \$192,950,000 in municipal funds and \$83,348,980 in commercial and private funds.

On May 13, 1946, the congress of the United States passed the Federal Airport act, which authorized the expenditure of \$500,000,000 in federal funds over a seven-year period for the construction and improvement of airports in the United States and its possessions. The act designated the Civil Aeronautics administration to administer the provisions of the bill (public law 377). The act specified that federal funds would be appropriated on a yearly basis for seven years and would not exceed \$100,000,000 in any one year, and that federal funds would be matched by subunits of government-sponsoring projects.

As of Feb. 1, 1950, local and state project sponsors at 726 locations had received grants of \$98,100,000 in federal funds and had matched those funds with their own money.

Planning an Airport.—The first step and one of primary importance in planning an airport is the determination of the type and extent of activities the airport ultimately will serve, even though only partial development is to be undertaken initially. Anticipated future expansion of facilities and activities based on available data and estimates should be included in the original planning. In this respect acquisition of sufficient land to allow for orderly expansion and development is of vital

importance. Other considerations to be taken into account in the planning stage are the estimated number of passengers and cargo transport movements that may be expected at ultimate development, the number and type of aircraft likely to be based at the field, the extent of training activities and the volume of business resulting from sales and service at the proposed airport.

To obtain a correlation between the design of airports and the design of aircraft to be used in air-carrier operations the Civil Aeronautics administration developed technical standard order-N6A, which as amended on Oct. 4, 1948, has the purpose of: (1) guiding employees of the CAA regarding approvals and recommendations for runway design; (2) indicating to sponsors of airport development projects the runway characteristics to which federal funds will be applied; and (3) indicating to manufacturers and operators of transport-type aeroplanes the airport runways that will be available.

The standards outlined in TSO-N6A for air-carrier service are as follows:

Service	Runway (feet)		Taxi- way (feet)	Landing Strip (feet)	Pavement Loading (per wheel in pounds)	
	Length	Width	Width	Width	Single wheel	Dual wheel
Feeder	3,500	100	40	300	15,000	20,000
Trunk line	4,200	150	50	400	30,000	40,000
Express	5,000	150	60	500	45,000	60,000
Continental	5,900	150	75	500	60,000	80,000
Intercontinental . .	7,000	200	75	500	75,000	100,000
Intercontinental express	8,400	200	100	500	100,000	125,000

The types of service in TSO-N6A are defined in the following manner:

Feeder: Airports for feeder-type service.

Trunk line: Airports to serve on air-line trunk routes.

Express: Airports at large cities or important junction points on trunk routes.

Continental: Airports serving long nonstop continental flights.

Intercontinental: Airports serving long intercontinental or transoceanic flights.

Intercontinental express: Airports serving transoceanic flights of largest types of aircraft.

Locating the Airport.—The selection of a site for an airport is of tremendous importance and an extremely difficult task resulting from the variety of vital factors that must be considered. In most instances the final selection of a site is determined by compromise after a consideration of all elements. On one hand an airport must be conveniently located to the community it is to serve since airports are almost entirely dependent on public use for financial success. Important considerations here are public transportation and travel distance. On the other hand the physical features of the terrain under consideration are of great importance with regard to construction costs and the safe operation of the airport when it has been developed. In general, an elevated location is best suited for the location of an airport because of fewer obstructions along the approaches to the field, better natural drainage, less fog and more uniform winds. Valley sites have the advantage of requiring less grading and are most easily accessible to ground transportation and public utilities.

Airport Approach Protection.—Obstructions in the approach zones of an airport may restrict its use to certain types of operations and in some cases cause abandonment of an otherwise well-designed airport. To avoid such situations airport sites should be so selected that the approaches to the runways are free from obstructions such as power lines, smokestacks, tall buildings or radio towers. Before final selection the practicability of removing or reducing all obstructions to a safe height should be assured.

The following horizontal and vertical approach standards are recommended for obstruction clearance:

50-to-1 for runways to be used in instrument approaches.

40-to-1 for other runways to be used for scheduled air-carrier operations or by similar aircraft in nonscheduled operations.

20-to-1 for all runways or landing strips to be used exclusively by smaller aircraft.

For example, if an obstruction is 10 ft. high 700 ft. from the end of the runway, it would fall beneath the normal minimum flight path of an aircraft taking off or making a landing.

Wind Data.—Wind direction is a vital factor in the selection of an airport site and the layout of the runways since aircraft take off and land into the wind. Determination of the direction of prevailing winds is made by an analysis of weather reports in the area covering at least ten years.

Runways should be oriented so that aircraft may be landed at least 95% of the time with cross winds not exceeding 15 m.p.h. Usually, 95% wind coverage with cross-wind components not exceeding 15 m.p.h. will provide 98% to 100% coverage with less than 30 m.p.h. cross-wind components. Since almost all airports will serve light aircraft as well as transport types the wind data should be analyzed on the basis of the 15-mi. cross-wind component.

Drainage and Soil.—One of the most important considerations governing the location and selection of an airport site is the nature and composition of the soil and subsoil upon which it is to be built. For the economical development of the area for aviation purposes, and especially for the life and durability of paved runways, taxi strips and aprons, detailed knowledge of the soil at the site, and especially its behaviour in contact with water, is vitally important.

Adequate drainage is especially essential to the proper maintenance of paved runways, for experience shows that more runway paving failures occur from unstable subsoil conditions caused by lack of proper drainage than for any other reason.

Grading.—In view of the fact that one of the few permanent features involved in the construction of an airport is the grading, a complete grading plan of the entire area ultimately to be included in the airport should be prepared, which will take into consideration the contemplated finished grades. Since excessive grades, particularly, make night landings more difficult, longitudinal and transverse landing areas in runway grades not to exceed 1½% are preferable on major airports. Obviously, however, it is not always feasible to adhere to this figure as a maximum, since wide topographical variations on a site often involve excessive quantities of earth movement. From the standpoint of aircraft operations alone, however, field grades should be held as close to 1½% as possible.

Airport Surfaces.—In sections of the country where the soil and climatic conditions permit the growth and maintenance of firm turf surfaces, it may be possible for airports with light and limited traffic to maintain continuous operations throughout all seasons of the year without resorting to artificial surfacing. However, under the strain of heavy traffic, turf is likely to become rutted, especially if exposed to alternate freezing and thawing.

Paved Runways.—The term "runway paving" is applied to the process of preparing a firm, stable, all-year, all-weather runway surface, free from dust or aggregate which may be blown or picked up by aircraft engine propellers, and designed to support the static and dynamic loads occurring in the landing and taking off of aircraft.

Hard surfacing may be divided roughly into two general types: rigid and flexible. Rigid-type pavements include portland-cement concrete of varying dimensions, with or without steel reinforcing, and certain asphaltic concretes and asphaltic or water-bound macadams which may approach rigid characteristics. Flexible paving includes virtually all of the bituminous types of construction with cutbacks, emulsions, planed or blade mixes, built-up penetrations and bituminous soil stabilization.

Rough nonskid wearing surfaces are avoided because of the excessive tire wear which such surfaces impose on landing aircraft. The preferable finishes for concrete surfaces are those approaching a smooth trowelled finish.

Lighting.—Airports vary so widely that each airport will

present a separate problem. The size and shape of an airport, the terrain, the amount of traffic, the types of aircraft to be used and the nature of the soil or runway surface all will play important parts in affecting the number, type and extent of the lights which should be used. The following types of lights are, however, considered standard equipment on all major air terminals in the U.S.:

Airport Beacon.—This is a double-ended light projector emitting two lights, one green and one white, from opposite ends. This light rotates at six revolutions per minute and tells the pilot there is a lighted field available. Beacons are generally mounted on towers set either on the ground or on top of airport buildings. In any case, the beacon should be mounted at least 20 ft. above any buildings or surrounding structures.

Illuminated Wind-Direction Indicator.—Two basic types of illuminated wind-direction indicators are in general use: the illuminated wind cone and the illuminated wind tee. Their primary function is to give the true direction of the wind at all times. They should also be readily visible at all times to aircraft approaching from any direction.

Runway Lights.—Runway lights are used on major air terminals to assist pilots in effecting landings and take-offs. They consist of white lights slightly elevated from the ground along the runways, spaced 200 ft. apart along each side of the runway. Their installation is always arranged in pairs opposite one another on both sides of the runway. They are controlled so that only one runway at a time may be illuminated.

On instrument runways the lights on the last 1,500 ft. of the runway are half yellow and half white so that they show yellow when viewed from the approach end of the runway. This marks a yellow caution zone warning the pilot he has left only 1,500 ft. of runway on which to come to a stop or to pull up and make another approach.

Across the ends of the runways are placed green threshold lights which define the ends of the runways.

Approach Lights.—Approach lights are lights located outside the landable area and arranged to indicate a favourable or preferred direction of approach. The principal use of approach lights is to mark a lead-in or approach lane for instrument landing.

Obstruction Lights.—Obstruction lights clearly mark with red lights all obstructions surrounding an airport. High obstructions like radio towers which extend more than 70 ft. above their surroundings are marked by lights at the top and at the one-third and two-third levels.

Air Marking.—The air marker is one of the simplest and least expensive aids to air navigation in common use in the United States, but it is, at the same time, most effective and necessary, particularly in so far as the private or itinerant flyer is concerned. Perhaps the chief hazard concerned in "contact flying" is the danger of becoming lost because of poor visibility or other reasons and it is obvious that this hazard is considerably lessened if the flyer can ascertain his exact whereabouts and orient himself by merely looking down as he passes over a town or city and reading a sign giving this information. Since this is the chief function of air marking, the markers should be of a letter size 10 to 20 ft., and legible under good visibility conditions from a height of at least 3,000 ft. Such markers are either painted or constructed on roofs, on the ground or painted directly on highways.

Seaplane Bases.—The word airport has been used for convenience to describe bases for land planes alone. Airports less narrowly defined, and seaplane bases should, however, be considered together since they provide essentially the same purpose. The limiting dimensions of a landing area for seaplanes are customarily determined by natural conditions. Open-sea take-offs are usually dangerous and frequently impossible and the greatest possible length of operating area is usually fixed by the width or depth of a harbour except where the whole body of water (lake, river, sound or bay) is so protected as not to become very rough. In an ideal seaplane base adequate rules governing the use of channels and the mooring of craft would

leave several straight runways of adequate length clear of any fixed obstructions or any great congestion of water traffic.

Major Air Terminals.—While there are a number of major air terminals scattered throughout the United States, only one has been selected to illustrate the development and growth and the requirements which must be met by a modern major air terminal.

Washington National airport, Washington, D.C., is the only federally owned and operated airport in the United States, being under the jurisdiction of the Civil Aeronautics administration. Approximately 4 mi. S. of Washington on a bend of the Potomac river, the airport is modern in every detail. All the latest safety devices for air navigation may be found there. The terminal building is streamlined for efficient handling of passengers, cargo, mail and freight. Construction work started on the field on Dec. 1, 1938, and the field was dedicated on June 14, 1941. The field covers 730 ac., of which 450 ac. comprise the landing area.

Washington National airport has four asphalt-paved runways as follows:

North-South	6,855 ft. long by 200 ft. wide
North-West	5,210 ft. long by 200 ft. wide
North-East	4,895 ft. long by 150 ft. wide
East-West	4,100 ft. long by 150 ft. wide

All the runways have unobstructed approaches. Of the eight approaches to the field, six are over water while only two are over land. The Potomac river bounds the field on three sides.

The airport was raised out of a series of mud flats along the Potomac river by the corps of engineers, U.S. army. In the construction of the landing area from the mud flats 19,500,000 cu.yd. of material were pumped from the river bottom to fill and reclaim 325 ac. from the marshes.

The design of the terminal building follows Southern Colonial lines in keeping with the architecture and landscaping of the nation's capital. The terminal building has 111,000 sq.ft. of space and houses besides the CAA administrative offices, the control tower, restaurants, barbershops and other concessions and also air line offices and ticket counters. The main lobby, glass enclosed on the runway side, is flanked by two promenade decks for use by visitors and sight-seeing parties. Twelve large hangars flank the administration building to serve the nine air lines serving the field. In the rear of the administration building is the parking area capable of handling 5,000 cars.

The control tower, atop the administration building, houses the latest in radio and radar equipment. For landings under bad weather conditions the pilot has a choice of two devices to be guided down through the overcast. In many instances the pilot using one system is monitored for greater safety by the other system. There is the instrument landing system, based on radio principles, which allows the pilot to fly down an invisible path by watching a needle on his instrument panel. Precision beam radar or ground controlled approach, using radar principles, is also used; the pilot is "talked down" by personnel on the ground who watch the progress of the aircraft on the radar scanning screen. Surveillance radar in use at the field enables tower personnel to see and locate all aircraft within a 30-mi. radius of the airport as an aid to the proper separation of traffic. The field has the most modern of runway and approach lights.

The net direct bookkeeping cost of the airport was \$9,889,043. Four government agencies took part in the planning and construction. Actual construction was done by the U.S. army engineers while the Civil Aeronautics administration, Public Buildings administration and Public Roads administration were involved in the planning. The Works Progress administration and the Public Works administration also participated but no charges were made for the services of these agencies since they involved relief labour.

Airports in Europe.—It is the general rule in Europe that the major airports serving international air traffic are financed and operated by the central government. This is true, however, to a lesser degree in Great Britain, where the trend follows that of the United States in providing municipally owned and operated

airports.

Detailed information on all types of airports in Europe was sketchy after World War II; however, most countries have followed the prewar trend in providing large and well-made terminals for international travel.

In Great Britain alone there were 25 airports of entry as of Jan. 1, 1950, while Germany had 9; Italy, 8; France, 9; and Belgium, 6.

London airport, located 12 mi. W. of Westminster bridge, boasts a 9,000-ft. runway along with one 6,000 ft. and one 5,700 ft., all having a 300-ft. width. Modern in every respect, the London airport has instrument landing system and ground controlled approach for instrument weather operations, high intensity approach and runway lights, a weather station and control tower. Airports at Bovington, Blackbushe, Hurn, Prestwick and the royal air force Valley and Manston fields also serve London as alternates in bad weather.

In Germany, Tempelhof field, Berlin, partially destroyed during World War II, was again in 1950 in commercial operation, serving not only the military but scheduled air lines. The longest paved runway at Tempelhof is 5,300 ft. Tempelhof serves as an airport of entry for Germany along with Gatow field, Berlin, Bremen, Cologne, Düsseldorf, Rheim Main at Frankfurt, Hamburg, Munich and Stuttgart.

Paris is served by two fields, Le Bourget and Orly, both operating as airports of entry. Orly has three concrete runways, the longest being 6,630 ft. by 197 ft. Le Bourget also has three concrete runways, the longest being 6,900 ft. in length by 197 ft. in width.

(Ho. Bm.)

AERODYNAMICS. The word aerodynamics is applied both to the study of the disturbances generated in air by the passage of solid bodies, such as aircraft, and to the study of the motion of free aircraft under the influence of air reactions. The former is a specialized development of *fluid dynamics* and the latter of *rigid dynamics*, i.e., the dynamics of rigid bodies under the action of external forces. (See DYNAMICS and HYDRODYNAMICS.)

The equations of motion of a slightly viscous fluid such as air can be formulated, but have not in general been solved, and in no instance has the complete motion of the air passing a body, such as a wing, been calculated directly from the laws of motion. Aeronautics is thus dependent for its data mainly upon direct experiment, and since quantitative experiments upon the full scale are difficult and costly, the bulk of the data available has been obtained upon small models of the parts concerned suspended in artificially induced currents of air. The technique of the measurement of air reactions upon models suspended in "wind tunnels," (see AERONAUTICS) as the tunnels containing these air currents are called, has reached a high development and many tunnels of great size and power have been built in all countries seriously concerned with aeronautics. The largest wind tunnel in the world is at Langley Field, Virginia; it has a cross section of 30 feet by 60 feet and is operated by two fans 35 feet 5 inches in diameter, driven by a 4,000 horse power slip-ring induction motor. The tunnel can accommodate a moderate sized aeroplane, one, for example, that would carry two or three passengers. New tunnels in England and Germany approach the size of the one at Langley Field.

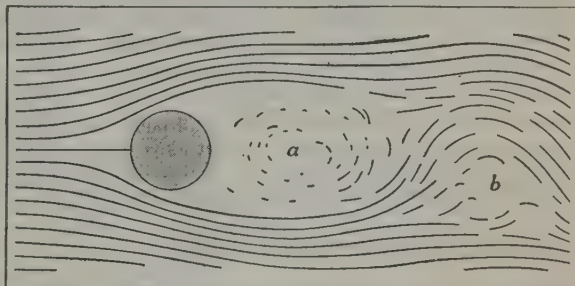
It is clearly of importance to determine how nearly similar is the manner in which the air flows around such models to the manner in which it flows around the corresponding full scale aeroplane. In many aeronautical problems air can be treated as though it were an incompressible and inviscid fluid. In these cases it can be shown that *similar bodies moving in a similar manner will generate similar air flows*, no matter what the size of the body, the density of the fluid, or the speed of the motion. Even the nature of the fluid, whether liquid or gas, is of no consequence, and experiments intended to relate to air may equally well be carried out in water, or in any other fluid which, for the purpose in hand, can be treated as incompressible and inviscid. The simple laws of aeronautics, such as that the pressure varies in proportion to the density of the air and to the square of the speed, are based upon

this assumption.

Effects of Compressibility and Viscosity.—In aeronautics air can generally be treated as though it were incompressible, unless velocities exceeding some 300 or 400 miles per hour are involved. When velocities higher than this occur, compressions and expansions of the air as it passes the solid body may seriously influence the flow; the rule for similarity of flow becomes less simple. It is then necessary that corresponding velocities in the motions to be compared should all bear the same ratio to the velocity of sound in the fluid in which the motion takes place. For example, if high speed experiments in air and water are to be strictly comparable, the experiments in water must be carried out at speeds four times as great as the corresponding speeds in air, because sound travels some four times as fast in water as in air; but when both the model and the full scale body move through air the actual speed of the model must be the same as that of the full scale body. Such high speeds as 300 to 400 miles per hour are not yet commonly met in aeronautics, except in racing aeroplanes and at the tips of the blades of high speed airscrews, and hence it is unnecessary to obey this law of similarity, except in connection with the tests of such screws.

For fluid flows which are appreciably influenced by viscosity yet another condition must be fulfilled to ensure similarity between two motions. Let μ be the viscosity of the fluid, ρ its density, V the velocity of the body through the fluid, and let l be some length which defines the size of the body—for instance the diameter, if the body be a sphere, or the length, if it be an airship.

Then the quantity $\frac{\rho V l}{\mu}$ must have the same value in each of the motions to be compared, otherwise viscosity will play a different part in each motion, and strict similarity will be impossible. This quantity $\frac{\rho V l}{\mu}$ has zero dimensions and is therefore a pure number or ratio, independent of the units in which its separate factors are expressed, provided that those units form a dynamically consistent



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FIG. 1.—THE TURBULENT FLOW OF FLUID PAST A CYLINDER

This illustrates the flow round all bodies which offer a high resistance to rapid motion through fluids. The motion of the fluid, which is from left to right, is characterized by a dead region *a*, followed by a turbulent wake *b*. Such a flow exerts a powerful drag upon the body

system, i.e., a system of units which allows Newton's laws of motion to be expressed in the form:—Force = mass $\times$ acceleration, the pound-poundal-foot-second and the gram-dyne-centimetre-second systems being examples. It is universally known as the *Reynolds number*, after the celebrated scientist Osborne Reynolds. When the Reynolds number of a flow is small, viscosity will play a predominating part in the motion, which will be of the kind usually associated with the flow of oils or treacle. When the number is large, the flow will be of the kind usually associated with water, and will approximate to that of an inviscid fluid. Thus the same fluid may act in a highly viscous manner when flowing slowly past small objects, and yet behave almost as though inviscid when flowing rapidly past large bodies. The Reynolds numbers which are of interest in aeronautics are of the order of a million; in these circumstances the air behaves almost as though it were inviscid, and the simple laws of comparison between model and full scale, to which reference has been made, can generally be applied without serious error. Certain flows, which are of great

interest in aeronautics (e.g., the flow about a wing at the stalling angle which is defined later) are, however, highly critical, in the sense that small disturbances may cause an entire change in the type of flow. These critical flows may be sensitive to changes in the Reynolds number, even though the value of the number is very large, and hence the greatest caution must be used in applying the results of small model experiments on these critical phenomena. The highly practical importance of some of these critical flows has led to great efforts being made to devise laboratory experiments in which the Reynolds number will be the same as that of the full scale flow to be represented. One way in which this has been successfully accomplished, though at great cost, is to enclose the whole wind tunnel in an air-tight chamber pumped up to a pressure of some 20 atmospheres; this increases ρ some 20 times, which compensates for the reduction in V and l necessary to bring the experiment within the scope of laboratory methods.

FLUID MOTION

The forms taken by the flow of air past a solid body can in general be classified as belonging to one of two characteristic types. Fig. 1 is typical of the flow around the majority of bodies not specially shaped to move easily through fluids. The motion, which in this figure is from left to right, is characterized by a dead region a , of small velocity and low pressure, followed by a turbulent wake b . Such a flow exerts a powerful drag upon the body, and much energy will be required to force the body rapidly through the fluid. Fig. 2 is typical of the flow around bodies which move easily through fluids, the dead region a is absent, whilst the wake has become very small. Flows of this type are generally called *streamline* flows, and bodies which generate them are called *streamline bodies*. The turbulent flow, as in fig. 1, is not yet susceptible to precise mathematical analysis, but streamline flows, as in fig. 2, approximate, when the Reynolds number is large, to the flow of a hypothetical inviscid fluid, the analysis of which has been thoroughly studied.

Bernoulli's Theorem.—This famous theorem relates to the steady flow of the hypothetical inviscid fluid, and states that the pressure p and the velocity v at all points on a single streamline are connected by the relation:

$$p + \frac{1}{2}\rho v^2 = \text{constant.}$$

In most aeronautical problems the air at all points far from the body is assumed to be undisturbed, so that its velocity relative to the body and its pressure are uniform; if these are called V and P respectively, then Bernoulli's equation leads easily to:

$$p - P = \frac{1}{2}\rho V^2 \left[1 - \left(\frac{v}{V} \right)^2 \right]$$

from which the pressure at any point can be deduced from the velocity at that point, or vice versa. The maximum pressure will thus occur where v is zero, and will have the value of $P + \frac{1}{2}\rho V^2$; this maximum pressure occurs on the surface of the solid body at the point where the streamlines divide. (See figs. 1 and 2.) This fact is used to measure the velocity of air in aeronautical experiments. If a tube, closed at one end and open at the other, is placed with the open end facing the air stream, the pressure within it will have the maximum value $P + \frac{1}{2}\rho V^2$. If the difference between this pressure and the pressure P of the undisturbed stream can be measured and if the density is known, the velocity V can be determined. The undisturbed, or static pressure P can be obtained within a closed tube placed with its axis parallel to the wind and having small holes punctured in its sides at some distance from the closed end. These two tubes are known respectively as the *pitot* and *static pressure* tubes; and together with some form of manometer, for measuring the difference between the pressures within them, they provide the standard speed measuring unit both in the laboratory and on aeroplanes in flight.

The Flow About a Streamline Body.—The theoretical study of a hypothetical inviscid fluid leads to the conclusion that when a solid body starts from rest to move through such a fluid, which is otherwise undisturbed, the form of the flow around the body is uniquely determined by its shape and mode of motion. This

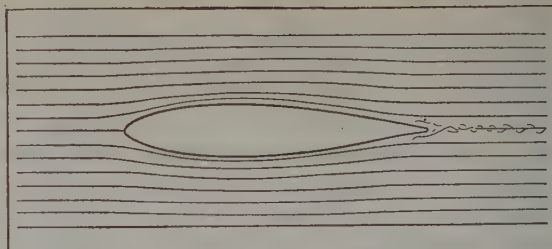


FIG. 2.—THE FLOW OF FLUID PAST A "STREAMLINE" BODY
In contrast to the turbulent flow round a body not especially shaped to move easily through fluids as in Fig. 1, this illustrates the flow round a body which offers small resistance to rapid motion through fluids

flow has the remarkable property that, although it may cause variations of pressure which tend to rotate the body, it exerts no resultant force upon the body, no matter what the shape of the body may be. The actual air flow about a streamline body, such as an airship (fig. 2) is a very close approximation to this theoretical flow, and hence the resultant of the pressures upon the surface of the body is almost zero—the small remaining drag, or resistance to motion, being nearly all due to *skin friction*, i.e., the tangential forces on the surface due to the friction of the air. When the Reynolds number is large, as in aeronautics, the fluid mechanism which exerts these skin friction forces is confined to a very thin sheath, or layer, enveloping the body. This is called the *boundary layer*; the motions within it are very complex and are known to provide the determining factor which decides whether the flow will be streamline or turbulent. Outside this very thin boundary layer the flow, if streamline, behaves very closely as though the fluid were absolutely inviscid.

A wing may be loosely described as a flattened streamline body. Its cross section in one plane containing the direction of motion has a typical streamline form, as in fig. 3 (see also AEROPLANE) which shows a modern wing section. So long as the incidence, or inclination of this section to the direction of motion is not too great, the flow about the wing will be streamline, the drag will be small and the wing will exert a lift perpendicular to the direction of motion which increases progressively with the incidence. If the incidence becomes too large the flow changes, more or less

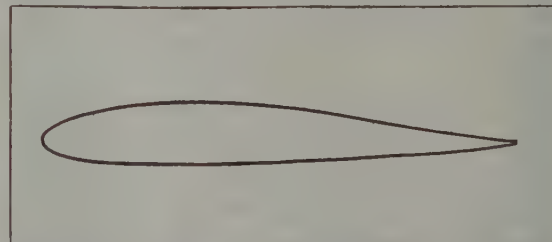


FIG. 3.—AN EXAMPLE OF AN AEROPLANE WING SECTION
The modern type of wing is more or less a flattened streamlined body. The actual air flow about a body of this shape is such a close approximation to the theoretical flow that the pressure upon its surfaces is almost zero

suddenly, to a form similar to that in fig. 1. The wing is then said to *stall* and its resistance to motion is greatly increased, whilst its lift no longer increases with incidence, but may even fall slightly.

Below the *stalling angle* the flow, though streamline, differs from that unique flow which could be generated from rest in an inviscid fluid, and approximates more nearly to one of a series of flows, which are possible to the inviscid fluid, but which could not be generated in it without the action of some additional agency. The way in which these flows are generated is still somewhat obscure, but it is known that their development is made possible by the slight trace of viscosity in the air, which allows eddies to be shed from the trailing edge of the wing, and that as these eddies are shed the flow about the wing changes until the appropriate flow has developed. When these changes have ceased and the flow has become steady the viscosity plays no further appreciable part in the motion, except in the boundary layer. Theoretically

there are, for each wing at each incidence, a series of such flows which could exist steadily in the inviscid fluid but could not be generated in it, and a question arises as to which one of them will occur in any given instance. Unlike the flows which could arise from rest in an inviscid fluid, these flows give theoretically, a lift upon the wing, and if the actual lift of the wing can be measured, the particular flow of this series which is occurring can be identified as that one which theoretically gives the measured lift. It is thus possible, by merely measuring the total lift of a wing, to calculate, with considerable accuracy, the direction and velocity of the flow at all points in its neighbourhood and from Bernoulli's equation the distribution of pressure over its surface. If the lift cannot be measured, the flow can be approximately identified as that one of the series in which the streams flow smoothly off the trailing edge of the wing without sharp changes of direction. This method of identification is not so accurate as the former.

Induced Drag.—Calculations such as the foregoing can most conveniently be made in relation to wings of infinite span, or length perpendicular to the direction of motion. For such wings the theoretical drag in the inviscid fluid is zero; the real drag is almost entirely due to skin friction and is so small that it may, in favourable circumstances, be less than one-fiftieth of the lift. When the span of the wing is finite, circulations are set up around the tips, the air flowing round them from the high pressure region beneath to the low pressure region above the wing. Vortices are thus generated, which trail from the wing tips and remain in the air long after the wing has passed. These vortices require power for their generation and consequently the power required per running foot to propel a finite wing, and the drag on the wing, are greater than for a wing of infinite span: for this reason the drag of a wing of practicable shape is seldom less than one-twentieth of the lift. L. Prandtl has developed approximate mathematical methods of calculating this drag, which he calls the *induced drag*. The difference between the actual and the induced drag is called the *profile drag*, because it depends upon the profile, or cross section, of the wing and is not dependent on the span.

For a given wing arrangement, the induced drag is proportional to the ratio, weight supported/span; this ratio is now called the *span loading*. The induced drag varies in *inverse* proportion to the air density and the square of the speed. The profile drag, for a given incidence and profile, depends upon the total wing area and varies in *direct* proportion to the density and the square of the speed. When calculating the drag of an aeroplane wing, it is now normal practice to divide the drag into these two parts and to study them separately. Induced drag can be calculated, not only for single wings, but for multiple wings, as in a biplane, or for wings in the presence of plane boundaries, such as the walls of a wind tunnel or the surface of the earth. Such calculations are used extensively in all modern laboratories and design offices.

FREE FLIGHT

Stability.—An aeroplane which, on being disturbed from a condition of steady flight in equilibrium, ultimately returns to the condition from which it was disturbed, is said to be *stable*. Complete stability in this sense can be achieved by correct proportioning of the parts of the aeroplane, but is by no means necessary for successful flight; for if the pilot has effective control over his aeroplane he can easily check any tendency to depart from equilibrium flight, which may result from a moderate instability. It is, however, important for the designer to know, not only whether his aeroplane will be stable or unstable, but the degree of stability or instability to be expected, for its behaviour in the hands of the pilot will depend upon this factor. The subject has therefore been extensively studied mathematically, but is so complicated that it is impossible here to do more than refer the reader to standard books on the subject.

Stalling.—As the speed of an aeroplane falls the lift falls, and sufficient lift to balance the weight can be obtained only by an increase of incidence. But it has been shown in a previous paragraph that when the incidence of a wing passes a certain critical angle the character of the air flow changes, and the lift ceases to increase. There is thus a minimum speed, associated with the

above critical angle, at which any aeroplane can fly steadily. This minimum speed of steady flight is called the *stalling speed*, the incidence at which it occurs is called the *stalling incidence*, and an aeroplane flying at an incidence greater than the stalling incidence is said to be flying *stalled*. With this change of flow at the stalling incidence is associated a complete change in the characteristics which determine the stability of aeroplanes and the action of their controls. For the effect of this change upon practical aviation see AEROPLANE.

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See also:—*Reports and Memoranda of the Aeronautical Research Committee*; *Reports of the National Advisory Committee for Aeronautics*; *Technische Berichte der Flugzeugmeisterei*. (B. M. J.)

AERO ENGINES. The purpose of the aero engine is to provide propulsive thrust, either by driving a propeller or by high-speed jet reaction. Any suitable power source might be used, but the internal-combustion piston engine and gas turbine predominate because of their low weight and bulk. The gas turbine may be designed to drive a propeller (turbo-prop) or as a jet propulsion engine (turbojet). Less common internal-combustion types are the ramjet, pulsejet and rocket engines.

HISTORY

The earliest aero engines were adaptations of existing power units and they achieved some success in powering slow-speed, lighter-than-air craft. In earlier experiments with heavier-than-air craft, the lack of a lightweight engine was a great handicap and no real progress was made until engines were designed specially for aeroplanes.

In 1851 a Frenchman, Henri Giffard, built the first aero engine. It was a steam engine which, with its boiler, weighed 351 lb. and developed only 3 horsepower. Nevertheless, it made possible the first controlled navigation of the air on Sept. 4, 1852, when Giffard piloted his airship from Paris to Trappes. The first internal-combustion engine was flown in 1872 when a German, Paul Haenlein, piloted an airship powered by a four-cylinder piston engine using coal gas fuel. Gasoline fuel was first used in a two-cylinder piston engine used by David Schwarz to propel the first rigid airship in 1897.

Early Aeroplane Engines.—The engine used by Orville and Wilbur Wright in the first free flight of an aeroplane on Dec. 17, 1903, was designed and built by them and delivered 12 h.p. for 179 lb. weight. In form it was similar to contemporary automobile piston engines, having four cylinders in-line, with water cooled barrels and air-cooled heads.

In the same year, Charles M. Manly designed and built a noteworthy engine for the ill-fated S. P. Langley "Aerodrome." Manly's engine developed 52 h.p. for 151 lb. weight. Its weight/power ratio of 2.88 lb. per horsepower was remarkably low at that time and compared favourably with the weight/power ratio of similar power engines of much later date. Its five water-cooled cylinders were arranged radially around its crankcase, a form of construction which was maintained throughout the years in the popular air-cooled radial piston engine.

Engines of World War I.—During 1914-18 the progress of aero engine development was accelerated considerably by the concentration of effort on the development of the aeroplane as a military weapon. Prominent among early World War I engines were the air-cooled rotary types. These were radial piston engines built in the general form of Manly's engine but radically different in that the cylinders rotated about a fixed crankshaft. Notable examples of the type were the Gnôme, Le Rhône, Clerget and Bentley used by the Allies and the Oberursel-Gnôme and Goebel of the Central Powers. These engines developed 80 h.p. to 230 h.p. and weighed 1.9 lb. to 3 lb. per horsepower. The rotary engine suffered from many inherent disadvantages but, in comparison with the more conventional engines currently available, it had the important advantages of lower weight and smoother running.

Design refinement of the in-line water-cooled engine reduced its

and introduced a new generation of Allied engines with 8 or 12 cylinders arranged in two banks in V form. Noteworthy among these were the 300-h.p. Hispano-Suiza (France), the 350-h.p. Rolls-Royce Eagle (Great Britain) and the 420-h.p. Liberty (U.S.); the European engines had weight/power ratios around 2.3 lb. per horsepower compared with 2.11 lb. per horsepower for the Liberty. Contemporary with the Allied Powers' V types were the six-cylinder in-line Mercedes, Benz and Maybach engines of the Central Powers, ranging from 100 h.p. to 260 h.p. and weighing more than 3.5 lb. per horsepower.

Notable engines under development in Britain when World War I ended were the 380 h.p. Cosmos Jupiter (later taken over by the Bristol company), a nine-cylinder air-cooled radial weighing about 1.7 lb. per horsepower; the 450-h.p. Napier Lion, a 12-cylinder, three-row, in-line water-cooled engine weighing 1.86 lb. per horsepower; and the 300-h.p. air-cooled Armstrong-Siddeley Jaguar. The Jaguar was the first aero engine to be designed with a mechanically driven supercharger.

Between Wars, 1918-39.—In this period a remarkable advance in aero engine efficiency was achieved and many long-distance flights demonstrating improved reliability were accomplished. Noteworthy among these was the first nonstop Atlantic crossing on June 14-15, 1919, by John Alcock and Arthur Brown in a Vickers' Vimy bomber powered by two 350-h.p. Eagle engines. Improved fuels and supercharging played a large part in increasing output from about 500 h.p. to 1,000 h.p. and reducing the weight/power ratio from about 1.5 to nearly unity.

Development was intensified in the 1930s, particularly in Europe. In 1932 the Bristol Aeroplane Company, Ltd., produced the first aero sleeve-valve engine, the nine-cylinder air-cooled radial Perseus of 560 h.p., and in 1934 the Rolls-Royce Merlin started its long and illustrious career at about 900 h.p. A noteworthy engine of this era was the 600-h.p. Junkers Jumo 205C two-stroke diesel. In the United States, the General Electric company brought to fruition the exhaust turbosupercharger, an idea which dated back to World War I and which had been the subject of experiment in many countries at various times.

Engines of World War II.—Again the influence of war resulted in an accelerated rate of engine development, best illustrated perhaps by the Merlin, which earned fame by powering Hurricane and Spitfire fighters in the battle of Britain. The military rating of the Merlin rose from 1,030 h.p. in 1939 to 1,830 h.p. in 1945. Its weight/power ratio based on these figures fell from 1.33 lb. per horsepower to 0.94 lb. per horsepower.

Apart from the development of particular engines to higher power by supercharging, etc., as in the case of the Merlin, larger engines were introduced into service as the war progressed and, by 1945, engines of 2,500 h.p. were in use. These larger engines succeeded in pegging weight/power ratio near unity in spite of the unfavourable influence of scale effect.

The liquid-cooled V and air-cooled radial types predominated in combat aircraft used by the Allies and axis powers. A significant difference in German engines was the use of direct fuel injection into the engine cylinders in place of the carburettor or bulk injectors used on Allied engines.

New basic engine types were introduced by both sides during the last year of the war. Of particular interest was the German use of a rocket engine in interceptor fighters, and a pulsejet engine in the V-1 missile. The V-1 brought the British Meteor fighter, powered by two Rolls-Royce Welland turbojets of 1,600 lb. static thrust, into service in Great Britain in 1944 as a defense measure.

British and German turbojet fighters appeared on the western front in 1945. By this time, the Meteor had two Rolls-Royce Derwent Mark I engines of 2,000 lb. thrust, weighing 0.48 lb. per pound thrust. German turbojets were heavy and uneconomical in comparison; e.g., the widely used Jumo 004B gave 1,980 lb. thrust and weighed 0.82 lb. per pound thrust.

Advent of the Gas Turbine.—The first gas turbine to fly powered a Heinkel jet aircraft flown in Germany in Aug. 1939. Development of the Heinkel turbojet was abandoned, however, and the axial type subsequently developed in Germany had not flown when Frank (later Sir Frank) Whittle's W.1 turbojet pow-

ered the Gloster E. 28/39 aeroplane on its maiden flight in Britain on May 14, 1941. Whittle's W.1 engine, which gave 855 lb. thrust and weighed 620 lb., was the direct ancestor of a line of centrifugal turbojets designed by Rolls-Royce in Britain and the General Electric company in the United States.

Conversion of the Rolls-Royce Derwent turbojet by fitting a propeller and reduction gear produced the Trent experimental turboprop which powered a Gloster Meteor aircraft and thus became the first turboprop to fly (Sept. 20, 1945). The Trent gave 790 h.p. and 1,220 lb. jet thrust.

By mid-century the turbojet had replaced the piston engine in most fighter aircraft and in some bombers. The appearance of the first turboprop air liner prototype, the Vickers Viscount, in Britain in 1948, and the first turbojet air liner prototypes in Canada (A. V. Roe C.102) and Britain (Comet) in 1949, indicated the strength of the challenge of the gas turbine in the transport field.

GENERAL REQUIREMENTS

The design of an aero engine is governed by four major considerations. It must be reliable and give a period of useful operation between overhauls sufficiently long to make it an economic proposition. Its weight and fuel consumption must be as low as possible and its frontal area must be as small as possible. Reliability and long life must always be the primary considerations, although they may have to be sacrificed temporarily in cases of extreme military emergency. The order of importance of the remaining criteria is determined by the speed, operating height and range of the aircraft for which the engine is intended. The aero engine design problem involves an attempt to satisfy simultaneously these interrelated and sometimes conflicting requirements.

Reliability.—The failure of an aircraft engine is a serious matter if, as a result, the pilot has inadequate power to manoeuvre his aircraft as he desires. Although modern civil aircraft are designed, in accordance with an international agreement, to have adequate reserves of power to meet all reasonable cases of engine failure, reliability remains as the first criterion of aero engine design and each individual engine type is subjected to exhaustive tests totalling thousands of hours, both on the ground and in flight, before being certified as an airworthy type for installation in production aircraft. A similar high design standard is set for all accessories and systems on which the engine depends, such as propellers, fuel and oil systems, etc.

Reliability in an efficient aero engine is not easily obtainable because of the importance of the simultaneous achievement of low weight, which entails minimum scantlings stressed to the economic optimum and a never-ending search for improved materials to carry high stress at elevated temperatures.

Low Weight.—The maximum weight of an aeroplane at take-off is limited by its take-off performance or by the strength of its structure. The importance of lightweight design of every component, including the power plant, is best illustrated by a simplified example relating to a typical piston-engined air liner with a maximum take-off weight of 100,000 lb. In round figures, the aircraft structure weighs 30,000 lb., the power plant 20,000 lb. and crew and equipment 10,000 lb., giving a total equipped weight of 60,000 lb. The remaining 40,000 lb. is disposable load, to be allocated between fuel and pay load (passengers and cargo) according to the distance to be flown.

When flying the maximum distance, with tanks filled to capacity, the maximum fuel weight is 35,000 lb., leaving 5,000 lb. for pay load. In this case, the pay load, which determines the revenue and profit of the operator, is only 5% of the take-off weight and it is easily verified that a small percentage decrease of the equipped weight produces a large percentage increase of the revenue-producing pay load. For example, 10% reduction of power plant weight, 2,000 lb., would give a 40% increase of pay load.

The foregoing applies to an existing aircraft with a fixed structure weight. Considering a new design, a reduction of equipment weight permits reduction of wing area and structure weight, and a lighter and smaller aeroplane requiring less power and fuel can be designed for given range and pay load. Reduced first costs (proportional to weight) and lower operating costs result.

Low Fuel Consumption.—It is clear from the foregoing that similar benefits derive if the fuel load is reduced by lowering the specific fuel consumption of the engine; that is, fuel consumption rate per horsepower developed, or pounds per horsepower per hour. The benefits resulting from reduction of fuel load may be slightly smaller than those obtained from an equal reduction of equipment weight for two reasons: first, because the mean aircraft weight is higher, and slightly higher power (and fuel consumption) is required during the flight; second, because it is possible to arrange the fuel tankage in a new aircraft design in such a manner that alteration of the fuel load has little effect on structure weight. Nevertheless, achievement of minimum fuel consumption is an important objective, particularly when considering aircraft designed to fly great distances.

Interrelation of Weight and Fuel Consumption.—Power plant weight and fuel consumption must be considered simultaneously in order to determine the most suitable type of power plant for a particular aircraft role. The obvious criterion is the sum of the power plant weight and the weight of fuel consumed by the engine during a specified time at a specified height, power and air speed. Different types of power plant may be compared in this manner but it should be noted that the method does not include the effects of the different engine types on the aircraft configuration and performance, and the answer obtained must be regarded as a first approximation. Borderline cases must be the subject of detailed aircraft design studies, to make certain of choosing the most suitable engine type.

Comparison of the turbojet with the piston engine and propeller combination provides an interesting example of the interrelation of weight and fuel consumption. At a moderate air speed, say 400 m.p.h., the turbojet consumes fuel at approximately twice the rate of the piston/propeller for the same thrust-horsepower but its power plant weight is only about one-third that of the piston/propeller. The difference of power plant weight in favour of the turbojet is exploited by carrying additional fuel in the jet aircraft, thus enabling it to compete with the piston-engined aircraft up to at least 1,000-mi. range at 400 m.p.h.

Small Size.—"Parasitic drag," which represents a considerable proportion of the total drag of an aeroplane, is dependent on the frontal area of the aircraft. It increases as the square of the air speed up to speeds in the region of acoustic velocity where it begins to increase even more rapidly. In addition, changes of frontal cross section (e.g., large engine nacelles on thin wings) are a source of unwanted drag at high air speeds.

The engine which can be installed entirely within the aircraft contours necessary to house the specified load makes an invaluable contribution to the important objective of minimum aircraft frontal area. The engine which adds to the frontal area must be debited with the concomitant drag increase.

Altitude Power.—Atmospheric density falls rapidly as altitude increases, reaching 20% of its sea level value at 44,000 ft. As the internal-combustion engine burns an approximately constant volume of air-fuel mixture in unit time, it follows that the weight of air-fuel mixture per unit time and the power extracted therefrom vary almost directly with atmospheric density, unless steps are taken to restore sea level conditions at the engine induction manifold by precompression in a supercharger.

In the piston engine, the power absorbed in overcoming internal friction is appreciable, and is independent of atmospheric density. In an unsupercharged engine, therefore, the power available to drive the propeller falls more rapidly than the atmospheric density, reaching about 9% of sea level power at 44,000 ft. An unsupercharged engine developing 1,000 h.p. at 44,000 ft. would be about 11 times the size and weight of an engine developing 1,000 h.p. at sea level, but if supercharged to 44,000 ft. it would be of reasonable size and weight.

In comparison with the piston engine, the gas turbine mass air flow falls less rapidly with increase of altitude and its internal friction losses are negligible. Furthermore, its mass air flow increases appreciably with increase of air speed. Thus, the turbo-prop is able to maintain its sea level power (static) up to 20,000 ft. at 400 m.p.h.

DESIGN PROBLEMS: GASOLINE PISTON ENGINES

Detonation.—The dominating factor in gasoline engine design is a combustion phenomenon termed "detonation." When detonation occurs the flame spreads throughout the charge in the cylinder at greatly accelerated speed, creating a high-pressure gas wave which produces an audible knock, akin to the noise of a hammer blow on metal, when it reaches the cylinder wall. Mild intermittent detonation is not serious. Prolonged violent detonation frequently results in piston failure. In a given engine, the tendency to detonate varies with the type of fuel used, and detonation may be suppressed by injecting water, alcohol or water-alcohol mixtures into the induction system.

With a given fuel, the major factors affecting detonation are the air/fuel ratio and the pressure and temperature of the compressed mixture in the combustion chamber. A mixture rich in fuel defers the onset of detonation. High pressure and temperature have the opposite effect. In different engines using the same fuel, design details, such as the shape of the combustion chamber and the relative positions of spark plugs and valves, exert considerable influence on detonating tendencies.

Compression Ratio.—Power output and specific fuel consumption are governed by the engine compression ratio; that is, the ratio of the maximum cylinder volume (piston at bottom) to the combustion chamber volume (piston at top). High compression ratio yields high power and low specific consumption, but it entails high pressure and temperature of the air-fuel mixture after compression and, therefore, increased tendency to detonate. The type of fuel available thus limits the maximum compression ratio and consequently limits maximum power output and minimum specific consumption.

Supercharging.—Supercharging involves the provision of a compressor which delivers air or air-fuel mixture at a pressure and temperature above those of the atmosphere. Although introduced originally for the purpose of maintaining sea level pressure in the induction manifold at altitude, the principle was extended to provide higher manifold pressures in order to increase power output and reduce weight/power ratio.

Increase of manifold pressure and temperature results in higher pressure and temperature of the air-fuel mixture in the cylinder after compression and increased tendency to detonate. With a given fuel, a choice must be made between a high degree of supercharge coupled with low compression ratio, and low supercharge with high compression ratio. The former yields an engine of small bulk with low weight/power ratio and high specific fuel consumption; the latter choice, a larger and heavier engine with lower specific consumption.

The centrifugal compressor established its supremacy at an early stage in supercharging experiments and maintained it thereafter. It accelerates the air to high velocity in a radial-vaned impeller and converts the kinetic energy into static pressure in a diffuser.

In many applications the supercharger is mechanically driven from the engine crankshaft through a speed-increasing gear. Ideally, the drive should provide variable speed in order to avoid unnecessary power loss at low altitude, but the added complication of a variable-speed drive is not warranted in many cases. A concession is often made by providing a two-speed drive.

The exhaust turbosupercharger is driven by a turbine deriving its power from the engine exhaust. In addition to using energy which might otherwise be wasted, this method of supercharging provides variable-speed drive without mechanical complication.

Air/Fuel Ratio (Mixture Strength).—The range of ignitable air-gasoline mixtures is reasonably wide. For each engine throttle setting there is an air/fuel ratio yielding maximum power, and a higher ratio (weak mixture) giving minimum specific consumption at lower power. Air/fuel ratios below the optimum for power (rich mixture) reduce power and increase specific consumption.

The antidetonating effect of rich mixture is exploited by using high manifold pressure to give high power for short period operation; e.g., at take-off, when consumption is unimportant. Detonation limits the use of weak mixture to cruising power, where minimum consumption is essential. Fortunately, the magnitude of the effect of air-fuel ratio on detonation is such that an acceptable

cruising-take-off power ratio is obtained.

Equal distribution of both fuel and air to all cylinders is important since the air-fuel ratio in the worst cylinder limits the performance of the whole engine.

Cooling System.—If the engine cylinders, and particularly the cylinder heads, are not adequately cooled the performance deteriorates and engine failure may result. On the other hand, overcooling must be avoided. It is not necessarily beneficial to the engine and it entails unnecessarily high cooling system drag. Equal cooling of all cylinders must be achieved if one cylinder is not to limit performance unduly.

The relative merits of air cooling and liquid cooling have been debated frequently. The fact that both survived in competition presents adequate proof that there are advantages peculiar to each system.

The oil used to lubricate bearings, gears, etc., absorbs heat in its passage through the engine and must be kept below a maximum temperature limit if its lubricating qualities are to be maintained. Again, overcooling is undesirable since, in addition to unnecessary drag, a film of oil may congeal on the metal surfaces of the cooler and eventually render it ineffective.

PISTON ENGINE TYPES

Aero piston engines are classified according to cooling system, arrangement of cylinders, heat cycle, etc. The four-stroke, spark ignition, gasoline cycle predominates to such an extent that its use may be assumed unless specifically stated otherwise. Conventional poppet valves in the cylinder head may be assumed also in the absence of a contrary statement. The most popular types in the larger engine sizes are the air-cooled radial and the liquid-cooled V.

Air-Cooled Radial.—A notable engine of this type was the 18-cylinder, two-row, sleeve-valve Bristol Centaurus, descendant of the first sleeve-valve engine (Perseus) of 1932. The Mark 662 operating on 115/145 grade fuel develops 2,810 h.p. at 2,900 r.p.m. for take-off; 2,405 h.p. at 7,750 ft. and 2,280 h.p. at 16,000 ft., in low- and high-speed supercharger drive, respectively, when cruising at 2,400 r.p.m. It weighed 3,270 lb., giving a weight/power ratio of 1.16 lb. per horsepower; its diameter was 56.6 in.

The largest radial engine at mid-century was the four-row, 28-cylinder Pratt and Whitney Wasp-Major, Model B.13 operating on 115/145 grade fuel developed 3,250 h.p. at 2,700 r.p.m. for take-off; 2,650 h.p. at 6,000 ft.; and 2,300 h.p. at 16,300 ft., when cruising at 2,550 r.p.m. It weighed 1.08 lb. per take-off horsepower and its diameter was 54 in.

Liquid-Cooled V.—Developed from the World War II Merlin, the Mark 620 was an excellent example of the type. It employed a very high degree of supercharge necessitating a two-stage, two-speed supercharger to obtain the required pressure ratio and a charge cooler to reduce the induction temperature. The coolant used in both radiator and charge cooler was a mixture of water and ethylene-glycol.

The Mark 620 gave 1,725 h.p. for take-off at 3,000 r.p.m. on 100/130 fuel. For cruising, 1,180 h.p. was obtained at 2,650 r.p.m. at 10,500 ft.; and 1,165 h.p. at 2,850 r.p.m. at 23,750 ft., in low and high supercharger gears, respectively. It weighed 1.01 lb. per take-off horsepower and its maximum height and width were 43.2 in. and 31.3 in., respectively.

Air-Cooled V.—Eight- and twelve-cylinder engines of this type at mid-century ranged in power from 150 h.p. to 600 h.p. and in weight/power ratio from 2.4 lb. to 1.4 lb. per horsepower.

H or M Engines.—This cylinder arrangement was developed in both air-cooled and liquid-cooled forms, the largest engine of the type being the 24-cylinder, sleeve-valve, liquid-cooled Napier Sabre. The Mark 5 Sabre gave 2,565 h.p. at 3,850 r.p.m. for take-off on 100/130 fuel, for a weight of 0.95 lb. per horsepower.

In-Line Engine.—This type survived mainly in small four- or six-cylinder engines suitable for light aircraft operating on lower-grade fuel. At mid-century these ranged in power from 90 h.p. to 380 h.p. and in weight/power ratio from 3.0 lb. to 1.65 lb. per horsepower.

Flat Engine.—Designed for mounting within the contours of the aeroplane wing, the flat engine virtually consists of two horizontal in-line engines operating on a common crankshaft. Engines of the type have two, four, six or eight cylinders, are mainly air-cooled and use lower-grade fuel. They ranged from 20 h.p. to 320 h.p. at mid-century and from 3.0 lb. to 1.8 lb. per horsepower.

Two-Stroke Gasoline.—The two-stroke cycle attracted much at-

tention throughout the history of aero engines, because of potentially greater power in a given engine size and correspondingly low weight/power ratio. The type was not brought to fruition in a large gasoline engine although small unsupercharged aero engines of 20 h.p. to 60 h.p. continued to be marketed. These had a good weight/power ratio for their size, offset by high fuel consumption.

Diesel Engine.—The low specific consumption achieved by diesels in other forms of transport naturally attracted much attention and aero diesels were developed in several countries at various times. The most successful, in that it was used in commercial and military aircraft, was the six-cylinder, opposed-piston, two-stroke Junkers Jumo 205C, which developed 600 h.p. and had a specific consumption of 0.38 lb. per horsepower per hour. Its weight/power ratio of 1.85 lb. per horsepower, though low for a diesel, was sufficiently high to limit its use to relatively long-range aircraft.

Composite Engine.—The composite engine is a combination of two engines of basically different design; e.g., a piston-turbine combination. Such designs usually aim at higher power and lower specific consumption by utilization of the waste heat in the piston engine exhaust. An excellent example of a simple form of composite engine was the Wright Turbo-Cyclone 18, which combined the 2,700 h.p. R.-3,350 with three impulse exhaust turbines delivering power to the engine crankshaft through reduction gearing. A 20% increase of power and an equivalent reduction of specific consumption was claimed for this arrangement.

DESIGN PROBLEMS: TURBINE ENGINES

The essential components of the aero gas turbine are its compressor, combustion chamber (or chambers) and turbine. In the turbojet, the power developed by the turbine just balances the power required to drive the compressor, and the engine output is measured in terms of a thrust force (pounds weight). In the turboprop, additional power is developed by the turbine to drive the propeller, and the output is measured in terms of horsepower plus a small residual thrust component. High power (thrust) output and good economy demand high compressor and turbine efficiencies and high combustion efficiency coupled with minimum pressure loss in the combustion system.

In contradistinction to the intermittent combustion of fuel at approximately constant volume in the piston engine, combustion in the aero gas turbine occurs continuously at nearly constant pressure. The design variables affecting the power output and fuel economy of the constant pressure heat cycle, namely the compressor pressure ratio, the maximum cycle temperature (or turbine inlet temperature) and the propulsive efficiency of the power plant at the appropriate aircraft speed and altitude, are closely interrelated.

Propulsive Efficiency.—Propulsive efficiency is the ratio of the power usefully employed in propelling the aircraft to the power available in the engine. It is a maximum when the difference between aircraft speed and jet velocity is small. In this respect, there is no fundamental difference between the engine-driven propeller and jet propulsion.

The propeller employs low jet velocity in relation to aircraft speed and therefore attains high efficiency; e.g., 85% up to about 450 m.p.h. air speed. Above this air speed the efficiency of the conventional propeller drops rapidly because of the inefficiency of its blades as airfoils at speeds (including rotational component) approaching acoustic velocity. At 700 m.p.h. its efficiency may be 50% or less.

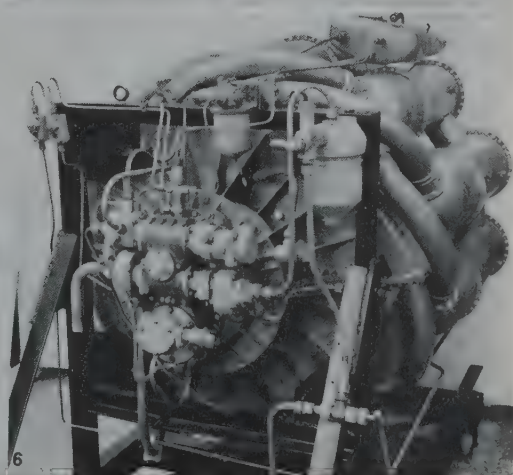
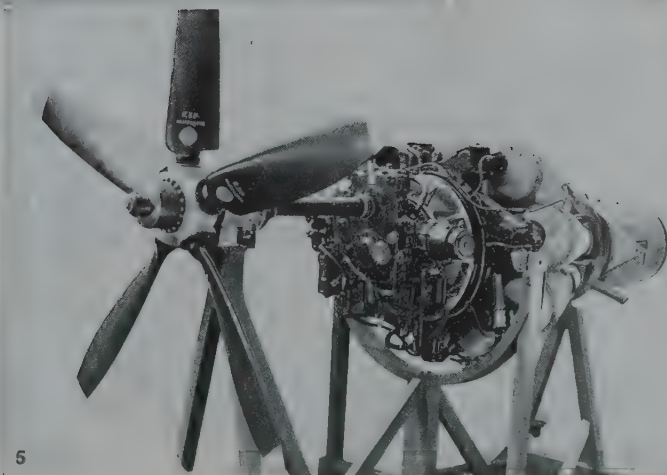
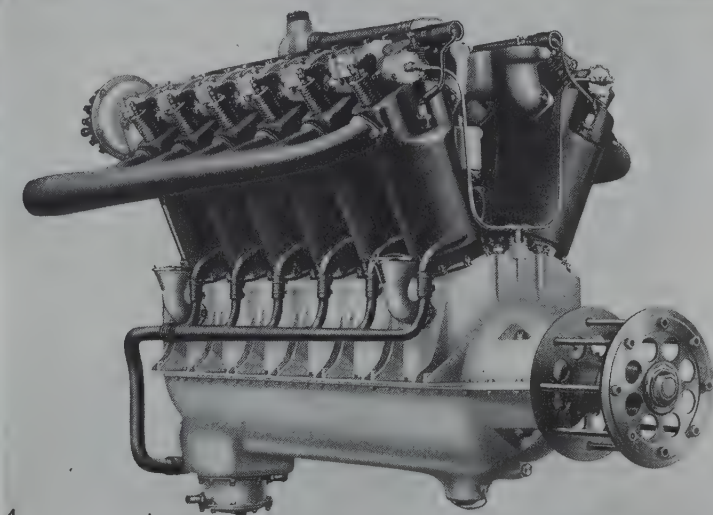
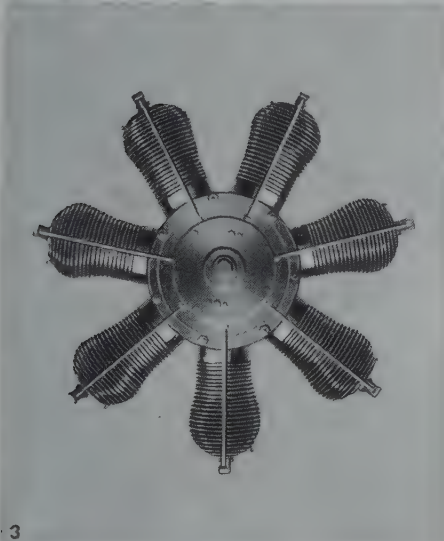
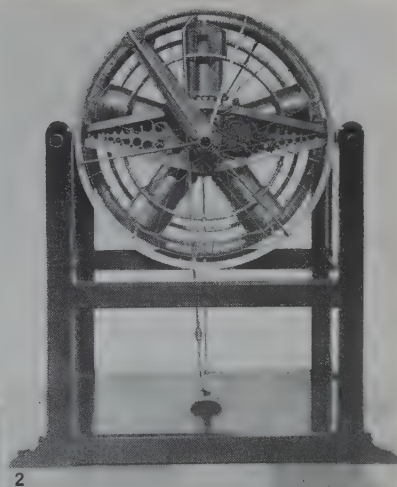
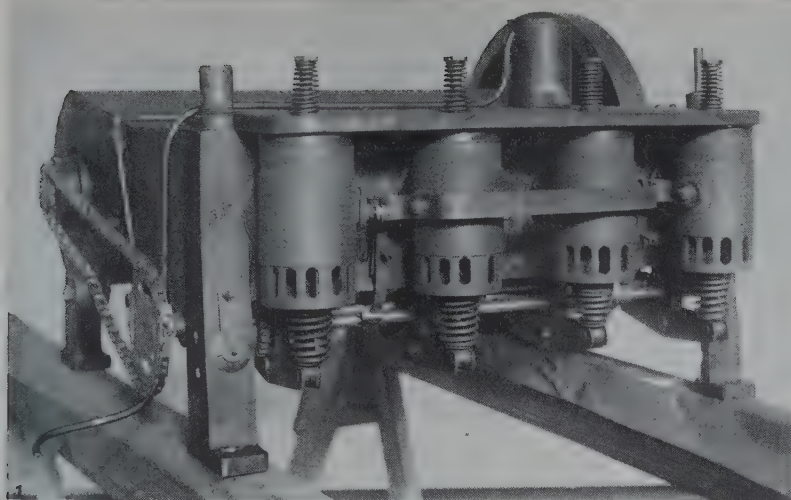
The turbojet employs high jet velocity (1,000 m.p.h. to 1,500 m.p.h.), and at 300 m.p.h. air speed its propulsive efficiency is about one-half that of the propeller.

As aircraft speed is increased, the diminishing difference between jet velocity and aircraft speed rapidly improves jet efficiency, which reaches parity with propeller efficiency at about 550 m.p.h. (55%-70%). At 700 m.p.h., jet efficiency is 65%-80% compared with 50% or less for the conventional propeller. These propulsive efficiency values largely explain the high fuel consumption of the turbojet at low air speed and its superiority at high air speed.

Turbine Inlet Temperature.—High turbine inlet temperature in the aero gas turbine yields maximum power, minimum weight and minimum frontal area, and, in the turboprop, minimum specific fuel consumption. In the turbojet, however, specific consumption increases with the increase of turbine inlet temperature unless the compressor pressure ratio is raised simultaneously. Since material strength properties are seriously reduced at high temperature, an increase of turbine inlet temperature demands improved materials for the combustion chamber, turbine, etc., or direct cooling of these items, unless engine reliability is to suffer. With materials available at mid-century, turbine inlet temperatures of 800°-850° C. (1,470°-1,560° F.) were in common use.

Pressure Ratio.—For a given value of turbine inlet temperature, there is an optimum value of compressor pressure ratio yielding maximum power and minimum weight-power ratio. Increase of pressure ratio above this optimum value reduces power but may improve specific fuel consumption if compressor efficiency can be maintained at a high level as the pressure ratio is increased.

The operating height and speed of the aircraft also affect the optimum pressure ratio, and the selection of a pressure ratio and turbine inlet temperature in a new engine design normally entails a compromise based on the relative importance of engine weight, frontal area and

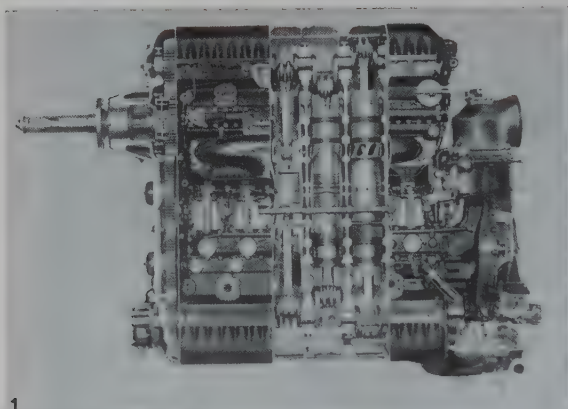


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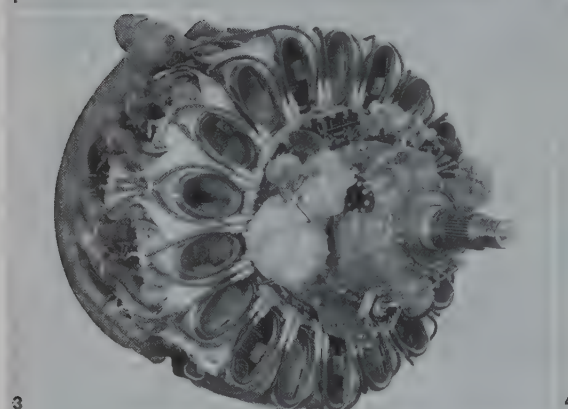
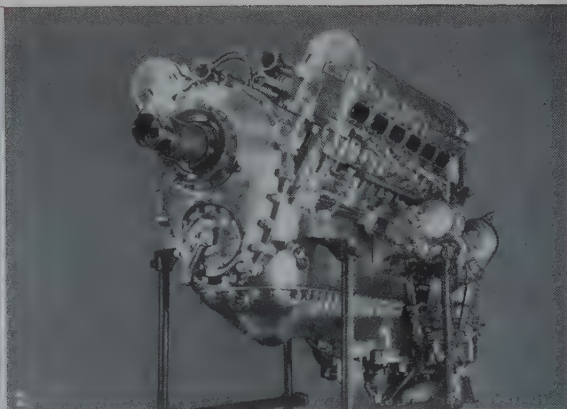
EXAMPLES OF EARLY AERO ENGINE TYPES

1. The Wright brothers' engine of 1903, first to propel an aeroplane
2. Manly's engine of the Langley "Aerodrome," 1903, which delivered 52 h.p. at 950 r.p.m., and weighed 2.88 lb. per horsepower
3. Front view of the "Gnome," a typical 65/80 h.p. rotary-type engine of World War I
4. The famous "Liberty 12" 420-h.p. engine, developed in the U.S. during World War I
5. The Rolls-Royce "Trent" experimental turboprop engine, first turboprop to fly, 1945
6. The Whittle W.1-type engine which powered the Gloster E.28/39, jet-propelled monoplane, on its first flight on May 15, 1941

AERO ENGINES



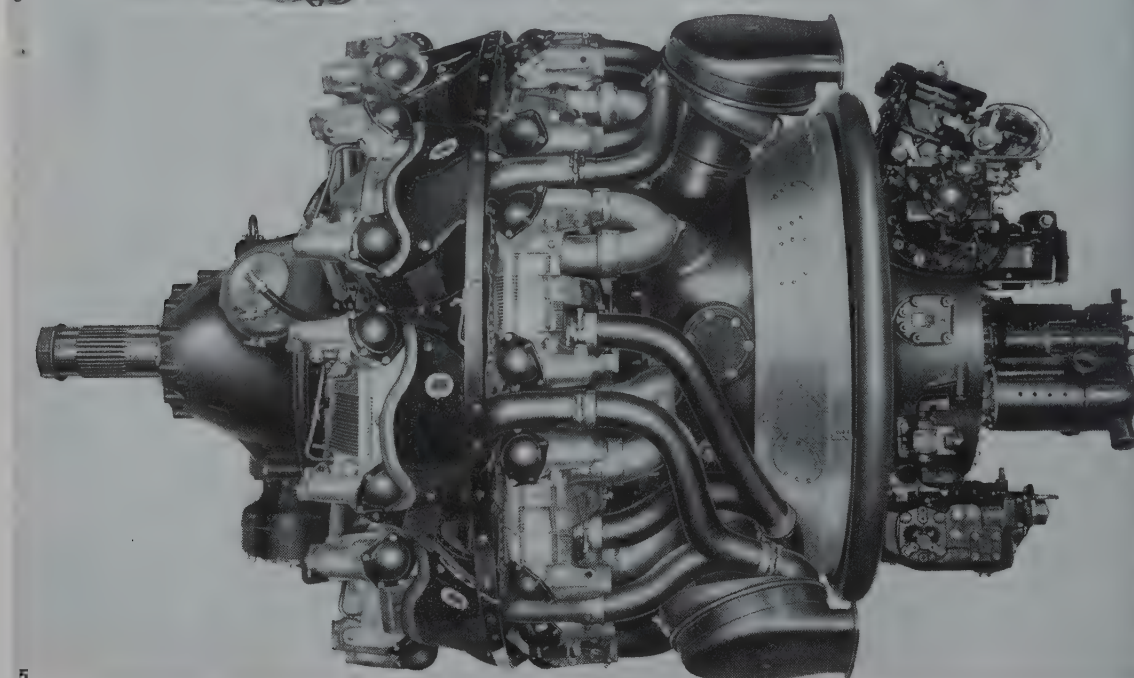
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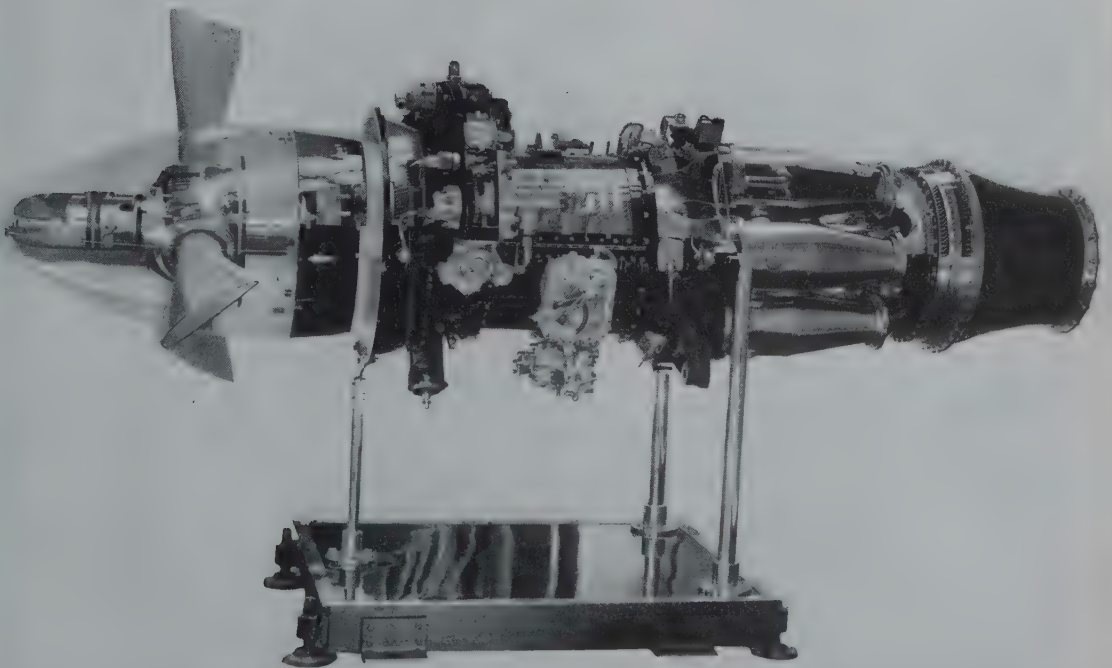
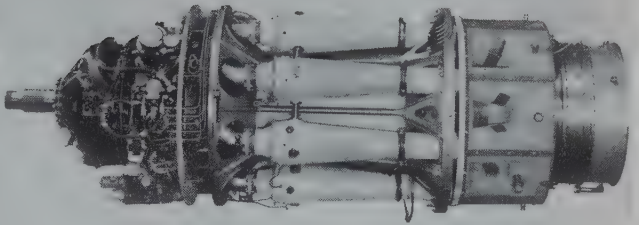
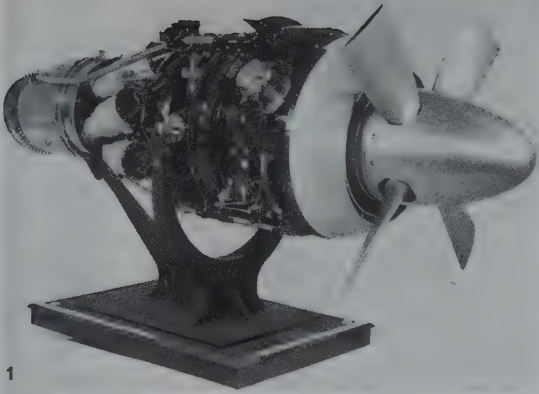
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TYPICAL PISTON ENGINES

1. Junkers "Jumo" 6-cylinder opposed-piston diesel engine
2. Rolls-Royce "Merlin," Mark 620

3. Bristol "Centaurus," Mark 662
4. Pratt and Whitney Wasp-Major, R-4360
5. Wright Aeronautical, Turbo-Cyclone 18

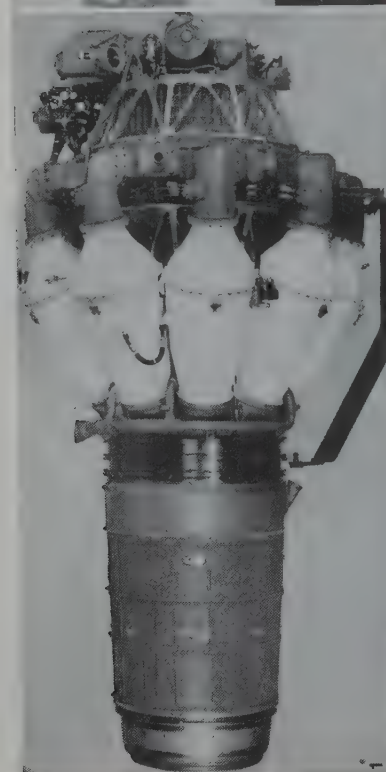
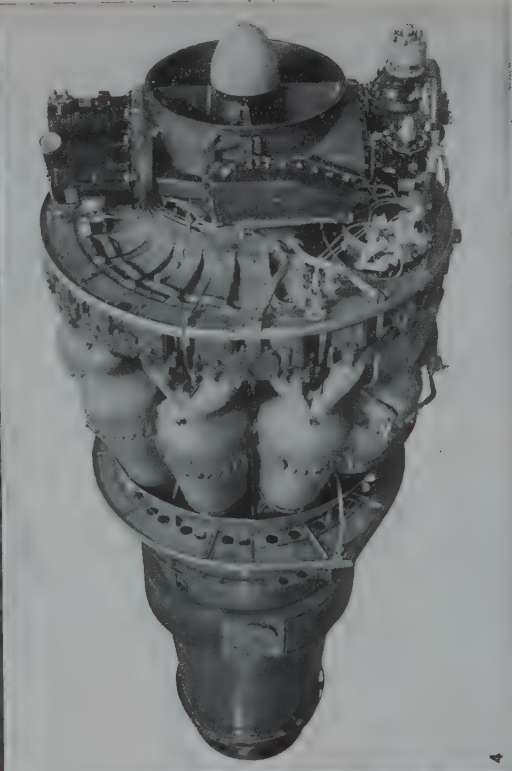
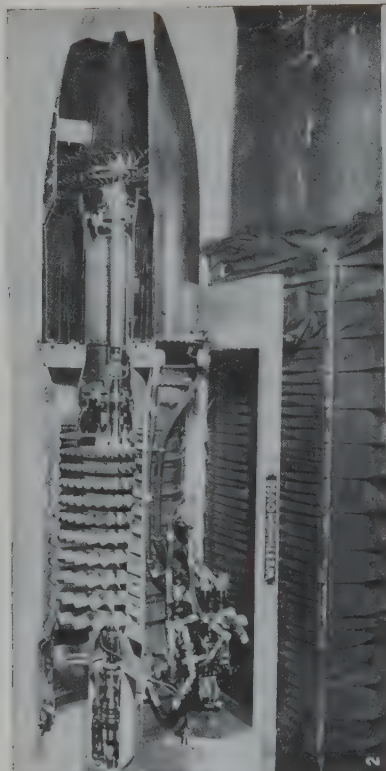


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TYPICAL TURBOPROP ENGINES

1. Rolls-Royce "Dart," two-stage centrifugal
2. Bristol "Proteus" (single engine), free-turbine, axial

3. Allison "Model 500" (T.40), coupled axial engine
4. Armstrong Siddeley "Mamba," axial



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TYPICAL TURBOJET ENGINES

- 1. Rolls-Royce "Nene," centrifugal
- 2. Westinghouse J.34 (24C), axial
- 3. General Electric J.47 (TG-190), axial
- 4. De Havilland "Ghost," centrifugal

specific fuel consumption in the type of aircraft for which the engine is intended.

TURBINE ENGINE TYPES

Gas turbine engines are classified according to the type of compressor used, centrifugal or axial, the centrifugal type being similar in principle to the piston engine supercharger. In the axial compressor air is constrained to move along a contracting annulus between a stationary casing and a moving rotor, by the action of alternate rows of fixed and moving airfoil blades which are mounted radially in the casing and rotor respectively. In comparison with the centrifugal compressor, the axial has lower frontal area for the same mass air flow (and power) and higher compression efficiency at the higher pressure ratios necessary for improved fuel economy.

Centrifugal Turboprop.—An example of the type was provided by the Rolls-Royce Dart, with a two-stage, single-sided compressor, driven by a two-stage turbine, which also drove the propeller through reduction gearing. The Dart had seven combustion chambers. It developed 1,400 s.h.p. (shaft horsepower) and 365 lb. jet thrust, or 1,540 e.h.p. (equivalent horsepower = shaft horsepower plus jet thrust divided by 2.6), for take-off at 14,500 r.p.m. The Dart weighed 930 lb., giving it a weight/power ratio of 0.6 lb. per equivalent horsepower; its diameter was 38.5 in.

Axial Turboprop.—In the smaller sizes, the low frontal area of the axial is offset to some extent by the grouping of engine auxiliaries around it. Nevertheless, the Armstrong Siddeley Mamba, giving 1,420 e.h.p. for take-off at 15,000 r.p.m. inside 31 in. diameter, provided a good illustration of low frontal area. The Mamba was similar to the Dart in mechanical arrangement, having a two-stage turbine and six combustion chambers. Its weight/power ratio was 0.54 lb. per equivalent horsepower.

In the 3,500-e.h.p. Bristol Proteus design length was saved at the expense of diameter by grouping the combustion chambers around the axial compressor. Even so, its diameter was the same as that of the Dart (38.5 in.) and about 70% of that of an air-cooled radial piston engine of equivalent power. The Proteus was noteworthy for its "free turbine" arrangement—the first two stages drove the compressor; the final (third) stage was on a separate shaft and drove the propeller through reduction gearing.

The Mamba and Proteus were also produced in coupled form; that is, two engines driving a contrarotating propeller through a common reduction gearbox. Coupling is a convenient way of doubling power plant output and has the potential advantage of better fuel economy at low or medium altitude where part-load specific consumption may be improved by stopping one engine of the pair.

An interesting example of a coupled turboprop was the Allison Model 500, which developed about 5,500 e.h.p. and weighed only 0.48 lb. per equivalent horsepower.

Centrifugal Turbojet.—The influence of the Whittle W.1 design can be traced in the Rolls-Royce Nene of 49.5 in. diameter, with a double-sided impeller driven by a single-stage turbine and combustion chambers. It gave 5,000 lb. thrust for take-off at 12,500 r.p.m. and weighed 0.35 lb. per pound thrust. This engine was built under licence by Pratt and Whitney (Turbo-Wasp).

Comparable to the Nene but featuring the single-sided impeller of the piston engine supercharger was the 5,000-lb. thrust de Havilland Ghost, power plant of the prototype Comet. It weighed 0.44 lb. per pound thrust and had a diameter of 53 in.

Axial Turbojet.—The General Electric J.47, giving 5,000 lb. thrust for take-off at 7,950 r.p.m. within 37 in. diameter and weighing 0.51 lb. per pound thrust, provided an interesting comparison with similar thrust centrifugal turbojets.

The use of a single annular combustion chamber, pioneered by Metropolitan-Vickers in Great Britain, is desirable if full advantage is to be gained from the low frontal area of the axial compressor. This is illustrated in the Westinghouse J.34, which gave 3,500 lb. thrust for take-off at 12,500 r.p.m. within 28 in. diameter and weighed 0.39 lb. per pound thrust.

Turbojet with Reheat.—The turbojet exhaust is sufficiently rich in oxygen due to high air-fuel ratios used, to support combustion of additional fuel downstream of the turbine, a process termed "reheat" or "afterburning." The absence of moving parts downstream of the combustion zone permits the use of high reheat temperatures, and static thrust increases of the order of 50% are theoretically possible. In flight the percentage increase of net thrust is doubled at high air speeds. Reheat is similar in principle to the ramjet and involves over-all flight specific consumptions two or three times those of the basic turbojet. Because of its high fuel consumption reheat is suitable for short period operation only.

OTHER JET TYPES

Ramjet.—Essentially the ramjet consists of an intake designed to convert the kinetic energy of the air to static pressure, a combustion chamber and final expansion nozzle. In principle it is similar to the turbojet, but the absence of moving parts permits operation at much higher temperatures. Because it depends on air speed to obtain the necessary pressure ratio, it needs external assistance to reach the designed operating speed and become self-sustaining.

There was little factual data available on ramjet performance at mid-

century. Its major advantage is extremely low weight, but it requires speeds of the order of 1,500 m.p.h. before its specific fuel consumption becomes competitive with that of the turbojet with reheat.

Pulsejet.—The pulsejet engine, as developed in Germany, has no moving parts except for numerous flexible reed valves completely covering its air intake and controlled by pressure fluctuations produced by intermittent explosions in the combustion chamber behind them. The engine is self-starting and, unlike the ramjet, develops static thrust. Its advantages are low weight and cost, but its specific consumption is high (three to four times that of turbojet). As used in the V-1 missile its useful life was limited by inlet valve failure to less than two hours.

Rockets.—The fact that its propellents contain both fuel and oxidizer simultaneously confers upon the rocket motor the unique advantage of independence of atmospheric conditions and the disadvantage of extremely high propellant consumption rate, offset to a small extent by low engine weight. High jet velocities (3,500 m.p.h.—5,000 m.p.h.) are generated, resulting in low propulsive efficiency at low air speeds. Clearly, the most efficient use of the rocket motor involves extremely high operating heights and air speeds.

Solid propellant rockets were used extensively in World War II, to assist the take-off of highly loaded aircraft. This is a special case in which the propellant weight is consumed before the take-off is completed and the dead-weight of fixtures may be jettisoned. Rather similar considerations apply to the suggested use of rockets for climb boost on turbojet-engined aircraft.

Liquid propellant rockets were used as the sole propulsive unit in several aircraft, notably German interceptor-fighters and the experimental U.S. Bell X.1, which was reported in 1949 to have exceeded acoustic velocity. The Walter 109-509-A.1 motor of the ME.103 weighed 370 lb. and gave 3,740 lb. thrust for a specific propellant consumption of 20.6 lb. per hour per pound thrust. The propellents were 80% hydrogen peroxide (oxidizer) and a fuel mixture of 57 parts methyl alcohol, 13 parts water and 30 parts hydrazine hydrate—the latter to produce spontaneous ignition in the combustion chamber. The Reaction Motors 6,000-C4 motor of the X.1, weighed 380 lb. and gave 6,000 lb. thrust for 17.2 lb. per pound thrust per hour specific consumption. The propellents were liquid oxygen and 75% ethyl alcohol.

Many possible combinations of chemical substances were suggested for rocket motors to reduce propellant consumption and provide greater safety. The monopropellents, containing both fuel and oxidizer in a single substance (e.g., hydrogen peroxide and nitromethane), are of interest as a move in the direction of greater simplicity.

FUELS AND LUBRICANTS

The most significant of many requirements common to all aero engine fuels are high calorific value, low freezing point and low volatility. They must also be relatively free from harmful impurities.

Calorific value is a measure of the heat energy released by combustion, and high calorific value yields low specific consumption. Hence the extensive use of hydrocarbon fuels derived from petroleum.

The freezing point, defined in terms of wax deposition, which may clog filters, etc., in the fuel system, is usually specified as not higher than -60°C . (-76°F).

Low volatility reduces the likelihood of fire if fuel is accidentally spilled over hot surfaces; e.g., during a crash landing.

Gasoline.—The two most important characteristics of gasoline fuels are volatility and detonation resistance. Volatility affects the combustion process, particularly when operating at low air temperatures. High volatility aids starting while low volatility may initiate rough running and adversely affect piston engine specific consumption. On the other hand, highly volatile fuel may "boil" in the aircraft tanks at altitude with consequent loss of fuel vapour through the tank vents and interruption of the fuel flow to the engine resulting from vapour locking in the fuel system.

The antidetonating qualities of gasoline fuels are determined by comparative testing against reference fuels of known detonations resistance in a standard test engine. The test procedure covers air/fuel ratio effects, and fuels are graded by awarding performance numbers; e.g., 115/145 grade, indicating relative detonation resistance weak/rich. Single grading numbers of 100 or lower (e.g., 87 octane) derive from an earlier test procedure which compared a given fuel, at one mixture strength only, with blends of iso-octane (high detonation resistance) and heptane (low detonation resistance), octane number being simply the percentage of iso-octane in the iso-octane-heptane blend of equivalent detonation resistance. The limit of the octane scale is 100 corresponding to 100 performance number.

Tetraethyl lead (T.E.L.) is extremely effective in raising the detonation limit of most hydrocarbon fuels. Its use introduces extra design problems in high-duty engines, but the results achieved fully justify the additional design effort.

Turbine Fuels.—With minor mechanical modifications the aero gas turbine can be adapted to burn a variety of hydrocarbon fuels ranging from diesel oil to low specific gravity gasoline. The optimum fuel is that giving the highest specific gravity (and calorific value) consistent with a freezing point of -60°C . or thereabouts and low volatility. In the absence of a detonation problem on the gas turbine, these requirements are not incompatible and are met by a fuel similar to the vapourizing oil used in farm tractors, etc.

Lubricants.—The aero piston engine demands a high-viscosity oil because of the high loadings of its bearings and propeller reduction gear teeth, both reduced to minimum proportions to achieve low weight. The change of oil viscosity with temperature should be small to avoid engine starting troubles at low temperatures.

Turbojet engines normally use ball and roller bearings and operate on thinner oil, with consequent alleviation of the low-temperature starting problem.

The turboprop demands a compromise between the requirements of its ball and roller main bearings and its reduction gearbox.

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(R. H. W.)

AEROLOGY, AEROLOGIST. In general, words denoting respectively the study of the atmosphere and one who is an expert in that study, hence synonymous with meteorology (*q.v.*) and meteorologist. Frequently, however, and particularly among professional meteorologists, these terms are used with exclusive reference to the upper air. But this use gradually declined in the United States because after 1917 in the U.S. navy aerology has been the official term for the science and practice of meteorology, including weather forecasting. Navy weather officers are aerologists.

(R. G. Se.)

AERONAUTICAL ARTICLES. The subject of aeronautics is treated in several series of articles. Under **FLIGHT** (**NATURAL**), will be found a study of birds' flight. From this readers can pass to a general survey of artificial flying under **AERONAUTICS** and **AVIATION, CIVIL**. Famous flights are discussed under **TRANS-OCEANIC** and **TRANS-CONTINENTAL FLIGHTS**.

The navigation and development of the balloon, and its transformation into an airship, can be studied in the articles **BALLOON**; **AIRSHIP**; and **AIRSHIP SHEDS**. Heavier-than-air flying machines are treated in the articles **AEROPLANE**; **BIPLANE**; **MONOPLANE**; **HELICOPTER**; **ORNITHOPTER**; **GYROPLANE**; and **AILERON**.

Flying machines capable of alighting upon water are dealt with in the article **SEAPLANE**; in this connection the article **AIRCRAFT CARRIERS** studies an important factor in the application of flying machines to naval warfare. The question of aircraft terminals and accommodation is treated in the articles **AERODROME** and **AIRSHIP SHEDS**. For engine details see the articles **AERO ENGINES**; **INTERNAL COMBUSTION ENGINES**; and **AIRSCREW**. The practical navigation of aircraft and their employment for various purposes can be studied in the articles entitled **AERIAL NAVIGATION**, and **AVIATION, CIVIL**. There are special articles on the **PARACHUTE**; **AERODYNAMICS**; and **AERIAL LAW**.

AERONAUTICS. The record of man's attempts to fly goes back into the remote past. The story of Icarus is a myth founded perhaps on some early failure to imitate the birds. Leonardo da Vinci thought and wrote about it, and there are some references to the subject in the works of Francis Bacon. In 1617 Fleyder of Tübingen lectured on flying; while in Italy, again, in his book *De motu animalium* (1680), G. A. Borelli discussed the question in connection with the strength of man's muscles and came to the conclusion that such flight was impossible.

history of airships see **BALLOON** and **AIRSHIP**. The first attempts, limited in all cases to the flight of models, were generally based on the endeavour to imitate the action of a bird's wings. Sir George Cayley, however, in 1796, constructed a tiny helicopter in which two windmills made of gull feathers were caused to revolve about a vertical axis. Figs. 1 and 2 illustrate two models due to Pénau, constructed in the early '70s of the 19th century; in the first of these the motive power is obtained from a screw driven by

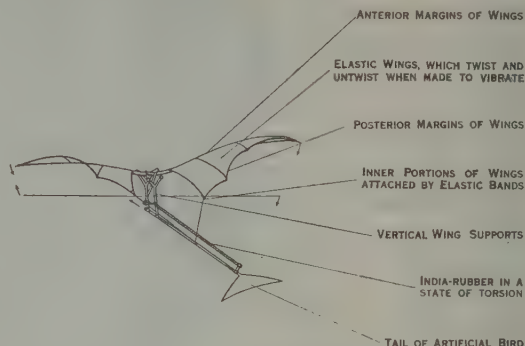


FIG. 2.—PENAUD'S SECOND MODEL, WHICH WAS PROPELLED BY A SCREW AND SUSTAINED BY A HORIZONTAL FLEXIBLE WING. PENAUD'S SUCCESS OVER OTHER SIMILAR MODELS WAS LARGELY BECAUSE OF THE INVENTION OF WHAT HE CALLED AN AUTOMATIC RUDDER, WHICH WAS A SMALL WING PLACED AFT OF THE MAIN WINGS

the torsion of an India-rubber cord; in the second an attempt is made to imitate the action of a bird's wings. W. S. Henson and J. Stringfellow in 1842 had already constructed models in which the supporting force was obtained from the wings while the motive power came from a screw, and from that time on some of the fundamental principles underlying flight began to be more generally recognized.

Early Mechanical Machines.—Early experimenters learned that a flat rectangular plane, when moved edgewise through the air, could develop a vertical "lift" as a result of the pressure of the air on the surface. They also learned that the resistance to forward movement, or "drag," could be overcome by the use of a propeller. If an engine of sufficient power and low weight could be devised, it became apparent that a flat surface, or "wing," could be made to move fast enough through the air to enable it to support the combined weight of the wing, engine and propeller and a human occupant. It was on principles such as these that a steam-engine powered machine was patented by Henson in 1842 and the first steam-powered model was successfully demonstrated by Stringfellow in 1848. Stringfellow, in 1868, exhibited at the Crystal Palace a model for which he received a prize of £100. Samuel P. Langley, of the Smithsonian Institution of Washington, D.C., worked on similar lines. It had been realized by this time that greater lifting power could be obtained by shaping the supporting surfaces; *i.e.*, by giving them a convex shape on the upper side and a concave on the lower. In 1896 a steam-driven model flew for a distance of about one-half mile along the Potomac river near Washington. At a later date Langley built a large machine which was intended for passengers. It was fitted with a remarkably light steam engine designed by Charles M. Manly and driven by two propellers; this was launched into the air from a vessel in the river. On each of the two occasions in 1903 on which it was tried, something went wrong with the launching arrangements, and the machine was wrecked. Another early machine was that of Sir Hiram Maxim; this too was damaged in a trial in 1894.

Giders.—Meanwhile, it had been realized that before success was reached more knowledge as to the conditions of balance in the air was necessary and, further, that much could be learned by the use of gliders depending for their support on natural air currents.

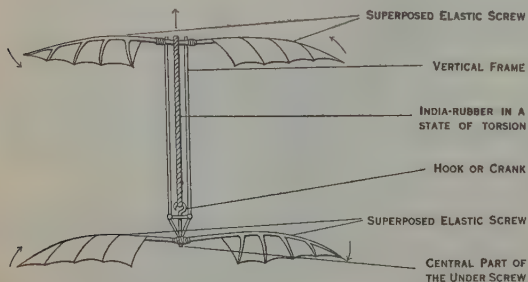


FIG. 1.—PENAUD'S HELICOPTER OR SCREW MODEL BUILT IN 1872. MOST OF THE PIONEERS IN AERONAUTICS DIRECTED THEIR ATTENTION TO THE CONSTRUCTION OF MODELS CAPABLE OF VERTICAL FLIGHT

Early History of Artificial Flight.—We are here concerned mainly with the flight of bodies heavier than air; for the early

TABLE I

Year	Experimenter	Tip to tip (feet)	Surface (square feet)	Weight (pounds)	Pounds per square foot	Speed per hour (miles)	Maximum flight (feet)	Motor	Horse-power	Pounds sustained per horse-power
1879	Tatin	6.2	7.5	3.85	0.51	18	100?	Compressed air	0.03	110?
1885	Hargrave (No. 16)	5.5	26.0	5.00	0.19	10	343	"	0.06	79
1889										
1893	Phillips	22.0	136.0	402.00	3.00	28	500?	Steam	5.60	72?
1894	Maxim	50.0	4,000.0	8,000.00	2.50	36	300?	"	363.00	28
1896	Langley	12.0	70.0	30.00	0.43	24	4,000	"	1.00	30
1897	Tatin and Ritchet	21.0	86.0	72.00	0.83	40	460	"	1.33	55
1897	Ader	49.0	270.0	1,100.00	4.00	50?	100?	"	40.00	27
1895	Lilienthal	23.0	151.0	220.00	1.46	23	1,200	Gravity	2.00	110
1896	Pilcher	23.0	170.0	200.00	1.17	25	900	"	2.00	100
1896	Chanute	16.0	135.0	178.00	1.31	22	360	"	2.00	89
1906	Santos-Dumont	39.0	560.0	550.00	0.98	22.26	2,900	Gasoline	50.00	23
1908	W. Wright	41.0	650.0	1,100.00	1.70	37	295,000	"	24.00	46

Experimenters, suspended from wings, jumped from natural or artificial heights and allowed the wind to carry them through the air. Otto Lilienthal, in Germany, who first showed the advantage of curving flat surfaces, was killed after making more than 2,000 safe flights in which he endeavoured to maintain his balance by shifting his position relative to the wings. Octave Chanute, in the United States, made the surfaces of the aeroplane movable, and constructed a number of machines.

The Modern Era.—Wilbur and Orville Wright, of Dayton, O., began their epoch-making work in 1900 with gliders. They introduced two great improvements: (1) the elevator, or horizontal rudder for steering the machine in the vertical plane, which they placed in front of the main planes (in nearly all modern machines it is attached to the tail); and (2) the flexing of the rear edge of the main planes to vary the lift on either or both at will and thus maintain the balance in the air. A gasoline motor driving a propeller was added in 1903. In 1905 they made 45 flights, in the longest of which they remained in the air for one-half hour and travelled 24½ mi. A little later, 1906, Alberto Santos-Dumont constructed a machine in which he flew a distance of about 250 yd. in 21 sec.

In 1908 Henri Farman, at Issy-les-Moulineaux, Fr., made a circular flight of 1 km. and on Sept. 29 he covered 24½ mi. in 42 min. Meanwhile, the Wrights had continued their work at Dayton. On Sept. 12, 1908, Orville made a flight of 45 mi. in 1 hr. 14½ min.; but a few days later he had an accident in which he was seriously injured and his passenger was killed. Wilbur Wright, on Sept. 21, 1908, at Le Mans, Fr., beat all previous records by a flight of 56 mi. in 1 hr. 31 min. 25½ sec. On Dec. 31 he remained in the air for 2 hr. 20 min. 23 sec. These great advances had been rendered possible by the improvement of the gasoline engine.

Table I gives some details, approximately correct, of the principal experiments made with flying machines from 1879 to Wilbur Wright's flight in France.

In 1909 a number of notable flights were made, several of them in monoplanes. On July 25 Louis Bleriot crossed the English channel from Calais, Fr., to Dover, Eng., and later H. Latham nearly achieved the same feat. In November Farman covered a distance of about 134¼ mi. in 4 hr. 17 min. 53 sec.

From this time progress in the development of improved flying machines and the accomplishment of record-making achievements was enormous. World War I and the postwar years witnessed the successive progress of aviation as a "wondrous freak," then an implement of destruction in war and finally a useful means of human transportation. The external form of the machine also underwent marked changes from the fragile "boxlike" structure of sticks, paper and wire, through the biplane era of World War I to the sturdy, multiengineed, all-metal monoplane transports. The toy models of Henson and Stringfellow were replaced by machines weighing 300,000 lb. or more and having ranges of more than 5,000 mi. Jet-powered fighter aircraft developed shortly after World War II were capable of speeds of more than 500 m.p.h. while research aircraft at mid-20th century had proved the feasibility of human flight faster than the speed of sound. (See also TRANS-OCEANIC AND TRANS-CONTINENTAL FLIGHTS.)

THE SCIENCE OF AERONAUTICS

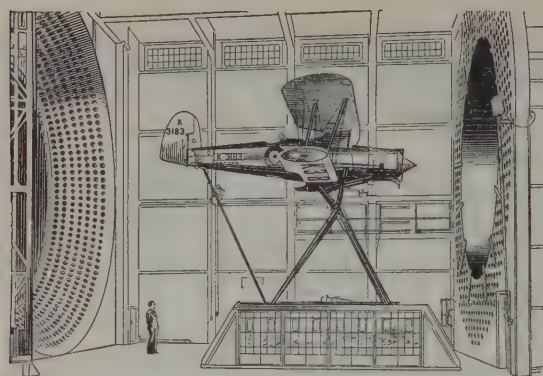
Early Experiments.—Even before 1909, the practical beginning of the era of aviation, experimenters had made remarkable progress in understanding the classic principles of fluid resistance and motion. The philosophical papers of Sir Isaac Newton (1642-1727), Jean Bernoulli (1667-1748), Jean le Rond d'Alembert (1717-83), Leonhard Euler (1707-83), Osborne Reynolds (1842-1912) and many other physicists advanced fundamental laws of fluid resistance which were basic to modern aerodynamics theories.

Still, much more had to be learned of the laws relating to the flow of air around aeroplanes in motion, the form and shape of aerodynamic bodies, the proper dimensioning, proportioning and location of wings and control surfaces and the most efficient method for propulsion. Experiments in aerodynamics had been made by Langley in 1891. A. F. Zahm at a later date (1902-03) had measured the air velocity, pressure and friction on surfaces of various forms. Sir Thomas Stanton, at the National Physical laboratory, Teddington, Eng., had experimented on the resistance of surfaces in a current of air and the pressure of the wind on plates. F. W. Lanchester, in his *Aerodynamics*, had described similar measurements. Lord Rayleigh, in various papers of great importance dating from 1876, had discussed questions of the resistance of fluids and in 1899 contributed to the Manchester *Memoirs* a paper on the mechanical principles of flight; but no organized attack on the questions raised by the flight of a body heavier than air had been made.

Government Sponsorship of Aeronautical Research.—As early as 1909 governments recognized the importance of concerted and co-ordinated effort in the field of aeronautical research to maintain leadership in aviation. England in 1909 established at the National Physical laboratory an advisory committee for aeronautics. Work of a similar character was in progress elsewhere; in Germany at Göttingen, under L. Prandtl; in Russia at Koutchino, where D. Riabouchinsky was director. In the United States on March 3, 1915, congress established the National Advisory Committee for Aeronautics (NACA) for the supervision and direction of the scientific study of the problems of flight. From the laboratories of these nations came scientific data upon which aeronautical engineers came to rely for the design of new planes.

The Wind Tunnel.—In studying the forces to which aircraft are subject in flight, mathematics alone is of little help; the dynamics of the air are too complex for reliable results and recourse must be had to experiment. To carry a given weight, how large must the wing be; what speed, shape, angular setting, etc., is needed? How should body and tail surfaces be placed, shaped and positioned for best results? How can speed, range, controllability and stability be predicted accurately prior to construction to ensure satisfactory results? Such are some of the questions of aerodynamicists. These and many others are quickly answered by testing models in a wind tunnel.

Wind tunnels are designed to produce a high-speed, steady flow of air through the test section, or throat, where the model is located. Thus, instead of passing through the air as does the full scale aeroplane, the model is stationary, with the air stream pass-



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FIG. 3.—THE 24-FT. WIND TUNNEL AT THE ROYAL AIRCRAFT ESTABLISHMENT, SHOWING AEROPLANE IN POSITION ON MAIN BALANCE

ing over it, making it relatively easy to explore the airflow streamlines over the model and measure its lift, drag and balancing forces. The model is also arranged so that it can be pitched to various angles with relation to the horizontal air stream; for airfoils this angle is known as the angle of attack.

Wind tunnels are of various kinds, shapes and sizes; small tunnels testing models of approximately ten-foot span at 100 m.p.h. air speeds are available at most aeronautical engineering institutions. Large-scale, subsonic and supersonic speed wind tunnels are mostly available only to government laboratories because of the cost of construction and operation. (See also AERODYNAMICS.)

Measurements of model forces in wind tunnels, lift (L), drag (D), moments (M) and centre of pressure ($C.P.$) are usually determined for a complete range of angles of attack and are plotted in the form of airfoil characteristics charts; these are of utmost importance to the aerodynamicist in calculations of the full-scale aeroplane. (See Fig. 4.)

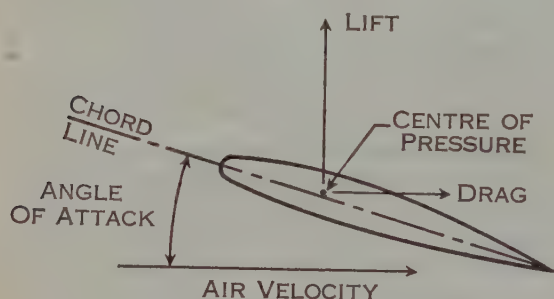


FIG. 4.—FORCES ACTING ON AN AIRFOIL IN AN AIR STREAM

Airfoil Characteristics.—"Airfoil section" is the technical name given to the curved-surface cross section of the wing. Its length is the chord (C); the width is its thickness (t). Airfoil sections have a long history of development from the early flat plate to the modern efficiently cambered sections. Fig. 5 shows the evolution of airfoils.

Variation of shape, curvature of upper and lower surfaces, thickness, shape of nose and trailing edge, all have important and varying effects on the lift, drag, moment and airflow over the wing. For slow-speed planes of 150 m.p.h. or less, thicker sections offer good lift at high angles of attack and permit low landing speeds. They also have ample space for light-weight internal structures. High-speed planes need thinner wings for low drag. Specially designed thin, sharp, nose sections are desirable for supersonic speed planes to offset air compressibility shock problems.

So long as the angle of attack remains constant, the lift, drag and moment are approximately proportional to the product of the density of the air, the square of the speed and the area of the wing

on which it acts; so we may write:

$$L = C_L \rho / 2 S V^2$$

$$D = C_D \rho / 2 S V^2$$

$$M = C_M C \rho / 2 S V^2$$

where C_L , C_D and C_M are known as airfoil aerodynamic coefficients; ρ is the air density (at sea level 0.002378 slugs per cubic foot), S the area of the wing and V the air speed.

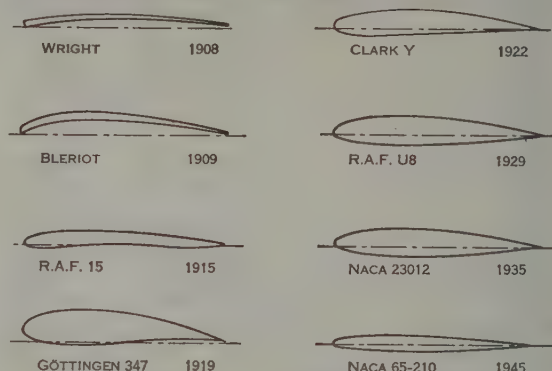


FIG. 5.—EVOLUTION OF THE MODERN AIRFOIL SECTION

From the wind-tunnel balances L , D and M are measured for a range of angles of attack; the three coefficients can then be calculated from the three equations. The results are then plotted in the form of curves, known as airfoil characteristics charts, an example of which is shown in fig. 6.

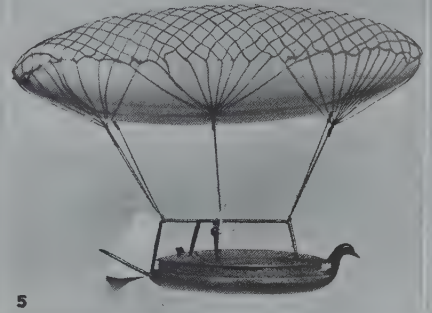
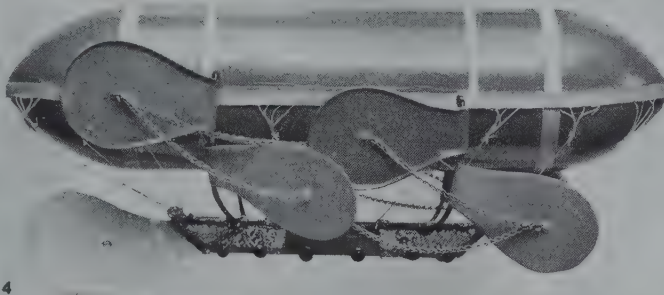
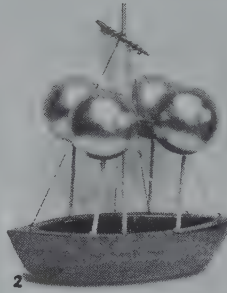
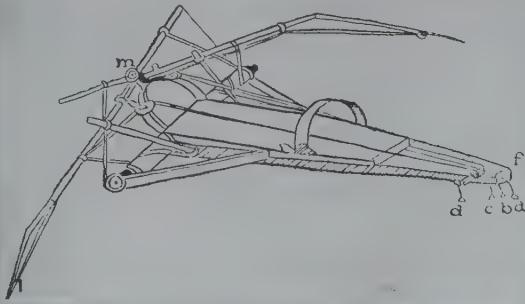
It is from curves such as these that the weight, speed and other performance characteristics of the aeroplane are computed.

Scale Effect.—Before applying wind-tunnel model data to a full-scale plane, scale effect corrections are necessary. Since the full-scale plane may be from ten to many times larger than the model, and since air speeds may be three times or more greater, and air density can vary, how can one step from wind-tunnel results to the actual plane? Dimensional theory shows that, compressibility aside, equivalent conditions are met if $VL\rho/\mu$ (called Reynolds number) of the model and full-size body are equal; where V is the air speed; L is a convenient linear dimension; ρ is the air density and μ the viscosity coefficient of air. Practically this means that since the model is small, the wind-tunnel test speed must be proportionally increased; for a one-tenth scale model a speed of about ten times the plane speed would be needed. This is impractical but the situation is easily remedied by the application of empirical corrections obtained from a series of tests run on other comparable bodies at varying Reynolds numbers. When such corrections are made to the drag curve, the slope of the lift curve and the maximum lift coefficient, it can be said that conditions for the full-size plane have been met.

Compressibility Effects.—As air speeds increase to more than 400 m.p.h., wind-tunnel data must be further corrected for the change in air density resulting from its being compressed at such speeds. The magnitude of corrections needed increase with the ratio V/v (called Mach number, M); where V is the plane speed and v is the speed of transmission of sound in air. Experiments show that lift curve slope increases, maximum lift decreases and drag coefficients rise rapidly as the Mach number approaches 1.

At the speed of sound, or $M=1$, tremendous changes occur to the conditions of airflow around airfoils and bodies. This is called the sonic region. Compression shock waves originate at this speed which produce tremendous changes of lift, drag and moment. By mid-20th century no mathematical theories had yet been developed to predict accurately the exact effects; recourse was made to sonic and supersonic wind-tunnel testing.

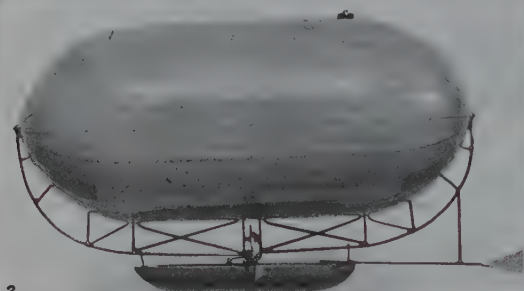
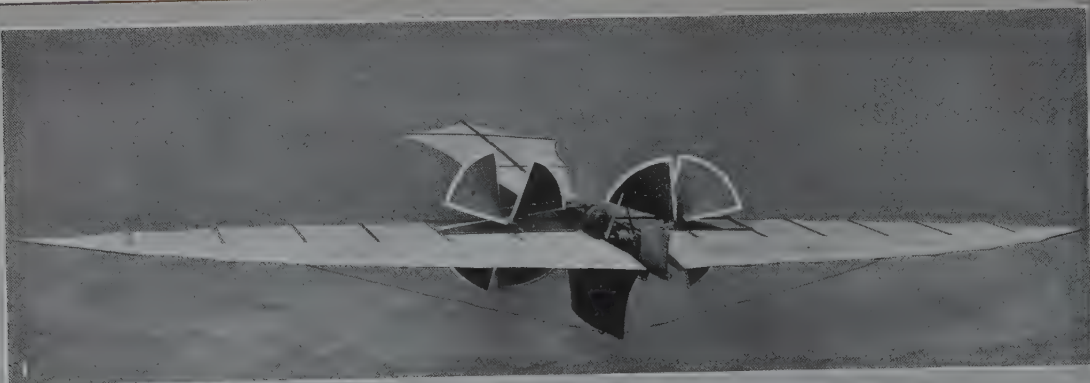
Stalling and Spinning.—From Fig. 6 it will be noted that as the angle of attack of the airfoil increases, a point is reached where the lift coefficient, C_L , suddenly falls; at this instant the plane can no longer maintain flight; its wings lose lift and it must pitch



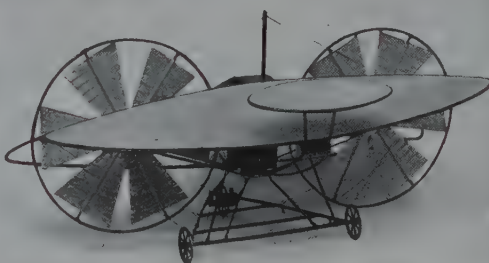
BY COURTESY OF (1) CHAPMAN AND HALL, (2, 3, 4, 5) SIMS AND COMPANY, (6) THE DIRECTOR OF THE SCIENCE MUSEUM

EARLY DEVICES OR PLANS FOR FLYING MACHINES, 1500 to 1843

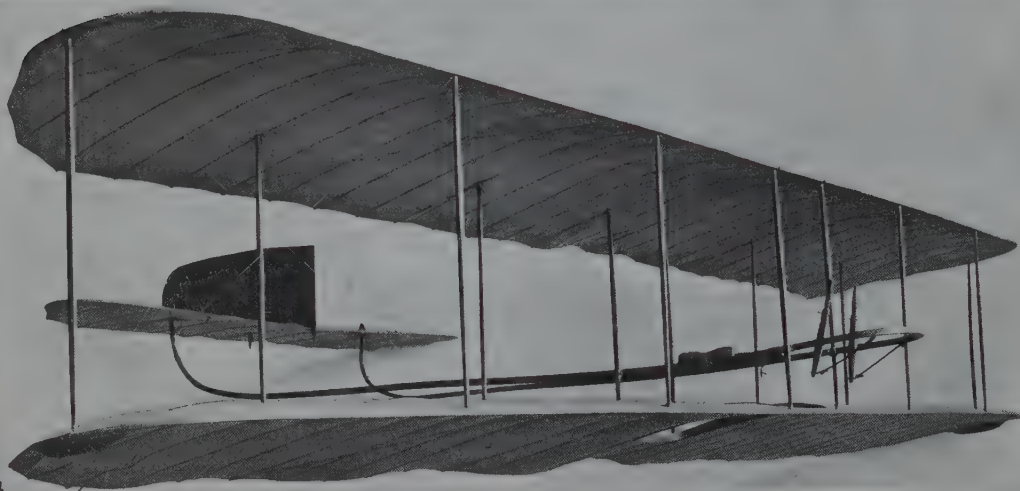
1. Leonardo da Vinci's conception of a flying machine 1500. The wings or "oars" were to be operated by a system of stirrups or pulleys
2. Francesco de Lana's flying boat, conceived about 1650. The plan was to attach a boat with sails to four large copper balls from which the air had been exhausted
3. Combination of helicopter and aeroplane planned in 1809 by Sir George Cayley, spoken of as the father of British aeronautics
4. The "Eagle," designed by Comte de Lennox in 1834 in collaboration with Le Berrier; dimensions 130 feet by 35 feet with a lifting power of 6,500 pounds
5. Hand-driven propeller type navigable balloon experimented with in 1816 by Sir George Cayley
6. Henson's "Aerial" steam carriage, designed in 1842. The extensive supporting structures occupied a nearly horizontal position, and it was equipped with a 25-h.p. steam engine, but it never left the ground



2



3



4

BY COURTESY OF (1) THE DIRECTOR OF THE SCIENCE MUSEUM, LONDON, (2, 3) SIMS AND COMPANY, (4) THE ROYAL AERO CLUB

NINETEENTH CENTURY EXPERIMENTAL NAVIGABLE BALLOON AND AEROPLANES

1. Stringfellow's aeroplane, built in 1848, the first model aeroplane to fly
2. Bell's patent locomotive navigable balloon, 1850; an early attempt at a semi-rigid dirigible with two hand-driven propellers
3. Thomas Moy's Aerial Steamer, 1874, which was fitted with a 3 h.p.

- steam engine but succeeded in rising only a few inches from the ground
4. Chanute's Glider, 1903. In experimenting with this and other forms of engineless aeroplanes, Octave Chanute made over a thousand glides without accident

downward with the sensation of falling; it is said to be stalled. All airfoils have this common fault. The violence of the stall, the behaviour of the plane immediately after stalling and the recoverability afterward are of extreme importance. From his knowledge of the shape of the lift curve, the engineer can properly proportion the wing, design twist into the wing, shape the wing tips, sweep the wing and provide stall-warning characteristics as needed to obtain the right stalling performance.

Since a large proportion of accidents arise from stalls close to the ground a well-designed plane will develop an unmistakable warning buffet, or shake, just preceding the stall; it will stall with the nose pitching downward only slightly so that very little altitude is lost and it will not roll to one side or go into a spin. Such a plane is known as "spinproof."

Spins occur after wing stall is reached if the plane is allowed to fall off and roll at the same time. Quickly thereafter it develops into a steady gyrational descending motion about a vertical axis of rotation somewhere ahead of the nose. Altitude is lost rapidly and recovery from the spin must be quickly effected to avert a crash. Many such accidents did occur until it was learned that proper positioning of tail surfaces, their shapes, sizes and locations of control surface were important for good spin-recovery characteristics. Planes can be so designed that they can be pulled out of a spin by simply centring all controls; when rotation ceases, recovery is completed by pulling out of the dive attitude which follows.

Landing Speed.—The plane must, on approach to a landing, be slowed down by increasing the wing angle of attack; this is done by pulling back on the elevator control, thus raising the nose. The slowest speed at which the plane can maintain steady flight in this approach is called the landing speed. This speed

can be computed from the equation:

$$V \text{ min.} = \sqrt{\frac{2}{\rho C_L \text{ max.}}} \times \frac{W}{S}$$

where $C_L \text{ max.}$ is the maximum airfoil lift coefficient and W/S is the wing loading; *i.e.*, weight divided by wing area.

It is desirable to have $V \text{ min.}$ as low as possible for safety reasons; for a conventional light plane where $C_L \text{ max.}$ is 1.35 and W/S is 12 lb. per square foot the landing speed would be 59 m.p.h.

Reduction of landing speed to a lower value is possible only if W/S is decreased (*i.e.*, decrease the plane's weight or increase the wing area) or $C_L \text{ max.}$ is increased. The latter is the more feasible, through three means: (1) use of leading edge slots; (2) use of trailing edge flaps; and (3) energizing or removing the layer of air on the top surface of the wing by what is termed boundary layer control. The trailing edge flap is most familiar; however, all these methods, in common, delay the breakdown of airflow over the wing at the normal stall angle so that much higher values of $C_L \text{ max.}$ can be achieved.

A flap added to the wing of the example above could develop a $C_L \text{ max.}$ of 2.0 with a resultant drop in landing speed to 48 m.p.h.

Performance.—Similarly, other important characteristics of the plane can be computed by using fundamental aerodynamic laws. Space does not permit going into all of these, but a few of the more important performance characteristics so determined are mentioned.

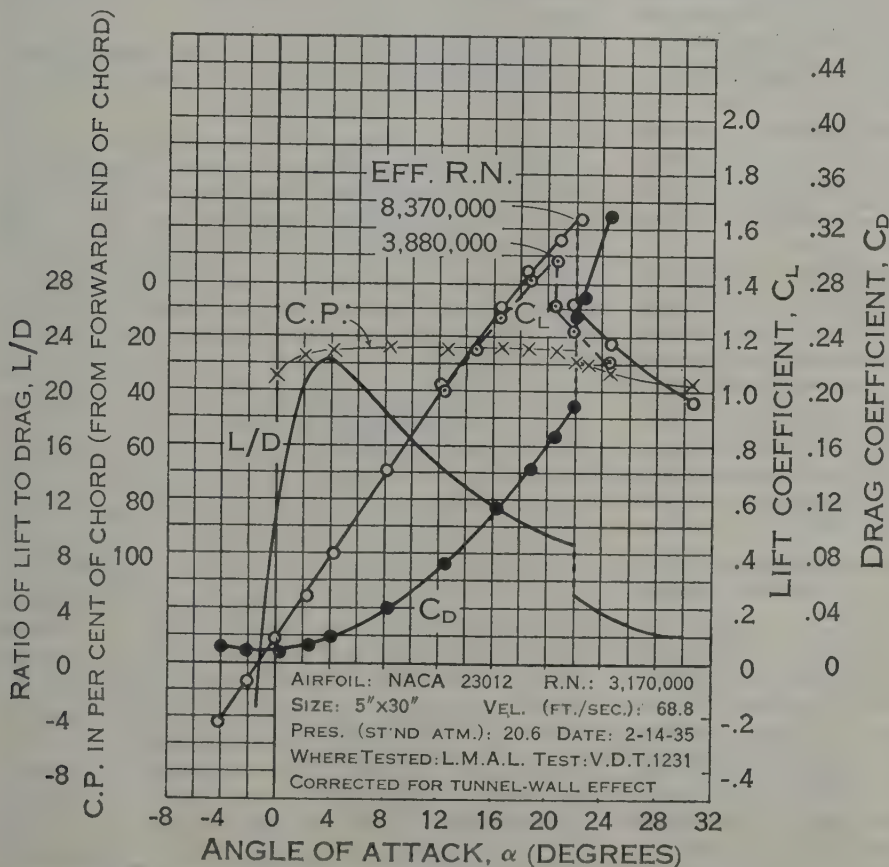
Speed.—Engine thrust must overcome the total drag of wing, struts, body, tail surfaces, etc. The maximum speed can be computed by equating the power available from the engine to the power absorbed to overcome total drag.

Climb and Ceiling.—The excess of power available from the engine over that required for level flight at a particular speed is the amount of energy available for climb, which is the rate at which the altitude is increased, expressed in feet per minute. As the altitude is increased, the rate of climb decreases; at that altitude where it becomes zero, the absolute ceiling of the aeroplane is said to have been reached.

Range.—Range can be determined by computing the power required for the given speed of flight times the engine specific fuel consumption (pounds per horsepower per hour) and the quantity of fuel available.

Stability.—It is well to consider what is meant by stability as applied to an aeroplane. Imagine that by some means—a sudden downward gust, for example—the motion of the plane is disturbed and the nose takes a downward direction.

If the pilot does nothing to counteract this, one of two resulting actions will occur. In a properly designed aeroplane the nose will automatically rise and after a few successively decreasing pitching oscillations it will, since it is stable, resume level flight of its own accord. Any disturbance in roll or yaw will similarly die out. On the other hand, an unstable machine will increase in oscillation, the nose rising and falling in



BY COURTESY OF THE NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

FIG. 6.—AIRFOIL CHARACTERISTICS OF NACA 23012 AIRFOIL, SHOWING THE EFFECT OF SCALE ON MAXIMUM LIFT COEFFICIENT AS SHOWN BY CHANGE IN THE REYNOLDS NUMBER

creasing amplitude, to such an extent as to become dangerously violent. It is not possible here to discuss the conditions necessary for stability; this requires a knowledge of a number of quantities known as stability derivatives which can be determined by suitable experiments in a wind tunnel.

An inherently stable plane will, when set on a course, try to keep it; this is an important characteristic since, lacking stability, safety is impaired, accurate navigational and blind flying impossible and strain of flying on the pilot intolerable.

THE AEROPLANE

As treated herein, classification and subdivisions under important subject headings are a necessary preliminary for an adequate and brief presentation of the science of design, use and operation of aeroplanes. The separate article **AEROPLANE** contains a detailed account of many essential design considerations, including flight and performance features.

Components.—The essential components of all aeroplanes are: (1) wings or lifting surface; (2) stabilizing and control surfaces; (3) fuselage, or body, housing occupants; (4) propulsion system, engines and propellers; (5) landing gear (*i.e.*, wheels, skis, water-tight hulls or seaplane floats); and (6) equipment, instruments and control devices.

The wings support the machine. They are carefully designed for minimum aerodynamic drag, good stalling characteristics (*see above*), low landing speeds and use of efficient light-weight structural materials. Steady motion in flight is achieved by a vertical tail surface (*fin*), a horizontal tail surface (*stabilizer*) and the effective *dihedral* angle of the wings. Small hinged planes, operable by the pilot, are attached to the rearward edges of these areas to obtain controllability: a *rudder*, attached to the fin, which guides the aeroplane horizontally; an *elevator*, which causes the craft to dive or climb, attached to the horizontal stabilizer; and *ailerons*, which produce a rolling motion of the craft by changing the angle of the incidence of the wing and are hinged along the rear edge of the wing. When moved, the aileron causes a loss or gain in lift on one wing with respect to the other, thereby allowing the pilot to rock the plane at will. The *fuselage* housing the pilot and passengers is most frequently a shell-like structure resembling an elongated streamline body. It contains the pilot's *cockpit*, which includes all flight and engine controls, radio, instruments and navigation equipment.

The propulsion system (*see Aircraft Propulsion*, below) provides thrust to overcome air drag and thus achieve forward speed.

Landing gears are essential for take-off and landing purposes. On land- and amphibian planes they usually consist of wheels and tires mounted at the end of extensible shock-absorbing struts. To reduce air drag it is customary to retract landing gears into the body or wings in flight. On flying boats and seaplanes the bottom surface of the landing structure is carefully shaped and proportioned to provide good hydrodynamic characteristics as regards handling and control characteristics, absence of tendency to porpoise and minimum "hump" speed; *i.e.*, that speed where the hull rises in the water, its resistance drops rapidly and skimming on the water surface is started.

Types of Aeroplanes.—Aeroplanes are customarily described with reference to operational use, wing arrangement, propulsion means, type of landing gear, etc.

Landplanes operate from airports, *seaplanes* and *flying boats* from sheltered water areas; *amphibians* operate from either water or land but have retractable landing wheels making it possible for the pilot to take off and land on water or an airfield. Skis are sometimes installed on landplanes to convert them to *skiplanes* for operation on snow and ice. *Tricycle*-type landplane landing gears have a front wheel located on the nose of the fuselage, allowing the aeroplane to remain in a level attitude on the ground. A *tail-wheel*-type aeroplane uses a wheel at the tail end of the fuselage requiring the plane to be in a "tail-low" attitude while at rest.

Aeroplanes with one main wing are called *monoplanes*; two wings, one above the other, *biplanes*. A tailless monoplane is called a *flying wing*. *Canard* monoplanes have the tailplane ahead of the main wing. The location of the monoplane's wing vertically

with respect to the fuselage designates it as a *low-wing*, *mid-wing* or *high-wing*, the mid-wing having the wings so attached to the fuselage as to seem to pass approximately through the middle.

Aeroplanes are either *propeller driven* or *jet powered*. Single-engine planes have one engine, usually in the nose of the fuselage. Multiengine aeroplanes employ two or more engines, disposed symmetrically on each side of the fuselage.

Development and Utility.—Space permits only a brief treatment of some major factors governing the development and use of modern aeroplanes. Four essential elements are considered: (1) safety; (2) speed and comfort; (3) reliability of service; and (4) special purpose. A discussion of each follows.

Safety.—Aeroplane designers are acutely conscious of safety requirements; calculations and thorough strength testing of all structural components are conducted for the maximum possible air and landing loads. Numerous tests are made of power plants, control systems, instruments, pressurization systems, fire detection and control procedures, etc. Finally, thorough flight tests are completed to prove the safety and reliability, even to the extent of simulating emergency conditions such as failure of vital control systems, loss of engines and entry into icing conditions.

Air-line operators also have thorough training and check-up programs to ensure the competence of pilots, flight engineers, navigators and mechanics. A continuous system of inspection, overhaul and replacement of critical components of the plane is maintained.

Speed and Comfort.—Higher operational speeds are sought, without sacrificing economy of fuel and sizable pay load. To do this, care is used in selecting the engine and propeller; thin wings and well-streamlined smooth bodies and surfaces are used to obtain minimum drag. Equipment must be compactly stored within the structure. Since low landing speeds are needed, high lift flaps are placed on wings to reduce the stalling speed.

Comfort and safety of passengers is achieved through pressurized cabins, high-altitude flying in smooth air, soundproofed compartments, comfortable chairs, safety belts and many other features.

Reliability of Service.—Reliability of modern aircraft engines, structures and equipment is such that delays to scheduled trips resulting from mechanical difficulties are rare. Poor visibility and bad meteorological conditions of storms and icing, however, were still real handicaps at mid-20th century. "All-weather" equipped aeroplanes and a world-wide system of aerial highways using radio devices for guiding pilots (and later automatically directing aircraft) were being developed. Blind flying instruments for control and trim as well as ice-removal equipment to keep engines, propellers and wings free of ice had become essential. Radio beams and electronic instrument landing systems were available to guide aircraft and make possible safe landings with cloud ceilings of 200 ft. and visibility of one-fourth mile.

Special Purpose.—Aeroplanes are designed to accomplish definite tasks, such as transportation of people and cargo, aerial survey and mapping, agriculture and forestry uses and military applications. The form, arrangement of body, proportioning of wings and control surfaces, number of and type of engines, are all dictated by the ultimate purpose of the particular design. People must be enclosed in comfortable heated and ventilated compartments. Cargo must be carried in compartments having large external openings and heavy floor structures. Camera installations and clear-view windows must be provided for aerial mapping work. Dispensing hoppers and spray equipment are specially designed for use in aerial-seeding and pest-control planes. Military aircraft have special design requirements of high strength for manoeuvrability at high speeds and extreme altitudes; bombers, fighters, training, observation and liaison planes all are designed under specialized requirements to make them suited for specific use.

Private Planes.—Great improvements were made in the design of small planes to accomplish low landing speeds, eliminate stalls and spins, simplify flying by use of two controls (*i.e.*, elimination of the rudder and use of a wheel for elevator and aileron control) and improve landing gears to simplify ground taxiing by use of a steerable tricycle landing gear. Research was undertaken to im-

TABLE II.—Data on Modern Aircraft

Aeroplane	Type	Seats		Power plant	Speed		Altitude (feet)	Normal range (miles) at S. L.	Rate of climb (ft. per min. at S. L.)	Service ceiling (feet)	Fuel capacity (gallons)	Weight (pounds)		Dimensions (feet)			Wing area (square feet)	Wing Loading	
		Crew	Others		Max. m.p.h.	Cruise m.p.h.						Gross	Empty	Span	Length	Height		(lb. per sq. ft.)	(lb. per h.p.)
Piper Cub.	Single-engine cabin	1	1	65-h.p. Continental	112	100	Sea level	350	510	13,450	12	1,220	574	35.268	22.29	6.625	178.5	6.83	18.77
Ercoupe	Single-engine cabin	1	1	75-h.p. Continental	120	105	Sea level	450	530	11,100	24	1,400	800	30.0	20.167	6.16	142.6	9.83	18.70
Navion	Single-engine cabin	1	3	135-h.p. Continental	163	155	Max. at sea level Cruise at 5,500	500	730	12,000	39.5	2,750	1,673	33.4	27.8	8.54	184.34	14.82	14.87
Douglas DC-3	2-engine transport	3	25	2-1,200-h.p. Wright	227	195	Max. at 7,500 Cruise at 7,500	—	890	24,000	822	24,000	16,308	95.0	64.5	16.92	987.0	24.3	10.0
Douglas DC-6	4-engine transport	4	56	4-2,100-h.p. Pratt & Whitney	358	315	Max. at 19,600 Cruise at 20,400	2,350	1,160	—	4,248	95,200	54,325	117.5	101.5	28.5	1,403.0	63.7	11.1
Convair 440	2-engine transport	3	40	2-2,500-h.p. Pratt & Whitney	336	291	Max. at 13,500 Cruise at 16,000	625	1,475	—	1,000	40,500	26,531	91.75	74.6	26.9	817.2	47.7	9.28
Grumman G-73	2-engine amphibian	2	8	2-600-h.p. Pratt & Whitney	215	180	Max. at 8,000 Cruise at 8,000	627	1,190	—	380	12,500	8,773	66.67	48.33	18.75	444.0	28.75	10.63
Beech Model 18S	2-engine transport	2	8	2-450-h.p. Pratt & Whitney	230	212	Max. at 5,000 Cruise at 10,000	1,500	1,180	20,600	202	8,750	5,817	47.58	34.0	9.21	349.0	25.1	9.72
Lockheed Constellation L-649	4-engine transport	4	56	4-2,000-h.p. Wright	350	300	Max. at 19,500 Cruise at 23,000	4,800	1,465	—	4,600	94,000	56,000	123.0	95.25	23.0	1,650.0	57.0	9.4
Boeing 377 Strato-cruiser	4-engine transport	4	86	4-3,500-h.p. Pratt & Whitney	375	300	Max. at 25,000 Cruise at 25,000	4,600	1,060	—	4,500	142,500	82,000	141.0	110.3	38.25	1,760.0	80.5	10.2
Sikorsky S-51 Helicopter	3-blade single rotor	1	3	450-h.p. Pratt & Whitney	103	85	Sea level	255	1,000	14,100	100	5,500	1,595	—	41.17	12.92	1,805.0*	3.05†	—
Bell 47 Helicopter	2-blade single rotor	1	1	178-h.p. Franklin	92	85	Sea level	212	700	8,500	—	2,200	1,482	—	30.42	8.37	970.0*	2.26†	—

*Area swept by main rotor.

†Blade loading.

prove the speed range; i.e., increase cruising speeds to more than 150 m.p.h. and reduce landing speeds to less than 50-60 m.p.h. Combination aeroplane-automobiles, in which wings could be detached, were also designed.

The fuselage structure of most modern private planes is either of welded steel tubing covered by painted or doped fabric or of riveted thin sheet aluminum alloy construction. Plywood and spot-welding metal construction have also been used. Wings may be constructed of wood or metal spars. Internally, ribs of a truss shape are attached, having the form of the wing airfoil. The complete structure is covered with doped fabric sewn to the ribs, or a thin sheet, or skin, of aluminum. In single-engine aircraft, small four- to six-cylinder air-cooled engines of approximately 100-150 h.p. are used, requiring 6-12 gal. of fuel per hour to operate. Propellers may be of wood or metal.

Commercial Air-Line Planes.—Table II includes general information on some of the most familiar air-line transport aircraft at mid-20th century. Approximately five years of intensive engineering development and testing are required to produce a successful modern transport. Since economic competition exists with railroads, buses and ships, low operating costs per mile flown are essential. Pay load (number of passengers or weight of cargo) must be as high as possible.

Special emphasis is given in design to safety aspects of structure, power plants, equipment and radio components. Multi-engines are desired to ensure safe arrival at emergency landing fields in the event of failure of one or more engines. Special procedures to detect and extinguish fires are developed. Automatic pilots and other controls, and thermal heating of wings and vulnerable icing areas are provided to make flying safer and easier. Hydraulic, electrical and mechanical controls, equipment and instruments are duplicated for safety reasons. To shorten landing runs and conserve brakes, reversing pitch propellers are employed.

ROTATING WING AIRCRAFT—GYROPLANES, HELICOPTERS

For centuries inventors had sought to develop wingless heavier-than-air flying machines using the principle of horizontally rotating propellers or the like. The attractive possibility of achieving hovering flight, a distinct advantage over fixed-wing aeroplanes which require long runways for take-offs and landings, stimulated inventors, but failures were the rule until about 1920, primarily because engines of sufficient power and low weight were unavailable.

Gyroplane.—In the 1920s, in Spain, Juan de la Cierva created the Autogiro, a strange-looking machine somewhat like a monoplane with a four-bladed rotor mounted on a central pylon and rotating horizontally above the fuselage. The engine-propeller installation on the front of the fuselage operated as on a conventional aeroplane. The lifting power of the rotor, which supported the aircraft in the air, was derived solely from the motion of the blades of the rotor as it moved edgewise through the air. The rotation was automatically achieved as a result of the air's passing upward past the individual blades, creating, in part, on each a horizontal, forward-acting force which tended to increase the rotational speed of the blade; hence, the terms "autorotation" and "autogiro."

This principle was exploited in various gyroplane developments with moderate success by later inventors in the United States and England. However, the advantages of these craft over conventional aeroplanes, particularly with respect to load-carrying ability, power requirements and speed, were insufficient to ensure commercial acceptance. More important, gyroplanes, incapable of hovering flight, were overshadowed by the advent of the helicopter.

Helicopter.—This type of aircraft is characterized by one or more horizontally rotating rotors directly driven by the aircraft engine. It has no wings. In free flight it can move at will in three dimensions: vertically, forward or backward, and sidewise. Each rotor usually consists of two, three or four separate blades extending radially from a central axis of rotation, or hub. The angle of attack of each blade can be changed at will by the pilot through movement of either of two levers, called the "collective

TABLE III.—Data on Modern Aero Reciprocating Engines Developed in the U.S.

Make and model	Type	Take-off rating		Min. fuel consumption at cruising power (lb. per h.p. per hr.)	Cylinders				Weight (lb. per max. h.p.)
		h.p. at r.p.m. at sea level	B.M.E.P. psi*		Number	Bore and stroke (inches)	Displacement (cubic inches)	Compression ratio	
Continental A-65-8	Horizontally opposed	65/2,300	131	.48	4	3.87x3.62	171	6.3:1	2.6
Lycoming O-235-C	"	100/2,600	130	.52	4	4.37x3.87	233	6.2:1	2.1
Franklin 6A1-165-B3	"	165/2,800	139	.50	6	4.5x3.5	335	7:1	1.7
Jacobs R-755-A1	Single-row radial	300/2,200	143	.43	7	5.25x5.0	755	6:1	1.7
Pratt & Whitney Wasp, Jr., B-5 (R-985)	"	450/2,300	157	.46	9	5.18x5.18	985	6:1	1.5
Pratt & Whitney Twin Wasp D-5 (R-2000)	2-row radial	1,450/2,700	211	.43	14	5.75x5.5	2,004	6.5:1	1.00
Pratt & Whitney Wasp Major TSB3-G (R 4360)	4-row radial	3,500/2,700	235	.44	28	5.75x6.0	4,363	6.7:1	.99
Wright Cyclone C18BD (R-3350)	2-row radial	2,500/2,800	211	.43	18	6.12x6.31	3,348	6.5:1	1.2

*Brake mean effective pressure, pounds per square inch.

pitch control" and the "cyclic control." Movement of the collective pitch lever results in the helicopter's ascending or descending; the cyclic control changes the plane of rotation of the rotor in the direction desired by the pilot—thus controlling forward, rearward and sideward motion.

One serious engineering problem concerns the counteraction of the engine torque force reaction arising from driving the rotor; unless counteracted by an oppositely applied torque capable of being varied by the pilot at will to suit the complete range of engine power, the effect would be to rotate the helicopter body in an opposite sense of the rotor rotation. A small auxiliary tail rotor, similar to the aeroplane propeller, mounted vertically on the rear of the fuselage and driven by a long drive shaft from the engine, is commonly used on single main rotor-type helicopters to provide antitorque forces. The tail rotor incorporates a blade, variable pitch-control mechanism operable by the pilot using conventional rudder pedals; the pilot can thus rotate the helicopter completely through 360° by this means while hovering. When more than one main rotor is used on the helicopter, such as in tandem, coaxial and other multirotor arrangements, the unfavourable engine torque effect can be effectively eliminated by causing each rotor to rotate in opposite directions.

Helicopter rotors are designed to continue rotation automatically in the event of engine failure, permitting safe descent and landing in small areas. This feature plus good speed range from zero to much more than 100 m.p.h., good lifting or pay load capacities and ability to operate from small areas, even rooftops, made the helicopter suitable for aerial taxicab and short-haul operations.

AIRCRAFT PROPULSION

Early attempts to fly failed or met with poor success because of inadequate knowledge of the power necessary and the lack of suitable engines. Steam was used by Phillips (1842), Henson (1842) and Stringfellow (1848) to drive models. Manly developed a small steam engine of 60 oz. which developed one horsepower; the four boilers weighed 7 lb. each. He later built the 52-h.p., five-cylinder gasoline engine used by Langley (1903). In

1894 Maxim devised a pair of two-cylinder compound engines, each weighing 600 lb. and giving 363 h.p.

Steam power was then dropped and the problem changed by improvements in the internal combustion engine burning gasoline. Santos-Dumont (1906) used a light and (for the time) powerful gasoline engine; about one year later Farman used an eight-cylinder Antoinette engine developing 40 h.p. at 1,100 r.p.m.

In 1908 Wilbur Wright, in his notable flights in France, employed a four-cylinder gasoline engine of 24 h.p., making 1,200 r.p.m. and connected by chain gearing to two wood propellers which revolved at 450 r.p.m. The weight of the motor was stated to be 200 lb.

From this time on progress was rapid. At first engines cooled by liquids, water or Prestone were used extensively but being heavy, and susceptible to failure because of leaks, were dropped in favour of air-cooled types.

Modern air-cooled aircraft radial engines of the reciprocating type were perfected to the point that power outputs of one horsepower per pound and fuel consumptions of 0.45 lb. per horsepower per hour became ordinary. Powers of from 50 to 3,500 h.p. were available. (See AERO ENGINES for other details.)

Types of Engines.—Aircraft engines were perfected along the following general lines: (1) reciprocating engines; (2) gas-turbines (turbojets) and (3) other reaction engines. Tables III and IV present typical characteristics of the first two types. Turbojets are also a form of reaction engine.

Reciprocating engines employ cylinders with moving pistons which, under the pressure of exploding fuel-air mixtures in the cylinders, rotate a crankshaft to produce power. Engines with cylinders located behind one another are called "in-line" engines. Radial engines have the cylinders disposed in a circle radially from the crankcase. The radial engine has the advantage of short length and compactness but presents a problem because of its large frontal area, requiring careful cowling to reduce drag and provide cooling.

Gas-turbine engines were a development of World War II. They consist of three essential components: (1) a compressor to

TABLE IV.—Data on Gas-Turbine Engines

Make	Compressor		Combustion chamber	Turbine		Size and weight				Performance		
	Flow	Stages		Flow	Stages	Length (inches)	Diameter (inches)	Frontal area (square feet)	Weight (pounds)	Take-off thrust (pounds)	Revolutions per minute	Fuel consumption at cruise (lb. per lb. thrust per hr.)
Allison 450-D4	Axial	11	8, tubular	Axial	1	146	37.0	7.5	2,260	4,900	7,800	1.06 at 2,890
General Electric TG-100B	Axial	12	8, tubular	Axial	1	144	36.7	7.35	4,525	5,000		1.056 at 2,930
Westinghouse 24C	Axial	11	Annular	Axial	2	120	28.0	5.16	1,250	3,200	12,500	1.08 min.
Pratt & Whitney JT-6B	Centrif.	1 double entry	9, tubular	Axial	1	104	49.6	13.4	1,723	5,000	12,300	1.11 at 2,700
Rolls Royce Derwent 5	Centrif.	1 double entry	9, tubular	Axial	1	83	43.0	10.1	1,280	3,500	14,700	1.0 min.
Allison 400-C4	Centrif.	1 double entry	14, tubular	Axial	1	102	50.0	13.6	1,805	3,825	11,500	1.31 at 2,180

provide high density air at high speeds; (2) a burner into which fuel is injected and burned with the compressed air; and (3) a turbine wheel which is rotated by the action of the expanding, hot, high-velocity gases on its blades. In turbojet engines the turbine supplies power to operate the compressor; thrust is obtained by means of the reaction pressure of the hot expanded, high-velocity gas as it escapes through the tail pipe of the engine. A turboprop engine is fitted with a frontal propeller driven by the turbine shaft through a gear reduction transmission in order to reduce its revolutions per minute; jet thrust from the escaping gases is also available. Gas-turbine engines are especially efficient for propelling high-speed, high-altitude planes. Low-grade fuels can be used, such as those having a kerosene base or low-quality gasoline.

All reaction engines develop thrust through the reaction force of hot gases expanding from a combustion chamber. In addition to gas turbines, other examples of reaction engines are pulsejet, ramjet and rocket engines. They have few or no moving parts and find application for driving aircraft at extremely high speeds by developing tremendous power; fuel consumption is enormous. Fuels are either liquids or solids; ordinary gasoline, alcohol and liquid oxygen and solid combustibles are typical propellents.

Engine Requirements.—The discussion which follows pertains primarily to air-cooled reciprocating engines.

The compelling objectives of engine research and development are to obtain a maximum of thrust for a minimum of frontal area, engine weight and fuel consumption. Steel as well as light, strong alloys of aluminum and magnesium are employed for construction of crankcase and pistons. Resistance to high temperature is needed. Special high-strength alloy steels are used for gears, crankshaft, valves, etc. Cylinder barrels and cylinder heads are air-cooled by using a large number of closely spaced fins around their outsides; cooling air, under pressure from high speed, is forced around such parts by cowlings and baffles which fit closely around the outside of the engine. The cowl also forms a streamline body enclosing the engine and reducing air drag to a low value. Cowl flaps or gills, adjustable by the pilot, control the amount of air passing over the engine; these can be opened wide on the ground, where maximum cooling is needed, and adjusted in the air so as not to cool the engine excessively under low temperature conditions.

Two spark plugs are used for each cylinder to increase reliability and obtain greater combustion efficiency. Intricate carburettor and fuel injectors which have automatic altitude compensation devices for maintaining proper fuel-air mixture ratios are installed; otherwise, as the air density falls with altitude, the flow of fuel would be excessive. Again, with increasing altitude, the power output of the engine falls off because of the reduced density of air and the resultant reduced mass of air drawn into the cylinders for combustion; superchargers, in the form of blowers or compressors, are provided to compress the air fed to the cylinders to make up for this deficiency. As a result, a typical supercharged engine, which develops a normal power of 1,070 h.p. at sea level, provides 1,100 h.p. at its critical altitude of 7,000 ft.

By increasing the compression of the cylinders, a large increase in power output is possible, but too great a compression produces detonation-knocking in the engine. This condition is detrimental to the engine. Special fuels with good detonation characteristics, identified as high-octane fuels, are available to reduce the severity of knocking. Still further improvement can be attained, especially during high-power take-off conditions, by injection of water directly into combustion chambers. This cools the hot gases somewhat, thus suppressing detonation, and allows higher powers to be drawn for the short time needed at take-off.

Performance and Operation.—Important to the designer in determining speed, range and performance of aircraft are the engine performance charts. These are in the form of carefully prepared curves showing the engine power output under varying conditions of revolutions per minute, intake (or manifold) pressure and atmospheric pressure (altitude effects) based on standard air conditions. Data of this nature are carefully prepared from

engine-dynamometer test data. Information on the fuel and oil consumption characteristics are also obtained.

Engines must be carefully controlled and operated in order to obtain maximum efficiency, range and dependability. In addition to the throttle, there are many other controls and instruments such as manifold pressure gauges, tachometers (revolutions per minute indicators), oil pressure gauges, temperature gauges and controls, fuel mixture controls and propeller pitch controls.

In addition to furnishing power for propulsion the engine also drives accessories such as fuel and hydraulic pressure pumps, electrical generators and air compressors.

Propellers.—The use of propellers to provide propelling thrust for marine craft and aeroplanes has long been familiar. In principle, thrust is obtained by imparting momentum to the column of air which passes through the propeller disk. The larger the disk area, the greater the pitch of the blades, and the higher the revolutions per minute the greater the amount of thrust force produced.

Important considerations to designers are the thrust, power and efficiency of a propeller. To determine such factors it is possible to apply simple laws of aerodynamics, since, in effect, the propeller is an airfoil moving in a curved path, thus developing lift and drag forces similar to those of a wing. In level flight, propeller thrust must equal the total air drag of the plane. The power delivered by the engine must equal that required to overcome the torque of the drag forces of the propeller. The efficiency of conversion of engine power to useful work is measured by the ratio of thrust horsepower to engine horsepower; values of propeller efficiencies of 85% are usual at cruising speed.

Propellers consist of blades and a hub, which may be of one-piece laminated wood construction, or of separate blade and hub construction; in such cases blades of wood, solid aluminum alloy or hollow steel materials are used.

Two general types of propellers are employed—fixed pitch and variable pitch; here, pitch refers to the angular setting of the blade with reference to its plane of rotation. A fixed pitch propeller can provide maximum efficiency at only one value of air speed to revolutions per minute ratio. A "best efficiency" propeller is one where the pitch can be continuously increased from low pitch at take-off speed, where large thrust is desired, to high pitch at high speed. Modern transports are equipped with such variable-pitch propellers; the hub encloses the complete pitch change mechanism, using either an electric motor or hydraulic actuator, and a constant speed governing mechanism which automatically maintains the engine revolutions per minute at the value selected by the pilot.

Two-, three- and four-bladed propellers are used. All propellers have an undesirable torque reaction which tends to cause the plane to roll; correction must be provided by adjustment of aerodynamic forces. Dual-opposite rotating propellers were developed to correct the condition but were not used extensively since torque reaction can usually be overcome adequately by less complex means.

Propellers are limited as to size and air speed. Physical limitations of ground and body clearances limit diameters. Propellers adequate to absorb more than 3,500 h.p. were developed. At extreme high speeds, approaching the speed of sound in air, propeller efficiencies deteriorate rapidly; hence, it seemed that their use would be confined to subsonic speed aircraft. For the same reason the rotational speed is limited to keep propeller tip speed within reasonable values.

Propeller icing can be prevented by alcohol deicing or by electrical heating elements.

"Feathering" of propellers to a 90° pitch position reduces air drag in the event of an engine failure, thus making flight with the remaining engines easier. Full reversal of pitch, as mentioned previously, allows application of rearward thrust while on the ground, thus providing an added safety feature to shorten ground roll on landing, the propeller serving as an air brake.

NAVIGATION

For clear-weather flights (visual or contact flying), orientation

and navigation are relatively simple and can be accomplished by reference to the ground, use of magnetic compass and air maps. For blind flying, however, where ground, sun or stars are invisible, elaborate instrumentation is necessary. Instruments can be grouped into four main categories: power plant, flight, navigation and landing.

Power-Plant Instruments.—These tell the pilot that the engines are being properly operated. They include the tachometer, for showing engine speed, pressure gauges for intake manifold, fuel, vacuum and hydraulic pressure, temperature indicators for motor, oil, carburettor and outside air temperatures, electrical gauges and fuel quantity indicators.

For multiengine aircraft these gauges are duplicated, one set for each engine.

Flight Instruments.—The purpose of such instruments is to indicate that the plane is being correctly and safely flown. Airspeed indicators show the speed and warn against flying too slowly (to avoid stalls) and too fast for structural safety. Machmeters indicate nearness to speed of sound, which varies with altitude. Altimeters indicate height of flight to aid the pilot in preventing collisions. Rate of climb instruments indicate ascent, descent or level flying.

The attitude of the airplane (*i.e.*, roll or pitch condition) is indicated by means of gyroscopic instruments which show the amount of bank and pitch in degrees from the normal attitude. Turns about a vertical axis are indicated by other similar instruments.

Many variations of gyroscopic instruments are used; the simplest is the turn and bank indicator. Others are stabilized magnetic direction indicators, free type directional gyros, artificial horizons and attitude gyro indicators. All these instruments incorporate a high-speed rotating wheel mounted in gimballs, which substantially maintains a fixed "reference" plane of rotation irrespective of disturbance to the plane. The gyroscope principle is incorporated into automatic pilot sensing controls to achieve controlled flight.

Navigation Aids.—The pilot needs guidance in the air so that he can set his course to his destination. Common magnetic compasses are inadequate, except for ground contact flying, since they are easily disturbed in rough air, are subject to many errors and can indicate only direction of heading and not location. Radio means are therefore used extensively for navigation under instrument conditions. Radio waves projected along invisible "airways" guide planes along a radio "beam" to the airport. Morse code transmission of two letters, -A and N-, tell the pilot if he is off course to the right or left by the letter he hears. Because of traffic congestion and poor reception under heavy static conditions, this system was being replaced at mid-century by very-high-frequency, omnidirectional radio ranges called VOR. The pilot sets his course on an indicator and can fly cross country by reference to a vertical pointer.

Landing Instruments.—Under clear weather conditions, approaches to airports and landings can be made easily by the pilot without the aid of special instruments. Radio devices are needed, however, under bad visibility conditions, to help locate the airport, line up with the proper runway, descend and make ground contact safely.

Two systems are used: one in civil aviation called instrument landing system (ILS) and the other ground controlled approach (GCA), a radar device. ILS consists of three radio aids: (1) a radio beam, the localizer, which guides the pilot right or left as he lines up to approach the runway; (2) a glide path, which guides him down at a safe angle from a point about 3,500 ft. from the end of the runway; and (3) an aid which consists of three marker beacons along his path, telling him his distance from the end of the runway (3 mi., 3,500 ft. and the end of the runway). In the GCA system, the plane is pictured as a "blip" on a radar screen in the control tower, and the radar operator informs the pilot of his position with respect to his right and left path and his position above or below the glide path.

The final landing is made visually after "breaking out" of the bottom of the cloud layer, usually not less than 200 ft. The final

aid to the pilot consists of high-intensity approach lights which lead him to the approach end of the runway and give visual guidance.

Automatic control devices are under development to accomplish the above approach to landing automatically; otherwise, in the ILS the pilot must do this manually by observing instruments. (See AERIAL NAVIGATION.) (B. L. S.)

AEROPLANE. The main problem that confronts the designer of any means of transport is to find a working compromise between the various demands of those who maintain and use the service. There is no conflict between the interests of the operator and those of the user. Their common requirements are safety, speed, comfort and adherence to a published timetable. As regards both safety and reliability, improvements in radio, the establishment of radio beacons, the installation of deicing apparatus, tremendous forward strides in instruments and aeroplanes, and improvements in operating facilities had great effects.

The cost of air transport by mid-20th century was comparable to first-class rail and ship accommodations. Time saving and ease of travel were evident from the ever-increasing passenger traffic.

For reasons which are explained in the article AERODYNAMICS a normal aeroplane cannot be maintained in flight at a speed less than a certain minimum "stalling" speed, which for a modern commercial aeroplane varies between 40 and 110 m.p.h. On the other hand, it is possible to give it enough engine power to drive it at between 90 and 400 m.p.h., while leaving a margin of some 20% of its total weight for passengers or goods. The aeroplane's permanent way, the air, is the only medium of transport which connects without interruption all places on the globe. It may be anticipated that the consequent possibility of transit free from the necessity of making transfers may prove to be as valuable as the speed which can be maintained.

From the point of view of design, with which this article deals, safety is discussed below; comfort is comparable to that of other types of travel and in the opinion of many, air travel furnishes superior comfort; and reliability (in so far as it depends on design) presents no special problems.

In what follows we shall discuss (1) the *Minimum Speed of Flight* and its influence on the design of aeroplanes; (2) the *Power Required for Flight*, including both that necessary to drive the aircraft through the air and also—the unique feature of transport by aircraft heavier-than-air—that expended in sustaining it in flight; (3) the possibilities of *Improvement of Performance* by reduction of resistance; (4) the *Origin of Aerodynamic Data of Design*; (5) the *Distribution of Weight* among the component parts; (6)

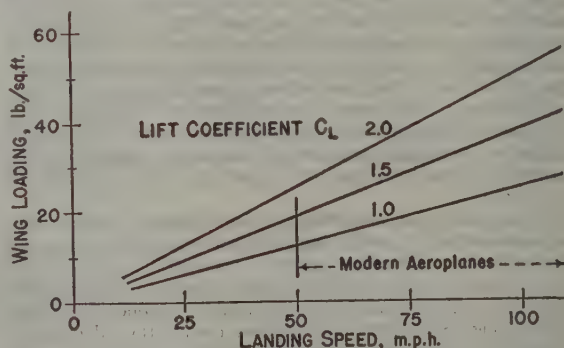


FIG. 1.—DIAGRAM SHOWING HOW THE LANDING SPEED VARIES WITH WING LOADING, W/S, AND LIFT COEFFICIENT, C_L .

the *External Form of Aeroplanes*, commenting on the most conspicuous features of modern aircraft; (7) *Stability and Control* and their influence on (8) the *Safety of Air Travel*; concluding with notes on (9) *Structural Design* and (10) *Materials used in Construction*.

1. MINIMUM SPEED OF FLIGHT

It is the impossibility of steady flight below the stalling speed

that constitutes the chief danger of air travel. Many attempts have been made to avoid this source of danger by devising an aeroplane which would be capable, as a whole, of remaining stationary in the air. Such machines have generally employed either flapping or rotating wings, the so-called ornithopters (*q.v.*) and helicopters (*q.v.*). The former have shared the legendary fate of Icarus. The latter, however, were proved possible of construction and flight. By mid-century they were performing many useful services in commercial and military aviation. (See also GYROPLANE.)

There is no fundamental obstacle to reducing the minimum speed of a normal aeroplane to about 25 m.p.h., instead of the 40 to 110 m.p.h. quoted above as typical of modern practice. In fact, the earliest flying machine had minimum speeds of this order. But the general proportions of such a machine would be uneconomical from every other point of view. In particular, almost the whole of the available weight would be absorbed by the structure and power plant, leaving no margin for paying load.

The relation between the total weight (W lb.), the area of the wing (S sq.ft.) and the aerodynamic coefficient (C_L) which determines their lift at any given speed (V ft./sec.) (see AERODYNAMICS) is

$$W = C_L S \frac{\rho V^2}{2},$$

ρ being the density of the air.

This may be put, for standard sea level air density, in the form

$$V = 19.8 \sqrt{\frac{w}{C_L}} \text{ m.p.h.},$$

where $w = W/S$ and is called the wing loading, in lb./sq.ft. Fig. 1 shows the relationship of w , C_L and landing speed. Fig. 2 shows the cross section of a vertical plane parallel to the direction of flight of some modern wing sections. For these the maximum value of C_L (which in virtue of the above relation corresponds to the minimum flying speed) is between 1.1 and 1.5 for a plain wing. Modern commercial aircraft using such wings have loadings from 9 to considerably more than 50 lb./sq.ft. In the latter case from fig. 1, using $C_L = 1.5$, a landing speed considerably greater than 100 m.p.h. would be evident (to be exact, 114 m.p.h.). This is too great for safety except on quite large airports; reduction can be made in two ways: (1) by reducing wing loading or (2) by seeking aerodynamic means for increasing C_L . The former course leads to a reduction in the pay load. Much attention was therefore devoted to the latter method.

A most effective high lift wing section is the "slotted" wing of Handley Page Ltd. (fig. 3). With this the maximum lift coefficient can be increased about 50% or more. The action of the device is, broadly speaking, to cause the flow characteristic of stalling (see AERODYNAMICS) to occur at a larger angle of incidence.¹ The increase in lift is dependent on the relative position of the main and auxiliary wings; i.e., on the size and shape of the slot between them, which can be varied in flight. With the slot closed the characteristics are nearly the same as those of a normal wing. In this respect form (a) (fig. 3) is superior to form (b), but in practice there are, with both, constructional difficulties in the way of ensuring a smooth and unbroken surface when the slot is closed.

Another method which has been widely used is to vary the curvature, or "camber," of the wing (fig. 4). In general, the

greater the curvature of a wing section the higher is the maximum lift, but the lower the efficiency at high speeds. This device attempts to secure both high lift and high efficiency by enabling the pilot to alter the curvature to suit the conditions of flight. The increase of lift attainable in this way is comparable to that achieved by the slot. By combining both these methods very high maximum lifts have been obtained. However, because of icing difficulties and mechanical complications this combination does not find much use; instead, other means of increasing lift were adopted.

A variation of the system of changing the camber is the use of flaps. Their use is now standard on the majority of air liners, having been necessitated by the greatly increased speeds. The increase in high speed and in cruising speed has inevitably increased the stalling speed and thus the landing speed. The employment of flaps has kept the landing speed at a practical figure. The use of flaps on the take-off also increases the lift and makes shorter take-off possible at the expense of speed. They are constructed by hinging the undersurface of the trailing edge of the wing in such a manner that the trailing edge may be opened by forcing down the undersurface by a system of control from the pilot's seat for landings and take-offs. Flaps were developed of several types, including a variation where the flap is extended rearward, using a system of linkage, and then deflected. Lift increase at stalling speed of as high as 100% was achieved, including the effects of propeller slip-stream velocity.

2. POWER REQUIRED FOR FLIGHT

Aerodynamic equations for drag and power required are usually expressed

$$D = C_D \tau S \frac{\rho V^2}{2}$$

$$P = DV/550 \text{ h.p.},$$

where $C_D \tau$ is the drag coefficient for the complete aeroplane, S the wing area in square feet and V is the air speed in ft./sec.

When an aeroplane of conventional design is flying horizontally (in air of a given density) the power of the engine is disposed of in the following ways: (1) About 15% is lost because of inefficiency of the propeller. (2) From 30% to 50% is used to overcome the air resistance of the body, including the engines, undercarriage, tail surfaces and other exposed body parts. (3) From 55% to 35% is similarly absorbed by the resistance of the wings. The large differences between the alternate values of (2) and (3) are caused by variations of speed, relative size of body compared with the wing, number of engines and type of aeroplane. As indicated by the formulas, the resistance of parts varies practically as the square of the air speed and the corresponding power as the cube thereof.

The aeronautical engineer, taking into account the above relationships between engine power and how it is absorbed by the aeroplane components, can prepare power characteristics charts for the plane. Fig. 5 shows this power relationship in simplest form. As speed increases the power required also increases rapidly from its lowest value at low speed. Note also that the power available from the engine increases likewise. Where these two curves intersect and the powers are equal, then the *high speed* in level flight is attained.

Fig. 5 also shows the relative effect of altitude on the power curves. It will be noted that there is a general increasing of power required and a lessening of power available. When that altitude is reached where the power available curve is just tangent to the power required curve, then the *absolute ceiling* has been reached.

Returning to the total resistance of the wings (3), this is divided by aerodynamicists into two parts, the *profile drag* and the *induced drag*. At high air speeds the profile drag can account for as much as 75% of the total. It is derived from the friction of air on the surface of the wing transmitted through a very thin layer of air (called the *boundary layer*) and from turbulence or *eddies* occurring aft of the wing trailing edge downstream.

The profile drag coefficient (C_{D_p}) increases only slightly as the wing angle of attack increases. Also, the thicker the wing airfoil section the higher C_{D_p} becomes.

The induced drag accounts for from 25% to upward of 60% of

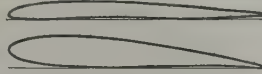


FIG. 2.—CROSS SECTIONS OF RECENT TYPES OF AEROPLANE WINGS

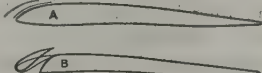


FIG. 3.—CROSS SECTION OF THE HANDLEY PAGE SLOTTED WING. WITH IT THE MAXIMUM LIFT COEFFICIENT CAN BE INCREASED ABOUT 50% OR MORE

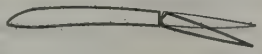


FIG. 4.—METHOD OF VARYING THE CURVATURE OF THE WING. IN GENERAL, THE GREATER THE CURVATURE THE HIGHER IS THE MAXIMUM LIFT

¹Angle of the chord to the longitudinal axis of the aeroplane. The chord of the wing sections in fig. 2 is indicated by a straight line.

the wing drag (see **AERODYNAMICS**; the *induced* drag of L. Prandtl). This arises from the rearward component of lift generated by the wing; for a given lift force it varies inversely as the square of speed and wing span. Large span wings are, therefore, most suited for slow-speed aircraft, or gliders, where low induced drag is sought.

The merit of separation of the aeroplane's total drag into various elements is evident since it allows the designer to examine the economics of each and to determine which will provide most fruitful benefits, if improved.

By referring again to fig. 5 other important considerations can be revealed. For example, flying at the maximum speed, using full engine power, is uneconomical from the point of view either of the life of the engine or fuel consumption. Reducing engine throttle to power outputs of about 60% to 75% maximum is more economical; the resulting speed is called the cruising speed.

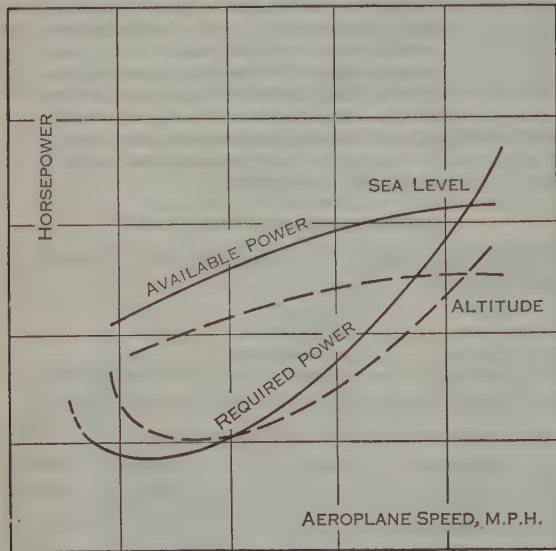


FIG. 5.—TYPICAL VARIATION OF POWER CURVES FOR AN AEROPLANE SHOWING THE RELATIONSHIP OF POWER AVAILABLE FROM THE ENGINE TO THAT REQUIRED FOR FLIGHT, AT SEA LEVEL AND AT ALTITUDE

The difference between the maximum power available and power required curves, at a given air speed, is called the excess horsepower. This is the amount of power available for rate and climb, expressed in ft./min. The speed for *best climb* is that point where the excess power is largest; i.e., somewhat higher than that where power required is a minimum. Rates of climb can vary from 300 ft./min. for small planes to more than 8,000 ft./min. for jet-powered aircraft.

3. IMPROVEMENT OF PERFORMANCE

Propeller (Airscrew) Efficiency.—A loss of between one-quarter and one-third of the power of the engine in the transmission assembly would hardly be tolerated in road or rail transport. Transport by water, however, is burdened by a loss identical in character and similar in amount. It arises from the fact that the propulsive force is obtained by driving a fluid backward. This condition cannot be entirely overcome, but propeller efficiency can be and is being greatly increased. Commercial aeroplanes have an altitude operating range from sea level to 25,000 ft. At 15,000 ft. the air density is approximately half that at sea level. Further, the plane's speed varies from zero at take-off to any value up to its maximum speed. A constant pitch propeller obviously will not operate at highest efficiency throughout these variable conditions. If it is designed for high efficiency at the surface, where maximum power is desired for take-off, it will have low efficiency at normal cruising altitudes and speeds. Resort is therefore made to adjustable pitch, controllable pitch and automatic propellers.

The first is adjustable on the surface with motors dead. The second is controllable by the pilot while in flight. The last is automatic. All these types became standard equipment. (See **AIRSCREW**.)

Jet Propulsion.—For very high altitudes, 40,000 ft. or more, and extreme high speeds the propulsive efficiency of the propeller and the power output of the reciprocating engine drops to such low values as to become uneconomical. Here the jet engine becomes superior from both standpoints. In the rarified upper atmosphere the compressor turbine of the jet engine boosts the pressure of the inlet air, thus increasing the quantity of intake oxygen to burn with the fuel. Thrust is obtained as a result of the reactive pressure of the expanding hot, high-velocity gases released through the tail pipe of the engine. Because of its small frontal area and low cooling loss compared to reciprocating engines (energy lost as a result of cooling cylinders) much lower air drag is realized which adds further to its advantage. At low air speeds, such as at take-off, the jet turbine is quite inefficient; as a result, high speed and altitude must be reached quickly to conserve fuel. In a typical 3,000-lb. thrust jet engine as much as 400 gal. fuel per hour may be burned at cruising speed.

Resistance of the Body.—In modern aeroplanes body drag must be kept to a low value. All possible equipment and parts are stored within fuselage and wings. The junction of fuselage and wing is carefully filleted, windshields are placed at proper angles, the shape of the body is carefully planned and its exact positioning on the wing designed to give lowest air drag when the wings are at normal cruising angles.

The reduction in resistance of engines is a problem usually solved by encasing them in aerodynamically efficient "nacelles." Further improvement in the form of actual forward thrust can be realized by recovering some heat energy, otherwise lost, in the cooling air and exhaust gases. Proper ducting of the heated gases accomplishes this.

Liquid-cooled engines had been practically abandoned by mid-century because of large drag losses of cooling radiators.

Resistance of the Undercarriage.—The undercarriage of an aeroplane has a high resistance, mainly because of the wheels. This condition was met in two ways. The wheels and landing gear may be covered with cowling in a streamline shape or the landing gear may be retractable. In the latter case the landing gear is hinged in such a manner as to permit it to fold into the wings, fuselage or engine nacelles. The retraction is usually activated by hydraulic or electric systems. Both methods of resistance reduction are in current use. The cowling (commonly called "breeches") is more common for small aeroplanes and the retractable gear for large ones.

Resistance of the Bracing of the Wings.—The early aeroplane was a mass of external struts and bracing with cables between wings, from wings to fuselage and engine bed, and between the various fixed and movable controls. The tendency thereafter was toward "clean" design. Modern construction methods and materials permit all bracing for monoplanes to be internal. Whereas this requires increase in weight, it is largely balanced by increase in aerodynamic efficiency. All modern high-speed transports and military aeroplanes are aerodynamically "clean" and highly streamlined. As speed requirements increase even rivet heads are made flush with the surface.

Supercharged Engines.—To avoid excessive power loss with increase in operating altitude, engines incorporate superchargers (centrifugal compressors) which increase the intake manifold pressure considerably over atmospheric pressure. An unsupercharged engine, if taken from sea level to 10,000 ft., suffers a loss of about 30% of its power. On the other hand, it is possible for a supercharged engine to deliver more power at altitude than it can at sea level.

4. ORIGIN OF AERODYNAMIC DATA OF DESIGN

The designer bases his calculations on data derived from four main sources: (1) Theoretical investigations, such as the Lancaster-Prandtl theory of the action of wings. (2) Experiments on models in wind tunnels. (3) Experiments on full-scale aero-

planes in flight. (4) Analysis of the measured performance of aeroplanes. References to the first of these divisions will be found in the article on AERODYNAMICS, where also the principles underlying experiments on models are dealt with.

Wind Tunnel.—The wind tunnel has played a great part in the development of aeronautics. Many manufacturing firms possess their own tunnels, used mainly for measurements of the resistance of aeroplane bodies, etc., with a view to improving performance. National wind tunnels exist in many countries, generally reserved in principle for research on problems of wide interest and application.

The main advantage of model experiments is the ease with which the experimenter can control the conditions.

Full-Scale Experiments.—Most of the leading aircraft-producing countries carry out full-scale experiments. In Great Britain they are made at the Royal Aircraft establishment under the control of the director of scientific research at the air ministry. In the United States they are carried out by the National Advisory Committee on Aeronautics, by the air forces and by most manufacturers.

Analysis of Performance Tests.—The measurements of speed and climb which are made during the acceptance tests of aeroplanes are a valuable source of information for the designer. Their analysis enables an over-all comparison between various types to be made on a rational basis, but necessarily lacks something in precision. For each type differs from the others in many features, so that, for example, an observed difference in speed cannot safely be ascribed to any one peculiarity. But with suitable precautions reliable information can be obtained in a convenient form. It is found that the factors which have the greatest influence on the speed and climb of an aeroplane are the *horsepower per unit of total weight* and the *total weight carried per unit of wing surface*. For further details of the method, and its limitations, reports of the National Advisory Committee for Aeronautics (U.S.) or of the Aeronautical Research committee (British) should be consulted.

5. DISTRIBUTION OF WEIGHT

Fig. 6 illustrates the relative proportions of the total weight taken up by the various sections into which it is convenient to divide the component parts. The figures apply to an average commercial aeroplane of moderate size. The distribution of weight varies from one machine to another.

Structure.—The "structure" includes a great deal which is not part of the essential structure of the aeroplane. A change in the specified strength affects about 60% to 70% only of the nominal structure weight.

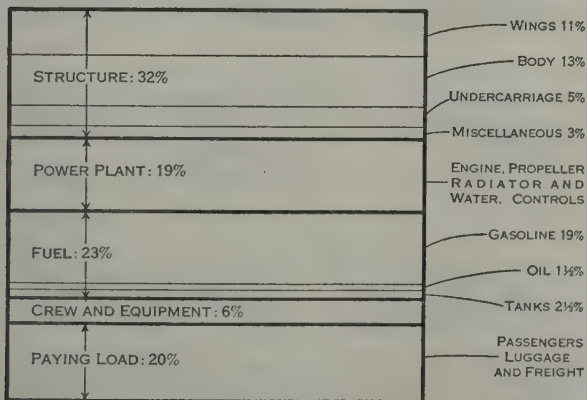


FIG. 6.—DISTRIBUTION OF TOTAL WEIGHT OF COMMERCIAL AEROPLANE

Power Plant.—The weight of the power plant depends mainly on the desired maximum speed of the aeroplane, and on the weight of the engine and its equipment per brake horsepower. There is generally a reduction in this item if an air-cooled engine is used instead of a water-cooled engine.

Fuel, etc.—The weight of fuel and tanks is dependent on the speed and duration of flight specified, and on the standard of fuel economy reached by the engine. The latter factor varies little for modern engines, both air- and water-cooled engines now giving one brake horsepower hour for about one-half pound of gasoline.

Crew, etc.—The crew and equipment tend naturally to absorb a progressively smaller proportion of the total weight as the size of the aeroplane increases.

Pay Load.—The pay load, being the balance after the above items have been accounted for, is from 13% to 20% of the gross loaded weight of the aeroplane. For slower aeroplanes it may reach a much higher percentage. Compared with other means of transport this is a high proportion. Both a passenger railway train and an ocean liner carry a much smaller percentage of pay load. That these means of transport are able to offer lower fares than aircraft is partly because of the higher running costs of an aeroplane per passenger mile, but mainly because of the fact that the volume of passenger traffic is as yet small compared to that of other common carriers.

The essential need for economy of weight in aircraft is due not only to the fact that but one-fifth of its weight is available for pay load, but to the higher cost of carrying this load by air, as compared with other ways. A saving in the weight of some part of the aeroplane of 1% of the whole allows a reduction of the cost of transport by about 5%.

6. EXTERNAL FORM OF AEROPLANES

Wings.—There is a striking variation in the appearance of wings of most modern planes as seen in plan. One thing they do have in common is large aspect ratios of about 6 or more (ratios of span to average chord). This is intended to keep induced drag caused by lift as low as possible. Three of the simplest plan shapes are shown in fig. 7. Variations of taper in chord (fig. 7b) and sweepback (fig. 7c) as well as actual wing tip shape distinguish planes from each other. These modifications are intended to enhance certain aerodynamic characteristics as desired by the designer such as good stall characteristics, manoeuvrability, large centre of gravity range, stability characteristics, etc. Extreme sweepback up to 45° is provided for jet-powered planes to reduce compressibility shock effects and trim changes which occur as the plane reaches the speed of sound (760 m.p.h. at sea level, standard air).

Near the tip of each wing is an *aileron* or a lateral control surface hinged about axes 1-1 (fig. 7a) and interconnected so that an upward movement of one is accompanied by a downward movement of the other. They are operated by rotation of the pilot's control wheel on the control column, and are the means for maintaining straight flight, or banking for a turn. (See also AILERON.)

High-lift wing flaps are also located along the trailing edge of the wing between the inboard end of the aileron and the fuselage. These are also hinged and are extended by the pilot, particularly on approach to landing, to decrease the landing speed. Partial extension is sometimes used to enhance take-off.

Wing Incidence.—The angular setting of the wing with respect to the longitudinal axis of the plane is called the angle of incidence in Great Britain and angle of attack in the United States; it is the angle between the airfoil chord line and the direction of the wind.

Number of Wings.—The appearance of aeroplanes in front and side elevation is as varied as in plan, mainly because of the use of one or more wings, engines, varied shapes of fuselage, etc.

It is of historical interest to note that biplanes, triplanes and even quadraplanes were in vogue from early years through 1922. Slowly these were displaced until even the biplane became a rarity. The trend to the monoplane was caused by the development of wing sections of great thickness, the desire to eliminate external bracing for drag reduction reasons and the development of high strength aluminum alloys permitting the use of stressed skin wings and fuselages.

In a biplane the relative position of the wings with respect to one another is defined by *gap*—the distance between the chords of the upper and lower wings—and *stagger*—the amount one wing is

set ahead of the other as measured by the horizontal distance from the leading edge of the upper wing to the corresponding point on the lower wing. These factors have considerable significance to

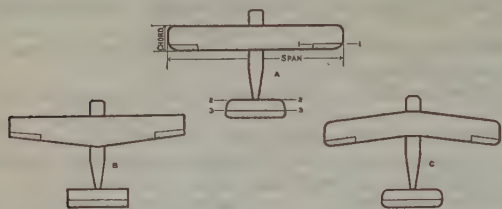


FIG. 7.—THE RELATIVE SIZES AND AREAS OF AEROPLANES, SHOWING THE SPAN OF THE MAIN WINGS IN RELATION TO THEIR CHORD, FROM WHICH THE AVERAGE RATIO OF SPAN TO CHORD MAY BE DEDUCED

the aerodynamicist who wishes to evaluate the mutual interference effects of the air flow over the respective wings by calculation.

Monoplanes vary in respect to position and shape of wings, type of fuselage and arrangement of tail areas, type of landing gear and number of power plants. Typical variations in front and side views are shown by figs. 8 and 9; in these figures, (a) shows an externally braced, high-wing, tail wheel type, light monoplane, (b) a low-wing, internally braced, tricycle gear monoplane, (c) a low-wing, twin-engine tricycle gear transport and (d) a four-engine, tricycle gear, low-wing air-line transport.

Horizontal Tail Area.—At a distance of approximately three chords behind the leading edge of the wings is the tail plane, in area about one-ninth that of the wings. In steady flight its function is to balance or trim the aeroplane; *i.e.*, to ensure that the resultant of all the air forces on the aeroplane passes through the centre of gravity. (See *AERODYNAMICS*.) It is generally in two parts. The front part, about 60% of the whole, is normally fixed, though means may be provided by which the pilot can alter its angle of incidence by rotating it about an axis such as 2-2 (fig. 7a), thus enabling the aeroplane to be trimmed for flying at various speeds. This operation is analogous to trimming the sails of a ship so that it carries no weather or lee helm.

In a modern aeroplane a movable tail plane is generally considered indispensable, unless trimming planes such as trim tabs (described later) are used, in which case the stabilizer need not be adjustable.

The rear part of the tail, or *elevator*, is hinged on an axis such as 3-3 (fig. 7a), and connected to the control column in such a way that a forward movement of the pilot's hand depresses the trailing edge of the elevator and causes the machine to dive, and vice versa. The elevator is the primary control organ of an aeroplane, since by it the pilot alters the angle of attack of the wings and hence in conjunction with the engine power controls the rate of climb or descent and the speed.

Vertical Tail.—The vertical stabilizing and controlling surfaces, a fixed fin and a movable rudder connected to foot pedals on which the pilot's feet rest, are generally situated at the aft end of the fuselage above the horizontal surfaces. They perform the same function as the rudder in a boat. The fixed fin provides directional stability; *i.e.*, it tends to keep the plane on a straight course. The hinged rear part of the vertical tail, or rudder, serves two functions; it provides a means to allow the pilot to "yaw" the aeroplane and change direction of flight, and it is used to trim the plane for straight flight, particularly when one wing engine of a multiengined aeroplane may not be operating. This latter function is quite important since the remaining engines have a tendency to lift the wing on one side more than the other and pull the plane into a power spin.

Rudder control forces for a large multiengined plane can be quite high and require considerable exertion on the part of the pilot. Accordingly, *trim tabs* are provided on the rudder to assist the pilot. These are small hinged surfaces attached to the trailing edge of the rudder, which, when moved (for example, to the right), force the rudder to the left because of its aerodynamic forces, and

effectively simulate application of "left" rudder pedal by the pilot. When adjusted properly the tab holds just enough rudder to maintain straight flying despite adverse yawing forces of an inoperative engine.

Variations of the trim tab principle, known as balancing tabs, servo-tabs or flying tabs, etc., are also employed, particularly on very large planes, to allow the pilot to manoeuvre without excessive rudder pedal pressures. These devices automatically assist the pilot to move the rudder in the desired direction as he presses the rudder pedal.

For small single-engine planes it is sometimes possible to dispense with a rudder entirely; thus we have the "two-control" plane (aileron and elevator control only). In such planes it is also necessary to limit the upward travel of the elevator to preclude development of wing stalling with subsequent entry into a spin; without a rudder recovery from a spin might become difficult if not impossible.

Location of Power Plant.—Engines, propellers, oil tank, accessories and controls are enclosed in body forms called *nacelles*. With few exceptions, "tractor" positions of propellers are used, although "pusher" arrangements are seen now and then. When two or more power plants are used it is customary to distribute them along the wings; each engine nacelle is in itself an integral unit able to function independently of others. Two and four engines are common, although trimotors are seen where the one engine is located in the nose of the fuselage. The vertical location of the "thrust axis" with respect to the plane's centre of gravity is important since care must be taken to avoid giving rise to large couples which would otherwise tend to rotate the aeroplane in a vertical plane as throttles are altered. Care must also be taken to locate tail surfaces above the propeller slip stream to avoid troublesome vibrations.

Fuselage and Landing Gear.—The fuselage serves as a connecting member of wings, power plants, tail surfaces and landing

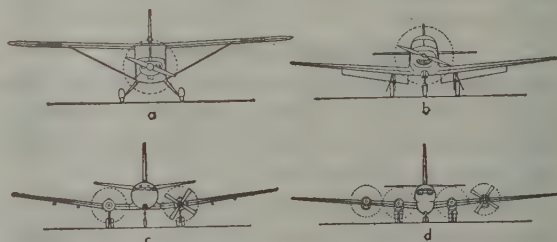


FIG. 8.—FRONT VIEW OF TYPICAL MONOPLANE ARRANGEMENTS: (A) THE PIPER STINSON VOYAGER; (B) THE RYAN NAVION; (C) THE MARTIN 2-0-2 AIRLINER; (D) THE BOEING STRATOCRUISER

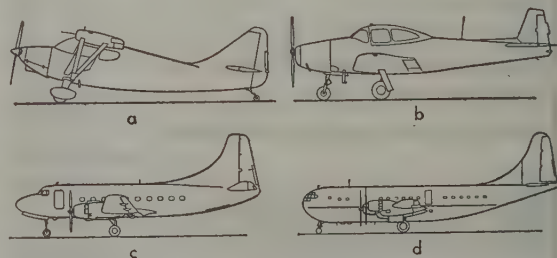


FIG. 9.—SIDE VIEW OF MONOPLANES SHOWING NOSE-WHEEL AND TAIL-WHEEL TYPE LANDING GEARS: (A) THE PIPER STINSON VOYAGER; (B) THE RYAN NAVION; (C) THE MARTIN 2-0-2 AIRLINER; (D) THE BOEING STRATOCRUISER

gear. It also contains accommodations for operating crew, passengers and cargo. Sometimes fuel tanks are included but mostly these are placed within the wing structure for safety and to conserve space. Open cockpit fuselages, where occupants are exposed to the air, were displaced by closed cabins, with opening doors on

the side or sliding canopies in the top to permit entry. On large transports, emergency exit openings are provided to permit rapid egress in the event of accident. The fuselage is designed as a boat hull, in flying boats, to permit operation from the water surface.

Landing gears are usually seen in tail-wheel or nose-wheel (tricycle) configurations. (See fig. 9.) For large transports, dual wheels are sometimes used on each landing gear strut to reduce wheel loads.

Retracting mechanisms are employed to rotate the gear upward into recesses in the wing and fuselage structure.

7. STABILITY AND CONTROL

The general principles of stability and control are dealt with in the article *AERODYNAMICS*, and the stabilizing and controlling surfaces have been referred to above. The necessary disposition and dimensions of these surfaces are decided in practice chiefly by direct comparison with previous designs. Since, however, aeroplanes are not merely scale copies of one type, some rational means of using the accumulated experience of previous work is essential, and it is this that research into the fundamentals of stability and control is able to supply. Needless to say, even these methods break down when the aeroplane in question is not broadly similar to those from which the data are derived, and then nothing short of a thorough investigation, assisted by model experiments, will suffice. Very often, even with the best that can be done in this way, uncertainties remain, and the designer is forced, as in other branches of engineering design, to rely upon his ability to draw conclusions from insufficient premises.

Stability.—Stability, the property of returning to a steady state of motion when deliberately or accidentally disturbed, implies as a necessary preliminary the existence of equilibrium, or "trim," in that state. An aeroplane is trimmed for a steady condition of flight by an adjustment of its tail plane, or adjustment of the trim tab controls, the elevator being left free. The degree of stability generally considered desirable for a commercial aeroplane can be attained by arranging the size of tail plane and the fore and aft position of the centre of gravity within certain limits. The further back the centre of gravity, the larger is the necessary tail area. The fore and aft position of the centre of gravity in relation to the wing is defined by its distance from a plane passing through the leading edge of the wing perpendicular to the chord, for a monoplane; for a biplane an equivalent monoplane wing is substituted. In normal aeroplanes this distance is usually about one-third the chord, though it has varied between one-quarter and one-half. The height of the centre of gravity of an aeroplane in relation to the wings has a secondary effect on its stability. In particular, a low centre of gravity is not necessary for stability.

Adequate stability is usually present when the horizontal tail area is approximately 12%–15% of the wing area and when a tail length ratio of from 2.5 to 3.0 is provided, the latter ratio being the distance from the tail plane to the centre of gravity divided by the wing chord.

Elevator areas of about 40% of the horizontal tail surface area usually provide sufficient controllability for the range of position of centre of gravity normally employed.

Lateral and directional stability depends mainly on the provision of adequate fin and dihedral angle. Good stability in these directions is of importance to comfort and instrument flight.

Aileron Control.—Ailerons of an area between one-twelfth and one-eighth of that of the wings are usually provided, and give adequate control at all normal flying speeds. At low speeds, however (more accurately, at angles of attack of the wings in the neighbourhood of stalling), not only are normal ailerons ineffective, but they may actually become a source of danger, their use aggravating an inherent tendency of the stalled wings to force the aeroplane into a spiral dive or spin. (See *AILERON*.)

Rudder Control.—An effective rudder is as essential for safety at low speeds as effective ailerons. The efficiency of any given rudder depends on its being arranged so that the body does not

shield it, but it is found that when the product of the ratios

$$\frac{\text{area of rudder and fin}}{\text{area of wings}}$$

and

$$\frac{\text{distance of rudder from centre of gravity}}{\text{semispan of wings}}$$

is above one-twentieth, a satisfactory control is obtained. The latter ratio is usually about one, so that the former should not be less than one-twentieth. The area of the rudder is generally about two-thirds that of the rudder and fin combined.

Automatic Pilot.—All modern transport aeroplanes are equipped with an automatic gyroscopic pilot. The device is designed to pilot the plane on a given heading. It can be adjusted for climb, descent or for turns. It is so arranged that the pilot can over control by the normal use of control column and rudder.

The automatic pilot has many advantages. It produces more steady flight than is otherwise possible and permits the pilot to attend his radio and navigational duties with greater freedom. Although it is not a normal practice, it may be set for take-off or landing.

8. SAFETY OF AIR TRAVEL

Air travel would have been much more quickly adopted except for a general public apprehension of the risks involved. These risks are associated with the following causes: (1) physical failure or error of the pilot, (2) fire when in flight, (3) collision when in flight, (4) breakage of the structure and (5) forced landing. Dangers of the first four types are not peculiar to aircraft and the precautions they involve are common to transport by road, rail and sea. The measures adopted in air transport largely eliminated them. It is mainly the dangers which may arise when an aeroplane is forced to land that loom large in the minds of those who might otherwise travel by air. While it cannot be said that these fears are entirely unwarranted, yet in so far as the design of aircraft is involved the position rapidly improved.

Forced Landings.—Forced landings may be necessitated by engine trouble, structural failure, fuel shortage, weather, ice forming on the aeroplane or loss of knowledge by the pilot of location. A well-qualified pilot with a properly equipped aeroplane should not experience forced landings caused by loss of bearings, and should never experience fuel shortage. Forced landings caused by weather, while annoying, are not dangerous in a country well-equipped with emergency landing fields. Structural failures are extremely rare in normal flight. Ice forming on the wings and propellers, however, was formerly a serious problem. The danger of ice is twofold. It adds considerable weight to the structure and at the same time decreases the normal efficiency thereof by spoiling the lifting qualities of the wings and the traction qualities of the propellers. Some trouble has also been experienced by ice forming in carburettors and reducing engine power output. However, invention as well as the development of efficient meteorological services and weather broadcasting systems largely if not completely met the situation. It would be a rare phenomenon if ice-forming conditions existed throughout the altitude range of the aeroplane. Altitudes for flight should be sought which do not favour icing. To arrive at such altitudes, however, it may be necessary to pass through icing layers. Since clear ice, under severe conditions, can form at the rate of three inches per minute, it is an important problem which gave much cause for thought and experimentation. Its importance was more keenly felt after the development of instrument flying. Formerly little cloud flying was attempted but with modern methods cloud flying is nearer the rule than the exception.

To prevent ice from forming in carburettors, heaters are installed to warm the incoming air. Propeller deicing is accomplished in one of two ways, either by use of a liquid solution using alcohol as a base or by electrical heating. The liquid solution is applied by centrifugal force through a rotating slinger ring onto the surface of the blade at the blade hub. Electrical heating is accomplished by specially developed coatings on the blade surface which become

heated as an electrical current is passed through it.

Two systems of preventing ice from forming on wings are used. One involves the use of pneumatic driven, pulsating, rubber pads on the leading edge; the pulsations crack the ice to be carried off by the air. Thermal heating of wing leading edges is another means; the waste exhaust heat from the engines is usually ducted along the leading edge for this purpose.

From the height of about 3,000 ft., for a single-engine plane, approximately four minutes are available in which the pilot may choose a landing place. If the failure occurs before the aeroplane has reached its cruising altitude, the time and the corresponding area of ground in which this landing place is to be found are reduced in proportion. These considerations unfortunately may result in the pilot's having to execute somewhat sharp turns in order to place the aeroplane correctly, and it is during these that the controllability of the machine is most severely tested. The ultimate danger lies in the fact that the speed of horizontal travel at the moment of landing cannot possibly be less than the stalling speed. In practice with a typical small plane in level flight it will be between 55 m.p.h. and 70 m.p.h. In a banked turn it can be from 15 m.p.h. to 25 m.p.h. higher because of the higher lifts required under the acceleration forces of the turn. The inexperienced pilot, in an endeavour to make the most of what space is available, frequently turns too tightly, stalls at a speed higher than he normally would expect and, before recovery can be completed, loses excessive altitude or spins and crashes.

9. STRUCTURAL DESIGN

The General Problem.—The discussion so far has concerned aerodynamic and performance aspects of the aeroplane. Of equal importance to the success of the plane is the internal design or structure which, while being extremely light, must still have the strength needed to cope with all possible loads it can experience in service. It must also be reliable in service and incorporate all known safeguards for safety. The modern plane structure (or air frame) is an intricately complicated unit requiring great ingenuity on the part of designers and necessitating many compromises before reaching its final form. A plane which is properly designed and meets all government regulations for strength and reliability is termed structurally airworthy. The art of designing for all safety requirements and proving that an airplane meets these requirements is denoted by the general term "airworthiness."

The structural airworthiness of the plane involves not only the use of ordinary principles applicable to conventional engineering structures but many specially developed theories applicable to thin shell structures which "fail" by elastic buckling. Great care must be taken to select proper materials and use these materials most efficiently by proper shaping, forming and joining. To proportion structural elements suitably a knowledge is required of the external, or applied, loads to calculate the stresses in each element. The margin between the stresses, so calculated, and the minimum safe or allowable stress for the element is the safety margin. As a minimum requirement this margin, on most commercial planes, must equal 50% of the applied load (*i.e.*, a factor of safety of 1.5 above the applied load must be attained before ultimate failure load is reached).

Assurance of reliability of structural parts is also essential to airworthiness. This simply means that they must be rigid enough to withstand abuse in service, must not be subject to disastrous fatigue failures caused by repeated loadings or vibrations, and must have ability to withstand wear or deterioration in adverse atmospheric conditions. An unreliable bolt in the control system could result in an accident as serious as one caused by structural failure of a wing spar. However, it cannot be claimed that parts can be designed for infinite life; hence, a reasonable program of inspection, maintenance and replacement of parts in service is a necessary consideration.

Finally, airworthiness is dependent on the success of the designer in incorporating special safety features. For example, control systems are duplicated, or otherwise devised, in such a way that should failure occur to any one part a separate means will be available to permit accomplishing a safe landing. Control sur-

faces have extra hinges. Passenger seats are designed for crash load conditions and are provided with special safety belts (aft-facing seats have been proposed to enhance safety in the event of minor accidents). Fuel tanks are designed to withstand minor crashes without rupture. Windshields are specially designed to resist the impact of collision with birds in flight. Fuselages are specially designed to withstand loads caused by "ditching" the plane in a forced landing on water or land.

Load Factors.—The one most important criterion of strength of an aeroplane structure is its "applied load factor." Various other terms are used but by definition the load factor (n) is the amount by which, because of accelerations imposed in manoeuvres or turbulent air, the normal loads are increased in the ratio L/W , L being the total wing lift and W being the weight of the aeroplane. This ratio is one for level flight where $L=W$, and can be positive or negative in other conditions. By reference to basic aerodynamic equations for lift it can be seen that L is directly proportional to angle of attack and the square of the speed (V^2). Thus, if the angle of attack is unchanged but the speed doubled, n would be 4. Assuming the lift coefficient can also be doubled simultaneously by increasing the angle of attack, a further increase of load factor to a total value of 8 would be experienced.

It is theoretically impossible to provide enough strength to prevent failure of the structure. Fortunately, however, reasonable maximum values of n can be specified for design purposes so that the likelihood of structural failure is remote during the life of the plane. The appropriate value can vary with the type of plane and its contemplated use; otherwise transport planes would be excessively heavy and uneconomical. For military fighters, n may be as high as 10; for private planes, 4.0, and for commercial transports, 2.5 to 3.0 can be safely used. Fig. 10 shows in briefest possible detail the general relationship of load factor and speed for a typical plane

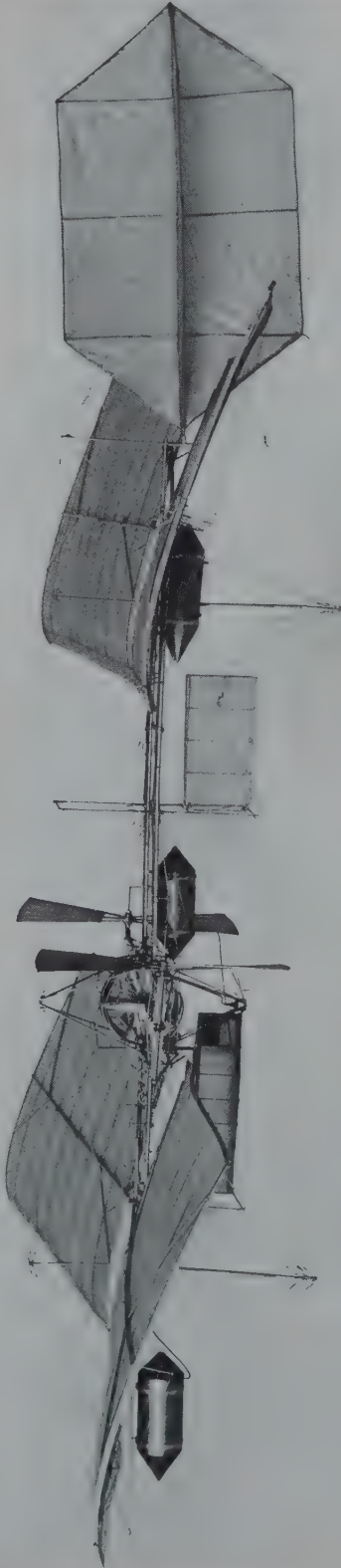
Manoeuvring Loads.—The loads induced by the pilot in manoeuvring the plane during turns, banks, stalls, pull-ups, rolls, etc., can be measured by means of an accelerometer. This instrument measures the load factor in terms of the normal acceleration caused by gravity, g . A $3g$ load factor is recorded when $\frac{L}{W} = 3$

(neglecting secondary factors such as the lift on the tail surface, etc.). The outside outline "envelope" of fig. 10 is the safe structural limit manoeuvring strength of the plane. The pilot is required to so operate his plane as to stay inside this envelope at all times. For the example shown, he must not exceed a positive $3g$ or a negative $1g$ load factor up to the "never exceed" limit speed (V_{ne}). For his part, the designer must make sure the wing, fuselage, tail surfaces and control systems are strong enough to withstand any combination of speed and " n " within the envelope.

Given the necessary control power and indifference to his own safety the pilot can, as before illustrated, impose quite high load factors in the plane structure. Most pilots "blank out" or temporarily lose control of certain senses, including sight, at less than $8g$. This consideration in itself provides a safety factor limiting practical application of extreme stresses, particularly for military fighter aircraft.

Rough Air or Gust Loads.—The sharp impact of rough or turbulent air on the plane produces "gust loads" which in principle are simply the aerodynamic effect of a rapid change of wing lift caused by change in the angle of attack. Vertical currents of air are responsible for this; the higher the vertical velocity of gust the higher the gust load factor produced. The designer can account for the effect of gusts in the manner shown by the 30 ft./sec. and 15 ft./sec. gust velocity broken lines of fig. 10. In these instances it will be noted that for a given gust velocity the higher the speed the greater the "bump" experienced. Planes are designed so that they can be safely flown at their cruising speed, V_c , in moderately rough air, which is usually associated with effective gust velocities of about 30 ft./sec. For very rough air it behoves the pilot to slow down even to a lower speed where much lower gust load factors will be the result.

Ground Loads.—In addition to being capable of taking stresses imposed under all flight conditions the structure must be designed



1



3



BY COURTESY OF (1, 2) THE DIRECTOR OF THE SCIENCE MUSEUM, LONDON, (3) THE AERONAUTICAL CHAMBER OF COMMERCE OF AMERICA

LANGLEY, WRIGHT AND BLÉRIOT MACHINES

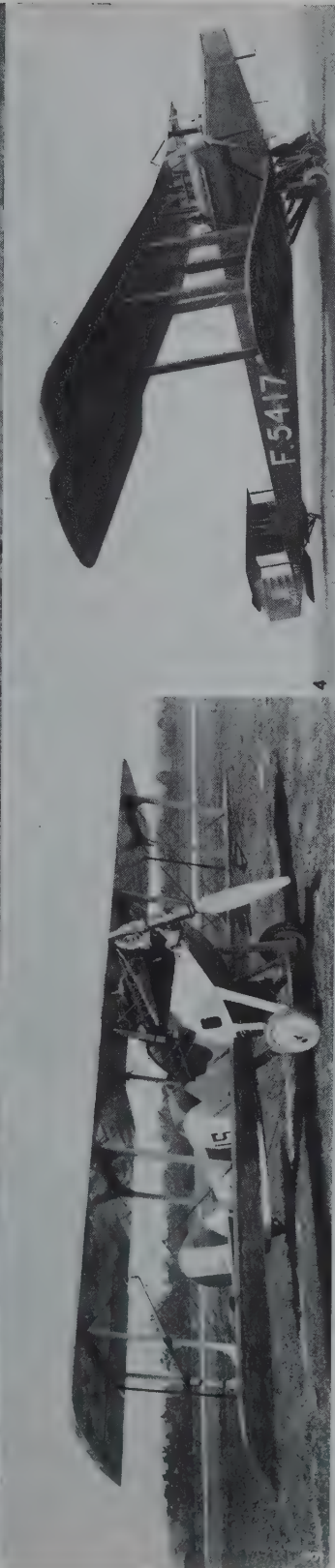
1. Langley's "Aerodrome," 1903, characterized by lightness and extensive flying surfaces. This machine crashed in two attempted launchings and never made a successful flight
2. Biplane of the Wright brothers, rising from the ground at Kitty Hawk, N. C., December 17th, 1903. Several successful flights were made in the United States and France
3. Monoplane of Louis Blériot which crossed the English Channel on July 25, 1909



BY COURTESY OF (1, 4) "FLIGHT," (2) SHORT BROTHERS & HARLAND LTD., (3) U.S. DEPARTMENT OF DEFENSE, AIR FORCE PHOTO, (5) THE BRISTOL AEROPLANE CO. LTD., (6) THE GLENN L. MARTIN CO.

BIPLANES OF 1910-12 AND THE FIRST SUCCESSFUL HYDROPLANE

1. Henry Farman biplane of 1912 (French)
2. Triple-twin biplane of 1911, powered by two 50-h.p. Gnome engines (British)
3. Curtiss hydroplane of 1911, first flying boat to successfully take off from, and land on, water (U.S.)
4. Valsin biplane of 1911 (French)
5. Bristol Boxkite powered by 50-h.p. Gnome engine, 1910 (British)
6. Glenn L. Martin biplane of 1912 (U.S.)



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AEROPLANES IN USE DURING WORLD WAR I

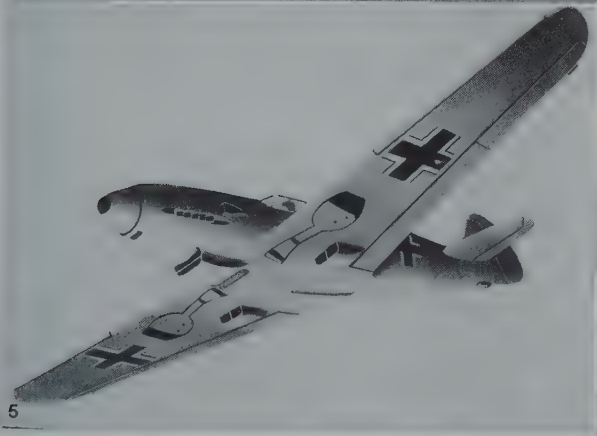
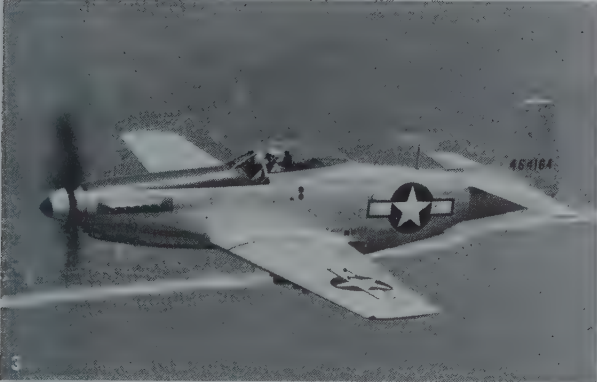
1. Fokker D.VII. (German) with British markings, captured by British troops during World War I
2. Bristol fighter F2B (British)
3. The LePere, French plane with U.S. Liberty engine
4. Handley Page 400, twin-engined bomber (British)
5. Nieuport fighter (French), with British markings
6. The Curtiss JN-4 "Jenny" (U.S.)



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AEROPLANES BETWEEN WORLD WARS I AND II

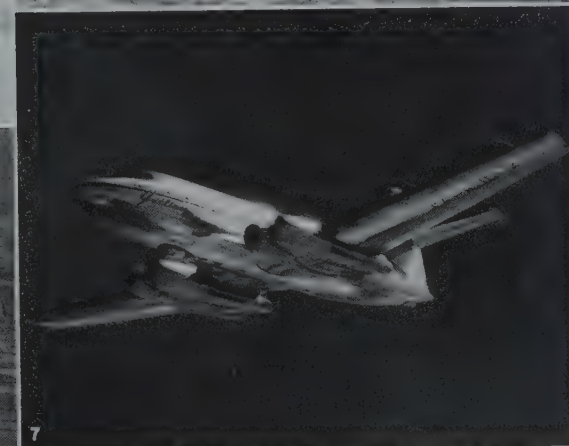
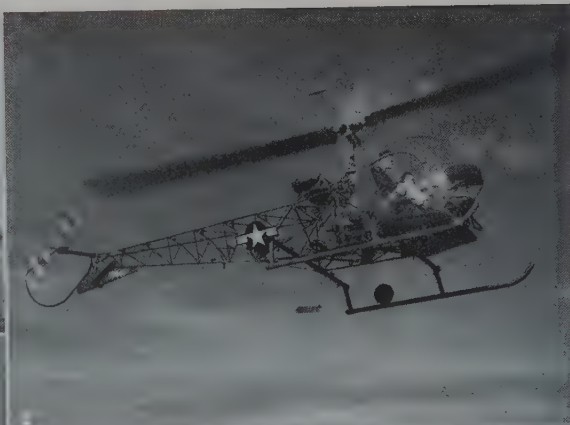
1. De Havilland Albatross, four-engined transport (British)
2. Ryan "Spirit of St. Louis" in which Charles A. Lindbergh made the first solo nonstop flight between the United States and France in 1927
3. Supermarine S6 seaplane (British)
4. Potez 630, two-engined bomber (French)
5. Fokke-Wulf Condor, four-engined plane (German)
6. Douglas DC-3 air liner (U.S.)



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AEROPLANES OF WORLD WAR II

1. PE-2, medium bomber (Russian)
2. De Havilland Mosquito, two-engine fighter bomber (British)
3. North American P-51H Mustang, single-seat fighter (U.S.)
4. Boeing B-29 Superfortress, bomber (U.S.)
5. Messerschmitt 109, single-seat fighter (German)
6. Supermarine Spitfire MK XII, single-seat fighter (British)



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AEROPLANES AFTER WORLD WAR II

1. Bell Airacomet, single-seat fighter monoplane, first U.S. jet-propelled aircraft
2. Bell HTL-4, navy version of the Model 47 helicopter (U.S.)
3. Gloster Meteor, single-seat jet fighter (British)
4. Lockheed Super Constellation, transport (U.S.)
5. Drawing of a MIG15 single-seat jet fighter (Russian)
6. De Havilland Comet, four-jet air liner (British)
7. Avro Canada Jetliner (Canadian)

to withstand those developed in landings. Here again recourse is made to load factors; only in this instance the acceleration forces are applied to the landing wheels rather than the wings. Landing gears usually incorporate shock struts, which absorb the energy of impact associated with the landing by developing a resisting force which acts continuously during the compressing of the strut. A well-designed landing gear is one which will limit the applied forces to less than about 4g for commercial aircraft. Normal

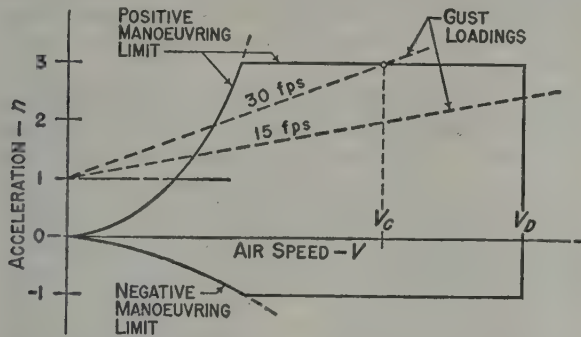


FIG. 10.—TYPICAL STRENGTH (V-N) DIAGRAM FOR AN AEROPLANE SHOWING MANOEUVRING AND GUST LOAD FACTOR CONDITIONS

landings are accomplished with much lower accelerations than this, but to take care of the worst cases of misjudgment and ground gust effects higher values are used.

Proof of Strength.—Knowing the external loads on the plane structure, calculations are made of the stresses imposed on each part, bolt and rivet. Most structures are highly redundant and calculations can only be made with difficulty. Where doubt may exist as to the actual value of stresses or the path taken by loads, recourse is made to structural testing. Elaborate jigs are required to hold the structure and allow proper loading and observation of results. A major portion of the time and expense of development of a modern plane is spent in the structural testing program. As a result, any commercial plane which conforms to the official criterion of strength and has been certificated by the airworthiness authorities of the government can, if operated sensibly, carry passengers with complete safety.

10. MATERIALS USED IN CONSTRUCTION

Early Composite Structures.—The materials most commonly used for the main structural members of early aeroplanes were wood and steel, with a fabric covering for the wings. The wood used was chiefly spruce of the highest grade, and in many aeroplanes the whole of the main structure, with the exception of ties and joints, was of this material. Ties and the joints or fittings by which they were attached to the other members were generally of steel. Steel tubes were used in some parts, either, as in the undercarriage, because of their robustness, or, as in the control mechanism, because of their efficiency in transmitting torsion.

The cross section of the wing spars has the I section used in general structural engineering, though the thickness of the web and flanges is much larger in proportion to the over-all dimensions of the section than is usual in steel I girders.

Wood as a structural material suffers from the following disadvantages: (1) Suitable grades cannot be freely obtained. (2) When exposed to the atmosphere, particularly to large changes in temperature and humidity, wood deteriorates more rapidly than steel or other metals. (3) The external appearance of wood is often misleading as an indication of its internal condition. (4) Glue and wood screws cannot be entirely avoided, and both are sources of weakness and uncertainty. (5) When a wooden structure is involved in an accident, many of its members break completely and splinter, and the structure disintegrates, whereas metal members often merely bend, and an all-metal structure generally preserves much of its original shape. (6) Wood has no inherent resistance to fire. These disadvantages formed the chief incen-

tive to the development of all-metal construction for planes.

All-Metal Structures.—The development of all-metal structures was originally mainly confined to replacing each of the wooden members of the composite structure described above by a metal member, using either steel or duralumin. In such a structure the load to be borne by each member was of a fairly simple character and could be estimated fairly closely. Hence, a comparison of the merits of a composite and an all-metal structure on these lines can be reduced to a comparison of typical members.

In small private aeroplanes welded steel tubular construction was still used quite extensively at mid-20th century. Wing spars might still be of wood, but more commonly they were of extruded aluminum alloy shapes. The exterior surfaces of wings, fuselage and tail surfaces might be either fabric or metal. When fabric was used it was usually a high-grade cotton fabric material laced onto the structure and finished with aircraft dope to give it tautness and air tightness. Metal coverings were made using a thin sheet aluminum alloy riveted construction. Streamlined steel or aluminum alloy tubing was used to form external bracing or struts for monoplane wings and landing gears.

For most planes the trend has been toward *monocoque* or semi-*monocoque* construction with the entire outer surface of the aeroplane of the metal stressed skin construction. Developments in the production of large, thin, uniform sheets of aluminum alloys, and in the art of welding and riveting, made desirable the *monocoque* type of construction in which the covering of the fuselage furnishes the strength. In the semi-*monocoque* type part of the stress is borne by the stressed skin and part by reinforcement.

Very high-speed aircraft require stiff structures for strength, rigidity and preservation of external contour. For such aircraft thick plate construction and large extruded and milled internal structural members are employed.

Materials Used.—The form and arrangement of internal structural members are dictated by the choice of materials, properties thereof and available methods for forming, fabricating and joining such materials. Aircraft materials fall into three principal classes: wood, steel and nonferrous metals. The accompanying table contains a brief listing of the most important of these, with appropriate weight and strength data for purposes of comparison. For many technical reasons a comparison of strength properties alone cannot be relied upon to indicate relative superiority; the particular application involved and other essential properties such as workability, fire resistance quality, heat insulating ability, surface hardness, relative rigidity, susceptibility to corrosion and availability of standard shapes enter into the choice.

Plastics had not yet reached the perfection needed for universal structural application at mid-century. Many nonprimary structural applications, however, are found for these materials in

Typical Properties of Aircraft Materials

Material	Specific weight lb./cu.in.	Tension yield lb./sq.in.	Tension ultimate lb./sq.in.	Modulus of elasticity E
Wood				
Spruce	0.015	—	9,400	1.3x10 ⁶
Mahogany plywood	0.021	—	5,770	0.75x10 ⁶
Ferrous metals				
Low carbon steel (1,020)	0.283	36,000	55,000	28x10 ⁶
Chrome-moly (4,130)	0.283	70,000	90,000	20x10 ⁶
Stainless (½ hard) (18-8)	0.286	110,000	158,000	28x10 ⁶
Aluminum alloys				
17 ST.	0.101	32,000	55,000	10.4x10 ⁶
24 ST.	0.100	46,000	65,000	10.5x10 ⁶
75 ST.	0.101	67,000	76,000	10.3x10 ⁶
Magnesium				
Mh	0.0635	22,000	32,000	6.5x10 ⁶
FS-1h	0.0645	29,000	39,000	6.5x10 ⁶

flooring, partitions, radomes, ducts and transparent enclosures.

Castings and forgings of both steel and aluminum alloys are used extensively for fittings, hinge brackets and parts carrying relatively large concentrated loads.

Resistance to corrosion is of importance in aircraft structures. Dissimilar metals, where joined together, must be suitably insulated from one another by tape or zinc chromate primer to prevent

galvanic corrosion. Alclad possesses excellent natural resistance to weathering. Steel parts plated with zinc or cadmium or painted with zinc chromate primers also have good corrosion resistance.

The high strength of aircraft metals, despite light weight, is obtained through alloying certain constituents such as carbon, chromium, nickel, copper and zinc with steel, aluminum or magnesium. Proper treatment of these alloys is required, such as heat treatment, aging and cold-working (rolling), to develop the best properties. New alloys were constantly developed to obtain improved strength properties both at low and high temperatures; examples of these included zirconium, cerium, titanium, etc.

Allowable Stresses.—What maximum stress will a particular strut, tubing, beam or bolt take before it will fail? How are such stresses determined? These questions require an answer before the stress analyst can be sure that the structural parts are safe. Aeroplane parts fail mostly under tension or compression loads. In the first case the matter is relatively simple since the important strength properties involved are the yield tensile strength and the ultimate tensile strength, the former being the stress at which plastic strain begins and the latter the stress at which rupture occurs. For all materials these values can be measured, using standard test specimens, in a tensile testing machine. The accompanying table shows such typical values. Knowing the allowable ultimate tensile stress of the material of the strut, tube or beam, the analyst can easily calculate the load which it can support in pounds by multiplying this stress by the appropriate cross-section area.

For compression allowable stress values the problem is much more complicated. Here failure may occur in a variety of ways; for example, by column buckling, by twisting or general instability and by local buckling or crushing. A long steel tube can fail under a very low end load by suddenly buckling laterally. If the load is relieved the tube will return to its original position unharmed. This is called column (or elastic) buckling. As the tube is shortened in length the allowable end load can be increased correspondingly; in practice, however, it will never reach in magnitude the load it can take in tension.

Thin sheets exhibit a similar characteristic by buckling readily under compressive loads. If the sheet is reinforced by attaching stringers lengthwise of the sheet, or by corrugating it, higher compressive loads can be carried before it will buckle. This is the principle of stiffened skin construction used in aircraft fabrication, making it possible to use lightweight thin metal materials. A great variety of types and shapes of stiffened structural elements are used by manufacturers. The allowable stresses for such elements are largely determined from a number of sheet stringer combination panel tests. Results of the tests, supplemented by theoretical methods, are then used to establish criteria which accurately predict failing loads for comparable elements of the aircraft structure.

There are many other stresses which are of importance to designers, among them allowable shear and bearing stresses of materials for use in determining the strength of rivet and bolt connections. Fatigue stresses, or the ability of a material to withstand cyclical repetition of load, are also important for determination of the useful life of a part in service.

Joining of Materials.—The aeroplane designer is faced with the problem of transforming materials which he procures in the form of flat sheet, bars, round tubing or extruded shapes such as angles, channels, zeels, etc., into parts of a plane. This requires forming of pieces, fitting to assembly jigs and joining the parts together. The three most common aircraft processes of joining parts are welding, riveting and bonding.

Welded construction is employed extensively for the joining of steel parts. The most common type is oxyacetylene torch welding, although electric resistance and arc welding are also used. Parts which require heat treatment for increased strength must be furnace-heated subsequent to welding and quenched under correct temperature conditions. Since heat destroys the strength properties of aluminum alloys, only certain such materials can be satisfactorily torch-welded, and this by skilled operators under controlled conditions. Spot welding of alclad aluminum alloys has, however, been successfully employed. Spot welding, using

automatic machines, is used also for fabricating parts made of stainless steel materials.

The most common method of joining high-strength aluminum alloy parts is by riveting. This requires the careful fitting of parts, drilling of rivet holes and, usually, manual driving of rivets with air guns. On exterior surfaces where a smooth surface is necessary, flush riveting is employed; i.e., the outside head of the rivet fits into a countersunk hole in the sheet. Rivet materials must be soft enough to drive without cracking and yet, because of the hardening effect of the working received in driving, it must develop the required strength to carry the required loads through the joint.

Bonding involves joining parts (exclusive of heat bonding by brazing) by using a plastic adhesive between surfaces. By this means it is possible to join not only like materials but materials such as aluminum alloy sheet to wood, rubber or plastic materials.

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AEROTHERAPEUTICS. In addition to the general use of open air and sunshine, there are several particular ways of using air for therapeutic purposes. Thus, oxygen-enriched air is used for those made ill through breathing irritant gases such as were used in warfare.

These gases evoke oedema of the lungs and danger of suffocation through want of oxygen. So, too, in cases of pneumonia, shock and failing circulation, oxygen inhalation is useful. It is administered either by a mask or in a special chamber in which the patient is put. In the latter case great precaution must be taken against the danger of fire.

Oxygen containing 5% of carbon dioxide provokes deep breathing, and is useful in cases when the lungs require expanding, as after operations for empyema, when hypostatic congestion of the lungs threatens, and in cases of poisoning by carbon monoxide, as in ordinary coal gas poisoning, etc. This mixture is particularly useful for breathing during induction of and after anaesthesia with ether, since the deep respiration induces anaesthesia quickly, and washes the ether out of the body at the end of the anaesthetic period. The breathing of nitrous oxide and oxygen in a compressed air chamber at half an atmosphere extra pressure gives deep and safe anaesthesia.

Certain dusts in the air act as irritants to those affected with hay fever and asthma; e.g., the pollen of plants, spores of aspergillus mould. It has been found possible to relieve such patients by sending them to high mountains.

In a mercurial or sulphur bath, the patient, enveloped in a sheet, sits on a chair beneath which a lamp is placed both to volatilize the drug and produce a steamy atmosphere. The vapour is absorbed by the skin. This treatment is used for syphilis and also for scabies and other affections of the skin. (See THERAPEUTICS.)

Air at a low pressure is used locally for cupping and thus producing local congestion, the blood being drawn into the part to which the cupping apparatus is applied at the expense of other organs. A similar result is got by local application of heat, poultices, etc. In operations where the chest cavity is opened air is blown into the lungs through a tube introduced through the larynx in order to keep the lungs distended.

Ozonized Air.—Ozonized air has been used in treatment of tuberculosis and wounds. Ozone is an irritant to the lungs and can be used safely only in very weak concentrations; e.g., in a concentration just perceptible to the smell. It takes away the power to smell bad odours, but otherwise has no valuable properties which have been proved. Its chief use, therefore, is for deodorizing offensive smells. (L. E. H.)

See "Aerotherapeutics," *American Journal of Physical Therapy*, vol. 3 (1926-27).

AERSCHOT, PHILIPPE DE CROY, DUKE OF (1526-1595), prince of Chimay, governor general of Flanders, was born

at Valenciennes, and inherited the estates of the ancient and wealthy family of Croy. He was appointed governor of the citadel of Antwerp when the Spanish troops withdrew in 1577. After a period of vacillation he deserted Don John toward the end of that year.

Jealous of the prince of Orange, he was then the head of the party which induced the archduke Matthias (afterward emperor) to undertake the sovereignty of the Netherlands, and soon afterward was appointed governor of Flanders by the state council.

A strong party, including the burghers of Ghent, distrusted the new governor, and Aerschot, who was taken prisoner during a riot at Ghent, was only released on promising to resign his office.

He then sought to regain the favour of Philip of Spain, and having been pardoned by the king in 1580 shared in the government of the Netherlands; but he refused to serve under the count of Fuentes when he became governor general in 1594, and retired to Venice. He died on Dec. 11, 1595.

See J. L. Motley, *The Rise of the Dutch Republic*.

AERTSZEN (or **AARTSEN**), **PIETER** (1507–1573), called “long Peter” on account of his height, Dutch historical painter, was born and died at Amsterdam. When a youth he distinguished himself by painting homely scenes, in which he reproduced articles of furniture, cooking utensils, etc., with marvellous fidelity. An excellent specimen of his style on a small scale, a picture of the Crucifixion, may be seen in the Antwerp museum. Aertszén was a member of the Academy of St. Luke, in the books of which he is entered as *Langhe Peter, schilder*. Three of his sons attained to some note as painters.

AESCHINES (5th century B.C.), an Athenian philosopher and orator and a friend of Socrates. Diogenes Laertius preserves a tradition that it was he, not Crito, who offered to help Socrates to escape from prison. He was always a poor man. He started a perfumery shop in Athens on borrowed capital, became bankrupt and retired to the Syracusan court. According to Diogenes Laertius (ii, 61), Plato, then at Syracuse, pointedly ignored Aeschines, but this does not agree with Plutarch *De adulatore et amico* (c. 26). On the expulsion of the younger Dionysius, Aeschines returned to Athens, and, finding it impossible to profess philosophy publicly owing to the contempt of Plato and Aristotle, was compelled to teach privately. Besides forensic speeches, noted for their purity of style, he wrote several philosophical dialogues: (1) *Concerning virtue, whether it can be taught*; (2) *Eryxias, or Erasistratus: concerning riches, whether they are good*; (3) *Axiochus: concerning death, whether it is to be feared*, but those extant are not genuine remains.

J. le Clerc made a Latin translation of them, with notes and several dissertations, entitled *Silvae Philologicae*, and they were edited by S. N. Fischer (Leipzig, 1786) and K. F. Hermann, *De Aeschin. Socrat. relig.* (Göttingen, 1850). The genuine dialogues appear to have been marked by the Socratic irony; an amusing passage is quoted by Cicero in the *De inventione* (i, 31). See also R. Hirzel, *Der Dialog*, i, 129–140 (1895); T. Gomperz, *Greek Thinkers*, vol. iii, p. 342, English trans. by G. G. Berry (London, 1905).

AESCHINES (389–314 B.C.), Athenian orator, the political opponent of Demosthenes. Aeschines and Demosthenes were both members of the first embassy to Philip (February–March 346 B.C.).

Philip's envoys appeared in the assembly on April 15 and 16, and between these two meetings Aeschines appears to have been won over to Philip's interest; on April 15 he refused, with Demosthenes, to accept a clause excluding Phocis; on April 16 he supported a peace in which the question was left vague. The same ambassadors went to administer the oaths to Philip, but, after so delaying on their journey that Philip had time to make conquests in Thrace, Philocrates and Aeschines (outvoting Demosthenes), allowed him to exclude the Phocians. But on his return Aeschines falsely assured the assembly that he had private information that Philip meant to support Phocis. The Athenians believed him and Phocis, left without support, surrendered.

In 345 Demosthenes accused Aeschines of misconduct, but Aeschines saved himself by an attack on Demosthenes' supporter (in *Timarchum*).

In 343 Demosthenes renewed the attack, and Aeschines secured

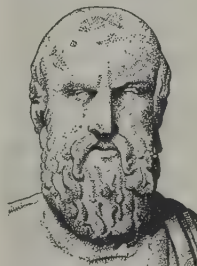
a bare acquittal (*De Falsa Legatione*).

In 340 war broke out again with Philip, and thanks to Aeschines, who stirred up a sacred war in 339, he managed to enter Greece unopposed, as general of the Amphictyonic forces. Athens and Thebes, united by Demosthenes, resisted desperately, but were decisively defeated at Chaeroneia (338).

Aeschines' party secured favourable terms from Philip, and prosecuted Demosthenes on various charges, but the Athenians loyally supported him, and in 336 it was proposed to crown him for public services. Aeschines brought a *graphê paranomôn* against the proposer (in *Ctesiphontem*), but the case was not tried till 330. Demosthenes' speech, “On the Crown” (a vindication of his whole policy), secured the condemnation of Aeschines, who withdrew to Rhodes.

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AESCHYLUS (525–456 B.C.), Greek poet, the first of the only three Attic tragedians of whose work entire plays survive, and in a very real sense the founder of the Greek drama, was born at Eleusis in 525 B.C. His father, Euphorion, belonged to the “Eupatridae” or old nobility of Athens, as we know on the authority of the short *Life* of the poet given in the Medicean manuscript (see note on “authorities” in the *Bibliography*). According to the same tradition he took part as a soldier in the great struggle of Greece against Persia; and was present at the battles of Marathon, Artemisium, Salamis and Plataea, in the years 490–479.



AESCHYLUS, FATHER OF THE GREEK DRAMA
Head now in the Capitoline Museum, Rome, believed to be that of Aeschylus, probably of about the 5th century B.C.

At least one of his brothers, Cynaegirus, fought with him at Marathon, and was killed in attempting a conspicuous act of bravery, and the brothers' portraits found a place in the national picture of the battle which the Athenians set up as a memorial in the Stoa Poecile (or “pictured porch”) at Athens.

The vigour and loftiness of tone which mark Aeschylus' poetic work were results not only of his native genius and gifts, powerful as they were, but also of the personal share he took in the great actions of a heroic national uprising.

In the same way, the poet's brooding thoughtfulness on deep questions—the power of the gods, their dealings with man, the dark mysteries of fate, the future life in Hades—though largely a result of his turn of mind and temperament, was doubtless connected with the place where his childhood was passed. Eleusis was the centre of the most famous worship of Demeter, with its processions, ceremonies, mysteries, impressive spectacles and nocturnal rites; and these were intimately connected with the Greek beliefs about the human soul and the underworld.

His dramatic career began early and continued for more than 40 years.

In 499, his 26th year, he first exhibited at Athens; and his last work, acted during his lifetime at Athens, was the trilogy of the *Oresteia*, exhibited in 458. The total number of his plays is stated by Suidas to have been 90, and the 7 extant plays, with the dramas named or nameable which survive only in fragments, amount to more than 70, so that Suidas' figure is probably based on reliable tradition. It is well known that in the 5th century B.C. each exhibitor at the tragic contests produced four plays, and Aes-

chylus must therefore have competed (between 499 and 458) more than 20 times, or once in two years. His first victory is recorded in 484, 15 years after his earliest appearance on the stage; but in the remaining 26 years of his dramatic activity at Athens he was successful at least 12 times. This clearly shows that he was the most commanding figure among the tragedians of 500-458, and for more than half that time was usually the victor in the contests. Perhaps the most striking evidence of his exceptional position among his contemporaries is the well-known decree passed shortly after his death that whosoever desired to exhibit a play of Aeschylus should "receive a chorus"; *i.e.*, be officially allowed to produce the drama at the Dionysia.

The existence of this decree, mentioned in the *Life*, is strongly confirmed by two passages in Aristophanes: first in the prologue of the *Acharnians* (which was acted in 425, 31 years after the poet's death), where the citizen, grumbling about his griefs and troubles, relates his great disappointment, when he took his seat in the theatre "expecting Aeschylus," to find that when the play came on it was *Troegnis*; and secondly in a scene of the *Frogs* (acted 405 B.C.), where the throne of poetry is contested in Hades between Aeschylus and Euripides, the former complains (*Frogs*, 866) that "the battle is not fair, because my own poetry has not died with me, while Euripides' has died, and therefore *he will have it with him to recite*"—a clear reference, as the scholiast points out, to the continued production at Athens of Aeschylus' plays after his death.

Apart from fables, guesses and blunders, of which a word is said below, the only other incidents recorded of the poet's life that deserve mention are connected with his Sicilian visits, and the charge preferred against him of revealing the "secrets of Demeter."

This tale is briefly mentioned by Aristotle (*Ethics*, iii, 2), and a late commentator (Eustratius, 12th century) quotes from one Heracleides Ponticus the version which may be briefly given as follows:

The poet was acting a part in one of his own plays, where there was a reference to Demeter. The audience suspected him of revealing the inviolable secrets, and rose in fury; the poet fled to the altar of Dionysus in the orchestra and so saved his life for the moment; for even an angry Athenian crowd respected the inviolable sanctuary.

He was afterward charged with the crime before the Areopagus, and his plea "that he did not know that what he said was secret" was accepted by the court and secured his acquittal. The commentator adds that the prowess of the poet (and his brother) at Marathon was the real cause of the leniency of his judges. The story was afterward developed, and embellished by additions; but as the main fact seems accepted by Aristotle, it is probably authentic in the above shape.

As to his foreign travel, the suggestion has been made that certain descriptions in the *Persae*, and the known fact that he wrote a trilogy on the story of the Thracian king Lycurgus, persecutor of Dionysus, seem to point to his having a special knowledge of Thrace, which makes it likely that he had visited it. This, however, remains at best a conjecture. For his repeated visits to Sicily, on the other hand, there is conclusive ancient evidence.

Hiero I, tyrant of Syracuse, who reigned about 12 years (478-467), and among other efforts at magnificence invited to his court famous poets and men of letters, had founded a new town, Aetna, on the site of Catania which he captured, expelling the inhabitants. Among his guests were Aeschylus, Pindar, Bacchylides and Simonides. About 476 Aeschylus was entertained by him, and at his request wrote and exhibited a play called *The Women of Aetna* in honour of the new town. He paid a second visit about 472, the year in which he had produced the *Persae* at Athens, and the play is said to have been repeated at Syracuse at his patron's request.

Hiero died in 467, the year of the *Seven against Thebes*; but after 458, when the *Oresteia* was exhibited at Athens, we find the poet again in Sicily for the last time. In 456 he died and was buried at Gela; on his tomb was placed an epitaph in two elegiac couplets saying: "Beneath this stone lies Aeschylus, son of Euphorion, the Athenian, who perished in the wheat-bearing land

of Gela; of his noble prowess the grove of Marathon can speak, or the long-haired Persian who knows it well." The authorship of this epitaph is uncertain, as the *Life* says it was inscribed on his grave by the people of Gela, while Athenaeus and Pausanias attribute it to Aeschylus. Probably most people would agree that only the poet himself could have praised the soldier and kept silent about the poetry.

Of the marvellous traditions which gathered round his name little need be said. Pausanias' tale, how Dionysus appeared to the poet when a boy, asleep in his father's vineyard, and bade him write a tragedy—or the account in the *Life*, how he was killed by an eagle letting fall on his head a tortoise whose shell the bird was unable to crack—clearly belong to the same class of legends as the story that Plato was son of Apollo, and that a swarm of bees settled upon his infant lips as he lay in his mother's arms. Less supernatural, but hardly more historical, is the statement in the *Life* that the poet left Athens for Sicily in consequence of his defeat in the dramatic contest of 468 by Sophocles; or the alternative story of the same authority that the cause of his chagrin was that Simonides' elegy on the heroes slain at Marathon was preferred to his own.

Apart from the inherent improbability of such pettiness in such a man, neither story fits the facts, for in 467, the next year following Sophocles' success, it is known that Aeschylus won the prize of tragedy with the *Septem*; and the Marathon elegy must have been written in 490, 14 years before his first visit to Sicily.

Aeschylus' Plays.—In passing from Aeschylus' life to his work, we have obviously far more trustworthy data, in the 7 extant plays (with the fragments of more than 70 others), and particularly in the invaluable help of Aristotle's *Poetics*. The real importance of our poet in the development of the drama (*see* DRAMA: *Greek*) as compared with his predecessors is shown by the fact that Aristotle, in his brief review of the rise of tragedy (*Poetics*, iv, 13), names no one before Aeschylus.

He recognizes, it is true, a long process of growth, with several stages, from the dithyramb to the drama; and it is not difficult to see what these stages were. The first step was the addition to the old choric song of an interlude spoken, and in early days improvised, by the leader of the chorus (*Poetics*, iv, 12). The next was the introduction of an actor (literally, an "answerer"), to reply to the leader; and thus we get dialogue added to recitation.

The "answerer" was at first the poet himself (Aristotle, *Rhetoric*, iii, 1). This change is traditionally attributed to Thespis (533 B.C.), who is, however, not mentioned by Aristotle. The mask, to enable the actor to assume different parts, by whomsoever invented, was in regular use before Aeschylus' day. The third change was the enlarged range of subjects. The lyric dithyramb tales were necessarily about Dionysus, and the interludes had, of course, to follow suit. Nothing in the world so tenaciously resists innovation as religious ceremony, and it is interesting to learn that the Athenian populace (then, as ever, eager for "some new thing") nevertheless opposed at first the introduction of other tales.

But the innovators won, or otherwise there would have been no Attic drama.

In this way, then, to the original lyric song and dances in honour of Dionysus was added a spoken (but still metrical) interlude by the chorus leader, and later a dialogue with one actor (at first the poet), whom the mask enabled to appear in more than one part.

Nevertheless, all the evidence points to the fact that in the development of the drama Aeschylus was the decisive innovator.

The two things that were important, when the 5th century began, if tragedy was to realize its possibilities, were (1) the disentanglement of the dialogue from its position as an interlude in an artistic and religious pageant that was primarily lyric; and (2) its general elevation of tone. Aeschylus, as we know on the express authority of Aristotle (*Poetics*, iv, 13), achieved the first by the introduction of the second actor; and though he did not begin the second he gave to it the decisive impulse and consum-

mation by the overwhelming effect of his serious thought, the stately splendour of his style, his high dramatic purpose, and the artistic grandeur and impressiveness of the construction and presentment of his tragedies.

As to the importance of the second actor no argument is needed. The interacting personal influences of different characters on each other are indispensable to anything that can be called a play, as we understand the word; and, without two "personae dramatis" at the least, the drama in the strict sense is clearly impossible. The number of actors was afterwards increased; but to Aeschylus is due the essential step; and therefore, as was said above, he deserves, in a very real sense, to be called the founder of Athenian tragedy.

Of the seven extant plays, *Supplices*, *Persae*, *Septem contra Thebas*, *Prometheus*, *Agamemnon*, *Choephoroe* and *Eumenides*, five can be dated with certainty, as the archon's name is preserved in the Arguments; and the other two approximately. The dates rest, in the last resort, on the *didaskalia*, or the official records of the contests, of which Aristotle (and others) compiled catalogues; and some actual fragments have been recovered. The order of the plays is probably that given above; and certainly the *Persae* was acted in 472, *Septem* in 467, and the trilogy in 458. The *Supplices* is generally regarded as the oldest; and the best authorities tend to place it not far from 490. The early date is strongly confirmed by three things: the extreme simplicity of the plot, the choric (instead of dramatic) opening, and the fact that the percentage of lyric passages is 54, or the highest of all the seven plays. The chief doubt is in regard to *Prometheus*, but the very low percentage of lyrics (only 27, or roughly a quarter of the whole), and still more the strong characterization, a marked advance on anything in the first three plays, point to its being later than any except the trilogy, and suggest a date somewhere about 460, or perhaps a little earlier. A few comments on the extant plays will help to indicate the main points of Aeschylus' work.

Supplices.—The exceptional interest of the *Supplices* is due to its date. Being nearly 20 years earlier than any other extant play, it furnishes evidence of a stage in the evolution of Attic drama which would otherwise have been unrepresented. It probably resembles in general structure the lost works of Choerilus, Phrynichus, Pratinas and the 6th century pioneers of drama.

The plot is briefly as follows: the 50 daughters of Danaus (who are the chorus), betrothed by Aegyptus (their father's brother) to his 50 sons, flee with Danaus to Argos, to escape the marriage. They claim the protection of the Argive king, Pelasgus; and he (by a pleasing anachronism) refers the matter to the people, who agree to protect the fugitives. The pursuing fleet of suitors is seen approaching; the herald arrives, orders off the cowering Danaids to the ships and finally attempts to drag them away. Pelasgus interposes with a force, drives off the Egyptians and saves the suppliants. Danaus urges them to prayer, and the grateful chorus pass away to the shelter offered by their protectors.

It is clear that we have here the drama just developing out of the lyric pageant. The interest still centres round the chorus. Character and plot—the two essentials of drama—are both here rudimentary. The play is a single situation. It should not be forgotten, indeed, that the play is one of a trilogy—an act, therefore, rather than a complete drama. But we have only to compare it with those later plays of which the same is true, to see the difference. Even in a trilogy, each play is a complete whole in itself, though also a portion of a larger whole.

Persae.—The next play that has survived is the *Persae*, the only extant Greek historical drama. The plot is still severely simple, though more developed than that of the *Supplices*. The opening is still lyric, and the first quarter of the play brings out, by song and speech, the anxiety of the people and queen as to the fate of Xerxes' huge army. Then comes the messenger with the news of Salamis, including a description of the sea-fight itself which can only be called magnificent. The play is not a tragedy in the true Greek sense; its real aim is not the "pity and terror" of the developed drama; it is the triumphant

glorification of Athens, the exultation of the whole nation gathered in one place, over the ruin of their foe; and one effective incident is the raising of Darius' ghost, and his prophecy of the disastrous battle of Plataea. But in the ghost's revelations there is a mixture of audacity and naïveté, characteristic at once of the poet and the early youth of the drama.

Septem Contra Thebas.—Five years later came the Theban tragedy, which is (like the *Supplices*) one of a connected series, dealing with the evil fate of the Theban house, and traces the fate through three generations, Laius, Oedipus and the two sons who die by each other's hands in the fight for the Theban sovereignty. This family fate, where one evil deed leads to another after many years, is a larger conception, strikingly suited to Aeschylus' genius, and constitutes a notable stage in the development of the Aeschylean drama. In the last extant work, the *Oresteia*, the poet traces the tragedy of the Pelopid family, from Agamemnon's first sin to Orestes' vengeance and purification. And the names of several lost plays point to similar handling of the tragic trilogy.

The *Seven against Thebes* is the last play of its series; and again the plot is severely simple. Father and grandfather have both perished miserably; and the two princes both claim the kingdom. Eteocles has driven out Polyneices, who fled to Argos, gathered a host under seven leaders (himself being one), and when the play opens has begun the siege of his own city. The king appears, warns the people, chides the clamour of women, appoints seven Thebans, including himself, to defend the seven gates, departs to his post, meets his brother in battle and both are killed. The other chieftains are all slain, and the enemy beaten off. The two dead princes are buried by their two sisters, who alone are left of the royal house.

Various signs of the early drama are here manifest. Half the play is lyric; there is no complication of plot; the whole action is recited by messengers; and the predicted mutual slaughter of the princes is brought about by no accidental stroke of destiny, but by the choice of the king, Eteocles himself. On the other hand, the opening is no longer lyric (like the two earlier plays) but dramatic; the main scene, where the king appoints the seven defenders, must have been an impressive spectacle. One novelty should not be overlooked. There is here the first passage of *dianoia*, or general reflection of life, which later became a regular feature of tragedy. Eteocles muses on the fate which involves an innocent man in the company of the wicked so that he shares unjustly their deserved fate (*Theb.* 597–608). The whole part of Eteocles shows a new effort of the poet to draw character, which may have something to do with the rise of Sophocles, who in the year before (468) won the prize of tragedy. There remain only the *Prometheus* and the *Oresteia*, which show such marked advance that (it may almost be said) when we think of Aeschylus it is these four plays we have in mind.

Prometheus.—The Prometheus-trilogy consisted of three plays: *Prometheus the Fire-bringer*, *Prometheus Bound*, *Prometheus Unbound*. The two last necessarily came in that order; the *Fire-bringer* is probably the first of the trilogy. That Prometheus sinned against Zeus, by stealing fire from heaven; that he was punished by fearful tortures for ages; that he was finally reconciled to Zeus and set free—all this was the ancient tale indisputably. Those who hold the *Fire-bringer* (Πυρφόρος) to be the final play, conjecture that it dealt with the establishment of the worship of Prometheus under that title, which is known to have existed at Athens. But the other order is on all grounds more probable; it keeps the natural sequence—crime, punishment, reconciliation, which is also the sequence in the *Oresteia*. And if the reconciliation was achieved in the second play, no scheme of action sufficing for the third drama seems even plausible.¹

The play that survives is a poem of unsurpassed force and impressiveness. Nevertheless, from the point of view of the

¹The *Eumenides* is quoted as a parallel, because there the establishment of this worship at Athens concludes the whole trilogy; but it is forgotten that in *Eumenides* there is much besides—the pursuit of Orestes, the refuge at Athens, the trial, the acquittal, the conciliation by Athena of the Furies; while here the story would be finished before the last play began.

development of drama, there seems at first sight little scope in the story for the normal human interest of a tragedy, since the actors are all divine, except Io; and between the opening where Prometheus is nailed to the Scythian rock, and the close where the earthquake engulfs the rock, the hero and the chorus, action in the ordinary sense is *ipso facto* impossible. This is just the opportunity for the poet's bold inventiveness and fine imagination.

Oceanus, the well-meaning palaverer old mentor, and Hermes, the blustering and futile jack-in-office, gods though they be, are vigorous, audacious and very human character-sketches; the soft entrance of the consoling nymphs is unspeakably beautiful; and the prophecy of Io's wanderings is a striking example of that new keen interest in the world outside which was felt by the Greeks of the 5th century, as it was felt by the Elizabethan English in a very similar epoch of national spirit and enterprise 2,000 years later. Thus, though dramatic action is by the nature of the case impossible for the hero, the visitors provide real drama.

Another important point in the development of tragedy is what we may call the "balanced issue." The hero is both a victim and a rebel. He is punished for his benefits to man; but though Zeus is tyrannous, the hero's reckless defiance is shocking to Greek feeling. As the play goes on, this is subtly indicated by the attitude of the chorus. They enter overflowing with pity. They are slowly alienated by the hero's impiety; but they decline, at the last crisis, the mean advice of Hermes to desert Prometheus; and in the final crash they share his fate.

Oresteia.—The last and greatest work of Aeschylus is the *Oresteia*, which also has the interest of being the only complete trilogy preserved to us. As in *Prometheus*, the plot, at first sight, is such that the conditions of drama seem to exclude much development in character-drawing. The gods are everywhere at the root of the action. The inspired prophet, Calchas, has demanded the sacrifice of the king's daughter, Iphigeneia, to appease the offended Artemis. The inspired Cassandra, brought in as a spear-won slave from conquered Troy, reveals the murderous past of the Pelopid house, and the imminent slaughter of the king by his wife. Apollo orders the son, Orestes, to avenge his father by killing the murderer, and protects him when after the deed he takes sanctuary at Delphi. The Erinyes ("Furies") pursue him over land and sea; and at last Athena gives him shelter at Athens, summons an Athenian council to judge his guilt, and when the court is equally divided gives her casting vote for mercy. The last act ends with the reconciliation of Athena and the Furies; and the latter receive a shrine and worship at Athens, and promise favour and prosperity to the great city. The scope for human drama seems deliberately restricted by such a story so handled. Nevertheless, the growth of characterization is not only visible but remarkable. Clytemnestra is one of the most powerfully presented characters of the Greek drama. And there is one other noticeable point. In this trilogy, Aeschylus, for the first time, has attempted some touches of character in two of the humbler parts, the watchman in *Agamemnon*, and the nurse in the *Choephoroe*. These two are veritable figures drawn from contemporary life; and though both appear only once, the innovation is most significant, and especially as adapted by Aeschylus.

Aeschylus' Characteristics.—It remains to say a word on two more points: the religious ideas of Aeschylus and some of the main characteristics of his poetry. The religious aspect of the drama in one sense was prominent from the first. But the new spirit imported by the genius of Aeschylus was religious in a profounder meaning of the term. The sadness of human lot, the power and mysterious dealings of the gods, their terrible and inscrutable wrath and jealousy (*aga* and *phthonos*), their certain vengeance upon sinners, all the more fearful if delayed—such are the poet's constant themes, especially in the *Oresteia*. And at times, particularly in the *Trilogy*, in his reference to the divine power of Zeus, he almost approaches a stern and sombre monotheism.

One specially noteworthy point in the *Agamemnon* is his ex-

PLICIT repudiation of the common Hellenic view that prosperity brings ruin. In other places he seems to share the feeling; but here (*Ag.* 730) he goes deeper, and declares that it is not *δλβος* but always wickedness that brings about men's fall. All through there is a recurring note of *fear* in his view of man's destiny. In one remarkable passage of the *Eumenides* (517-525) this fear is extolled as a moral power which ought to be enthroned in men's hearts, to deter them from impious acts or from the pride that impels them to such sins.

Of the poetic qualities of Aeschylus' drama and diction, both in the lyrics and the dialogue, the briefest word must here suffice. He is everywhere distinguished by grandeur and power of conception, presentation and expression, and most of all in the latest works, the *Prometheus* and the *Trilogy*. He is pre-eminent in depicting the slow approach of fear, as in the *Persae*; the imminent horror of impending fate, as in the broken cries and visions of Cassandra in the *Agamemnon* (1072-1177), the long lament and prayers to the nether powers in the *Choephoroe* (315-478), and the gradual rousing of the slumbering Furies in the *Eumenides* (117-139). The fatal end in these tragedies is foreseen; but the effect is due to its measured advance, to the slowly darkening suspense which no poet has more powerfully rendered. Again, he is a master of contrasts, as when the floating vision of consoling nymphs appears to the tortured Prometheus (115-135); or the unmatched lyrics which tell (in the *Agamemnon*, 228-247) of the death of Iphigeneia; or the vision of his lost love that the night brings to Menelaus (410-426). And not least noticeable is the extraordinary range, force and imaginativeness of his diction. One example of his lyrics may be given which will illustrate more than one of these points. It is taken from the lament in the *Septem*, sung by the chorus and the two sisters, while following the funeral procession of the princes. (*Sept.* 854-860):—

Nay, with the wafting gale of your sighs, my sisters,
Beat on your heads with your hands the stroke as of oars,
The stroke that passes ever across Acheron,
Speeding on its way the black-robed sacred bark,—
The bark Apollo comes not near,
The bark that is hidden from the sunlight—
To the shore of darkness that welcomes all! (A. St.)

BIBLIOGRAPHY.—**Authorities:** The chief authority for the text is a single ms. at Florence, of the early 11th century, known as the Medicean or M., written by a professional scribe and revised by a contemporary scholar, who corrected the copyist's mistakes, added the scholia, the arguments and the *dramatis personae* of three plays (*Theb.*, *Agam.*, *Eum.*), and at the end of the *Life of Aeschylus* and the *Catalogue* of his dramas. The ms. has also been further corrected by later hands. In 1896 the Italian Ministry of Public Instruction published the ms. in photographic facsimile, with an instructive preface by Signor Rostagno. Besides M. there are some eight later mss. (13th to 15th century), and numerous copies of the three select plays (*Sept.*, *Pers.*, *Prom.*) which were most read in the later Byzantine period. These later mss. are of little value.

Editions.—The three first printed copies (Aldine, 1518; Turnebus and Robortello, 1552) give only those parts of *Agamemnon* found in M., from which ms. some leaves were lost; in 1557 the full text was restored by Vettori (Victorinus) from later mss. After these four, the chief editions of the seven plays were those of Schütz, Porson, Butler, Wellauer, Dindorf, Bothe, Ahrens, Paley, Hermann, Hartung, Weil, Merkel, Kirchhoff and Wecklein. Editions of separate plays, special studies, etc. Wilamowitz-Moellendorf, Enger, Conington, Blaydes, Cobet, Meineke, Madvig, Ellis, W. Headlam, Davies, Tucker, Verrall, Haigh and Hoernle. The *Fragmentes* have been edited by Nauck and also by Wecklein. The Aeschylean staging is discussed in Albert Müller's *Lehrbuch der griechischen Bühnenalterthümer*; in "Die Bühne des Aeschylus," by Wilamowitz (Hermes, xxi.); in Smith's *Dict. of Antiquities*, art. "Theatrum" (R. C. Jebb); in Dörpfeld and Reich's (*Das griechische Theater*), Haigh's *Attic Theatre*, and Gardner and Jevons' *Manual of Greek Antiquities*. English verse translations; *Agamemnon*, Milman and R. Browning; *Oresteia*, *Suppliants*, *Persae*, *Seven against Thebes*, *Prometheus Vinculus*, by E. D. A. Morshead; *Prometheus*, E. B. Browning; the whole seven plays, Lewis Campbell. *Oresteia* by G. Murray, by R. C. Trevelyan, by G. M. Cookson; prose translation by W. G. and C. E. S. Headlam.

AESCULAPIUS, the Latin form of ASKLEPIOS (Ἀσκληπίος) the name of the Greek god of medicine, the son of Apollo and the nymph Coronis. He probably came from Thessaly. The centaur Cheiron taught him the art of healing. At length Zeus, who, being afraid that he might render all men immortal, slew him with a thunderbolt (Apollodorus iii. 10; Pindar, *Phthia*, 3; Diod. Sic. iv.

71r). Homer mentions him as a skilful physician, whose sons, Machaon and Podaleirius, are physicians in the Greek camp before Troy (*Iliad*, ii. 731r). Temples were erected to Asklepios in many parts of Greece, near healing springs or on high mountains. The practice of sleeping (*incubatio*) in these sanctuaries was very common, it being supposed that the god effected cures or prescribed remedies to the sick in dreams. All who were healed offered sacrifice (especially a cock) and hung up votive tablets, recording their names, their diseases, and the manner in which they had been cured. Many of these tablets have been discovered at Epidauros, the god's most famous shrine. Herodas (*Mimes*, 4) gives a description of one of his temples, and of the offerings made to him. The cult of Asklepios was introduced into Rome by order of the Sibylline books (293 B.C.); to avert a pestilence. The god was fetched from Epidauros in the form of a snake and a temple assigned him on an island in the Tiber (Livy x. 47; Ovid, *Metam.* xv. 622). Asklepios is commonly represented standing, dressed in a long cloak, with bare breast; his usual attribute is a club-like staff with a serpent coiled round it. He is often accompanied by Telesphorus, the boy genius of healing, and his daughter, Hygieia, the goddess of health. Votive reliefs representing such groups have been found near the temple of Asklepios at Athens.

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AESERNIA (mod. *Isernia*, Italy), Samnite town 58 mi. N.E. of Beneventum on the road to Corfinium, at the junction of a road past Venafrum to the Via Latina. These routes are all followed by railways to Campobasso, Sulmona and Caianello. A Roman colony from 263 B.C., it became the headquarters of the Italian revolt after the loss of Corfinium, and was only recovered by Sulla at the end of the war, in 80 B.C. Massive ancient walls serve as foundation to modern ones.

AESOP (Gr. *Ἀἰσώπης*), author of *Fables* about animals, generally with a didactic purpose, which have given their name to a whole class of stories, is supposed to have lived from about 620 to 560 B.C. The place of his birth is uncertain. He was the slave of Iadmon of Samos and met with a violent death at the hands of the inhabitants of Delphi. When a pestilence came upon them, the Delphians offered compensation for his death, and the award was claimed by Iadmon, grandson of his old master. Herodotus, who is authority for this (ii. 134), does not state the cause of Aesop's death; various reasons are assigned by later writers—his insulting sarcasms, the embezzlement of money entrusted to him by Croesus for distribution at Delphi (Schol. Ar. Vesp. 1446), the theft of a silver cup.

Aesop must have been freed by Iadmon, or he could not have conducted the public defense of a Samian demagogue (Aristotle, *Rhetoric*, ii. 20). Legend says that he afterwards lived at the court of Croesus, where he met Solon, and dined in the company of the Seven Sages of Greece with Periander at Corinth. But it is impossible to say whether there is any grain of fact in this confused chronology. During the reign of Peisistratus he is said to have visited Athens, on which occasion he related the fable of *The Frogs asking for a King*, to dissuade the citizens from changing Peisistratus for another ruler.

The current stories about him are derived from a life, or rather

romance, prefixed to a book of fables, purporting to be his, collected by Maximus Planudes, a monk of the 14th century. This describes him as ugly and deformed, as he is represented in the marble figure in the Villa Albani at Rome. That this life, however, was in existence a century before Planudes, appears from a 13th-century ms. of it found at Florence. In Plutarch's *Symposium of the Seven Sages*, at which Aesop is a guest, there are jests on his original servile condition, but nothing derogatory is said about his personal appearance. We are further told that the Athenians set up a noble statue of him by Lysippus, which furnishes a strong argument against the fiction of his deformity. The obscurity in which the history of Aesop is involved has induced some scholars to deny his existence altogether.

It is probable that Aesop did not commit his fables to writing (*Wasps*, 1259; Plato, *Phaedo*, 61 b). Demetrius of Phalerum (345–283 B.C.) made a collection in ten books, probably in prose, which has been lost. Next appeared an edition in elegiac verse, cited by Suidas, but the author's name is unknown. Babrius, a Roman, turned the fables into choliambics in the earlier part of the 3rd century A.D. The most celebrated of the Latin adapters is Phaedrus, a freedman of Augustus. Avianus (of uncertain date, perhaps the 4th century) translated 42 fables into Latin elegiacs. The collections, which we possess under the name of *Aesop's Fables*, are late renderings of Babrius's version, or Babrius was translated into Syriac, and back again into Greek. Ignatius Diaconus, in the 9th century, made a version of 53 fables in choliambic tetrameters. Stories from Oriental sources were added, and from these collections Maximus Planudes made and edited the collection which has come down to us under the name of Aesop, and from which the popular fables of modern Europe have been derived.

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AESOPUS, a Greek historian who wrote a history of Alexander the Great, a Latin translation of which, by Julius Valerius, was discovered by Mai in 1816. He is known as the pseudo-Callisthenes.

(See the references s.v. *CALLISTHENES*.)

AESOPUS, CLODIUS, Roman tragedian, flourished in the first century B.C.

Cicero was on friendly terms with him. Aesopus made a last appearance in 55 B.C.—when Cicero tells us that he was advanced in years—on the occasion of the splendid games given by Pompey at the dedication of his theatre.

Horace (*Sat.* iii. 3. 239) mentions his taking a pearl from the ear-drop of Caecilia Metella and dissolving it in vinegar, that he might have the satisfaction of swallowing eight thousand pounds' worth at a draught.

BIBLIOGRAPHY.—Cicero, *De Divinatione*, i. 37; *pro Sestio*, 56, 58; Quint., *Instit.* xi. 3, III.; Macrobius, *Sat.* iii. 14.

AESTHETICS. If we examine a poem in order to determine what it is that makes us feel it to be a poem, we at once find two constant and necessary elements: a complex of *images*, and a *feeling* that animates them. Let us, for instance, recall a passage learnt at school: Virgil's lines (*Aeneid*, iii., 294, *sqq.*), in which Aeneas describes how on hearing that in the country to whose shores he had come the Trojan Helenus was reigning, with Andromache, now his wife, he was overcome with amazement



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AESOP. SITTING IN THE DOORWAY.
RECOUNTING ONE OF HIS FAMOUS
TALES
Reproduced after the woodcut in
"Aesopi vita latine cum versione
italica," etc., printed in Venice, March
27, 1492

and a great desire to see this surviving son of Priam and to hear of his strange adventures. Andromache, whom he meets outside the walls of the city, by the waters of a river renamed Simois, celebrating funeral rites before a cenotaph of green turf and two altars to Hector and Astyanax; her astonishment on seeing him, her hesitation, the halting words in which she questions him, uncertain whether he is a man or a ghost; Aeneas's no less agitated replies and interrogations, and the pain and confusion with which she recalls the past—how she lived through scenes of blood and shame, how she was assigned by lot as slave and concubine to Pyrrhus, abandoned by him and united to Helenus, another of his slaves, how Pyrrhus fell by the hand of Orestes and Helenus became a free man and a king; the entry of Aeneas and his men into the city, and their reception by the son of Priam in this little Troy, this mimic Pergamon with its new Xanthus, and its Scaean Gate whose threshold Aeneas greets with a kiss—all these details, and others here omitted, are images of persons, things, attitudes, gestures, sayings, joy and sorrow; mere images, not history or historical criticism, for which they are neither given nor taken. But through them all there runs a feeling, a feeling which is our own no less than the poet's, a human feeling of bitter memories, of shuddering horror, of melancholy, of homesickness, of tenderness, of a kind of childish *pietas* that could prompt this vain revival of things perished, these playthings fashioned by a religious devotion, the *parva Troia*, the *Pergama simulata magnis*, the *arentem Xanthi cognomine rivum*: something inexpressible in logical terms, which only poetry can express in full. Moreover, these two elements may appear as two in a first abstract analysis, but they cannot be regarded as two distinct threads, however intertwined; for, in effect, the feeling is altogether converted into images, into this complex of images, and is thus a feeling that is contemplated and therefore resolved and transcended. Hence poetry must be called neither feeling, nor image, nor yet the sum of the two, but "contemplation of feeling" or "lyrical intuition" or (which is the same thing) "pure intuition"—pure, that is, of all historical and critical reference to the reality or unreality of the images of which it is woven, and apprehending the pure throb of life in its ideality. Doubtless, other things may be found in poetry besides these two elements or moments and the synthesis of the two; but these other things are either present as extraneous elements in a compound (reflections, exhortations, polemics, allegories, etc.), or else they are just these image-feelings themselves taken in abstraction from their context as so much material, restored to the condition in which it was before the act of poetic creation. In the former case, they are non-poetic elements merely interpolated into or attached to the poem; in the latter, they are divested of poetry, rendered unpoetical by a reader either unpoetical or not at the moment poetical, who has dispelled the poetry, either because he cannot live in its ideal realm, or for the legitimate ends of historical enquiry or other practical purposes which involve the degradation—or rather, the conversion—of the poem into a document or an instrument.

Artistic Qualities.—What has been said of "poetry" applies to all the other "arts" commonly enumerated; painting, sculpture, architecture, music. Whenever the artistic quality of any product of the mind is discussed, the dilemma must be faced, that either it is a lyrical intuition, or it is something else, something just as respectable, but not art. If painting (as some theorists have maintained) were the imitation or reproduction of a given object, it would be, not art, but something mechanical and practical; if the task of the painter (as other theorists have held) were to combine lines and lights and colours with ingenious novelty of invention and effect, he would be, not an artist, but an inventor; if music consisted in similar combinations of notes, the paradox of Leibniz and Father Kircher would come true, and a man could write music without being a musician; or alternatively we should have to fear (as Proudhon did for poetry and John Stuart Mill for music) that the possible combinations of words or notes would one day be exhausted, and poetry or music would disappear. As in poetry, so in these other arts, it is notorious that foreign elements sometimes intrude themselves; foreign either *a parte*

objecti or *a parte subjecti*, foreign either in fact or from the point of view of an inartistic spectator or listener. Thus the critics of these arts advise the artist to exclude, or at least not to rely upon, what they call the "literary" elements in painting, sculpture and music, just as the critic of poetry advises the writer to look for "poetry" and not be led astray by mere literature. The reader who understands poetry goes straight to this poetic heart and feels its beat upon his own; where this beat is silent, he denies that poetry is present, whatever and however many other things may take its place, united in the work, and however valuable they may be for skill and wisdom, nobility of intellect, quickness of wit and pleasantness of effect. The reader who does not understand poetry loses his way in pursuit of these other things. He is wrong not because he admires them, but because he thinks he is admiring poetry.

Other Forms of Activity As Distinct from Art.—By defining art as lyrical or pure intuition we have implicitly distinguished it from all other forms of mental production. If such distinctions are made explicit, we obtain the following negations:

1. *Art is not philosophy*, because philosophy is the logical thinking of the universal categories of being, and art is the unreflective intuition of being. Hence, while philosophy transcends the image and goes to its own purposes, art lives in it as in a kingdom. It is said that art cannot behave in an irrational manner and cannot ignore logic; and certainly it is neither irrational nor illogical; but its own rationality, its own logic, is a quite different thing from the dialectical logic of the concept, and it was in order to indicate this peculiar and unique character that the name "logic of sense" or "aesthetic" was invented. The not uncommon assertion that art has a logical character, involves either an equivocation between conceptual logic and aesthetic logic, or a symbolic expression of the latter in terms of the former.

2. *Art is not history*, because history implies the critical distinction between reality and unreality; the reality of the fact and the reality of a fancied world: the reality of action and the reality of desire. For art, these distinctions are as yet unmade; it lives, as we have said, upon pure images. The historical existence of Helenus, Andromache and Aeneas makes no difference to the poetical quality of Virgil's poem. Here, too, an objection has been raised: namely that art is not wholly indifferent to historical criteria, because it obeys the laws of "verisimilitude"; but, here again, "verisimilitude" is only a rather clumsy metaphor for the mutual coherence of images, which without this internal coherence would fail to produce their effect as images, like Horace's *dolphinus in silvis* and *aper in fluctibus*.

3. *Art is not natural science*, because natural science is historical fact classified and so made abstract; nor is it *mathematical science*, because mathematics performs operations with abstractions and does not contemplate. The analogy sometimes drawn between mathematical and poetical creation is based on merely external and generic resemblances; and the alleged necessity of a mathematical or geometrical basis for the arts is only another metaphor, a symbolic expression of the constructive, cohesive and unifying force of the poetic mind building itself a body of images.

4. *Art is not the play of fancy*, because the play of fancy passes from image to image, in search of variety, rest or diversion, seeking to amuse itself with the likenesses of things that give pleasure or have an emotional and pathetic interest; whereas in art the fancy is so dominated by the single problem of converting chaotic feeling into clear intuition, that we recognize the propriety of ceasing to call it fancy and calling it imagination, poetic imagination or creative imagination. Fancy as such is as far removed from poetry as are the works of Mrs. Radcliffe or Dumas père.

5. *Art Is Not Feeling in Its Immediacy.*—Andromache, on seeing Aeneas, becomes *amens*, *dirigit visu in medio, labitur, longo vix tempore fatur*, and when she speaks *longos ciebat incassum fletus*; but the poet does not lose his wits or grow stiff as he gazes; he does not totter or weep or cry; he expresses himself in harmonious verses, having made these various perturbations the object of which he sings. Feelings in their immediacy are "expressed"

for if they were not, if they were not also sensible and bodily facts ("psycho-physical phenomena," as the positivists used to call them) they would not be concrete things, and so they would be nothing at all. Andromache expressed herself in the way described above. But "expression" in this sense, even when accompanied by consciousness, is a mere metaphor from "mental" or "aesthetic expression" which alone really expresses, that is, gives to feeling a theoretical form and converts it into words, song and outward shape. This distinction between contemplated feeling, or poetry, and feeling enacted or endured, is the source of the power, ascribed to art, of "liberating us from the passions" and "calming" us (the power of *catharsis*), and of the consequent condemnation, from an aesthetic point of view, of works of art, or parts of them, in which immediate feeling has a place or finds a vent. Hence, too, arises another characteristic of poetic expression—really synonymous with the last—namely its "infinity" as opposed to the "finitude" of immediate feeling or passion; or, as it is also called, the "universal" or "cosmic" character of poetry. Feeling, not crushed but contemplated by the work of poetry, is seen to diffuse itself in widening circles over all the realm of the soul, which is the realm of the universe, echoing and re-echoing endlessly: joy and sorrow, pleasure and pain, energy and lassitude, earnestness and frivolity, and so forth, are linked to each other and lead to each other through infinite shades and gradations; so that the feeling, while preserving its individual physiognomy and its original dominating motive, is not exhausted by or restricted to this original character. A comic image, if it is poetically comic, carries with it something that is not comic, as in the case of Don Quixote or Falstaff; and the image of something terrible is never, in poetry, without an atoning element of loftiness, goodness and love.

6. *Art is not instruction or oratory*: it is not circumscribed and limited by service to any practical purpose whatever, whether this be the inculcation of a particular philosophical, historical or scientific truth, or the advocacy of a particular way of feeling and the action corresponding to it. Oratory at once robs expression of its "infinity" and independence, and, by making it the means to an end, dissolves it in this end. Hence arises what Schiller called the "non-determining" character of art, as opposed to the "determining" character of oratory; and hence the justifiable suspicion of "political poetry"—political poetry being, proverbially, bad poetry.

7. As art is not to be confused with the form of practical action most akin to it, namely instruction and oratory, so *a fortiori*, it must not be confused with other forms directed to the production of certain effects, whether these consist in pleasure, enjoyment and utility, or in goodness and righteousness. We must exclude from art not only meretricious works, but also those inspired by a desire for goodness, as equally, though differently, inartistic and repugnant to lovers of poetry. Flaubert's remark that indecent books lacked *vérité*, is parallel to Voltaire's gibe that certain "poésies sacrées" were really "sacrées, car personne n'y touche."

Art in Its Relations.—The "negations" here made explicit are obviously, from another point of view, "relations"; for the various distinct forms of mental activity cannot be conceived as separate each from the rest and acting in self-supporting isolation. This is not the place to set forth a complete system of the forms or categories of the mind in their order and their dialectic; confining ourselves to art, we must be content to say that the category of art, like every other category, mutually presupposes and is presupposed by all the rest: it is conditioned by them all and conditions them all. How could the aesthetic synthesis, which is poetry, arise, were it not preceded by a state of mental commotion? *Si vis me flere, dolendum est*, and so forth. And what is this state of mind which we have called feeling, but the whole mind, with its past thoughts, volitions and actions, now thinking and desiring and suffering and rejoicing, travelling within itself? Poetry is like a ray of sunlight shining upon this darkness, lending it its own light and making visible the hidden forms of things. Hence it cannot be produced by an empty and dull mind; hence those artists who embrace the creed of pure art or art for

art's sake, and close their hearts to the troubles of life and the cares of thought, are found to be wholly unproductive, or at most rise to the imitation of others or to an impressionism devoid of concentration. Hence the basis of all poetry is human personality, and, since human personality finds its completion in morality, the basis of all poetry is the moral consciousness. Of course this does not mean that the artist must be a profound thinker or an acute critic; nor that he must be a pattern of virtue or a hero; but he must have a share in the world of thought and action which will enable him, either in his own person or by sympathy with others, to live the whole drama of human life. He may sin, lose the purity of his heart, and expose himself, as a practical agent, to blame; but he must have a keen sense of purity and impurity, righteousness and sin, good and evil. He may not be endowed with great practical courage; he may even betray signs of timidity and cowardice; but he must feel the dignity of courage. Many artistic inspirations are due, not to what the artist, as a man, is in practice, but to what he is not, and feels that he ought to be admiring and enjoying the qualities he lacks when he sees them in others. Many, perhaps the finest, pages of heroic and warlike poetry are by men who never had the nerve or the skill to handle a weapon. On the other hand, we are not maintaining that the possession of a moral personality is enough to make a poet or an artist. To be a *vir bonus* does not make a man even an orator, unless he is also *dicendi peritus*. The *sine qua non* of poetry is poetry, that form of theoretical synthesis which we have defined above; the spark of poetical genius without which all the rest is mere fuel, not burning because no fire is at hand to light it. But the figure of the pure poet, the pure artist, the votary of pure Beauty, aloof from contact with humanity, is no real figure but a caricature.

That poetry not only presupposes the other forms of human mental activity but is presupposed by them, is proved by the fact that without the poetic imagination which gives contemplative form to the workings of feeling, intuitive expression to obscure impressions, and thus becomes representations and words, whether spoken or sung or painted or otherwise uttered, logical thought could not arise. Logical thought is not language, but it never exists without language, and it uses the language which poetry has created; by means of concepts, it discerns and dominates the representations of poetry, and it could not dominate them unless they, its future subjects, had first an existence of their own. Further, without the discerning and criticizing activity of thought, action would be impossible; and if action, then good action, the moral consciousness, duty. Every man, however much he may seem to be all logical thinker, critic, scientist, or all absorbed in practical interests or devoted to duty, cherishes at the bottom of his heart his own private store of imagination and poetry; even Faust's pedantic *famulus*, Wagner, confessed that he often had his "grillenhafte Stunden." Had this element been altogether denied him, he would not have been a man, and therefore not even a thinking or acting being. This extreme case is an absurdity; but in proportion as this private store is scanty, we find a certain superficiality and aridity in thought, and a certain coldness in action.

The Science of Art, or Aesthetics, and Its Philosophical Character.—The concept of art expounded above is in a sense the ordinary concept, which appears with greater or less clarity in all statements about art, and is constantly appealed to, explicitly or implicitly, as the fixed point round which all discussions on the subject gravitate: and this, not only nowadays, but at all times, as could be shown by the collection and interpretation of things said by writers, poets, artists, laymen and even the common people. But it is desirable to dispel the illusion that this concept exists as an innate idea, and to replace this by the truth, that it operates as an *a priori* concept. Now an *a priori* concept does not exist by itself, but only in the individual products which it generates. Just as the *a priori* reality called Art, Poetry or Beauty does not exist in a transcendent region where it can be perceived and admired in itself, but only in the innumerable works of poetry, of art and of beauty which it has formed and continues to form, so the logical *a priori* concept of art exists nowhere but in the par-

ticular judgments which it has formed and continues to form, the refutations which it has effected and continues to effect, the demonstrations it makes, the theories it constructs, the problems and groups of problems, which it solves and has solved. The definitions and distinctions and negations and relations expounded above have each its own history, and have been progressively worked out in the course of centuries, and in them we now possess the fruits of this complex and unremitting toil. Aesthetic, or the science of art, has not therefore the task (attributed to it by certain scholastic conceptions) of defining art once for all and deducing from this conception its various doctrines, so as to cover the whole field of aesthetic science; it is only the perpetual systematization, always renewed and always growing, of the problems arising from time to time out of reflection upon art, and is identical with the solutions of the difficulties and the criticisms of the errors which act as stimulus and material to the unceasing progress of thought. This being so, no exposition of aesthetic (especially a summary exposition such as can alone be given here) can claim to deal exhaustively with the innumerable problems which have arisen and may arise in the course of the history of aesthetics; it can only mention and discuss the chief, and among these, by preference, those which still make themselves felt and resist solution in ordinary educated thought; adding an implied "et cetera," so that the reader may pursue the subject according to the criteria set before him, either by going again over old discussions, or by entering into those of to-day, which change and multiply and assume new shapes almost daily. Another warning must not be omitted: namely that aesthetics, though a special philosophical science, having as its principle a special and distinct category of the mind, can never, just because it is philosophical, be detached from the main body of philosophy; for its problems are concerned with the relations between art and the other mental forms, and therefore imply both difference and identity. Aesthetics is really the whole of philosophy, but with special emphasis on that side of it which concerns art. Many have demanded or imagined or desired a self-contained aesthetics, devoid of any general philosophical implications, and consistent with more than one, or with any, philosophy; but the project is impossible of execution because self-contradictory. Even those who promise to expound a naturalistic, inductive, physical, physiological or psychological aesthetics—in a word, a non-philosophical aesthetics—when they pass from promise to performance surreptitiously introduce a general positivistic, naturalistic or even materialistic philosophy. And anyone who thinks that the philosophical ideas of positivism, naturalism and materialism are false and out of date, will find it an easy matter to refute the aesthetic or pseudo-aesthetic doctrines which mutually support them and are supported by them, and will not regard their problems as problems still awaiting solution or worthy of discussion—or, at least, protracted discussion. For instance, the downfall of psychological associationism (or the substitution of mechanism for *a priori* synthesis) implies the downfall not only of logical associationism but of aesthetics also, with its association of "content" and "form," or of two "representations," which (unlike Campanella's *tactus intrinsecus*, effected *cum magna suavitare*) was a *contactus extrinsecus* whose terms were no sooner united than they *discedebant*. The collapse of biological and evolutionary explanations of logical and ethical values implies the same collapse in the case of aesthetic value. The proved inability of empirical methods to yield knowledge of reality, which in fact they can only classify and reduce to types, involves the impossibility of an aesthetics arrived at by collecting aesthetic facts in classes and discovering their laws by induction.

Intuition and Expression.—One of the first problems to arise, when the work of art is defined as "lyrical image," concerns the relation of "intuition" to "expression" and the manner of the transition from the one to the other. At bottom this is the same problem which arises in other parts of philosophy: the problem of inner and outer, of mind and matter, of soul and body, and, in ethics, of intention and will, will and action, and so forth. Thus stated, the problem is insoluble; for once we have divided the inner from the outer, body from mind, will from

action, or intuition from expression, there is no way of passing from one to the other or of reuniting them, unless we appeal for their reunion to a third term, variously represented as God or the Unknowable. Dualism leads necessarily either to transcendence or to agnosticism. But when a problem is found to be insoluble in the terms in which it is stated the only course open is to criticize these terms themselves, to inquire how they have been arrived at, and whether their genesis was logically sound. In this case, such inquiry leads to the conclusion that the terms depend not upon a philosophical principle, but upon an empirical and naturalistic classification, which has created two groups of facts called internal and external respectively (as if internal facts were not also external, and as if an external fact could exist without being also internal), or souls and bodies, or images and expressions; and everyone knows that it is hopeless to try to find a dialectical unity between terms that have been distinguished not philosophically or formally but only empirically and materially. The soul is only a soul in so far as it is a body; the will is only a will in so far as it moves arms and legs, or is action; intuition is only intuition in so far as it is, in that very act, expression. An image that does not express, that is not speech, song, drawing, painting, sculpture or architecture—speech at least murmured to oneself, song at least echoing within one's own breast, line and colour seen in imagination and colouring with its own tint the whole soul and organism—is an image that does not exist. We may assert its existence, but we cannot support our assertion; for the only thing we could adduce in support of it would be the fact that the image was embodied or expressed. This profound philosophical doctrine, the *identity of intuition and expression* is, moreover, a principle of ordinary common sense, which laughs at people who claim to have thoughts they cannot express or to have imagined a great picture which they cannot paint. *Rem tene, verba sequuntur*; if there are no *verba*, there is no *res*. This identity, which applies to every sphere of the mind, has in the sphere of art a clearness and self-evidence lacking, perhaps, elsewhere. In the creation of a work of poetry, we are present, as it were, at the mystery of the creation of the world; hence the value of the contribution made by aesthetics to philosophy as a whole, or the conception of the One that is All. Aesthetics, by denying in the life of art an abstract spiritualism and the resulting dualism, prepares the way and leads the mind towards idealism or absolute spiritualism.

Expression and Communication.—Objections to the identity of intuition and expression generally arise from psychological illusions which lead us to believe that we possess at any given moment a profusion of concrete and lively images, when in fact we only possess signs and names for them; or else from faulty analysis of cases like that of the artist who is believed to express mere fragments of a world of images that exists in his mind in its entirety, whereas he really has in his mind only these fragments, together with—not the supposed complete world, but at most an aspiration or obscure working towards it, towards a greater and richer image which may take shape or may not. But these objections also arise from a confusion between *expression* and *communication*, the latter being really distinct from the image and its expression. Communication is the fixation of the intuition-expression upon an object metaphorically called material or physical; in reality, even here we are concerned not with material or physical things but with a mental process. The proof that the so-called physical object is unreal, and its resolution into terms of mind, is primarily of interest for our general philosophical conceptions, and only indirectly for the elucidation of aesthetic questions; hence for brevity's sake we may let the metaphor or symbol stand and speak of matter or nature. It is clear that the poem is complete as soon as the poet has expressed it in words which he repeats to himself. When he comes to repeat them aloud, for others to hear, or looks for someone to learn them by heart and repeat them to others as in a *schola cantorum*, or sets them down in writing or in printing, he has entered upon a new stage, not aesthetic but practical, whose social and cultural importance need not, of course, be insisted upon. So with the painter; he paints on his panel or canvas, but

he could not paint unless at every stage in his work, from the original blur or sketch to the finishing touches, the intuited image, the line and colour painted in his imagination, preceded the brush-stroke. Indeed, when the brush-stroke outruns the image, it is cancelled and replaced by the artist's correction of his own work. The exact line that divides expression from communication is difficult to draw in the concrete case, for in the concrete case the two processes generally alternate rapidly and appear to mingle, but it is clear in idea, and it must be firmly grasped. Through overlooking it, or blurring it through insufficient attention, arise the confusions between *art* and *technique*. Technique is not an intrinsic element of art but has to do precisely with the concept of communication. In general it is a cognition or complex of cognitions disposed and directed to the furtherance of practical action; and, in the case of art, of the practical action which makes objects and instruments for the recording and communicating of works of art; e.g., cognitions concerning the preparation of panels, canvases or walls to be painted, pigments, varnishes, ways of obtaining good pronunciation and declamation and so forth. Technical treatises are not aesthetic treatises, nor yet parts or chapters of them. Provided, that is, that the ideas are rigorously conceived and the words used accurately in relation to them it would not be worth while to pick a quarrel over the use of the word "technique" as a synonym for the artistic work itself, regarded as "inner technique" or the formation of intuition-expressions. The confusion between art and technique is especially beloved by impotent artists, who hope to obtain from practical things and practical devices and inventions the help which their strength does not enable them to give themselves.

Artistic Objects: the Theory of the Special Arts, and the Beauty of Nature.—The work of communicating and conserving artistic images, with the help of technique, produces the material objects metaphorically called "*artistic objects*" or "*works of art*": pictures, sculptures and buildings, and, in a more complicated manner, literary and musical writings, and, in our own times, gramophones and records which make it possible to reproduce voices and sounds. But neither these voices and sounds nor the symbols of writing, sculpture and architecture, are works of art; works of art exist only in the minds that create or recreate them. To remove the appearance of paradox from the truth that beautiful objects, beautiful things, do not exist, it may be opportune to recall the analogous case of economic science, which knows perfectly well that in the sphere of economics there are no naturally or physically *useful* things, but only demand and labour, from which physical things acquire, metaphorically, this epithet. A student of economics who wished to deduce the economic value of things from their physical qualities would be perpetrating a gross *ignoratio elenchi*.

Yet this same *ignoratio elenchi* has been, and still is, committed in aesthetic, by the theory of special *arts*, and the limits or peculiar aesthetic character of each. The divisions between the arts are merely technical or physical, according as the artistic objects consist of physical sounds, notes, coloured objects, carved or modelled objects, or constructed objects having no apparent correspondence with natural bodies (poetry, music, painting, sculpture, architecture, etc.). To ask what is the artistic character of each of these arts, what it can and cannot do, what kinds of images can be expressed in sounds, what in notes, what in colours, what in lines, and so forth, is like asking in economics what things are entitled by their physical qualities to have a value and what are not, and what relative values they are entitled to have; whereas it is clear that physical qualities do not enter into the question, and anything may be desired or demanded or valued more than another, or more than anything else at all, according to circumstances and needs. Even Lessing found himself slipping down the slope leading to this truth, and was forced to such strange conclusions as that actions belonged to poetry and bodies to sculpture; even Richard Wagner attempted to find a place in the list for a comprehensive art, namely Opera, including in itself by a process of aggregation the powers of all the arts. A reader with any artistic sense finds in a single solitary line from a poet at once musical and picturesque qualities, sculptural strength and

architectural structure; and the same with a picture, which is never a mere thing of the eyes but an affair of the whole soul, and exists in the soul not only as colour but as sound and speech. But when we try to grasp these musical or picturesque or other qualities, they elude us and turn into each other, and melt into a unity, however we may be accustomed to distinguish them by different names; a practical proof that art is one and cannot be divided into arts. One, and infinitely varied; not according to the technical conceptions of the several arts, but according to the infinite variety of artistic personalities and their states of mind.

With this relation (and confusion) between artistic creations and instruments of communication or *objets d'art* must be connected the problem of *natural beauty*. We shall not discuss the question, raised by certain aestheticians, whether there are in nature other poets, other artistic beings, beside man; a question which ought to be answered in the affirmative not only out of respect for the song-birds, but, still more, out of respect for the idealistic conception of the world as life and spirituality throughout; even if (as the fairy-tale goes) we have lost the magic herb which when we put it in our mouth, gives us the power of understanding the language of animals and plants. The phrase *natural beauty* properly refers to persons, things and places whose effect is comparable to that of poetry, painting, sculpture and the other arts. There is no difficulty in allowing the existence of such "*natural objets d'art*," for the process of poetic communication may take place by means of objects naturally given as well as by means of objects artificially produced. The lover's imagination creates a woman beautiful to him, and personifies her in Laura; the pilgrim's imagination creates the charming or sublime landscape, and embodies it in the scene of a lake or a mountain; and these creations of theirs are sometimes shared by more or less wide social circles, thus becoming the "*professional beauties*" admired by everyone and the famous "*views*" before which all experience a more or less sincere rapture. No doubt, these creations are mortal; ridicule sometimes kills them, satiety may bring neglect, fashion may replace them by others; and—unlike works of art—they do not admit of authentic interpretation. The bay of Naples, seen from the height of one of the most beautiful Neapolitan villas, was after some time described by the Russian lady who owned the villa as *une cuvette bleue*, whose blue encircled by green so wearied her that she sold the villa. But even the *cuvette bleue* was a legitimate poetical creation.

Literary Kinds and Aesthetic Categories.—Effects at once greater and more detrimental upon the criticism and historical study of art and literature have been produced by a theory of similar but slightly different origin, the theory of *literary and artistic kinds*. This, like the foregoing, is based on a classification in itself justifiable and useful. The foregoing is based on a technical or physical classification of artistic objects; this is based on a classification according to the feelings which form their content or motive, into *tragic, comic, lyrical, heroic, erotic, idyllic, romantic* and so on, with divisions and subdivisions. It is useful in practice to distribute an artist's works, for purposes of publication, into these classes, putting lyrics in one volume, dramas in another, poems in a third and romances in a fourth; and it is convenient, in fact, indispensable, to refer to works and groups of works by these names in speaking and writing of them. But here again we must deny and pronounce illegitimate the transition from these classificatory concepts to the poetic laws of composition and aesthetic criteria of judgment, as when people try to decide that a tragedy must have a subject of a certain kind, characters of a certain kind, a plot of a certain kind and a certain length; and, when confronted by a work, instead of looking for and appraising its own poetry, ask whether it is a tragedy or a poem, and whether it obeys the "laws" of one or other "kind." The literary criticism of the 19th century owed its great progress largely to its abandonment of the criteria of kinds, in which the criticism of the Renaissance and the French classicists had always been entangled, as may be seen from the discussions arising out of the poems of Dante, Ariosto and Tasso, Guarini's *Pastor fido*, Corneille's *Cid*, and Lope de Vega's *comedias*. Artists have profited by this liberation less than critics; for anyone with

artistic genius bursts the fetters of such servitude, or even makes them the instruments of his power; and the artist with little or no genius turns his very freedom into a new slavery.

It has been thought that the divisions of kinds could be saved by giving them a philosophical significance; or at any rate one such division, that of lyric, epic and dramatic, regarded as the three moments of a process of objectification passing from the lyric, the outpouring of the ego, to the epic, in which the ego detaches its feeling from itself by narrating it, and thence to the drama, in which it allows this feeling to create of itself its own mouthpieces, the *dramatis personae*. But the lyric is not a pouring-forth; it is not a cry or a lament; it is an objectification in which the ego sees itself on the stage, narrates itself, and dramatizes itself; and this lyrical spirit forms the poetry both of epic and of drama, which are therefore distinguished from the lyric only by external signs. A work which is altogether poetry, like *Macbeth* or *Antony and Cleopatra*, is substantially a lyric in which the various tones and successive verses are represented by characters and scenes.

In the old aesthetics, and even to-day in those which perpetuate the type, an important place is given to the so-called categories of beauty: the *sublime*, the *tragic*, the *comic*, the *graceful*, the *humorous* and so forth, which German philosophers not only claimed to treat as philosophical concepts, whereas they are really mere psychological and empirical concepts, but developed by means of that dialectic which belongs only to pure or speculative concepts, philosophical categories. Thus they arranged them in an imaginary progress culminating now in the Beautiful, now in the Tragic, now in the Humorous. Taking these concepts at their face value, we may observe their substantial correspondence with the concepts of the literary and artistic kinds; and this is the source from which, as excerpts from manuals of literature, they have found their way into philosophy. As psychological and empirical concepts, they do not belong to aesthetics; and as a whole, in their common quality, they refer merely to the world of feelings, empirically grouped and classified, which forms the permanent matter of artistic intuition.

Rhetoric, Grammar and Philosophy of Language.—Every error has in it an element of truth, and arises from an arbitrary combination of things which in themselves are legitimate. This principle may be confirmed by an examination of other erroneous doctrines which have been prominent in the past and are still to a less degree prominent to-day. It is perfectly legitimate, in teaching people to write, to make use of distinctions like that between simple style, ornate style and metaphorical style and its forms, and to point out that here the pupil ought to express himself literally and there metaphorically, or that here the metaphor used is incoherent or drawn out to excessive length, and that here the figure of "preterition," there "hypotyposis" or "irony," would have been suitable. But when people lose sight of the merely practical and didactic origin of these distinctions and construct a philosophical theory of form as divisible into simple form and ornate form, logical form and affective form, and so forth, they are introducing elements of rhetoric into aesthetics and vitiating the true concept of expression. For expression is never logical, but always affective, that is, lyrical and imaginative; and hence it is never metaphorical but always "proper"; it is never simple in the sense of lacking elaboration, or ornate in the sense of being loaded with extraneous elements; it is always adorned with itself, *simplex munditiis*. Even logical thought or science, so far as it is expressed, becomes feeling and imagination, which is why a philosophical or historical or scientific book can be not only true but beautiful, and must always be judged not only logically but also aesthetically. Thus we sometimes say that a book is a failure as theory, or criticism, or historical truth, but a success as a work of art, in view of the feeling animating it and expressed in it. As for the element of truth which is obscurely at work in this distinction between logical form and metaphorical form, dialectic and rhetoric, we may detect in it the need of a science of aesthetics side by side with that of logic; but it was a mistake to try to distinguish the two sciences within the sphere of expression which belongs to one of them alone.

Another element in education, namely the teaching of languages, has no less legitimately, ever since ancient times, classified expressions into periods, propositions and words, and words into various species, and each species according to the variations and combinations of roots and suffixes, syllables and letters; and hence have arisen alphabets, grammars and vocabularies, just as in another way for poetry has arisen a science of prosody, and for music and the figurative and architectural arts there have arisen musical and pictorial grammars and so forth. But here, too, the ancients did not succeed in avoiding an illegitimate transition *ab intellectu ad rem*, from abstractions to reality, from the empirical to the philosophical, such as we have already observed elsewhere; and this involved thinking of speech as an aggregation of words, and words as aggregations of syllables or of roots and suffixes; whereas the *prius* is speech itself, a continuum, resembling an organism, and words and syllables and roots are a *posterius*, an anatomical preparation, the product of the abstracting intellect, not the original or real fact. If grammar, like rhetoric in the case above considered, is transplanted into aesthetic, the result is a distinction between expression and the means of expression, which is a mere reduplication; for the means of expression are just expression itself, broken into pieces by grammarians. This error, combined with the error of distinguishing between simple and ornate form, has prevented people from seeing that the philosophy of language is not a philosophical grammar, but is wholly devoid of grammatical elements. It does not raise grammatical classifications to a philosophical level; it ignores them, and when they get in its way, destroys them. The philosophy of language, in a word, is identical with the philosophy of poetry and art, the science of intuition-expression, aesthetics; which embraces language in its whole extension, passing beyond the limits of phonetic and syllabic language, and in its unpaired reality as living and completely significant expression.

Classical and Romantic.—The problems reviewed above belong to the past—a past extending through centuries—rather than to the present; of their mis-stated questions and misconceived solutions there now remain mere relics and superstitions which affect academic treatises more than they do the consciousness and culture of ordinary people. But it is necessary to watch carefully for new shoots from the old stock, which still appear from time to time, in order to cut them down. Such is, in our own time, the theory of styles applied to the history of art (Wölfflin and others) and extended to the history of poetry (Strick and others), a new irruption of rhetorical abstractions into the judgment and history of works of art. But the chief problem of our time, to be overcome by aesthetics, is connected with the crisis in art and in judgments upon art produced by the romantic period. Not that this crisis was not foreshadowed by precedents and parallels in earlier history, like Alexandrian art and that of the late Roman period, and in modern times the Baroque art and poetry which followed upon that of the Renaissance. The crisis of the romantic period, together with sources and characteristics peculiar to itself, had a magnitude all of its own. It asserted an antithesis between *naïve* and *sentimental* poetry, *classical* and *romantic* art, and thus denied the unity of art and asserted a duality of two fundamentally different arts, of which it took the side of the second, as that appropriate to the modern age, by upholding the primary importance in art of feeling, passion and fancy. In part this was a justifiable reaction against the rationalistic literature of classicism in the French manner, now satirical, now frivolous, weak in feeling and imagination and deficient in a deep poetic sense; but in part, *romanticism* was a rebellion not against *classicism* but against the classical as such: against the idea of the serenity and infinity of the artistic image, against catharsis and in favour of a turbid emotionalism that could not and would not undergo purification. This was very well understood by Goethe, the poet both of passion and of serenity, and therefore, because he was a poet, a classical poet; who opposed romantic poetry as "hospital poetry." Later, it was thought that the disease had run its course and that romanticism was a thing of the past; but though some of its contents and some of its forms were dead, its soul was not: its soul consisting in this tendency on the part of art towards

an immediate expression of passions and impressions. Hence it changed its name but went on living and working. It called itself "realism," "verism," "symbolism," "artistic style," "impressionism," "sensualism," "imagism," "decadentism," and nowadays, in its extreme forms, "expressionism" and "futurism." The very conception of art is attacked by these doctrines, which tend to replace it by the conception of one or other kind of non-art; and the statement that they are fighting against art is confirmed by the hatred of the extremists of this movement for museums and libraries and all the art of the past—that is, for the idea of art which on the whole corresponds with art as it has been historically realized. The connection of this movement, in its latest modern form, with industrialism and the psychology produced and fostered by industrialism is obvious. What art is contrasted with is practical life as lived to-day; and art, for this movement, is not the expression of life and hence the transcending of life in the contemplation of the infinite and universal, but the cries and gesticulations and broken colours of life itself. The real poets and artists, on the other hand, rare at any time, naturally continue, nowadays as always, to work according to the old and only idea of what art is, expressing their feelings in harmonious forms; and the real connoisseurs (rarer, these also, than people think) continue to judge their work according to this same idea. In spite of this, the tendency to destroy the idea of art is a characteristic of our age; and this tendency is based on the *proton pseudos* which confuses mental or aesthetic expression with natural or practical expression—the expression which passes confusedly from sensation to sensation and is a mere effect of sensation, with the expression which art elaborates, as it builds, draws, colours or models, and which is its beautiful creation. The problem for aesthetics to-day is the reassertion and defence of the classical as against romanticism: the synthetic, formal theoretical element which is the *proprium* of art, as against the affective element which it is the business of art to resolve into itself, but which to-day has turned against it and threatens to displace it. Against the inexhaustible fertility of creative mind, the gates of hell shall not prevail; but the hostility which endeavours to make them prevail is disturbing, even if only in an incidental manner, the artistic taste, the artistic life and consequently the intellectual and moral life of to-day.

The Criticism and History of Art and Literature.—Another group of questions raised in works on aesthetics, though not unsuitable to such works, properly belongs to logic and the theory of historical thought. These concern the aesthetic judgment and the history of poetry and the arts. By showing that the aesthetic activity (or art) is one of the forms of mind, a value, a category, or whatever we choose to call it, and not (as philosophers of various schools have thought) an empirical concept referable to certain orders of utilitarian or mixed facts, by establishing the *autonomy of aesthetic value*, aesthetics has also shown that it is the predicate of a special judgment, the *aesthetic judgment*, and the subject-matter of history, of a special history, the history of poetry and the arts, *artistic and literary history*.

The questions that have been raised concerning the aesthetic judgment and artistic and literary history are making allowance for the peculiar character of art, identical with the methodological questions that arise in every field of historical study. It has been asked whether the aesthetic judgment is *absolute* or *relative*; but every historical judgment (and the aesthetic judgment affirming the reality and quality of aesthetic facts is an historical judgment) is always both absolute and relative at once: absolute, in so far as the category involved in the construction possesses universal truth; relative, in so far as the object constructed by that category is historically conditioned: hence in the historical judgment the category is individualized and the individual becomes absolute. Those who in the past have denied the absoluteness of the aesthetic judgment (sensationalistic, hedonistic or utilitarian aestheticians) denied in effect the quality, reality and autonomy of art. It has been asked whether a knowledge of the history of the time—the whole history of the time in question—is necessary for the aesthetic judgment of the art of that time; it certainly is, because, as we know, poetic creation presupposes

all the rest of the mind which it is converting into lyrical imagery, and the one aesthetic creation presupposes all the other creations (passions, feelings, customs, etc.) of the given historical moment. Hence may be seen the error both of those who advocate a merely historical judgment upon art (historical critics) and of those who advocate a merely aesthetic (aesthetic critics). The former would find in art all the rest of history (social conditions, biography of the artist, etc.), but would omit that part which is proper to art; the latter would judge the work of art in abstraction from history, depriving it of its real meaning and giving it an imaginary meaning or testing it by arbitrary standards. Lastly, there has appeared a kind of scepticism or pessimism as to the possibility of understanding the art of the past; a scepticism or pessimism which in that case ought to extend to every part of history (history of thought, politics, religion and morality), and refutes itself by a *reductio ad absurdum*, since what we call contemporary art and history really belong to the past as much as those of more distant ages, and must, like them, be re-created in the present, in the mind that feels them and the intellect that understands them. There are artistic works and periods that remain to us unintelligible; but this only means that we are not now in a position to enter again into their life and to understand them, and the same is true of the ideas and customs and actions of many peoples and ages. Humanity, like the individual, remembers some things and forgets many others; but it may yet, in the course of its mental development, reach a point where its memory of them revives.

A final question concerns the form proper to artistic and literary history, which, in the form that arose in the romantic period, and still prevails to-day, expounds the history of works of art as a function of the concepts and social needs of its various periods, regarding them as aesthetic expressions of these things and connecting them closely with civil history. This tends to obscure and almost to render invisible the peculiar character of the individual work of art, the character which makes it impossible to confuse one work of art with any other, and results in treating them as documents of social life. In practice no doubt this method is tempered by what may be called the "individualizing" method, which emphasizes the individual character of the works; but the mixture has the defects of all eclecticism. To escape this, there is nothing to do but consistently to develop individualizing history, and to treat works of art not in relation to social history but as each a world in itself, into which from time to time the whole of history is concentrated, transfigured and imaginatively transcended in the individuality of the poetic work, which is a creation, not a reflection, a monument, not a document. Dante is not simply a document of the middle ages, nor Shakespeare of the English Renaissance; as such, they have many equals or superiors among bad poets and non-poets. It has been objected that this method imposed on artistic and literary history the form of a series of disconnected essays or monographs; but, obviously, the connection is provided by human history as a whole, of which the personalities of poets constitute a part, and a somewhat conspicuous part (Shakespearian poetry is an event no less important than the Reformation or the French Revolution), and, precisely because they are a part of it, they ought not to be submerged and lost in it, that is, in its other parts, but ought to retain their proper proportions and their original character.

History of Aesthetics.—From the character of aesthetics as a philosophical science (see above) it follows that its history cannot be separated from that of philosophy at large, from which aesthetics receives light and guidance, and gives back light and guidance in its turn. The so-called subjectivist tendency which modern philosophy acquired with Descartes, for instance, by promoting enquiry into the creative power of the mind, indirectly promoted enquiry into the aesthetic power; and conversely, as an example of the influence of aesthetic on the rest of philosophy, it is enough to recall the effect which the mature consciousness of creative imagination and poetic logic had in liberating philosophical logic from the traditional intellectualism and formalism, and raising it to the level of speculative or dialectical logic in

the philosophies of Schelling and Hegel. But if the history of aesthetics must be seen as a part of the entire history of philosophy, it must on the other hand be enlarged beyond its boundaries as ordinarily defined, which would restrict it almost entirely to the series of works by so-called professional philosophers and of the academic treatises known as "systems of philosophy." Genuine and original philosophical thought is often to be found, alive and energetic in books not written by professional philosophers and not outwardly systematic; ethical thought, in works of asceticism and religion; political, in the works of historians; aesthetic, in those of art-critics, and so forth. Further, it must be remembered that, strictly speaking, the subject-matter of the history of aesthetics is not the problem, the single problem, of the definition of art, a problem exhausted when that definition has been or shall have been attained; but the innumerable problems which are perpetually springing up in connection with art, in which this one problem, the problem of defining art, acquires particularity and concreteness, and in which alone it truly exists. Subject to these warnings, which must be carefully borne in mind, a general sketch of the history of aesthetics may be given, to provide a preliminary orientation, without running the risk of being understood in an unduly rigid and simplification manner.

A sketch of this kind must accept, not merely as convenient for purposes of exposition but as historically true, the common statement that aesthetics is a modern science. Graeco-Roman antiquity did not speculate about art, or speculated very little; its chief concern was to create a method of artistic instruction, not a "philosophy" but an "empirical science" of art. Such are the ancient treatises on "grammar," "rhetoric," "institutions of oratory," "architecture," "music," "painting" and "sculpture"; the basis of all later methods of instruction, even those of to-day, in which the old principles are restated and interpreted *cum grano salis*, but not abandoned, because in practice they are indispensable. The philosophy of art did not find favourable or stimulating conditions in ancient philosophy, which was primarily "physics" and "metaphysics," and only secondarily and intermittently "psychology" or more precisely "philosophy of mind." To the philosophical problems of aesthetics it only referred in passing, either negatively, in Plato's denial of the value of poetry, or, positively, in Aristotle's defence, which attempted to secure for poetry a realm of its own between that of history and that of philosophy, or again in the speculations of Plotinus, who for the first time united the previously disconnected concepts of "art" and "the beautiful." Other important thoughts of the ancients were that to poetry belonged "tales" (*μύθοι*) and not "arguments" (*λόγοι*), and that "semantic" (rhetorical or poetical) propositions were to be distinguished from "apophantic" (logical). Lately an almost wholly unexpected strain of ancient aesthetic thought has come to light, in the Epicurean doctrines expounded by Philodemus, in which imagination is conceived in what seems almost a romantic way. But these observations remained, for the time being, practically sterile; and the ancients' firm and sure judgment in artistic matters was never raised to the level and consistency of a theory, owing to an obstacle of a general nature—the objectivistic or naturalistic character of ancient philosophy, whose removal was only commenced, or demanded, by Christianity when it brought the problems of the soul into the focus of thought.

But even Christian philosophy, partly through its predominant transcendence, mysticism and asceticism, partly through the scholastic form which it borrowed from ancient philosophy and with which it remained content, while it raised the problems of morality in an acute form, and handled them with delicacy, did not penetrate deeply into the mental region of imagination and taste, just as it avoided the region which corresponds to it in the sphere of practice, the region of passions, interests, utility, politics and economics. Just as politics and economics were conceived moralistically, so art was subordinated to moral and religious allegory; and the germs of aesthetics scattered through the ancient writers were forgotten or only superficially remembered. The philosophy of the Renaissance, with its return to naturalism, revived, interpreted and adapted the ancient poetics

and rhetorics and treatises on the arts; but though it laboured long at "verisimilitude" and "truth," "imitation" and "the idea," "beauty" and the mystical theory of beauty and love, "catharsis" or the purgation of passion, and the problems of the literary kinds, traditional and modern, it never reached a new and fruitful principle. No thinker arose capable of doing for the Renaissance treatises on poetry and art what Machiavelli did for political science, asserting with emphasis, not merely by the way and as an admission, its original and autonomous character.

Much more important in this respect, though its importance was long overlooked by historians, was the thought of the later Renaissance, known in Italy as the *seicento*, Baroque, or the literary and artistic decadence. This was the time at which the distinction was first insisted upon between the "intellect" and a faculty called *ingegno*, *ingenium*, "wit" or "genius," as especially inventive of art; and, corresponding to this, a faculty of judgment, which was not ratiocination or logical judgment, because it judged "without discourse" or "without concepts," and came to be called "taste." These terms were reinforced by another, which appeared to denote something not determinable in logical concepts and in some way mysterious: "*nescio quid*" or "*je ne sais quoi*"; an expression particularly frequent in Italy (*non so che*), and imitated in other countries. At the same time were sung the praises of the enchantress "imagination," of the "sensible" or "sensuous" element in poetic imagery, and of the miracles of "colour," in painting, as opposed to "drawing" which seemed not altogether free from an element of cold logic. These new intellectual tendencies were somewhat turbid, but at times were purified and raised to the level of reasoned theory, e.g., Zuccolo (1623), who criticized "metric art" and replaced its criteria by the "judgment of sense," which to him meant not the eye or the ear but a higher power united to the senses; Mascardi (1636), who rejected the objective and rhetorical distinction between the styles, and reduced style to the particular individual manner arising out of the particular "wit" of each writer, thus asserting the existence of as many styles as there are writers; Pallavicino (1644), who criticized "verisimilitude" and assigned to poetry as its proper domain that of "first apprehensions" or imaginations, "neither true nor false"; and Tesauro (1654), who tried to work out a logic of rhetoric as opposed to the logic of dialectic, and extended the rhetorical forms beyond merely verbal form, to pictorial and plastic form.

Cartesianism, to which we have already referred, though, in the hands of Descartes and his successors, hostile to poetry and imagination, from another point of view, as stimulating enquiry into the subject or the mind, helped these scattered efforts (as we have said) to consolidate themselves into a system and to search for a principle to which the arts could be reduced; and here too the Italians, welcoming Descartes' method but not his rigid intellectualism or his contempt for poetry, art and imagination, wrote the first treatises on poetry in which the concept of imagination played a central or leading part (Calopreso 1691, Gravina 1692 and 1708, Muratori 1704 and others). These had considerable influence on Bodmer and the Swiss school, and, through them, on the new German criticism and aesthetics and that of Europe at large; so that a recent writer (Robertson) could speak of "the Italian origin of romantic aesthetics."

These minor theorists led to the work of G. B. Vico, who in his *Scienza nuova* (1725-1730) propounded a "poetic logic" which he distinguished from "intellectual logic"; regarded poetry as a mode of consciousness or theoretic form preceding the philosophical or reasoning form, and asserted as its sole principle the imagination, which is strong in proportion as it is free from ratiocination, its enemy and destroyer; praised as father and prince of all true poets the barbaric Homer, and with him, though impaired by theological and scholastic culture, the half-barbaric Dante; and attempted, though without success, to discern English tragedy and Shakespeare, who, though undiscovered by Vico, would, had he known him, certainly have been his third barbaric and supreme poet. But in aesthetics as elsewhere, Vico in his lifetime founded no school, because he was before his time, and also because his philosophical thought was concealed

beneath a kind of historical symbolism. "Poetic logic" only began to make progress when it reappeared in a far less profound shape, but in a more favourable environment, in the works of Baumgarten, who systematized an aesthetics of a somewhat hybrid Leibnizian origin, and gave it various names, including *ars analogi rationis*, *scientia cognitionis sensitivae*, *gnoseologia inferior*, and the name it has retained, *aesthetica* (*Meditationes*, 1735; *Aesthetica*, 1750-58).

The school of Baumgarten, or (more correctly) of Leibnitz, which both did and did not distinguish imaginative from logical form (for it regarded it as *cognitio confusa* and none the less ascribed to it a *perfectio* of its own), and the current of English aesthetics (Shaftesbury, Hutcheson, Hume, Home, Gerard, Burke, Alison, etc.), together with the essays on beauty and art which abounded at this time, and the theoretical and historical works of Lessing and Winckelmann, contributed to provide the stimulus, partly positive and partly negative, to the formation of the other masterpiece of 18th century aesthetics, the *Critique of Judgment* (1790) by Immanuel Kant, in which the author (after doubting it in the first *Critique*) discovered that beauty and art afford subject-matter for a special philosophical science—in other words, discovered the autonomy of the aesthetic activity. As against the utilitarians he showed that the beautiful pleases "without interest" (i.e., utilitarian interest); against the intellectualists, that it pleases "without concepts"; and further, against both, that it has "the form of purposiveness" without "representation of a purpose"; and, against the hedonists, that it is "the object of a universal pleasure." In substance, Kant never went further than this negative and generic assertion of the beautiful, just as, in the *Critique of Practical Reason*, once he had vindicated the moral law, he did not go beyond the generic form of duty. But the principles he had laid down were laid down once for all. After the *Critique of Judgment*, a return to hedonistic and utilitarian explanations of art and beauty could (and did) take place only through ignorance of Kant's demonstrations. Even the return to Leibnitz and Baumgarten's theory of art as confused or fanciful thinking would have been impossible, had Kant been able to link up his own theory of the beautiful, as pleasing apart from concepts, and as purposiveness without representation of purpose, with Vico's imperfect and inconsistent but powerful theory of the logic of imagination, which was to some extent represented in Germany at this time by Hamann and Herder. But Kant himself prepared the way for the reassertion of the "confused concept" when he ascribed to genius the virtue of combining intellect and fancy, and distinguished art from "pure beauty" by defining it as "adherent beauty."

This return to the tradition of Baumgarten is apparent in post-Kantian philosophy when it regards poetry and art as a form of the knowledge of the Absolute or the Idea, whether equal to philosophy, inferior and preparatory to it, or superior to it as in Schelling's philosophy (1800) where it becomes the organ of the Absolute. In the richest and most striking work of this school, the *Lectures on Aesthetic* of Hegel (1765-1831), art, with religion and philosophy, is placed in the "sphere of absolute mind," where the mind is set free from empirical knowledge and practical action, and enjoys the beatific thought of God or the Idea. It remains doubtful whether the first moment in this triad is art or religion; different expositions of his doctrine by Hegel himself differ in this respect; but it is clear that both, art and religion alike, are at once transcended and included in the final synthesis which is philosophy. This means that art, like religion, is substantially an inferior or imperfect philosophy, a philosophy expressed in imagery, a contradiction between a content and a form inadequate to it which only philosophy can resolve. Hegel, who tended to identify the system of philosophy, the dialectic of concepts, with actual history, expressed this by his famous paradox of the death of art in the modern world, as incapable of subserving the highest interests of the age.

This conception of art as philosophy, or intuitive philosophy, or a symbol of philosophy, or the like, reappears throughout the idealistic aesthetics of the first half of the 19th century, with rare exceptions, e.g., Schleiermacher's *Lectures on Aesthetic* (1825, 1832-33) which we possess in a very incomplete form. In spite of the high merit of these works, and the enthusiasm for poetry and art which they express, the reaction against this type of aesthetics was, at bottom, a reaction against the artificial character of the principle on which they were based. This reaction took place in the second half of the century, simultaneously with the general reaction against the idealistic philosophy of the great post-Kantian systems. This anti-philosophical movement certainly had its significance as a symptom of discontent and of a desire to find new paths; but it did not produce an aesthetics correcting the errors of its predecessors and carrying the problem a stage further. In part, it was a breach in the continuity of thought; in part, a hopeless attempt to solve the problems of aesthetics, which are philosophical problems, by the methods of empirical science (e.g., Fechner); in part, a revival of hedonistic and utilitarian aesthetic by a utilitarianism resting on association of ideas, evolution and a biological theory of heredity (e.g., Spencer). Nothing of real value was

added by the *epigoni* of idealism (Vischer, Schasler, Carriere, Lotze, etc.), or the followers of the other early 19th century philosophical movements, e.g., the so-called formalistic aesthetics (Zimmermann) derived from Herbart, or the eclectics and psychologists, who, like all the rest, laboured at two abstractions, "content" and "form" ("aesthetics of content" and "aesthetics of form"), and sometimes tried to fasten the two together, failing to see that by so doing they were only uniting two fictions into a third. The best thoughts on art in this period are to be found not in the professional philosophers or aestheticians but in the critics of poetry and art, e.g., De Sanctis in Italy, Baudelaire and Flaubert in France, Pater in England, Hanslick and Fiedler in Germany, Julius Lange in Holland, etc. These writers alone make amends for the aesthetic trivialities of the positivistic philosophers and the empty artificiality of the so-called idealists.

The general revival of speculative thought led to greater successes in aesthetics in the first decades of the 20th century. Especially noteworthy is the union which is taking place between aesthetics and the philosophy of language, facilitated by the difficulties under which linguistic, conceived as the naturalistic and positivistic science of the phonetic laws of language and similar abstractions, is labouring. But the most recent aesthetic productions, because they are recent and still in process of development, cannot as yet be historically placed and judged.

BIBLIOGRAPHY.—The chief monuments of aesthetic thought have already been referred to in the foregoing outline. It may be added that the latest revision of the text of Aristotle's *Poetics*, together with a commentary, is that of A. Rostagni (Turin, 1927), and that the fragments of the Epicurean aesthetic of Philodemus (polemic against Neoplatonism of Parium) have been edited by Jensen (*Philodemus über die Gedichte Fünftes Buch*, Berlin, 1923). Of Vico's second *Scienza nuova* the complete critical edition is that of F. Nicolini (Bari, 1911-16). Of Baumgarten, there is a reprint of the *Meditationes philosophicae de nonnullis ad poema pertinentibus* (1735), edited by Croce, Naples, 1900; but the *Aesthetica*, a very rare book, has unfortunately not been reprinted, though a previously unpublished course of Baumgarten's lectures on aesthetics has been published by B. Poppe (A. G. Baumgarten: Berne-Leipzig, 1907). Of Hegel's *Vorlesungen über die Aesthetik*, which we possess in Hotho's redaction (ed. 2, Berlin, 1842-43).

For the history of aesthetics, R. Zimmermann, *Geschichte der Aesthetik als philosophischer Wissenschaft* (Wien, 1858), and M. Schasler, *Kritische Geschichte der Aesthetik* (Berlin, 1872), may be consulted, though their standards of judgment are now out of date. See also B. Bosanquet, *A History of Aesthetic* (London, 1892). A history of aesthetics is contained in the second part of B. Croce's *Estetica come scienza dell'espressione e linguistica generale* (Bari, 1902; ed. 5, 1922; Eng. trans., abridged, London, 1915; 2nd ed., complete, 1922), and an essay completing and correcting this work, entitled *Inizio, periodi e caratteri della Estetica*, in the same author's *Nuovi saggi di Estetica* (ed. 2, Bari, 1926), which contains the most mature form of the writer's theoretical and historical thought on the subject. For ancient aesthetics Ed. Müller, *Geschichte der Theorie der Kunst bei den Alten* (Breslau, 1831-37), is still very useful; among recent works, E. Panofsky, *Idea* (Leipzig, 1924), and A. Rostagni, "Per un'estetica dell'intuizione presso gli antichi" (in *Atene e Roma*, a review of classical philology, Florence, 1920); *Aristotele e l'aristotelismo nella storia dell'Estetica antica* (Florence, 1921). For mediaeval aesthetics the best work is contained in books on Dante, e.g., Vossler's; cf. also Compagnot, *Virgilio nel medio evo* (ed. 2, Florence, 1896) vol. i. For Renaissance aesthetics, J. E. Spingarn, *A History of Literary Criticism in the Renaissance* (New York, 1899); K. Borinski, *Die Poetik der Renaissance und die Anfänge der literarischen Kritik in Deutschland* (Berlin, 1896). For the Italian seicento, Croce, *Storia*, cit., and essays in *Problemi di Estetica* (ed. 2, Bari, 1923) and *Storia dell'età barocca in Italia* (Bari, 1928); J. M. Robertson, *Studies in the Genesis of Romantic Theory* (London, 1923); H. Quigley, *Italy and the Rise of a New School of Criticism in the 18th Century* (Glasgow, 1921). For Vico's aesthetics, B. Croce, *La filosofia di G. B. Vico* (ed. 2, Bari, 1922; Eng. trans. London, 1913). For German 18th century aesthetics, R. Sommer, *Grundzüge einer Geschichte der deutschen Psychologie und Aesthetik von Wolf-Baumgarten bis Kant-Schiller* (Würzburg, 1892). For the origin of Kant's aesthetics, O. Schlappé, *Kants Lehre vom Genie und die Entstehung der Kritik der Urteilskraft* (Göttingen, 1901). For that of Schiller, V. Basch, *La poétique de Schiller* (ed. 2, Paris, 1911). For the Hegelian aesthetics the old but penetrating study of Th. W. Danzel, *Über die Aesthetik des hegelischen Philosophie* (Hamburg, 1844), must not be forgotten. For English aesthetics, A. E. Powell (Mrs. Dodds), *The Romantic Theory of Poetry* (London, 1926). For the *Epigoni* of idealism, E. v. Hartmann (who was one of them), *Die deutsche Aesthetik seit Kant* (Berlin, 1886). For recent aesthetics: H. Wildon Carr, *The Philosophy of B. Croce: The Problem of Art and History* (1917); E. F. Carr, *The Theory of Beauty* (ed. 2, London, 1923); R. G. Collingwood, *Outlines of a Philosophy of Art* (1925). For the history of the philosophy of language in the idealistic period (Hamann, Herder, Humboldt) cf. H. Steinthal, *Ursprung der Sprache* (ed. 4, Berlin, 1888); *Geschichte der Sprachwissenschaft bei den Griechen und Römern* (ed. 2, Berlin, 1890-1891). For recent philosophy of language as aesthetics, Croce, *opp. cit.*, and Vossler, Spitzer, Lerch, Bertoni, Bartoli, etc. (B. Cr.)

AESTHETICS, EXPERIMENTAL. Great artists throughout the centuries have contributed to an empirical aesthetic in the broad sense of the term. Some of them have given us extensive treatises based upon an analysis of their own methods of artistic production, or upon an investigation of existing works of art. Hogarth, for example, examined many forms of architecture, as well as the lines of the human figure, in a search for a norm of beauty which he thought he had found in the serpentine line, and Goethe in his *Farbenlehre* has made keen observations in regard to the aesthetics of colour. From the long list of names might also be mentioned Leonardo da Vinci, Sir Joshua Reynolds and M. E. Chevreul. G. Th. Fechner, however, is generally considered the founder of experimental aesthetics. He not only discussed the formal, or direct, and the associative factors underlying beauty on the basis of his experience of works of art, but he devised experiments in order to settle scientifically the question of the most pleasing proportions in geometrical forms and in line division. This problem had engaged the attention of a number of writers, whose results are in strong disagreement. Wolff insisted upon the proportion of 1:1, while Adolf Zeising thought the proportion of the golden section (1:1.618) to be the most pleasing, on the principle that it gives the greatest possible diversity in a harmonious unity. It was the proportion of the golden section that Fechner desired to put to experimental proof. He spread figures of different sizes, such as ellipses, before the observer, with instructions to choose the one which seemed the most pleasing, or he had the person construct a figure according to the most pleasing proportion. It was these two methods of choice and construction, together with that of use, which he proposed as the proper empirical methods of investigation, and these methods have continued to be employed up to the present day. Fechner found the golden section to hold in many instances, but he also found the proportions of 1:1 and 1:3 to be pleasing under certain circumstances. Lightner Witmer thought that Fechner used too few figures, and that the experiments were not properly controlled. He therefore used a serial order of figures with the least perceptible difference of proportion between them. He also had the figures compared in pairs. His results do not always agree with those of Fechner, but he established the importance of the golden section for rectangles, ellipses and line division. An interesting fact came to light in experiments conducted by R. P. Angier. His subjects divided a line at what seemed to them the most pleasing point. Although several persons came near the golden section, no one actually chose it. Nevertheless, the average of all observers was almost exactly the golden section. His results served as a warning not to place too much weight upon averages in the search for an aesthetic norm. In general, however, it may be said that the golden section and symmetry are pleasing, that a division very near the middle and one which makes the shorter line less than a quarter of the length of the whole line are displeasing.

Numerous experiments have been made upon form and balance, with the principal aim of obtaining a psychological explanation of the pleasing effects. T. H. Haines and A. E. Davies, from their work with a series of cards having a constant length and varying width, decided that eye-movements, associations, balance between forces of attention, and suggestion, were the factors which determined the aesthetic effect. Ethel D. Puffer made an extensive study of balance by the use, among other objects, of lines of various sizes and in various positions. She found that the best aesthetic balance generally corresponded to the mechanical balance, and explained the results in terms of interest which, in the last analysis, meant for her a balance of motor impulses. L. J. Martin asserted that our preference for lines and shapes depends very much upon our attitude toward the objects we are judging. A slanting line, when interpreted as a bad vertical, is displeasing, but when we think of it as a horizontal line which is raising itself to a vertical, it is pleasing. F. Sander believes that absence of feelings of tension produces a restful effect such as is experienced in viewing Greek architecture, while vivid tensions underlie our reactions to Romanesque and Gothic architecture.

The theory of empathy made famous by Th. Lipps has also been offered frequently as an explanation of the aesthetic feelings aroused by lines, forms and other properties of art objects. A modern psychological interpretation of this theory is that the individual imitates in terms of his own reactions the patterns suggested by the art object. These reactions are projected by the individual into the external object and are perceived not as his own but as the dynamic qualities of the object. Experiments furnish some support for this theory of empathy in that implicit or nascent muscular activity related to the stimulus-situation has been detected during the act of perception.

The empathic value of lines in expressing emotional moods has been demonstrated in experiments in which subjects have been asked to draw lines indicative of emotional states and qualities or in which they have been asked to match various types of lines with descriptive adjectives. The agreement concerning the expressiveness of lines is much greater than chance expectation. For example, moods with little motor expression such as sadness and quietness are represented in the subject's drawings by wide sweeping curves whereas moods of excitement are represented by sharp curves and acute angles. Investigations of the ability of children to approximate adult judgment in this field show that even kindergarten pupils do better than chance, that there is a positive correlation between this ability and age and that artistic children do better than non-artistic children. The early recognition of the expressive qualities of pure lines argues against an associational explanation and suggests an empathic basis in the type of bodily response occurring in a given emotional condition.

The modern trend, however, is to emphasize the relationship of the line to the form of which it is a part, or the relationship of the figure to the total pattern in which it appears. As early as 1903 Legowski concluded from his experiments on preferences for the same type of figures of varying proportions that the comprehensibility of the relationships was the cause of their pleasantness. More recently Birkhoff has studied form preference and used as a measure of aesthetic pleasure the relation between order and complexity. The elaborations of his basic formula, $M = \frac{O}{C}$ (M = aesthetic measure, O = order and C = complexity) are not as objective as their mathematical expression might suggest, but Birkhoff's results do indicate that the degree of pleasure is related to ability to resolve complex relationships into a unified pattern—a very old aesthetic doctrine.

Colour.—Goethe in his *Farbenlehre* discussed the moods aroused by colours, and the different psychological effects of different colour combinations. Chevreul studied colours from the aesthetic standpoint, and remarked that complementary colours form the most pleasing combinations, as there is a harmony in the contrast, and half a century later Bezold stated that the colours which are very nearly, but not quite, complementary form the best combinations. Towards the end of the last century, Jonas Cohn and August Kirschmann performed controlled experiments on colour in the manner advocated by Fechner. Both men found contrast to be pleasing, and Cohn's results led him to conclude that saturated colours are in most instances preferred. From about this time the number of treatises on colour preferences began to grow rapidly, and the papers have covered a large field of investigation. The effects of hue, saturation and brightness, together with such factors underlying preference as the time of exposure of the colours, suggestion and association, have been studied. A large number of treatises deal with the colour preferences of infants and school children, and the changes in colour preference which occur with age. Comparative studies have also been made of the colour preferences of the sexes and of races. The experiments were done under such widely different conditions that in many cases they are hardly comparable, and the results are so numerous and varied that they are difficult to summarize. In no instance was there any great agreement in regard to the preference either for single colours or for combinations, and often there was not even a great constancy in the choice of the individual observer. All that one can indicate are general tendencies. Red and blue seem to be the favourite colours, and orange and yellow usually rank low. It appears from the mass of information that has been collected that men have the strongest preference for blue and women for red. A typical order of preference is blue, red, purple, green, orange, yellow, which would mean that the colours at the ends of the spectrum have the best chance of being chosen as the most pleasing. Also, saturated colours have a strong attraction, but are not always preferred. As Titchener has remarked, there seem to be two types of observers, one of which prefers saturated colours, the other definitely prefers unsaturated or what are popularly called artistic colours. E. Bulough has made an analysis of the psychological attitude of persons toward colours, and has found that there are four main types of judgments: the objective, where the peculiarities of the colours such as clarity are observed; the physiological, where the aspects of warmth, hardness, etc., are noted; the associative, where the colours remind the observer of some experience; and the character judgment, where the colours are expressive of mood. It seems, then, that our preference depends very much upon our attitude. Indeed, as von Allesch has stated, the old talk of beauty and ugliness of colours has only relative meaning. All colours can be all things at the right moment and at the right place. Nevertheless, we may say that in general complementary colours seem to be pleasing in combination, and probably also those colours which are nearly complementary. On the other hand, colours which are neighbouring in the spectrum do not seem to go together. Harmony, however, can generally be obtained from the inharmonious combination of two colours by the proper selection of a third colour to form a triad.

Sound.—The most important work on the psychology of music is that of Carl Stumpf. His book *Tonpsychologie* (1890) is a classic in this field and contains, among many theories and facts of importance, his psychological theory of consonance, which is based upon an empirical study of the perception of tonal combinations. For Stumpf, degree of consonance is correlated with degree of fusion of

the two tones of a musical interval. In his subsequent writings, he has vigorously attacked the physical theory of consonance of Herman v. Helmholtz and F. E. Krüger. Stumpf has also done extensive work upon the tonal quality of vowels and consonants. One of his latest investigations in the auditory field is a comparison of singing and talking, which he finds not fundamentally different. In speaking we use for the most part a continuous change in tone, while in singing we use discrete tonal steps. H. T. Moore has shown experimentally that, up to a certain point, the pleasantness of tonal intervals grows with our experience of them, which accounts for the gradual change in our attitude toward consonance and dissonance. O. Abraham and E. M. von Hornbostel, in their analysis of tonal intervals, have discovered two factors underlying the experience, one a qualitative, the other a quantitative, which they call distance or width of interval, and accord quality, respectively. C. E. Seashore has devised a series of tests which can be given by means of phonograph records. In his latest work he describes the results obtained by photographing the vibrations of the singing voice. He has detected the presence of the vibrato, or synchronous oscillations of pitch and intensity at the rate of five to eight per second in artistic singing.

In experiments upon the appreciation of pictures the introspective method has usually been employed. O. Külpe showed pictures for three seconds each to a number of persons, and recorded their reports. He did not find evidence of empathy to support Lipps's theory. On the other hand, muscular sensations in a form which, according to Karl Groos, is called inner mimicry are present at times, but not always. A unique method of investigating the effect of pictures upon children was used by R. Schultze, who photographed the children while they were looking at the pictures. One was often able to judge from the photographs which picture the child had been looking at, as well as the mood which had been aroused.

A laboratory research in the field of literature which is suggestive, both from the point of view of method and content, is that of R. C. Givler. He showed conclusively the importance of the mere sound of words in conveying the meaning as well as the moods of poetry. Most of the investigations of the aesthetics and psychology of prose and poetry, however, have been in the nature of a direct analysis of the works themselves, or a study of the life of the artist, and do not come under experimental aesthetics in the narrow sense of that term, as used in this article. J. L. Lowes' *The Road to Xanadu* (1927) might, however, be mentioned as a model piece of research of this nature. Comparing the contents of a note-book left by Coleridge with the text of *The Rhyme of the Ancient Mariner* and *Kubla Khan*, Lowes has been able to analyse most convincingly the subconscious mind of that poet. Freud and his followers have also made numerous analyses of the subconscious minds of artists. Their results will undoubtedly be of interest to those persons who believe in the psycho-analytic method, and even the sceptic will find some suggestive material in their writings.

A promising modern development in experimental aesthetics is the genetic investigation of artistic creation and appreciation. The fundamentals of preference for form and pattern are well on their way toward assimilation by the time children enter grade school. Children between the ages of two and five years prefer balance in tri-dimensional designs to imbalance. Controlled observation confirms the popular belief in the sensitivity of young children to rhythm in music. Graphic rhythm (regular repetition in two-dimensional form) is preferred in pictorial presentation by five-year olds. Children of this age even show an appreciation of rhythm in abstract design. One study of talented children, aged five to seven years, definitely established the presence of creative artistic imagination at this age level. The pictures painted by the children were not generalized depictions of simple objects or stereotyped forms but were of a compositional character. Moreover, these talented novices showed a critical attitude toward their work characteristic of the professional. They were seldom satisfied with their first efforts and usually expressed in specific terms a critical evaluation of each stage of the production as they went along.

An interesting problem in the psychology of art is the relationship among the various fields of artistic expression (music, painting, etc.). Critics with a classical bias have affirmed the uniqueness of each of the arts, whereas artists of a less conservative bent have sometimes assumed a common basis and a common method of appeal to all the arts. An extreme example is the colour organ which attempts to use the temporal presentation of music in the visual field. The writings of Gertrude Stein and the paintings of some surrealists are likewise attempts to cut across the conventional bounds of the art fields in the belief in the unity of all psychological experience. The problem has been approached experimentally by comparing the moods aroused by painting with those aroused by music and by comparing the qualities of the various sensory modalities. J. Cowles presented 33 subjects with seven pictures as they listened to seven successive musical selections. They were asked to specify the picture which best suited each musical selection. A fairly high degree of agreement was found in the pairing of the visual and the auditory stimuli. Pictures suggestive of activity were nearly always paired with musical selections of prominent dynamic changes. That similar moods can be established in the individual through appeals to the different senses does not mean, however, that sensory qualities of the various sensory modalities have

even a rough equivalence. The eye and the ear as well as the other sense receptors give rise to distinctive qualities and even the intensive attributes of these qualities are not strictly comparable. Moreover, Karwoski and Odbert in a study of colour music have challenged the absolute nature of coloured hearing (that form of synaesthesia in which people experience a definite and a constant colour sensation when a certain tone is sounded). They found no constant relationship between tone and colour which held for all subjects and even the individual subject showed considerable variability in his visual response. The photism reported depended upon the total stimulus-situation and upon the familiarity with the musical selection as well as upon the tones themselves. Experimental psychology corroborates those critics who would keep apart the various arts in their objective techniques though not necessarily in their appeal to affective experience.

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(H. S. L.; D. KA.)

AESTIVATION, literally "summer residence," a term used in zoology for the condition of torpor into which certain animals pass during the hottest season in hot and dry countries, contrasted with the similar winter condition, hibernation. In botany the word is used of the folded arrangement of the petals in a flower before expansion in the summer, contrasted with "vernal" of leaves which unfold in the spring. See **hibernation**.

AETA, a Negrito tribe of the Philippine islands, woolly-haired, dark-skinned, dwarfish (the male stature is about 4ft. gin.) inhabiting the mountainous districts of the larger islands and some of the smaller. They are characterized by a large and clumsy foot with abnormally divergent great toe. The social unit is the family; polygamy is permitted, but monogamy prevails. The dead are normally buried, but the bodies of those whom it is wished to honour are exposed on platforms or in trees. Bows and poisoned arrows are used, long spears and darts barbed with flint or shell. Fire is made by means of a flexible thong pulled to and fro in a notch in a cleft stick. They pray to a great serpent to show them yams and honey.

The Aeta were long recognized as the owners of the soil in spite of the arrival of Malayan settlers, and in Luzon they levied taxes upon the Tagalog and other tribes (until these arrived in such numbers as to push them back into the hills) taking the heads of defaulters. For much longer, perhaps even yet, they kept a debit and credit account of heads with the Igorots and other neighbours.

See Reed, *Negritos of Zambales*, Ethnol. Survey of the Philippines, II. (1904); Worcester, *Non-Christian tribes of N. Luzon*, Philippine Jnl. of Science, I. (1906); A. L. Kroeber, *Peoples of the Philippines*, American Museum of Natural History (1919).

(J. H. H.)

AETHELBALD, king of Mercia, succeeded Ceolred, A.D. 716, at the beginning of the period of Mercian supremacy. His activities as a warrior were slight; in 733 he raided Somerset as far as Somerton, and led unimportant campaigns against the Northumbrians and the Welsh. In 752 Cuthred of Wessex led a successful raid into Oxfordshire against him. Aethelbald encouraged the development of the church, making large grants of land, and publishing a decree in 749 which freed ecclesiastical lands from all obligations to the king except the *trinoda necessitas*.

See Bede, *Hist. Ecc.* (ed. Plummer), v. 23 and *Continuatio s.a.* 740, 750, 757; *Saxon Chronicle* (Earle and Plummer), s.a. 716, 733, 737,

740, 741, 743, 755; Mabillon, *Acta Sanctorum*, ii. pp. 264, 275–276, 279, 283–284; P. Jaffé, *Monumenta Moguntiana*, iii. pp. 168–177; W. de G. Birch, *Cartul. Saxon.*, 178 (1885–93).

AETHELBALD, king of Wessex, was the son of Aethelwulf, with whom he led the West Saxons to victory against the Danes at Aclea, 851. According to Asser he rebelled against his father on the latter's return from Rome in 856, and deprived him of Wessex, which he ruled until his death in 860. On his father's death in 858 he married his widow, Judith.

See Asser, *Life of Alfred* (W. H. Stevenson, 1904), 12; *Saxon Chronicle*, s.a. 851, 855, 860.

AETHELBERT, king of Kent, son of Eormenric, came to the throne in A.D. 560. Aethelbert's supremacy, described by Bede as extending in 597 to the Humber, can have been little more than nominal, though he exercised stricter sway over Essex, where his nephew, Sabert, was king. An attempt to extend his kingdom westwards was defeated in 568 by Ceawlin at Wibbandune. Aethelbert's reign is chiefly remarkable for the introduction of Christianity. He married a Christian princess, Berta, daughter of Charibert, king of Paris, who brought over a bishop as private confessor. When in 597 Augustine landed in Thanet, the king treated his mission tolerantly, gave him a dwelling in Canterbury and allowed monks to preach there, afterwards being baptized himself, but making no attempt to force conversion on his subjects. In 604 he founded the see of Rochester, and his influence established Mellitus at London in the same year. He published a code of laws, the first of its kind, containing a list of money fines for various offences against the clergy.

BIBLIOGRAPHY.—See Stubbs, *Dict. of Christian Biog. Ethelbert*; Bede, *Hist. Ecc.* (Plummer i. 25, 26, ii. 3, 5); *Saxon Chronicle* (Earle and Plummer), s.a. 568.

AETHELBERT, king of the West Saxons, succeeded to the under-kingdom of Kent during the lifetime of his father, Aethelwulf, and retained it until the death of his elder brother, Aethelbald, in 860, when he became sole king of Wessex and Kent till his death in 865. His reign was marked by two serious attacks by the Danes, who were repelled in 860 by the levies of Hampshire and Berkshire, though not before they had sacked Winchester, while in 865 they ravaged Kent after agreeing to take money for peace. Aethelbert was buried at Sherborne.

BIBLIOGRAPHY.—See the *Saxon Chronicle* (Earle and Plummer), s.a. 860, 865; *King Alfred's Will*; W. de G. Birch, *Cartul. Saxon.*, 553.

AETHELFLAED or **ETHELFLEDA**, the "Lady of the Mercians," the eldest child of Alfred the Great, was married about 886 to Aethelred, earl of Mercia, to whom Alfred entrusted the control of Mercia. On the accession of her brother Edward, Aethelflaed and her husband continued to hold Mercia. In 907 they fortified Chester, and in 909 and 910 either Aethelflaed or her husband must have led the Mercian host at the battles of Tettenhall and Wednesfield (or Tettenhall-Wednesfield, if these battles are one and the same). It was probably about this time that Aethelred fell ill, and the Norwegians and Danes from Ireland unsuccessfully besieged Chester. Aethelflaed won the support of the Danes against the Norwegians, and seems also to have entered into an alliance with the Scots and the Welsh against the pagans.

In 911 Aethelred died, and Edward took over Middlesex and Oxfordshire. Except for this, Aethelflaed's authority remained unimpaired. In 912 she fortified "Scergeat" and Bridgnorth, Tamworth and Stafford in 913, Eddisbury and Warwick in 914, Cherbury, "Weardbyrig" and Runcorn in 915. In 916 she sent an expedition against the Welsh, which advanced as far as Brecknock. In 917 Derby was captured from the Danes, and the next year Leicester and York both submitted to her. She died in 918 at Tamworth (June 12), and was buried in St. Peter's Church at Gloucester. This noble queen, whose career was as distinguished as that of her father and brother, left one daughter, Aelfwyn. For some 18 months Aelfwyn seems to have wielded her mother's authority, and then, just before the Christmas of 919, Edward took Mercia into his own hands, and Aelfwyn was "led away" into Wessex. Aethelflaed and her husband wielded almost kingly authority; the royal title is often given them by the chroniclers.

See *The Saxon Chronicle*, s.a. (especially the Mercian register in MSS. B, C and D); Florence of Worcester; *Fragments of Irish Annals* (ed. O'Connor), pp. 227–237; D.N.B., s.v. (A. M.)

AETHELFRITH, king of Northumbria, is said to have come to the throne in A.D. 593, being the son of Aethelric (probably reigned 568–72). He married Acha, daughter of Ella (Aelle), king of Deira, whom he succeeded, probably in 605, expelling his son Edwin. In 603 he repelled the attack of Aidan, king of the Dalriad Scots, at Daegsastan, defeating him with great loss. Later in his reign, probably in 614, he defeated the Welsh in a great battle at Chester, and massacred the monks at Bangor who were assembled to aid them by their prayers. This war had a strategic importance in the separation of the North Welsh from the Strathclyde Britons. In 617 Aethelfrith was defeated and slain at the river Idle by Raedwald of East Anglia, whom Edwin had persuaded to take up his cause.

See Bede, *Chronica Maiora*, §531; *Hist. Ecc.* (Plummer) i. 34, ii. 2; *Saxon Chronicle*, s.a. 593, 603, 605, 616; *Hist. Brittonum*, §§57, 63; *Annales Cambriae*, s.a. 613.

AETHELING, an Anglo-Saxon word meaning originally "of noble descent," but soon restricted to members of a royal family, and in the *Anglo-Saxon Chronicle* used almost exclusively for members of the royal house of Wessex. It was occasionally used after the Norman Conquest to designate members of the royal family. In the 10th century, the *wergild* of an aetheling was equal to that of an archbishop and one-half of that of a king.

AETHELNOth (d. 1038), archbishop of Canterbury, known also as EGELNODUS or EDNODUS, was a son of the ealdorman Aethelmaer, and a member of the royal family of Wessex. He became a monk at Glastonbury, then dean of the monastery of Christ Church, Canterbury, and chaplain to King Canute, and on Nov. 13, 1020, he was consecrated archbishop of Canterbury. He appears to have exercised considerable influence over Canute, largely by whose aid he restored his cathedral at Canterbury. Aethelnoth, who was called the "Good," died on Oct. 29, 1038.

AETHELRED, king of Mercia, succeeded his brother Wulfhere in A.D. 675. In 676 he ravaged Kent, destroying the monasteries and churches and taking Rochester. Aethelred married Osthryth, the sister of Egrith, king of Northumbria, but a quarrel arose between the two kings, presumably over the possession of the province of Lindsey, which Egrith had won back at the close of the reign of Wulfhere. In a battle on the banks of the Trent in 679, the king of Mercia was victorious and regained the province. Aelfwine, the brother of Egrith, was slain, but at the intervention of Theodore, archbishop of Canterbury, Aethelred agreed to pay a wergild for the Northumbrian prince and so prevented further hostilities. Osthryth was murdered in 697 and Aethelred abdicated in 704, choosing Coenred as his successor. He then became abbot of Bardney, and, according to Eddius, recommended Wilfrid to Coenred on his return from Rome. Aethelred died at Bardney in 716. See WILFRID.

BIBLIOGRAPHY.—Eddius, *Vita Wilfridi* (Raine), 23, 40, 43, 45–48, 57; Bede, *Hist. Ecc.* (ed. Plummer), iii. 11, iv. 12, 21; *Saxon Chronicle*, s.a. 676, 679, 704, 716. (F. G. M. B.)

AETHELRED I., king of Wessex and Kent (866–871), was the fourth son of Aethelwulf of Wessex, and should, by his father's will, have succeeded to Wessex on the death of his eldest brother Aethelbald. He seems, however, to have stood aside in favour of his brother Aethelbert, king of Kent, to whose joint kingdoms he succeeded in 866. Aethelred's reign was one long struggle against the Danes. In the year of his succession a large Danish force landed in East Anglia, and in the year 868 Aethelred and his brother Alfred went to help Burgred, or Burhred, of Mercia, against this host, but the Mercians soon made peace with their foes. In 871 the Danes encamped at Reading, where they defeated Aethelred and his brother, but later in the year the English won a great victory at "Aescdesun." A fortnight later they were defeated at Basing, but partially retrieved their fortune by a victory at "Maeretun" (perhaps Marden, in Wiltshire), though the Danes held the field. In the Easter of this year Aethelred died, perhaps of wounds received in the wars against the Danes, and was buried at Wimborne.

BIBLIOGRAPHY.—*The Saxon Chronicle*, sub ann.; Birch, *Cartul. Saxon.* vol. ii. Nos. 516-526; D.N.B., s.v.; *Eng. Hist. Review*, i. 218-234.

AETHELRED II. or ETHELRED (c. 968-1016), king of the English (surnamed **THE UNREADY**; i.e., without rede or counsel), son of King Edgar by his second wife, Aelfthryth, was born in 968 or 969 and succeeded to the throne on the murder of his half-brother Edward (the Martyr) in 978. In the year after his accession the Danish invasions recommenced, though as yet their object was plunder only, not conquest. For an account of the repeated invasions, which gathered strength as time went on, see **ENGLISH HISTORY**. Aethelred's policy of buying off the raiders failed, and the massacre of Danes in England carried out by his orders on St. Brice's Day (Dec. 2, 1001) only made matters worse. Next year Sweyn returned, his hostility fanned by the desire for revenge. For two years he ravaged and slew; in 1003 Exeter was destroyed; Norwich and Thetford were sacked in 1004. No effectual resistance was offered, despite efforts here and there; disorganization of the country was complete. In 1005 the Danes were absent in Denmark, but they came back next year, and emboldened by the utter lack of resistance, they ranged far inland. In 1007 Aethelred bought them off for a larger sum than ever (£36,000), and for two years the land enjoyed peace. In 1009, however, in accordance with a resolution made by the witan in the preceding year, Aethelred collected such a fleet "as never before had been in England in any king's day"; but owing to a miserable court quarrel the effort came to nothing. The king then summoned a general levy of the nation, with no better result. Just as he was about to attack, the traitor Edric prevented him from doing so, and the opportunity was lost. In 1010 the Danes returned, to find the kingdom more utterly disorganized than ever. "There was not a chief man in the kingdom who could gather a force, but each fled as he best might; nor even at last would any there resist another." Incapable of offering resistance, the king again offered money, this time no less than £48,000. While it was being collected, the Danes sacked Canterbury and slew the archbishop Alphege. The tribute was paid soon afterwards; and about the same time the Danish leader Thurkill entered the English service.

From 1013 an important change is discernible in the character of the Danish attacks, which now became definitely political in their aim. In this year Sweyn sailed up the Trent and received the submission of northern England, and then, marching south, attacked London. Failing to take it, he hastened west and at Bath received the submission of Wessex. Then he returned northwards, and after that "all the nation considered him as full king." London soon acknowledged him, and Aethelred, after taking refuge for a while with Thurkill's fleet, escaped to Normandy. Sweyn died in Feb. 1014, and Aethelred was recalled by the witan. At once he hastened north against Canute, Sweyn's son, but Canute sailed away, only to return next year, when the traitor Edric joined him and Wessex submitted. Canute and Edric harried Mercia, and were preparing to reduce London, when Aethelred died there on April 23, 1016. Weak, self-indulgent, improvident, he had pursued a policy of opportunism to a fatal conclusion.

Aethelred's wife was Emma, or Aelfgifu, daughter of Richard I. the Fearless, duke of the Normans, whom he married not later than 985. After the king's death Emma married Canute the Great, and after his death in 1035 she struggled hard to secure England for her son, Hardicanute. In 1037, however, when Harold Harefoot became sole king, she was banished; she went to Flanders, returning to England with Hardicanute in 1040. In 1043 Edward the Confessor seized the greater part of Emma's great wealth, and the queen lived in retirement at Winchester until her death on March 6, 1052. By Aethelred Emma had two sons, Edward the Confessor and the aetheling Aelfred (d. 1036), and by Canute she was the mother of Hardicanute. Her marriage with Aethelred was an important step in the history of the relations between England and Normandy, and J. R. Green says "it suddenly opened for its rulers a distinct policy, a distinct course of action, which led to the Norman conquest of England.

From the moment of Emma's marriage Normandy became a chief factor in English politics."

BIBLIOGRAPHY.—*The Anglo-Saxon Chronicle* (ed. C. Plummer, Oxford, 1892-99); Florence of Worcester (ed. B. Thorpe, London, 1848-49); *Encomium Emmae* (ed. G. H. Pertz in the *Scriptores Rerum Germanicarum*, Band xix., Hanover, 1866) for the latter part of the reign. See also J. M. Kemble, *Codex Diplomaticus aevi Saxonici* (London, 1839-48); and B. Thorpe, *Ancient Laws* (London, 1840).

AETHELSTAN (c. 894-940), Saxon king, was the son (probably illegitimate) of Edward the Elder. He had been the favourite of his grandfather Alfred, and was brought up in the household of his aunt Aethelflaed, the "Lady of the Mercians." On the death of his father in 924, Aethelstan succeeded him, and was crowned at Kingston shortly after.



AFTER G. M. COLLEN'S BRIT. SAXONICA

SHIELD OF AETHELSTAN
The cross boutoné, on a field of red and blue, is surmounted by a crest coronet of gold. The circle at the base is gold.

One of Aethelstan's first public acts was to hold a conference at Tamworth with Sihtric, the Scandinavian king of Northumbria, and as a result Sihtric received Aethelstan's sister in marriage. In the next year Sihtric died and Aethelstan took over the Northumbrian kingdom. He now received, at Dacre, in Cumberland, the submission of all the kings of the island; viz., Howel Dda, king of West Wales, Owen, king of Cumbria, Constantine, king of the Scots, and Ealdred of Bamburgh, and henceforth he called himself "rex totius Britanniae." About this time (the exact chronology is uncertain) Aethelstan expelled Sihtric's brother Guthfrith, destroyed the Danish fortress at York, received the submission of the Welsh at Hereford, fixing their boundary along the line of the Wye, and drove the Cornishmen west of the Tamar, fortifying Exeter as an English city. In 934 he invaded Scotland by land and sea, perhaps owing to an alliance between Constantine and Anlaf Sihtricsson. The army advanced as far north as Dunottar, in Kincardineshire, while the navy sailed to Caithness. Simeon of Durham speaks of a submission of Scotland as a result; if it ever took place it was a mere form, for three years later we find a great confederacy formed in Scotland against Aethelstan. This confederacy of 937 was joined by Constantine, king of Scotland, the Welsh of Strathclyde, and the Norwegian chieftains, Anlaf Sihtricsson and Anlaf Godfredsson, who, though they came from Ireland, had powerful English connections. A great battle was fought at Brunanburh (perhaps Brunswark or Birrenswark hill in south-east Dumfriesshire), in which Aethelstan and his brother Edmund were completely victorious. England had been freed from its greatest danger since the days of the struggle of Alfred against Guthrum.

Aethelstan was the first Saxon king who could claim in any real sense to be lord paramount of Britain. In his charters he is continually called "rex totius Britanniae," and he adopts for the first time the Greek title *basileus*. This was not merely an idle flourish, for some of his charters are signed by Welsh and Scottish kings as *subreguli*. Further, Aethelstan was the first king to bring England into close touch with continental Europe. By the marriage of his half-sisters he was brought into connection with the chief royal and princely houses of France and Germany. His sister Eadgifu married Charles the Simple, Eadchild became the wife of Hugh the Great, duke of France, Eadgyth was married to the emperor Otto the Great, and her sister, Aelfgifu, to a petty German prince. Embassies passed between Aethelstan and Harold Fairhair, first king of Norway, with the result that Harold's son Haakon was brought up in England, and is known in Scandinavian history as Haakon Adalsteinsföstri.

Aethelstan died at Gloucester in 940, and was buried at Malmesbury, an abbey which he had munificently endowed during his lifetime. Apparently he was never married, and he certainly had no issue. A considerable body of law has come down to us in Aethelstan's name. The chief collections are those issued at Grately, in Hampshire, at Exeter, at Thunresfeld, and

the *Iudicia civitatis Lundonie*. In the last-named one personal touch is found when the king tells the archbishop how grievous it is to put to death persons of 12 winters for stealing. The king secured the raising of the age limit to 15.

BIBLIOGRAPHY.—Primary: *The Saxon Chronicle, sub ann.*; William of Malmesbury, *Gesta Regum*, i. 141–157, Rolls Series, containing valuable original information (v. Stubbs' Introduction, II. ix., lxxvii.); Birch, *Cartul. Saxon.* vol. ii. Nos. 641–747; A. S. Laws (ed. Liebermann), i. 146–183; Aethelweard, Florence of Worcester. Secondary: *Saxon Chronicle* (ed. Plummer) vol. ii. p. 132–142; D. N. B., s.v.

(A. M.)

AETHELWEARD or ETHELWARD, Anglo-Saxon historian, was the great-grandson of Aethelred, the brother of Alfred, and ealdorman or earl of the western provinces (i.e., probably of the whole of Wessex). He was the author of a Latin chronicle extending to the year 975. Up to the year 892 he is largely dependent on the *Saxon Chronicle*, with a few details of his own; later he is largely independent of it. He was the friend and patron of Aelfric, the grammarian.

BIBLIOGRAPHY.—Primary: *The Saxon Chronicle*, 994 E; Birch, *Cartularium Saxonicum*; A. S. Laws (ed. Liebermann), pp. 220–24; *Fabii Ethelwerdi Chron.*, Mon. Hist. Brit., pp. 449–54. Secondary: Plummer, *Saxon Chronicle*, vol. ii. p. ci.; Napier and Stevenson, *Crawford Charters*, pp. 118–20; D.N.B., s.v.

AETHELWULF, king of the West Saxons, succeeded his father, Egbert, in A.D. 839. Aethelwulf's reign was chiefly occupied with struggles against the Danes. After the king's defeat 843–44, the Somerset and Dorset levies won a victory at the mouth of the Parret (c. 850). In 851 Ceorl, with the men of Devon, defeated the Danes at Wigganburg, and Aethelstan of Kent was victorious at Sandwich; despite this the Danes wintered in England that year for the first time. In 851 also Aethelwulf and Aethelbald won their great victory at Aclea, probably the modern Ockley. In 853 Aethelwulf subdued the North Welsh, in answer to the appeal of Burgred of Mercia, and gave him his daughter Aethelswith in marriage. The year 855 is the date of the Donation of Aethelwulf and of his journey to Rome with Alfred. On his way home he married Judith, daughter of Charles the Bold. According to Asser he was compelled to give up Wessex to his son Aethelbald on his return, and content himself with the eastern under-kingdom. He died in 858.

See Asser, *Life of Alfred* (W. H. Stevenson, 1904), 1–16; *Saxon Chronicle*, s.a. 823, 836, 840, 851, 853, 855.

AETHER: see **ETHER** (PHYSICS).

AETHICUS (=ETHICUS) **ISTER**, "the philosopher of Istria," the supposed but unknown author of a description of the world written in Greek. An abridgment, under the title of *Cosmographia Ethici*, written in barbarous Latin, and wrongly described as the work of St. Jerome, probably belongs to the 7th century.

The name Aethicus is also attached to a geographical treatise probably dating from the 6th century, a reproduction of the cosmography of Julius Honorius.

BIBLIOGRAPHY.—D'Avezac (1852); Pertz (1853); Wuttke (1854); Riese's *Geographi Latini Minores* (1878); see also Bunbury, *History of Ancient Geography*.

AETIOLOGY or ETIOLOGY, strictly, science or philosophy of causation, but generally used to denote the part of any special science (and especially of that of medicine and disease) which investigates the causes and origin of its phenomena. An *aetiological myth* is one which is regarded as having been invented *ex post facto* to explain some fact, name, or coincidence, the true account or origin of which has been forgotten. Such myths were often based on grotesque philological analogies, according to which an existing connection between two personalities (cities, etc.) was traced back to a common mythical origin. The preferred spelling of the word in the United States is *Etiology*.

AETION or EETION, a Greek painter, mentioned by Cicero, Pliny, and Lucian. His most noted work, described in detail by Lucian (*Herodotus or Eetion*, 5), was a picture representing the marriage of Alexander and Roxana. Through a misunderstanding of the words of Lucian, Aetion has been supposed to belong to the age of Antonines; but there can be little doubt

that he was a contemporary of Alexander and of Apelles (Brunn, *Geschichte der griechischen Künstler*, ii. p. 243). Pliny gives his date as 350 B.C.

AETIUS (ah-ët'i-oos) (fl. 350), surnamed "the Atheist," founder of an extreme sect of Arians, was a native of Coele-Syria. He studied successively under the Arians, Paulinus, bishop of Antioch, Athanasius, bishop of Anazarbus, and the presbyter Antonius of Tarsus. At the first synod of Sirmium he won a dialectic victory over the homoiousian bishops, Basilus and Eustathius, who sought in consequence to stir up against him the enmity of Caesar Gallus. In 356 he went to Alexandria with Eunomius (q.v.) in order to advocate Arianism, but he was banished by Constantius. Julian recalled him from exile, bestowed upon him an estate in Lesbos, and retained him for a time at his court in Constantinople. At the accession of Valens (364) he retired to his estate at Lesbos, but soon returned to Constantinople, where he died in 367. The Anomean sect of the Arians, of whom he was leader, are sometimes called after him *Aetians*. His work *De Fide* has been preserved in connection with a refutation written by Epiphanius (*Haer.*, lxxvi. 10).

See A. Harnack, *History of Dogma*, vol. iv. *passim*.

AETIUS (died 454), a Roman general of the closing period of the Western empire, born at Dorostolus in Moesia, late in the 4th century. He was the son of Gaudentius, who, although possibly of barbarian family, rose in the service of the Western empire to be master of the horse, and later, count of Africa. Aetius passed some years as hostage, first with Alaric and the Goths, and later in the camp of Rhuas, king of the Huns, acquiring in this way the knowledge which enabled him afterwards to defeat them. In 424 he led into Italy an army of 60,000 barbarians, mostly Huns, which he employed first to support the *primicerius* Ioannes, who had proclaimed himself emperor, and, on the defeat of the latter, to enforce his claim to the supreme command of the army in Gaul upon Placidia, the empress-mother and regent for Valentinian III. His calumnies against his rival, Count Boniface, which were at first believed by the emperor, led Boniface to revolt and call the Vandals to Africa. Upon the discovery of the truth, Boniface, although defeated in Africa, was received into favour by Valentinian; but Aetius came down against Boniface from his Gallic wars, and in the battle which followed wounded Boniface fatally with his own javelin. From 433 to 450 Aetius was the dominating personality in the Western empire. In Gaul he won his military reputation, upholding for nearly 20 years, by combined policy and daring, the falling fortunes of the empire. His greatest victory was that of Châlons-sur-Marne (Sept. 20, 451), in which he led the Gallic forces against Attila and the Huns. This was the last triumph of the empire. Three years later (454) Aetius presented himself at court to claim the emperor's daughter in marriage for his son Gaudentius; but Valentinian, suspecting him of designs upon the crown, slew him with his own hand.

"That he was the one prop and stay of the Western empire during his life is the unanimous verdict of his contemporaries; but whether he was a really great general or statesman we cannot tell. He was beaten by Boniface; and it was not he, but the Goths and their king, who really triumphed in the Mauriac plain; yet he recovered Gaul in a series of campaigns, and he kept the Visigoths in check. . . . If he was less Roman than his predecessor Constantius, he was far more Roman than his successor Ricimer; and if he had occasionally used the arms of the Huns for his own ends, he had also used them to maintain the empire. One merit he had which must count for much—the merit of recognizing and encouraging men of ability. Majorian and Marcellinus, two of the finest figures in the history of the fallen empire, were men of his training." (Ernest Barker in *Cambridge Mediaeval Hist.*, vol. i., I., 418–419.)

See T. Hodgkin, *Italy and her Invaders*, vols. i. and ii. (1880).

AETIUS, a Greek physician, born at Amida in Mesopotamia, flourished at the beginning of the 6th century A.D. He was court physician at Byzantium. He wrote a large medical work in 16 books, founded on Oribasius and compiled from various sources, especially Galen (Galenos). Eight books of the Greek original were printed in Venice in 1534, and a complete Latin translation by Cornarius at Basel, 1542.

See Weigel, *Aetianarum exercitationum specimen* (1791); Danielius, *Beitrag zur Augenheilkunde des Aetius* (1889); Zernos, *Aetii sermo sextidectimus et ultimus*, editio princeps (1901); T. C. Allbutt, *Greek Medicine in Rome* (1921); M. Neuberger, *History of Medicine*, vol. i (1910).

AETNA, a Latin hexameter poem of 644 lines ascribed by the mss. to Virgil. This ascription is now universally rejected, but it is obvious that the author was an imitator of Virgil who was familiar with the Aeneid as well as the Bucolics and Georgics, and therefore lived at least as late as the time of Augustus. As there is no mention of the eruption of Vesuvius which destroyed Pompeii and Herculaneum it is safe to presume that the work was composed before A.D. 79. The poem has been attributed by various authorities to Claudian, Cornelius Severus and Manilius, but modern opinion assigns it to Lucilius Junior, the friend of Seneca, whose interest in, and knowledge of scientific matters is alluded to in the philosopher's correspondence. He is known to have been a governor of Sicily and to have written poems. *Aetna* discusses the possible explanation of the volcano's action.

Text edited (1920) by Robinson Ellis in J. P. Postgate's *Corpus Poetarum Latinorum*.

AETOLIA, a district of northern Greece, bounded on the south by the Corinthian Gulf, on the west by the river Achelous, on the north and east by the western spurs of Parnassus and Oeta. The land naturally falls into two divisions. The basins of the lower Achelous (mod. *Aspropotamo*) and Euenus (*Phidharis*) form a series of alluvial valleys intersected by detached ridges which mostly run parallel to the coast. This district of "Old Aetolia" lacks a suitable sea-board, but the inland, and especially the plain of central Aetolia lying to the north of Lakes Hyria and Trichonis and Mount Aracynthus, forms a rich agricultural country. The northern and eastern regions are broken by an extensive complex of chains and peaks, whose rugged limestone flanks are clad at most with stunted shrubs and barely leave room for a few precarious mule-tracks. These heights often rise in the frontiers of Tymphrestus, Oxa and Corax to more than 7,000 ft.; the snow-capped pinnacle of Kiona attains to 8,240 ft. A few defiles pass through this barrier to the other side of the north Greek watershed.

In early legend Old Aetolia, with its cities of Pleuron and Calydon, figures prominently. During the great migrations (see DORIANS) the population was largely displaced, and the old inhabitants long remained in a backward condition. In the 5th century some tribes were still living in open villages under petty kings, addicted to plunder and piracy, and hardly recognized as Hellenes at all. Yet their military strength was not to be despised: in 426 their archers and slingers easily repelled an Athenian invasion under Demosthenes. In the 4th century the Aetolians began to take a greater part in Greek politics, and, in return for helping Epameinondas (367) and Philip of Macedon (338), recovered control of their sea-board, to which they annexed the Acarnanian coast and the Oeniadae. Aetolia's prosperity dates from the period of Macedonian supremacy. It may be ascribed partly to the wealth and influence acquired by Aetolian mercenaries in Hellenistic courts, but chiefly to the formation of a national Aetolian league, the first effective institution of this kind in Greece. Created originally to meet the peril of an invasion by the Macedonian regents Antipater and Craterus, who had undertaken a punitive expedition against Aetolia after the Lamian War (322), and by Cassander (314-311), the confederacy grew rapidly during the subsequent period of Macedonian weakness. Since 290 it had extended its power over all the uplands of central Greece, where its command over Heracleia (280) provided it with an important defensive position against northern invaders, its control of Delphi and the Amphictyonic council with a useful political instrument. The valour of the Aetolians was conspicuously displayed in 279, when they broke the strength of the Celtic irruption by slaughtering great hordes of marauders. The commemorative festival of the Soteria, which the league established at Delphi, obtained recognition from many leading Greek states. After annexing Boeotia (by 245) the Aetolians controlled all central Greece. Endeavouring next to expand into Peloponnesus, they allied themselves with Antigonus Gonatas of Macedonia against the

Achaean league (*q.v.*), and besides becoming protectors of Elis and Messenia won several Arcadian cities. Their naval power extended to Cephalonia, to the Aegaeon islands and even to the Hellespont. The league at its zenith had thus a truly imperial status.

Later in the century its power began to be sapped by Macedonia. To check King Demetrius (239-229) the Aetolians joined arms with the Achaeans. In 224 they held Heracleia Trachis against Antigonus Doseon, but lost control of Boeotia and Phocis. Since 228 their Arcadian possessions had been abandoned to Sparta. At the same time a new enemy arose in the Illyrian pirate fleets, which outdid them in unscrupulousness and violence. The raids of two Aetolian chiefs in Achaean territory (220) led to a coalition between Achaea and Philip V. of Macedon, who assailed the invaders with great energy, driving them out of Peloponnesus and marching into Aetolia itself, where he surprised and sacked the federal capital Thermon. After buying peace by the cession of Acarnania (217) the league concluded a compact with Rome. In the great war of their Roman allies against Philip the federal troops took a prominent part, their cavalry being largely responsible for the victory of Cynoscephalae (197). The Romans in return restored central Greece to the league, but by withholding its former Thessalian possessions excited its deep resentment. The Aetolians now invited Antiochus III. of Syria to European Greece, and so precipitated a conflict with Rome. But in the war they threw away their chances. In 192 they wasted themselves in an unsuccessful attempt to secure Sparta. In 191 they supported Antiochus badly, and by their slackness in the defence of Thermopylae made his position in Greece untenable. Having thus isolated themselves the Aetolians stood at bay behind their walls against the Romans, who refused all compromises, and, after the general surrender in 189, restricted the league to Aetolia proper and assumed control over its foreign relations. By the time of Sulla, the functions of the Aetolian league had become purely nominal. The federal constitution closely resembled that of the Achaean league, for which it doubtless served as a model. The general assembly, convoked every autumn at Thermon to elect officials, and at other places in special emergencies, shaped the league's general policy; it was nominally open to all freemen, though no doubt the Aetolian chieftains really controlled it. The council of deputies from the confederate cities undertook the routine of administration and jurisdiction. The *strategus* (general), aided by 30 *apocleti* (ministers), had complete control in the field and presided over the assembly, though with restricted advisory powers. The Aetolians also used the Amphictyonic synod for passing solemn enactments. The league's relation to outlying dependencies is obscure; many of these were probably mere protectorates or "allied states" and secured no representation. The federal executive was certainly much more efficient than that of the Achaeans, and its councils suffered less from disunion; but its generals and admirals, official or otherwise, enjoyed undue licence; hence the league deservedly gained an evil name for the numerous acts of lawlessness or violence which its troops committed. But as a champion of republican Greece against foreign enemies no other power of the age rendered equal services. In the 15th century Aetolia passed under the rule of Scanderbeg and the Venetians, but was finally conquered for the Turks by Mohammed II. In the War of Independence it was the scene of severe fighting, including the sieges of Missolonghi.

(M. C.)

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AFARS (DANAKIL), a tribe of African "Arabs" of Hamitic stock. They occupy the arid coast-lands between Abyssinia and the sea. They claim to be Arabs, but are more akin to the Galla and Somali. The tribe is roughly divisible into a pastoral and a

coast-dwelling group. Their religion is chiefly fetich and tree-worship; many, nominally, profess Mohammedanism. They are distinguished by narrow straight noses, thin lips and small pointed chins. They wear, generally, nothing but a waist-cloth. They are divided into many sub-tribes, each having an hereditary sultan.

See Fr. Scaramucci and E. H. Giglioli, *Notizie sui Danakil* (1884); P. Paulitschke, *Ethnographie Nordost-Afrikas* (2 vols., Berlin, 1893-1896), and *Die geographische Ersorschung der Adal-Länder und Harars in Ost-Afrika* (Leipzig, 1884).

AFER, DOMITIUS, a Roman orator and advocate, was born at Nemausus (Nîmes). He became an informer and gained the favour of Tiberius by accusing Claudia Pulcra, a cousin of Agrippina, of treason. He was consul under Caligula (39) and superintendent of the water supply under Nero. He died in A.D. 60. His pupil, Quintilian, who calls him the greatest orator he had ever known, quotes some of his witty sayings (*dicta*), collections of which were published, and mentions two books by him *On Witnesses*.

See Quintilian, *Instit.* vi. 3. 42, viii. 5. 16, x. 1. 118, etc.; Tac. *Ann.* iv. 52, 68, xiv. 19; Dio Cassius lix. 19, lx. 33; Pliny, *Epp.* ii. 14, viii. 18.

AFFECTION, literally, a state resulting generally from an external influence. The term was at one time employed to denote the states even of material bodies, but is now confined to certain mental states only, in fact, to certain feelings. It is popularly used of a sentiment between persons amounting to more than good will or friendship. By ethical writers the word has been used generally of distinct states of feeling, both lasting and spasmodic; some contrast it with "passion," as being free from the distinctively sensual element. More specifically the word has been restricted to emotional states which are in relation to persons. In the former sense, it is the Gr. *πάθος*, and as such it appears in Descartes and most of the early British ethical writers. On various grounds, however—e.g., that it does not involve anxiety or excitement, that it is comparatively inert and compatible with the entire absence of the sensuous element—it is generally and usefully distinguished from passion. In this narrower sense the word has played a great part in ethical systems, which have spoken of the social or parental "affections" as in some sense a part of moral obligation. For a consideration of these and similar problems, which depend ultimately on the degree in which the affections are regarded as voluntary, see H. Sidgwick, *Methods of Ethics*, pp. 345-349.

In psychology the terms "affection" and "affective" are used for the characteristic quality of experiences that are neither cognitive nor conational. As all intellectual phenomena have by some psychologists been reduced to sensation, so all feeling has been regarded as reducible to simple mental affection, the element of which all emotional manifestations are ultimately composed. The nature of this element is a problem which has been provisionally, but not conclusively, solved by many psychologists; the method is necessarily experimental, and all experiments on feeling are peculiarly difficult. The solutions proposed are two. In the first, all affective phenomena are primarily divisible into those which are pleasurable and those which are the reverse. The main objections to this are that it does not explain the infinite variety of phenomena, and that it disregards the distinction which most philosophers admit between higher and lower pleasures. The second solution is that every sensation has its specific affective quality, though by reason of the poverty of language many of these have no name. W. Wundt, *Outlines of Psychology* (trans. C. H. Judd, Leipzig, 1897), maintains that we may group under three main affective directions, each with its negative, all the infinite varieties in question; these are (a) pleasure, or rather pleasantness, and the reverse, (b) tension and relaxation, (c) excitement and depression.

Two methods of experiment have been tried. The first, introduced by A. Mosso, the Italian psychologist, consists in recording the physical phenomena which are observed to accompany modifications of the affective consciousness. Thus it is found that the action of the heart is accelerated by pleasant, and retarded by unpleasant, stimuli; again, changes of weight are found to accompany modifications of affection—and so on.

The second is Fechner's method; it consists in recording the changes in feeling-tone produced in a subject by bringing him in contact with a series of conditions, objects or stimuli graduated according to a scientific plan and presented singly, in pairs or in groups. The result is a comparative table of likes and dislikes.

(See FEELING.)

AFETTUOSO (Ital.), a musical direction signifying that the composition or particular passage so marked is to be played with much expression and feeling. *Espressivo* and *con espressione* are other terms having much the same significance.

AFFIDAVIT, a written statement sworn or affirmed to before some person who has authority to administer an oath or affirmation. Evidence is chiefly taken by means of affidavits in the chancery division of the High Court of Justice in England on a petition, summons or motion. Interlocutory proceedings before trial are conducted by affidavits, e.g., for discovery of documents, hence called *affidavit of documents*. Affidavits are sometimes necessary as proof that certain legal formalities have been duly and legally performed. On special application to the court a deponent may be cross-examined on the statements contained in his affidavit. In Scotland the testimony of witnesses by affidavit is almost unknown, except in proceedings in the Sheriff Court of Chancery, and petitions for the sequestration of bankruptcy, where affidavits are enjoined by statute. In the rules of the Supreme Court (R.S.C. Ord. XXXVIII.) certain formal requirements are laid down for all affidavits and affirmations in causes or matters depending in the High Court. An affidavit must consist of title, body or statement and jurat. It must be written or printed on foolscap, bookwise, in the first person; give correctly the names of the parties to the action; and the description and true place of abode of the deponent. An affidavit is confined, except on interlocutory motions, to such facts as the witness is able of his own knowledge to prove. The signature of the deponent must be written opposite to the jurat, which must contain the place, date and time of swearing, and this signed by the officer or magistrate before whom the affidavit is sworn. An affidavit sworn on a Sunday is not invalid. Quakers, Moravians and Separatists were first privileged to make a solemn declaration or affirmation, and by the Common Law Procedure Act, 1852, and other statutes all persons prevented by religious belief from taking an oath were allowed to affirm; and, finally, by the Oaths Act, 1888, every person who objects to be sworn is allowed to affirm in all places and for all purposes where an oath is required by law. By an act of 1835 justices are permitted to take affidavits in any matter by declaration, and a person making a false affidavit in this way is liable to punishment. The same act prohibited justices of peace from administering oaths in any matter in which they had not jurisdiction as judges, except when an oath was specially authorized by statute, as in the bankruptcy law, and excepting criminal inquiries, parliamentary proceedings and instances where oaths are required to give validity to documents abroad. Scottish justices can act in England and *vice versa*. The Oaths Act, 1888, and the Commissioner of Oaths Act, 1889, consolidated all previous enactments relating to oaths and gave the lord chancellor power to appoint commissioners for oaths to take affidavits for all purposes (see OATH).

In the United States affidavit has the same meaning as in England and its general uses are the same, but it is not substituted for oral evidence in court to anything like the extent to which that is done in the English courts of chancery. The statutes of each State designate the persons before whom affidavits may be made outside the State, and special commissioners are appointed for that purpose by each State. Affidavits made abroad must be made before such commissioners or persons so designated, who are usually diplomatic and consular officials, justices, notaries public or mayors.

AFFILIATION, in law, the procedure by which the paternity of a bastard child is determined, and the obligation of contributing to its support enforced. In England a number of statutes on the subject have been passed, the chief being the Bastardy Act of 1845, the Bastardy Laws Amendment Acts of 1872 and 1873, the

Affiliation Orders Act, 1914, the Affiliation Orders Act, 1918, and the Bastardy Act, 1923. The mother of a bastard may summon the putative father to petty sessions within 12 months of the birth (or at any later time if he is proved to have contributed to the child's support or ceased to reside in England within 12 months after the birth), and the justices, after hearing evidence on both sides, may, if the mother's evidence be corroborated in some material particular, adjudge the man to be the putative father of the child, and order him to pay a sum not exceeding 20 shillings a week for its maintenance, together with a sum for expenses incidental to the birth, or the funeral expenses, if it has died before the date of order, and the costs of the proceedings. An order ceases to be valid after the child reaches the age of 13, except as regards arrears, but the justices may in the order direct the payments to be continued until the child is 16 years of age. An appeal to quarter sessions is open to both the mother and the defendant, and a further appeal on questions of law to the King's Bench. Should the child afterwards become chargeable to the parish, the sum due by the father may be received by the relieving officer. When a bastard child whose mother has not obtained an order, becomes chargeable to the parish, the guardians may proceed against the putative father for a contribution, and such an order may be varied and continued in favour of the mother or person having custody of the child. Any woman who is single, a widow, or a married woman living apart from her husband, may make an application for a summons. The Bastardy Act, 1872, makes due provision for the enforcement of an order of affiliation, and commitment is governed by the Summary Jurisdiction Act, 1879, and the Criminal Justice Act, 1914. In the case of soldiers an affiliation order cannot be enforced in the usual way, but by the Army Act 1881, as amended in 1883, 1891, 1904 and 1915, if an order has been made against a soldier of the regular forces, a portion of the soldier's pay may be retained. There is similar legislation with regard to sailors in the Royal Navy, by the Naval Discipline Act, 1915.

It having been found in practice that affiliation orders became ineffective owing to the unwillingness or inability of the mother to make continual appearances before the justices, under the Affiliation Orders Act, 1914, collecting officers may be appointed.

In the United States the father is primarily responsible for the support of a bastard child. The mother is responsible in the event of the father's death.

In the British colonies there is some procedure (usually termed *filiation*) akin to that described above, by means of which a mother can obtain a contribution to the support of her illegitimate child from the putative father. On the continent of Europe, however, the legislation of the various countries differs rather widely. (See *ADOPTION*; also *BASTARD*; *POOR LAW*.)

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AFFINE GEOMETRY. An affine geometry, as distinguished from a projective geometry, involves a definition of parallelism. Thus, when from the definitions and theorems of the ordinary euclidean geometry of the plane all those involving euclidean measurement of length and angle are eliminated, the residue is an affine geometry. In this case the line at infinity is unique, in that any two lines meeting in a point of the former are parallel. In the projective geometry of the plane there is no such preferred line; when any line is designated as preferred in this sense, we have a corresponding affine geometry. For example, in affine geometry there is a distinction between an ellipse, a parabola and a hyperbola, but not in projective geometry; moreover, only when the geometry is metrical is there a distinction between circles and ellipses.

The euclidean affine geometry is given analytic form by means of coordinates x and y referred to two intersecting lines of the plane in the usual manner. In this case the equations

$$\begin{aligned} x_1 &= a_{11}x + a_{12}y + a_1, \\ y_1 &= a_{21}x + a_{22}y + a_2, \end{aligned} \quad (1)$$

where the a 's are arbitrary constants subject to the condition

$a_{11}a_{22} - a_{12}a_{21} \neq 0$, define the most general transformation of points of the plane among themselves which transforms parallel lines into parallel lines. Such a transformation is called *affine*. The transformations (1) form a group, and we may say, following Klein, that the body of definitions and theorems expressing properties of quantities invariant under this group is an affine geometry. If $x', y', x'', y'', x''', y'''$ are the coordinates of three non-collinear points, the quantity

$$\begin{vmatrix} x' & y' & 1 \\ x'' & y'' & 1 \\ x''' & y''' & 1 \end{vmatrix} \quad (2)$$

is invariant under transformations (1) for which $a_{11}a_{22} - a_{12}a_{21} = 1$. These transformations are called *equiaffine*. There is a considerable body of theorems concerning properties of plane curves which remain invariant under equiaffine transformations. In particular, there is a metric theory based upon a certain invariant of the type (2) associated with a curve.

The foregoing concepts are readily generalized to spaces of higher order. Thus there is for spaces of three dimensions a theory of curves and surfaces analogous in many respects to the theory for euclidean space of three dimensions. The developments of these ideas have been made by many geometers, notably Klein, Möbius, Sylvester and lately by Blaschke and Pick.

Any n independent variables x_i , where i takes the values 1 to n , may be thought of as the coordinates of a general n -dimensional space, or variety, in the sense that each set of values of the x 's defines a point. In a space thus defined there is not a basis for the comparison of directions at different points. Such a basis is provided when a definition of parallelism is added. In Riemannian geometry we say, following Levi-Civita, that at points of a curve, defined by $x_i = f_i(t)$, ($i = 1, \dots, n$), a set of functions ξ^i of t satisfying the system of equations

$$\begin{aligned} \xi^i \left(\frac{d\xi^j}{dt} + \sum_{k,l=1}^{n-1} \Gamma_{kl}^i \xi^k \frac{dx_l}{dt} \right) \\ - \xi^j \left(\frac{d\xi^i}{dt} + \sum_{k,l=1}^{n-1} \Gamma_{kl}^j \xi^k \frac{dx_l}{dt} \right) = 0 \quad (i, j = 1, \dots, n) \end{aligned} \quad (3)$$

are the components of a family of vectors parallel with respect to the curve; in this case Γ_{kl}^i are functions of the x 's determined by the metric of the space (see RIEMANNIAN GEOMETRY). As thus defined, parallelism is relative to a curve, and not absolute, as in euclidean space. If the Γ 's in (3) are taken as n^2 arbitrary functions of the x 's, equations (3) may be taken as the definition of parallelism for a general V_n , thus generalizing Levi-Civita's concept of parallelism for spaces with a Riemannian metric. In this case we say that the space is *affinely connected*, following Weyl; the Γ 's are called the coefficients of the affine connection.

When $\Gamma_{kl}^i = \Gamma_{lk}^i$, the connection is called *symmetric*, otherwise *asymmetric*. When, and only when, the connection is symmetric, there exist preferred coordinate systems, with a given point as origin, with respect to which corresponding components of a vector at the given point and of a parallel one at a nearby point are the same. When the connection is asymmetric, there are other connections giving an equivalent definition of parallelism; the definition is unique for symmetric connections.

The fundamental curves of an affinely connected space are those whose tangents are parallel with respect to the curves; i.e., they are the straight lines of the space. They are the integral curves of the differential equations obtained when $\xi^i = dx_i/dt$ in (3). Some writers call them the *paths* of the space, others *geodesics*, since they are the generalizations of the geodesics of Riemannian spaces. There are many affine connections with the same paths, so that the theorems dealing with the paths and not with a particular affine connection constitute a projective geometry. A theory of affinely connected spaces, in many respects analogous to Riemannian geometry, has been developed recently, notably by Cartan, Eddington, Einstein, Schouten, Joseph M. Thomas, Tracy Y. Thomas, Veblen and Weyl.

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AFFINITY, in law, as distinguished from consanguinity (*q.v.*), the term applied to the relation which each party to a marriage, the husband and wife, bears to the kindred of the other. Affinity is usually described as of three kinds: (1) *direct*, that relationship which subsists between the husband and his wife's relations by blood or between the wife and the husband's relations by blood. The marriage having made them one person, the blood relations of each are held as related by affinity in the same degree to the one spouse as by consanguinity to the other. But the relation is only with the married parties themselves, and does not bring those in affinity with them in affinity with each other; so a wife's sister has no affinity to her husband's brother. This is (2) *secondary* affinity. (3) *Collateral* affinity is the relationship subsisting between the husband and the relations of his wife's relations.

The subject is chiefly important from the matrimonial prohibitions by which the canon law has restricted relations by affinity. Taking the table of degrees within which marriage is prohibited because of consanguinity, the rule has been thus extended to affinity, so that wherever relationship to a man himself would be a bar to marriage, relationship to his deceased wife will be the same bar, and *vice versa* on the husband's decease.

Briefly, *direct* affinity is a bar to marriage. This rule has been founded chiefly on interpretations of the eighteenth chapter of Leviticus. Formerly by law in England, marriages within the degrees of affinity were not absolutely null, but they were liable to be annulled by ecclesiastical process during the lives of both parties; in other words, the incapacity was only a canonical, not a civil, disability. By the Marriage Act of 1835 all marriages of this kind not disputed before the passing of the act were declared absolutely valid, while all subsequent to it were declared null. This rendered null in England, and not merely voidable, a marriage with a deceased wife's sister or niece. (See MARRIAGE.)

AFFINITY, CHEMICAL, the property or relation in virtue of which substances are capable of entering into chemical combination with each other. (See CHEMISTRY; VALENCY.)

AFFIRMATION, the declaration that something is true; in logic, a positive judgment, the union of the subject and predicate of a proposition; particularly, in law, the solemn declaration allowed to those who conscientiously object to taking an oath.

AFFORESTATION: see FORESTS AND FORESTRY.

AFFRAY is the misdemeanour of breaking the peace in public to the terror of the king's subjects. Fighting in public is an affray, but no actual violence is necessary, and the offense is committed even where a man arms himself with weapons so as to cause terror to the public. Abusive and threatening words alone will not amount to an affray. In 1903 at the Carnarvon assizes before Justice Wills a conviction was obtained in *Rex v. Meade* where the accused went about armed and discharged a loaded revolver in a public street. He was also indicted under a statute of 1328 (2 Edw. III c. 3). (See also RIOT.)

In the United States the English common law as to affray applies, subject to certain modifications by the statutes of particular states (Bishop, *Amer. Crim. Law*, 9th ed., 1923, vol. i, § 535). The Indian penal code (§159) adopts the English definition of affray, with the substitution of "actual disturbance of the peace" for "causing terror to the lieges."

AFFRE, DENIS AUGUSTE (1793-1848), archbishop of Paris, was born at Saint-Rome-de-Tarn, on Sept. 27, 1793. He was educated for the priesthood at St. Sulpice, where in 1818 he became professor of dogmatic theology. After filling a number of ecclesiastical offices, he was elevated to the archbishopric of Paris in 1840. Though opposed to the government of Louis Philippe, he took no part in politics, but devoted himself to his pastoral work. His episcopate is chiefly remembered for its tragic close. During the riots of June 23 to 26, 1848, the archbishop was led to believe that by his personal interference peace might be restored be-

tween the soldiers and the insurgents. Accordingly, in spite of the warning of General Cavaignac, he mounted the barricade at the entrance to the Faubourg St. Antoine, bearing a green branch as a sign of peace. He had spoken only a few words, however, when the insurgents, hearing shots and believing they were betrayed, opened fire on the soldiers, and the archbishop was struck by a stray bullet. He died on June 27, 1848, and the following day the national assembly issued a decree expressing their sorrow because of his death. The public funeral held on July 7 was, it is said, one of the most striking spectacles of its kind. The archbishop wrote several treatises of considerable value, including an *Essai sur les hieroglyphes égyptiens* (Paris, 1834).

See Ricard, *Les grands évêques de l'église de France au XIX^e siècle* (Lillie, 1893); L. Alazard, *Denis-Auguste Affre, archevêque de Paris* (Paris, 1905).

AFFREIGHTMENT. Payment for the carriage of goods by water, more especially by sea, is called freight, and a bargain made between the carrier and the person whose goods are to be so carried is called a contract of affreightment. The law does not require that a contract of this kind shall be made in writing, but usually it is expressed in that form. The terms on which goods are carried by sea are, except in coasting trade, ordinarily expressed in a charter-party or a bill of lading or both. The former may be shortly described as a contract between a shipowner and a merchant for the hire or use of a ship, and the latter as a receipt for goods, stating the terms on which they are delivered to and received by a ship. A charter-party usually relates to the full cargo of a ship, and a bill of lading may do the same, but it is more often given with reference to a particular parcel of goods.

Terms Implied by Law.—The parties to a contract of affreightment are assumed by law (unless the contract expressly negatives or qualifies the assumption) to have dealt with each other on the footing of certain obligations included among the terms of contract. In the unusual case of no terms being expressly agreed, the implied terms alone would regulate the relations of the parties. In the common case of terms being expressly agreed, the implied terms are included, subject to any modification of them specifically and explicitly made by the express terms. It should be mentioned in passing that, where the goods are carried under bills of lading, certain terms are by statute (as explained below) included in the contract which the parties are not free to exclude even if they wish.

Subject then to any modification made by the contract, a person who for payment carries goods by sea is under an implied obligation to exercise due care and diligence. Except possibly in a case where the sea carrier is not a common carrier (*i.e.*, where he does not profess himself ready to carry goods for everybody) he has a further degree of responsibility, in that he is liable for every accident, unless caused by act of God, or of the king's enemies, or by inherent defect of the goods themselves, or by their having been sacrificed for the general safety. He also impliedly undertakes absolutely that the ship is seaworthy at the beginning of the voyage, and that he will proceed on the voyage with reasonable dispatch, and without unnecessary deviation. Seaworthy has a special meaning as explained later. The carrier may in some circumstances be entitled to claim statutory limitation of the amount of his liability.

On the part of the shipper an undertaking is implied not to ship dangerous goods without notice, and he or the person entitled to take delivery of the goods is impliedly under obligation (1) to be prepared, without notice from the carrier, to take delivery within a reasonable time after the arrival of the ship at the place of delivery, and (2) to pay freight and general average contribution (if any) before he can claim delivery of the goods. In some circumstances where performance of the contract becomes impossible the parties may be released from performance under terms deemed to be implied in the contract.

Parties to the Contract.—As already mentioned, the terms of contract are ordinarily expressed in a charter-party (shortly, a charter) or a bill of lading, or both. A bill of lading may be more fully described as "a receipt for goods shipped on board a

ship, signed by the person who contracts to carry them, or his agent, and stating the terms on which the goods were delivered to and received by the ship. It is not the contract, for that has been made before the bill of lading was signed and delivered, but it is excellent evidence of the terms of the contract" (Scrutton). Usually the printed form of the particular carrier is filled up in writing and signed by the captain, broker or other agent of the carrier, and the terms of the contract made or deemed to have been made before the bill of lading was given are thus reduced to documentary form. Though in form a receipt, a bill of lading is also a transferable document of title representing the goods to which it relates.

Where the contract is between a shipper and a carrier who is himself the shipowner the bill of lading binds the shipowner. In the case of a chartered ship—*i.e.*, a ship hired by a charterer—the bill of lading may, according to the circumstances, bind the shipowner or the charterer. Charters are varied in form. Under some, where the shipowner parts with the whole possession and control of the ship (so that the charter amounts to a demise, a form rare in modern practice) the contract would be between the shipper and the charterer. Under other charters the charterer may merely undertake that a full cargo shall be shipped and guarantee payment of a certain freight. There the contract would be between shipper and shipowner. Where, in intermediate cases, the shipper is a person other than the charterer, the bill of lading may, according to the terms of the charter, bind the shipowner or the charterer.

Charter-parties.—Charters (apart from the unusual form amounting to a demise of the ship) are entered into for a voyage (or series of voyages) or for a period of time. A voyage charter commonly provides that the ship, as described, shall proceed to a named place, and there load a cargo, and shall then proceed to a named place of discharge, where the cargo is to be delivered. Freight is to be paid in a lump sum, or at a rate named on the cargo carried, or calculated in some other way. The number of days within which the charterers are to load and discharge (called lay days) is specified, and also a rate for demurrage should the ship be longer detained, with provisions to apply in the event of stoppages occurring. "Days" in a charter is understood to mean calendar days of 24 hours commencing at midnight. Sundays and holidays are included unless expressly excepted. "Working days" means all days on which work is ordinarily done at the port, excluding Sundays and holidays. Provisions as to time are frequently expressed in hours instead of days. Further clauses deal with issue of bills of lading, exceptions from liability, discharge of cargo, payment of freight, general average, ceasing of charterer's liability, brokerage, etc.

By a time charter the ship is hired to the charterers for a specified time, commencing on a certain date, when the ship is to be placed at the disposal of the charterers, at some specified place, or place to be named, to be employed in lawful trades between certain limits. The clauses deal with various matters in connection with the employment of the ship, such as payments for stores, provisions, wages, insurance, fuel, port and other charges, the appointment and giving of directions to the master of the ship, stevedoring, exceptions from shipowner's liability, arbitration, etc. A number of common forms of charter are in use containing clauses adjusted to the requirements and conditions of particular trades.

In determining the effect to be given to a charter it may be necessary to take into consideration along with its express terms other terms which, as already explained, are implied by law. Thus if a charter contains no express provision as to seaworthiness there is underlying the contract, and implied and involved in it, a warranty by the shipowner that the ship is seaworthy. The special meaning attached to this word is that the ship shall have that degree of fitness which an ordinarily careful and prudent owner would require his ship to have at the commencement of her voyage, having regard to all the probable circumstances of it. Not only must the ship be tight, staunch and strong, but also fit for the carriage of the particular kind of cargo to be carried. This implied absolute warranty of sea-

worthiness is fulfilled if the ship is seaworthy when she leaves her moorings, and does not include any undertaking that the ship shall continue seaworthy; but where the voyage is in stages the ship must be fit for each stage when entered upon.

There may also have to be taken into consideration, in construing a charter, trade usages or customs with reference to which the parties are presumed to have made their contract. The express terms often refer to custom (which in a charter means a settled and established practice of the port), and they may be explained by evidence of usage or custom short of alleging anything inconsistent with them. For example, stipulations as to loading or discharging cargo in a port may be thus construed. Evidence of custom may be given to explain the meaning of working day at the port.

When a ship has reached the place (under a voyage charter) she is to be ready to load, and is ready to load, and the charterers have been notified of this, the ship is an arrived ship and the lay days (for loading) begin to run.

Subject to any express or implied qualification, a charterer undertakes absolutely to furnish a cargo. When he fails to furnish a full cargo the damages which the shipowner is entitled to recover for this breach of contract are called dead freight. It is the duty of the master of the ship on behalf of the owner to receive and properly stow on board the cargo to be carried, which ordinarily is to be delivered to him alongside, but this duty may be subject to modification by custom or contract.

Should a ship be detained beyond the lay days the charterer will become liable to pay for the detention. If the basis for payment has been agreed by the charter the payment is known as demurrage. If it has not been agreed or if the charter refers to a fixed number of demurrage days which has been exceeded, then the payment, or part of it, will be damages for detention, the rate of which may have to be ascertained and may be different from the demurrage rate.

A common provision in a charter is the cesser clause, which is to the effect that the charterer's liability shall cease on the shipment of the cargo to the extent to which the charter gives the shipowner a lien. Under common law the shipowner's lien on the cargo is in respect only of freight and general average contributions. The cesser clause ordinarily confirms this, and gives a lien for demurrage, and sometimes also for dead freight.

Bills of Lading.—Though either a charter or a bill of lading or both together may express the terms of a contract, the transactions in which no bill of lading is issued are few, because the bill of lading, in addition to its primary purpose of expressing terms of contract, serves in commerce as a transferable document of title representing the goods to which it relates. Where the charterer is also the shipper, the bill of lading, as between shipowner and charterer, is regarded as no more than a receipt which does not alter the contract contained in the charter. It is merely a receipt until used by the charterer as a transferable document of title, *i.e.*, until negotiated. Where the shipper is a person other than the charterer, the bill of lading is the evidence of the contract and does not, except by plain words, incorporate or impose on the shipper the obligations of the charter. Where the shipper (whether he is the charterer or not) has indorsed the bill of lading to a holder for value, the bill of lading is the only evidence of the contract.

Apart from statutory limitations on freedom of contract presently to be referred to, a common form of bill of lading (as set out in Carver, *Carriage of Goods by Sea*), was as follows:—

"Shipped, in good order and condition, by....., in and upon the good ship called the....., whereof..... is master for this present voyage, now riding at anchor in the port of....., and bound for..... (description of goods) marked and numbered as in the margin, and are to be delivered in the like good order and condition at..... aforesaid (the act of God, the king's enemies, fire, and all and every other dangers and accidents of the seas, rivers, and navigation of whatever nature and kind soever excepted), unto....., or

to his assigns, he or they paying freight for the said goods at the rate of with primage and average accustomed. In witness whereof, the master or agent of the said ship hath affirmed to bills of lading, all of this tenor and date, the one of which bills being accomplished the others to stand void.

"Dated in the day
of
"(Signed)"

Many "negligence clauses" (exceptions from liability formerly inserted to protect sea carriers) have disappeared from bills of lading as a result of legislation. In the United States the Harter act was passed in 1893. It requires the exercise of due diligence properly to equip the ship and make it seaworthy, and, subject to this being done, gives exemption from navigation risks as distinguished from carrier's risks which the act compulsorily imposes on the carrier by prohibiting the insertion in any bill of lading or shipping document of any clause whereby obligations carefully to handle and stow the cargo and to care for and deliver the same may be lessened, weakened or avoided. Similar legislation was afterward passed by some of the British dominions.

More recent legislation has attempted to define by its express terms the liabilities as well as the immunities of the carrier. The Carriage of Goods by Sea act, 1924, was formulated in this way. Scheduled to it is a series of rules which are in effect standard clauses to be deemed part of the terms of bills of lading. This act is applicable to these documents when issued in Great Britain or Northern Ireland. Similar legislation has been passed in Australia, India, most of the British colonies and Belgium.

The Carriage of Goods by Sea act requires that (subject to limited exceptions) the bill of lading shall expressly incorporate as part of its terms the provisions of the rules scheduled to the act. These impose on the carrier an irreducible minimum of responsibility for the safe carriage of the goods.

Though the act thus defines the carrier's liabilities, it does not (except in the case of the implied absolute undertaking to provide a seaworthy ship) expressly exclude the implied obligations referred to above. Though an alternative basis of liability is expressly laid down, the question apparently might arise whether those obligations (other than that of seaworthiness) still exist underlying the contract and implied and involved in it. In any event the compulsory minimum of responsibility is a protection to third persons (such as endorsees) who, though not parties to the contract, may be affected by it, as well as to shippers.

As the rules scheduled to the act become part of the terms of British and Belgian bills of lading they are important, but it is not practicable to give here more than a summary.

Under the definitions in article I "Goods" includes articles of every kind except live animals and deck cargo and "carriage of goods" covers the period from the time when the goods are loaded on to the time when they are discharged from the ship.

By article II the carrier is subject to the responsibilities and liabilities, and entitled to the rights set forth in the rules.

The carrier's responsibilities and liabilities detailed in article III are to exercise due diligence to (1) make the ship seaworthy, (2) properly man, equip and supply the ship, (3) make the holds fit and safe for goods. He must also properly and carefully load, handle, stow, carry, keep, care for and discharge the goods, and issue a bill of lading showing certain particulars of quantity and condition of goods. This document becomes *prima facie* evidence of receipt by the carrier of the goods as therein described. Unless notice of loss or damage is given on delivery (or, if not apparent, within three days) delivery is *prima facie* evidence of delivery and, in any event, carrier is discharged from all liability unless suit is brought within one year. Nothing may be added lessening carrier's liability, but clauses increasing it are allowable, e.g., clause making bill of lading *conclusive* evidence of shipment.

Article IV relieves the carrier from liability for loss or damage resulting from (1) unseaworthiness, unless caused by want of due diligence, (2) a number of specified perils (e.g., act or neglect of the servants of the carrier in the navigation or in the management of the ship, fire, perils of the sea, act of God, etc.) which

are mostly perils arising without the actual fault or privity of the carrier. Reasonable deviation is allowed. The carrier is not liable for loss or damage to goods in an amount exceeding £100 per package or unit unless value is declared before shipment and inserted in bill of lading.

Under the form of bill of lading set out above the goods are to be delivered to a named person "or to his assigns." A document in this form is by English law a negotiable instrument, in the sense that it is transferable by indorsement and delivery. A bill of lading may be indorsed by the person named in it (the shipper or the consignee) either in blank, by a simple signature on the back, or specially by indorsing and signing a direction to deliver to some other person or order. The indorsee may then transfer by indorsing in blank or specially. If indorsed in blank, or made out to a name left blank, or to bearer, a bill may be dealt with by mere delivery.

The indorsement and delivery of a bill of lading transfers such property as it was the intention of the parties to the indorsement to transfer, and, by the Bills of Lading act, 1855, also transfers to the indorsee, to whom the property in the goods passes, the rights and liabilities of the shipper under the bill of lading. A pledgee is however not an indorsee to whom the property passes, and does not incur liabilities unless he takes delivery of the goods.

Performance of the Contract.—Reference has already been made to the implied undertakings by the carrier that he will proceed on the voyage with reasonable dispatch and without unnecessary deviation, and to the doubt whether these obligations still underlie the contract where a bill of lading has been issued subject to the statutory rules.

To complete the voyage the sea carrier should, if necessary, repair the ship, or tranship the cargo in order that it may be forwarded to its destination.

If necessary for the common safety a shipmaster may jettison cargo properly stowed. Any such extraordinary sacrifice or expenditure intentionally and reasonably made or incurred for the common safety, for the purpose of preserving from peril the property involved in a common maritime adventure, is a general average act. Damages, losses and expenses which are the direct consequence of a general average act are borne by ship, freight and cargo as contributing interests. The contributions are adjusted by a general average statement. If, as is commonly the case, the charter or bill of lading incorporates by reference the York-Antwerp rules, 1924, the adjustment is made as provided by those rules. (See further as to this under AVERAGE.)

Should the contract prove impossible of performance owing to circumstances which were unforeseen, and to which no provision in the contract is applicable (in particular where circumstances arise from the occurrence of war or in some other way, involving such delay as to frustrate the commercial purpose of the adventure) the contract may be held by the court to have come to an end by virtue of a provision implied in it. Cases of this kind are, of course, quite different from those where the contract, when made, cannot be performed without breaking the law. It is then void from the beginning for illegality.

Under the contract the ship is bound to proceed (unless prevented by an excepted peril) to the agreed place of discharge. On the ship's arrival there the charterer or consignee is bound to take delivery. Unless, under express provision, or by custom, notice of arrival is to be given, none is required. In the case of goods imported from abroad into Great Britain, if the owner of the goods fails to make entry of them at the customs, or to take delivery, the goods may, under and subject to compliance with the provisions of the Merchant Shipping act, 1894, sections 492-501, be landed and warehoused. Delivery should not be made except to a person producing a bill of lading making the goods deliverable to that person. By custom, bills of lading are made out in sets, usually of three copies, but the carrier is justified in delivering to the first person producing a bill of lading making the goods deliverable to him, if without notice or knowledge of anything making it wrong to do so.

If goods are carried to the place where the voyage is to end, and, though damaged, are in a merchantable condition and ready

for delivery, freight is payable. For delivery short of destination no freight is due unless the parties have taken steps justifying the conclusion that they intended to make a fresh contract whereby the owner of the goods has agreed to accept the goods at an intermediate port. English law in this respect differs from some continental laws under which proportional distance freight is payable. For short delivery at destination pro rata freight is payable. The carrier is entitled to a lien for freight payable on delivery. This is a possessory lien entitling him to withhold delivery until payment. It extends also to a general average contribution and to expenses incurred in the protection and preservation of the goods. If expressly so provided by the contract, the lien may extend to other matters, e.g., demurrage, damages for detention and dead freight.

See T. G. Carver, *Carriage of Goods by Sea* (1925); T. E. Scrutton, *Charter-parties and Bills of Lading* (1925). (S. D. C.)

AFFRETTANDO (Ital.), a musical term having just the same significance as *accelerando*, i.e., a quickening of the tempo or speed, but with a suggestion of hurry and agitation in addition.

AFGHANISTAN, a country of Asia. Estimated area is 245,000–270,000 sq.mi. Pop. (est. 1938) 7,000,000. It is bounded on the north by Russian Turkistan, on the west by Iran and on the east and south by Chitral and the northwestern provinces of India including Baluchistan. Surveys from 1872 to 1935 delimited this frontier which was accepted by the present (1945) government of Afghanistan. A portion of the southeastern frontier has

not been demarcated.

Boundaries.—From the town of Zulfikar on the Hari Rud river the boundary between Afghanistan and Russia is roughly parallel to the Paropamisus, and about 35 mi. N. of it, till it strikes the Kushk river at Chahil Dukhteran a few miles from the Russian post of Kushk, the terminus of the branch railway from Merv. From Chahil Dukhteran the boundary runs northeast, crossing the Murghab river near Maruchak (an Afghan fortress), and passing through the hills of the Chul, and the undulating deserts of the Alei Turkmen, to the Oxus (Amu Darya), leaving the valleys of Charsamba and of Andkhui (to which it runs approximately parallel) within Afghan limits. These valleys define the limits of cultivation in this direction. Throughout this region the boundary is generally marked by pillars, but here and there local water partings or watercourses are used. The boundary meets the Oxus at Khamiab at the western extremity of the cultivated district of Khwaja Salar and from that point to the eastern end of Lake Victoria in the Pamirs the Oxus river forms the northern limit of Afghanistan. (See Oxus.) Eastward from Lake Victoria the frontier was determined by the Pamir Boundary commission (1895). A part of the little Pamir is Afghan, but the boundary crosses this Pamir before the great bend northward of the Aksu takes place, and passing over a series of crags and untraversable mountain ridges, is lost on the Chinese frontier in the snowfields of Sarikol. Bending back westward the frontier now follows the water parting of the Hindu Kush; and as the Hindu Kush abso-



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THE LAND OF THE AFGHANS HAS BEEN SUCCESSIVELY, IN ITS LONG AND INTERESTING HISTORY, A CONGERIES OF PETTY STATES, THE CENTRE OF GREAT EMPIRES RULED BY FOREIGNERS AND A DISMEMBERED COUNTRY, FURNISHING PROVINCES TO THREE MONARCHIES. IT IS NOW AN INDEPENDENT SOVEREIGN STATE RULED BY A KING. AS A COUNTRY FROM WHICH THE KHYBER PASS GIVES ADMISSION TO INDIA, AFGHANISTAN HAS ALWAYS POSSESSED A STRATEGIC IMPORTANCE IN EASTERN AFFAIRS

lutely overhangs the Oxus nearly opposite Ishkashim, it follows that, at this point, Afghanistan is about 10 mi. wide. Thus a small high portion of the state extends eastward from its northeastern corner and is attached to the great Afghan quadrilateral by the thin link of the Panja valley. These narrow limits (called Wakhan) include the lofty spurs of the northern flank of the Hindu Kush, which in this area is traversed by a number of high and difficult passes, the lowest and best known of which is the Baroghil (12,460 ft.). The backbone or main water divide of the Hindu Kush continues to form the boundary between Afghanistan and the North-West Frontier province of India until it reaches Nuristan. From near the Dorah pass (14,800 ft.), which connects Chitral with the Afghan province of Badakshan, a long straight, snow-clad spur reaches southward, which divides the Nuristan valley of Bashgol from that of Chitral, and this continues to define the eastern limits of Afghanistan till it nearly touches the Chitral river opposite the village of Arnawai, 45 mi. south of Chitral. Here the Bashgol and Chitral valleys unite and the boundary passes to the water divide east of the Chitral river; along this water divide it extends to the Nawa Kotal. From here to Palosai on the Kabul river the exact line is (1946) undetermined. From Palosai the line runs due south till it reaches the hamlet of Torkham at the western extremity of the Khyber pass. It then turns west following the main ridge of the Morgha and Safed Koh ranges which divide Afridi Tirah from the Eastern province, and then, rounding off the cultivated portions of the Kurram valley below the Peiwar, it crosses the Kaitu and passes to the upper reaches of the Tochi. Crossing these again, it is continued on the west of Waziristan, finally striking the Gomal river at Domandi. From Domandi (the junction of the Kunder river with the Gomal) the Afghan boundary marches with that of Baluchistan. (See BALUCHISTAN.) It is carried southwest mainly along the Kunder and Kadanai to a point beyond the Sind-Peshin terminal station of New Chaman, west of the Khojak range, and then drops south to Shorawak and Nushki. From Nushki it crosses the Helmand desert, touching the crest of a well-defined watershed for a great part of the way and, leaving Chagai to Baluchistan, it strikes nearly west to the Iranian frontier, and joins it on the Koh-i-Malik Siah mountain, south of Seistan.

From Koh-i-Malik Siah the boundary with Iran runs northeast till it reaches the Helmand river which it follows northward, leaving the town of Nasratabad (Nasirabad) and the Hamun to Iran. It then bends to the west as far as the Siah Koh mountain. Thence it runs through desolate country in a generally north-northwesterly direction till it turns for a short space northeast so as to leave the important valley of Yazdan within the Iranian frontier. It then turns northwest to the Namaksar (salt lake) which it crosses, and veers northeast across the Hashtadan plain to join the Hari Rud at the point where this river bends north. The boundary then follows the course of the Hari Rud to Zul-fikar.

Principal Features.—The dominant feature of Afghanistan is the great central range of mountains which divides the country approximately from east to west. This range, known in its eastern portion as the Hindu Kush, takes off from the Little Pamir in the extreme northeast, and after forming the boundary between Chitral and Afghanistan to a point south of the Dorah pass turns westward, and spreads across central Afghanistan in a series of deep ravines and broken ridges gradually diminishing in height from the eastern peaks of 24,000 ft. Opposite Kabul and some 150 mi. to the north of it, the main ridge is about 20,000 ft. in height. Farther west it spreads out fanwise in a series of subsidiary ranges, such as the Paghman range (16,000 ft.), while the main ridge continues westward under the names of the Koh-i-Baba (15,000 ft.), the Band-i-Baian (13,000 ft.) and the Band-i-Baba (12,000 ft.), and finally the Paropamisus mountains which continue as a series of low ridges in a northwesterly direction till they reach the valley of the Hari Rud.

Round the central structure the country is divided into four main divisions depending on the four principal river systems. In the north the high pastures of Badakshan descend to the valley of the Oxus and the rich lands of Afghan Turkistan with its principal

city, Mazar-i-Sharif. In the west the valley of the Hari Rud contains the city of Herat and the fertile surrounding country. In the southeast the valley of the Helmand and its tributaries water the city of Kandahar and the country to the north and east. In the centre and east the Kabul river system, which includes among its tributaries the Logar, Panjshir and Kunar rivers, waters the Kabul plateau, the rich valleys of Chardeh and Koh-i-Daman, and at a lower altitude the country of the Eastern province round Jalalabad. Subsidiary to these main divisions are the valley of the Murghab river in the northwest, and the area round the headwaters of the Kurram, Tochi and Gomal rivers in the southeast.

Climate.—Three main traits are characteristic; namely, extremes of temperature (both seasonal and diurnal), wind and dryness, in respect to which elevation rather than latitude is the chief deciding feature. In the north the valley of the Oxus has a temperature which may rise to 112° F. in the summer, while in Kabul and Ghazni on the southern side of the main range the maximum shade temperature rarely rises above 100° F. The minimum temperature in these areas falls as low as -10° to -15° F. in February. At Kandahar and Jalalabad on lower levels the variation is between 110° and 15° F. In the north the daily variation of summer temperature exceeds 30° F.

The heat of summer is aggravated by hot winds, particularly on the western frontier from Herat to Seistan where a wind with a velocity which reaches 110 m.p.h. blows continuously from June to September. In winter periodic blizzards from the northwest bring heavy falls of snow at altitudes of more than 5,000 ft.

The average yearly rainfall is 11 in., the greater part of which falls between December and April. An occasional shower falls in summer, but the influence of the southwest monsoon hardly extends to Afghanistan.

Generally speaking the climate is good. At altitudes in the neighbourhood of 6,000 ft. the spring and autumn are particularly fine, with clear cool days and nights and a dry invigorating atmosphere.

Flora and Fauna.—On the main ranges at 6,000 to 10,000 ft. grow large forest trees, among which conifers are most prominent, such as *Cedrus deodara*, *Abies excelsa*, *Pinus longifolia*, *P. pinaster*, *P. pinex* (the edible pine) and the larch. Yew, hazel, juniper, walnut, wild peach and almond are also found. Growing under the shade of these are several varieties of rose, honeysuckle, currant, gooseberry, hawthorn and luxuriant herbage, the Ranunculaceae being abundant and rich in genera. The lemon and wild vine are commonest on the northern mountains. The walnut and oak (evergreen, holly-leaved and kermes) descend to the secondary heights, where they become mixed with alder, ash, khinjak, *Arbutus*, juniper, *Indigofera* and dwarf laburnum, with species of *Astragalus*, etc. Lower again and down to 3,000 ft. grow wild olive, species of rock-rose, wild privet, acacias and mimosas, barberry and *Zizyphus*; and, in places, *Chamaerops humilis* (which is applied to a variety of useful purposes), *Bignonia* or trumpet flower, sissu, *Salvadora persica*, verberna, acanthus, varieties of *Gesneria*. The lowest terminal ridges, especially toward the west, are naked in aspect. Their scanty vegetation is almost wholly herbal; shrubs are only occasional; trees almost nonexistent. Labiate composite and umbelliferous plants are most common. Ferns and mosses are almost confined to the higher ranges. On the dreary Kandahar tablelands grow many vigorous plants, such as papilionaceous *Leguminosae*, and the camel-thorn (*Hedysarum alhagi*), *Astragalus* in several varieties, spiny rest-harrow (*Ononis spinosa*), the fibrous roots of which often serve as a toothbrush; plants of the subfamily *Mimosa*, such as the sensitive mimosa; a plant of the rue family, called by the natives *lipad*; the common wormwood; also certain orchids, and several species of *Salsola*. Rue and wormwood give domestic medicines—the former for rheumatism and neuralgia; the latter for fever, debility and dyspepsia, as well as for a vermifuge. The *lipad*, of heavy nauseous odour, is believed to keep off evil spirits. On some sides and hollows of ravines are found rose-bay (*Nerium oleander*), called in Persian *khar-zarah*, or assbane, wild laburnum and various *Indigofera*. The chief cultivated trees are mulberry, willow, poplar, ash and occasionally the plane.

Of commercial value is the gum resin of *Narthex asafoetida* of the high and dry plains of western Afghanistan, especially between Kandahar and Herat. In the highlands of Kabul edible wild rhubarb is an important local luxury. Walnut and edible pinenut are both wild growths, which are exported. The *sanjit* (*Elaeagnus orientalis*), common on the banks of watercourses, furnishes an edible fruit. The dried tuber of a mountain orchis affords the nutritious mucilage called *salep*; a good deal of this goes to India. *Pistacia khinjuk* affords a mastic. The true pistachio is found only on the northern frontier; the nuts are imported from Badakhshan and Kunduz. Mushrooms and other fungi are also used as food.

Wild animals include the wolf, fox, hyena, wild dog, wild cat, common leopard, mongoose, wild sheep, mole, shrew, hedgehog, bats, several species of jumping mouse, jerboa and pica hare.

Bears are found in the forests and the Mongolian tiger inhabits the thick reed country of the Oxus.

Of the goat family the markhor, orial and ibex are found in the central ranges, while the wild sheep, ovis poli and ammon inhabit the Afghan Pamirs. Two types of deer are said to exist.

There are said to be 124 specimens of birds including several varieties of pheasants, duck, teal, cranes, pelican, snipe, partridge and chikor. Smaller birds include the golden oriole, magpie, bulbul, swallow, quail and sparrow. Brown trout (*Salmo oxienensis*) are plentiful in some of the rivers of the Oxus basin; mahseer and snow trout (*chush*) are found in the rivers of the Indus watershed.

Agriculture and Animal Husbandry.—Afghanistan is mainly a pastoral country. Of a total area of about 270,000 sq. mi. probably not more than 20,000 sq. mi. are under cultivation. The remainder consists of desert land in the south and south-east, and of highland country providing seasonal grazing throughout the year. On the whole the soil is fertile, particularly in the wide loess plains north of the Hindu Kush and in the eastern and southern areas. In these places and along the valleys wherever irrigation is possible good crops are obtained. Irrigation is carried out by means of a network of channels, often many miles in length, and sometimes subterranean (*karez*), and attention has been directed by the government to the construction of irrigation dams to conserve flood waters, and of canals. Dry farming is also practised in certain areas.

The principal crops are wheat, the staple food of a large portion of the inhabitants, rice particularly in the valleys, barley and lucerne for fodder, sugar beets, Indian corn, millet, lentils and mustard seed. Vegetables are extensively cultivated and include potatoes, carrots, turnips, onions, chillies, tomatoes, sugar cane, peas and cabbages.

Horticulture is largely practised, particularly around Kabul and Kandahar where the Sardas melon is famous. Grapes of many varieties and excellent quality are exported in large quantities to India. Other fruits include all well-known European varieties. The mulberry is grown extensively and in some localities forms the staple food of the inhabitants. Dried and crushed with walnuts it is made into a cake (*tulchan*) and stored for winter use.

Domestic animals include sheep of which immense flocks are to be found. The northern variety are famous as the producers of the Afghan lambskin (*karakul*). Cattle of various types are also kept in large numbers; horses, of which the northern variety (Turkoman) is the best known; donkeys, extensively used for light transport; camels of two types for heavy transport, goats and poultry.

The principal wealth of Afghanistan lies in the flocks and herds which roam the great pasture lands below the mountains. From the pastures around Andkhui come the highest quality lambskin or astrakhan, while the southern sheep provide wool, mutton and melted butter (*ghi*). The cattle are kept chiefly for milk and also provide a considerable quantity of skins and hides.

Minerals.—A complete geological survey of Afghanistan still (1946) remains to be carried out. The following are the principal minerals known to exist.

Extensive coal-bearing strata have been located and surveyed in the area south of Haibak and between it and Ishpushta on

the north road. The exploitation of this deposit which runs into many millions of tons and is said to be of good quality is hampered by the difficulties of the mountainous country in which it is situated. A survey of the country in 1937-38 disclosed favourable indications of petroleum beds in the northern provinces which, however, have proved unattractive to oil companies because of their distance from the sea. Large deposits of rock salt are worked in northern Afghanistan, while brine deposits at Andkhui and Herat supply the western part of the country. Reports of the reopening of the former gold mine near Kandahar have hitherto proved false, but alluvial deposits of gold are said to exist in the bed of the Oxus and elsewhere. Silver is reported in Hazarajat; the silver mines in the Panjshir valley are no longer worked. Large deposits of iron ore have been found on the southern side of the Hindu Kush in the Ghorband valley, and there are occurrences of lead ore elsewhere. Sulphur, gypsum and alabaster are all to be found in some quantity in the area of the Kamard valley on the northern slopes of the Hindu Kush. There is a ruby mine on the Jagdalak pass east of Kabul, while lapis lazuli of high quality is found in Badakhshan, though the mine has not been worked for some years.

People.—The term Afghan really applies to one section only of the people, but this is the dominant section known as the Durani. The Ghilzai (almost as powerful as the Durani) are believed to be of Turkish origin; the Hazaras, the Chahar-Aimak, Tajiks, Uzbeks, Nuristanis and others are more or less subject races. Popularly any inhabitant of Afghanistan is known as Afghan on the Indian frontier without distinction of origin or language; but the language division between the Parsiwan (or Persian-speaking Afghan) and the Pathan of the Indian frontier is a very distinct one. All upper-class Afghans speak the Persian language. The predominance of the Afghan in Afghanistan dates from the mid-18th century, when Ahmad Shah carved out Afghanistan from the previous conquests of Nadir Shah and called it the Durani empire.

The Durani Afghans claim to be Ben-i-Israel, and insist on their descent from tribes carried away captive from Palestine to Media by Nebuchadrezzar. Yet they also claim to be Pukhtun (or Pathan) in common with all other Pushtu-speaking tribes, whom they do not admit to be Afghan. The bond of affinity between the various peoples who compose the Pathan community is simply the bond of a common language. All of them recognize a common code or unwritten law called Pukhtunwali, which appears to be similar in general character to the old Hebraic law, though modified by Mohammedan ordinances, and strangely similar in some points to Rajput custom. Besides their division into clans and tribes, the whole Afghan people may be divided into dwellers in tents and dwellers in houses; and this division is apparently not coincident with tribal divisions, for of several of the great clans at least a part is nomad and a part settled. Such is the case with the Durani and with the Ghilzai.

Dominant Stock.—Afghans have fine figures, aquiline profiles, fair complexions and a small group yielded an average cephalic index of 74.8, a value nearer to that found among Rajputs in Indian than to that among the Pukhtun (Pathan) groups (av. ceph. ind. 80-83) of the Indian frontier or to that among some of the subject peoples. Among the latter, the Hazaras are tall, very broadheaded (av. ceph. ind. 85.0) and akin in feature to peoples of parts of Turkistan and Mongolia; they are said to have been planted in Afghanistan by Jenghiz Khan, and they inhabit especially the mountains west of Kabul. The Tajiks are as broadheaded as the Hazaras but belong to the pale rosy-skinned rather than to the yellow-skinned stock; they seem to be an old-established, settled, agricultural people.

Tribal law, with the custom of hospitality, and the vendetta in many forms are rules of life, and even the settled Afghan is very much a soldier. They have great power of endurance, and are frequently lawless and fanatical. But their character is lightened by a sense of humour, and a ready wit and courtesy which makes them pleasant to deal with, though in business affairs poverty has made them often avaricious and hard bargainers. Among their rulers are to be found men of fine character and discrimination

who are essaying the task of civilizing a difficult people with some success.

The cultivators, including owners, tenants, labourers and slaves, are skilled irrigators, utilizing every fragment of profitable land; some of the Ghilzai are specially skilled in building underground water channels (*karez*). The settled folk live chiefly in village communities and leave handicraft and commerce largely to subject races save that some Ghilzai are wandering traders (*powindaks*). Afghanistan is a stronghold of Islam, of the Sunni sect for the most part, though the Hazaras and others are Shiah. The last stronghold of idolatry, Kafiristan, to the north of Jalalabad was subdued in 1895 and the people converted to Islam, their country's name being changed to Nuristan, or "Land of Light." Some of the Durani Afghans of Kandahar and Zamindawar districts are very fanatical "Ghazis," that is, men who have vowed their lives to the extinction of other creeds.

Language.—Pushtu, the language of the Pathans, is spoken by about one-third of the population, and principally in the eastern and southern areas. It belongs to the Aryan subdivision of the Indo-European group of languages, and is divided into two main divisions, the soft dialect spoken in the Kandahar area and the hard spoken by the eastern tribes. An endeavour is being made to convert it into the national language, but difficulties of vocabulary and pronunciation tend to preserve as the official language a somewhat archaic form of Persian which is spoken at court, and widely used by Tajiks, by the Mongols of Hazarajat and other non-Pathan inhabitants of central Afghanistan. Turki is spoken by the Uzbeks and other tribes of Turkish origin to be found in northern Afghanistan. Pushtu has no literature in the accepted sense of the term. A Khattak chief of the 17th century, Khushal Khan, wrote ballad poetry of a virile type, and at different times after that there have been Afghan verse writers. A collection of songs of the Afghans is in existence but these verses possess little artistic merit.

Administration.—Until the accession of Amanullah in 1919 the government of the country was an absolute monarchy. After that time a system of democratic government was evolved, but evolution was inevitably slow in so backward a country and much power still rests in the hands of the king and his immediate advisers.

The administration is carried on by a national council (*Majlis-i-Shura-i-Milli*) composed of approximately 110 members elected from the various provinces at three yearly intervals, and by a house of nobles (*Majlis-i-Aiyan*) of 45 persons appointed by the king. The executive body is the cabinet consisting of the prime minister and 14 other ministers, and includes a minister for national defense, interior, foreign affairs, justice, commerce, revenue and education. In addition there is a national assembly (*Loe Jirga*) consisting of more than 1,000 delegates from all provinces which meets only at times of great national emergency.

For administrative purposes Afghanistan is divided into seven major and two minor provinces, Kabul, Kandahar, Herat, Mazar-i-Sharif, Eastern province, Southern province and the Kataghan and Badakshan province. The minor provinces are Farah-Chakansur and Maimana. Each province is in charge of a governor and is subdivided into districts (*Hakumat*). The governor is assisted by local officials in charge of revenue, justice, communications, health and so on. The ten larger towns are controlled by municipal committees under a president (*Rais-i-Baladiyah*).

All Afghan subjects and foreigners of non-diplomatic status are subject to Mohammedan religious law (*Shariat*). A code of laws is in existence but its provisions are complicated and not easily understood by the general public. The courts range from the police (*Haquq*) court to the high court of appeal (*Tamiz*). Punishments vary from the death sentence which requires confirmation by the king to fines.

No budget of national income and expenditure is published but the annual revenue is believed to be in the neighbourhood of \$16,000,000. The main sources of revenue are land taxes and customs duties.

After 1931 primary education was compulsory. Secondary

schools were established in the main centres, while for higher education Afghanistan still relies on the universities of India and other foreign countries to which selected students are sent each year.

Communications.—There are no railways in Afghanistan. Main roads connect the principal centres of the country and link up with the Indian road system at Torkham and Chaman, and with Iran at Islam Kila west of Herat. A road driven through the passes of the Hindu Kush to connect Kabul directly with the northern provinces was opened in 1933. The main roads though usually metalled and fit for wheeled traffic are rough and often impassable through snow in the winter months. A system of fairweather secondary roads was being developed throughout the country in 1946. There is no regular air service in Afghanistan. The Russians maintain an irregular air service for the conveyance of mail and diplomatic personnel, while a service connecting Kabul with Berlin was operated for a short time in 1938–39 by the Luft-Hansa company.

Afghanistan is a member of the International Postal and Telegraph union. Post offices have been established in the principal towns and regular motor mail services are in operation. A telegraph and telephone system links the provinces with the capital, while a world-wide radio installation connects Kabul with the outside world.

Commerce and Industry.—The plan for the economic development of Afghanistan adopted by Nadir Shah and his advisers in 1932 was based on the partial industrialization of Afghanistan. This plan included the installation of hydroelectric works, the erection of textile factories, of machinery for the extraction of sugar from beet and of cotton ginning and other plants. The principal object of these schemes is to enable Afghanistan to be self-supporting so far as possible in certain essential commodities, and so avoid the necessity for extensive importation of basic requirements. At the same time state-controlled companies have been formed to regulate the purchase and sale of the principal imports and exports, while the financial equilibrium of the state is maintained by the establishment of a national bank with branches at home and abroad.

The principal export commodities are the Afghan lambskin, of which more than 1,000,000 are exported annually; wool; cotton; fruit, both fresh and dried; nuts; hides and skins; cattle felts; sheepskin coats (*postins*); carpets; asafoetida; and timber. Imports consist principally of textiles, piece goods, sugar, petroleum products, machinery, hardware and manufactured rubber goods.

The greatest volume of trade is with India and Russia except for the export of lambskins, the principal market for which was (1945) the United States.

Archaeology.—There is an extensive field for archaeological research in Afghanistan. A French archaeological mission enjoyed a monopoly of research after 1922, and did much valuable work among the Buddhist remains at Hadda near Jalalabad, at Bamian, where the famous giant statues of Buddha cut in the cliff face still stand, and around Kabul. Their discoveries include a remarkable find in 1938 at Begram, site of one of Alexander's cities, and subsequently a principal city of the Kushan empire. But much remains to be done. The ruins of Balkh (Mother of Cities) near Mazar-i-Sharif, and once a great entrepôt for trade between China and the west, are still untouched, the Sasanian cities of Seistan still lie half buried in the sand, and Mahmud's great city of Ghazni awaits excavation. In addition there are many areas in Wakhan on a branch of the old silk road, on the Indian frontier and in the valleys of the Hindu Kush which have yet to be explored (1945).

The Armed Forces.—The organization of the army is based on a scheme formulated in 1917 for an establishment of six corps with headquarters at Kabul (two corps), Jalalabad, Matun, Herat and Mazar-i-Sharif. Additional corps or divisions are now located at Kandahar, Ghazni, Urghun, Khanabad and Gardez. Recruitment is on a voluntary basis with some element of compulsion since quotas are allotted to areas. The total strength of the army in 1939 was about 60,000, but was raised during the

World War II period, chiefly by the recall of discharged men. It is probable that in the event of war, numbers could be raised to 100,000 with 300,000 to 400,000 armed levies. The forces are armed with modern weapons including a few tanks. Military schools under Turkish supervision are in operation. A certain amount of motor transport was purchased to increase the mobility of the army, and reorganization is in progress with the object of providing a central reserve at headquarters from which a mobile striking force could be furnished to support provincial troops.

A small air force is in existence and provides a useful means of carrying out reconnaissance in a country where communications are difficult and of overawing unruly tribesmen.

The king is head of the armed forces, and is advised by a minister of national defense, who is also commander in chief.

HISTORY

The geographical term Afghanistan ("land of the Afghans") is an anachronism as applied to the country before 1747, when it first became a separate and independent state, and though it is now the official name of the kingdom it is not in common use among the Afghans.

The Afghan chroniclers call their people *Ben-i Israil*, or "Children of Israel," and claim for them descent from King Saul, whom they call *Tālūt*, through a son named Jeremiah, who is said to have had a son named Afghana; but this legend assumes so many conflicting and improbable forms that it may be safely regarded as a late invention. According to one account Afghana was settled by Sulaiman (Solomon) in the Sulaiman mountains, and according to another, evidently connected with the account of the captivity of the Ten Tribes, his descendants were removed from Palestine by Nebuchadrezzar and found their way to the mountainous country about Herat. Another legend related that in pre-Islamic times Bilo (father of the Biluchis), Uzbak (father of the Uzbaks) and Afghana were considered as brethren. The historian Firishta cites a legend which makes the Afghans Copts, of the race of pharaoh; and the Afghans explain their conversion to Islam by a story to the effect that nine years after Mohammed's announcement of his mission a holy man named Kais, sent to Medina to make inquiry of him, became a zealous Moslem and on his return converted his countrymen, adding that all true Afghans are descended from Kais and his three sons, but ignoring the other descendants of Afghana. Omitting the legend which attributes to the Afghans a Coptic descent we find the grandson of King Saul made contemporary with Mohammed Uzbak Khan, who flourished in the 14th century, as well as with King Solomon; and Kais, whose name suggests Kish, Saul's father, made contemporary with the prophet Mohammed.

Despite these and other discrepancies some intelligent British officers, well acquainted with the Afghans, have accepted the story of their Hebrew descent. Their belief has been based on certain Afghan customs and on the fancied resemblance of a well-known type of Afghan physiognomy to the physical characteristics of the Jews; but the Afghans, as Moslems, have many customs similar to those of the Hebrews, and they share their physical resemblance to the Jews with other races in no way connected with them.

Early Period.—Until 500 B.C. Afghanistan formed part of the Achaemenian empire, and comprised the ancient provinces of *Aria*, or *Hari Rud*; *Bactria*, or *Balkh*; *Drangiana*, or *Seistan* and the *Helmand valley*; *Arachosia*, or *Kandahar*; and *Paropamisus*, the region of the *Hindu Kush* and *Kabul*. The population in the north was *Iranian*, and in the south contained a large *Indian* element; but the most interesting people mentioned in the Greek records are the *Paktyes* in *Arachosia*, which *Herodotus* calls *Paktyike*, for in their name we may trace that of the *Pakhtun* or *Push-tun*, by which the Afghans still describe themselves. The story of *Alexander's* campaign in the eastern provinces of the *Persian* empire need not be repeated here, but the cities of *Herat* (*Alexandria Arion*) and *Kandahar* (*Alexandria Arachosion*) were either founded or restored by him.

He was succeeded in the eastern provinces of his empire by

Seleucus Nicator, the founder of the *Seleucid* dynasty, but the *Indian* provinces and the *Kabul valley* fell to *Chandragupta* (*Sandracottus*), the founder of the *Maurya* dynasty.

Greek Dynasty.—As the power of the *Seleucids* waned an independent Greek dynasty was established, about 246 B.C., in *Bactria*, and about 50 years later annexed a great part of north-western *India*, but *Afghanistan* passed from its possession into that of the *Parthians* (who occupied its western provinces), and the *Sakas*, a *Scythian* tribe, who conquered the eastern provinces about 130 B.C. and gave their name to *Seistan* (*Sakastan* or *Sakastene*). Within 200 years the *Yue-chi* (*q.v.*), another central *Asian* tribe, expelled the *Parthians* and founded the *Kushan* dynasty, which ruled *Afghanistan*, and, at the height of its power, northern *India*, as far as *Benares* on the east and *Malwa* on the south. This dynasty adopted the *Buddhist* religion, and *Kanishka*, the greatest king of the line, convened the great council which settled the canon of northern *Buddhism*, and is mentioned as a champion of *Buddhism* by *Huen Tsang*, the *Chinese* pilgrim; *al-Biruni*, the *Mohammedan* traveller, philosopher and geographer; and in the *Mongol* versions of the *Buddhist* story.

The empire of *Kanishka* did not long survive his death, but *Kushan* principalities continued in the southeastern valleys of the *Hindu Kush*, until they were overrun by the *Ephthalites*, or *White Huns*, who held possession of northern and eastern *Afghanistan* in the 5th and 6th centuries A.D.

The Caliph Empire.—The title of *Arab* conquest and *Islamic* propaganda in the 7th century reached western *Afghanistan*, and penetrated as far as *Kabul* where, however, *Hindu* dominion soon afterward asserted itself. As the power of the *caliphs* declined their provincial governors founded dynasties owing a nominal allegiance to them but virtually independent. One of the earliest of these was the *Arab* dynasty of the *Tahirids*, who included *Herat* and *Balkh* in their kingdom of *Khurasan*, in which they were succeeded by a native *Persian* dynasty, the *Saffarids*, who were overcome in the 9th century by the *Samanids* of *Balkh* and *Bukhara*, another *Persian* house. *Alptigin*, a *Turkish* slave of this house, established himself in *Ghazni*, where he was succeeded, after a short interval, by another *Turkish* slave, *Sabuktigin*, who threw off the yoke of the *Samanids* and annexed to his dominions not only the *Hindu* kingdom of *Kabul*, but the territory lying between it and the *Indus*. Assistance given by him to the *Samanids* was rewarded with the government of *Khurasan*, to which he appointed his elder son *Mahmud*, and *Afghanistan* became the nucleus of a great empire. *Sabuktigin* died in 997, and his son *Mahmud*, after deposing a younger brother, ascended the throne in 998. The tale of his predatory raids into *India* need not be repeated here. He added to his empire *Baluchistan*, and, later in his reign, the *Indian* kingdom of the *Punjab*, the province of *Multan* and the greater part of western *Persia*, and divided with *Ilak Khan*, the founder of a *Turkish* dynasty in *Transoxiana*, the dominions of the house of *Saman*, which came to an end during his reign.

The hitherto obscure town of *Ghazni* now became a great and splendid city, for *Mahmud* was no mere ravager and despoiler. It is in *Mahmud's* reign that we first hear of the small state of *Ghor*, in the ranges southeast of *Herat*, which *Mahmud* reduced to vassalage, and the rulers of which, eventually, extinguished his dynasty. He himself paved the way for the destruction of his empire by admitting into *Khurasan* the *Seljuk Turks*, who afterward stripped his descendants of their possessions in the north and west and founded a great empire on the ruins of that of *Ghazni*.

Mahmud died in 1030 and his descendants continued to reign over a gradually diminishing empire, with *Ghazni* as their capital, until 1140, when *Alauddin Husain*, chief of *Ghor*, to avenge the death of his brother, *Saifuddin*, who had been treacherously put to death by the sultan of *Ghazni*, captured and burnt the city, driving *Mahmud's* descendant, *Khusrav Shah*, into the *Punjab*. The destruction of the great city of *Ghazni* earned for its author the cognomen of *Jahansuz*, "the World-Burner."

Ghor Dynasty.—In 1186 the *World-Burner's* nephew, *Muizuddin Mohammed*, commonly known as *Mohammed Ghori*,

treacherously enticed Khustav Malik, the last of the Ghaznavids, from Lahore, and imprisoned him for the short remainder of his life. Having secured the Punjab, Mohammed invaded India, and founded there a Moslem empire which endured, in name at least, until 1858.

This dynasty of Ghor is commonly believed to have been of Afghan origin, but the belief rests on a very slender foundation of evidence. Legend also assigns it descent from Zahak; and though this is no better attested than their Afghan genealogy, it seems to be probable that they were Tajiks of Persian race. The Afghans themselves are Indo-Iranian by race, and their antiquity as a separate people is uncertain. Firishat's statement that the inhabitants of the Sulaiman mountains were known as Afghans in the 1st century of the *Hijra* (the 7th century of the Christian era) carries no weight, but the name occurs in al-'Utbi's *History of Sultan Mahmud*, written about A.D. 1030, coupled with that of the Khalaj or Khaljis, who were apparently a Turkish tribe domiciled in western Afghanistan, but always antagonistic to the true Afghans. Both names occur in the history of India during the 13th and 14th centuries, and the Indian historians are not careful to distinguish between the two peoples. Hence it is, probably, that some Europeans have carelessly classed all the five dynasties which preceded the Timurids on the throne of Dihli as "Pathans," or Afghans, though in fact two of them were Turkish, one was Khalji and one was of Arab descent.

The Moslem empire in India was founded by a manumitted slave of Mohammed Ghor, and shortly after Mohammed's death his great empire fell to pieces and was divided between provincial governors and members of his own family holding small principalities in Afghanistan. These petty princes were subdued by the shahs of Khvarazm, or Khiva, of whose great but ephemeral empire Afghanistan for a time formed part.

Mongol Rule.—In the 13th century Afghanistan, like Persia, suffered the dreadful calamity of invasion by the heathen Mongols of Jenghiz Khan, who settled to the north of the Hindu Kush; but the rest of the country, owing to its inhospitable nature, suffered less than more fertile and populated lands. It was here, however, that the gallant Jalaluddin, last of the shahs of Khvarazm, made his most strenuous efforts to avenge on these savages the annexation and devastation of his kingdom.

The greater part of Afghanistan remained under Mongol rule until the rise of Timur Lang (Tamerlane), who established himself in northern Afghanistan in the latter part of the 14th century, wresting Herat from the Kurts, a family which claimed descent from the princes of Ghor (*see* MONGOLS).

The Moghul Empire.—In 1504, Babur, fifth in descent from Timur, having been expelled from his ancestral dominions in Transoxiana, occupied Kabul and made it the capital of a kingdom which he established in Afghanistan; and in 1522 he captured Kandahar from the Arghans, a Moghul family which had long held it, but he did not remain long content with his Afghan kingdom. In 1526 he invaded India, defeated Ibrahim Lodi, the Afghan sultan of Delhi, on the field of Panipat, and founded the state which is usually known to Europeans as the Moghul empire, though Babur was no Moghul, and would have resented the designation. Kabul and Kandahar remained for the time merely provinces of Babur's Indian empire, and Herat fell into the hands of the Safavi shahs of Persia.

Babur's son, Humayun, was expelled from India by the Afghan, Sher Khan, and was compelled to seek an asylum with Shah Tahmasp of Persia, who helped him to recover Kandahar, held by his rebellious brother. From Kandahar Humayun proceeded to Kabul, from which city he ousted another brother, and after spending seven years in re-establishing his authority in Afghanistan was able, in 1554, to recover his Indian empire, but died shortly afterwards, as the result of an accident, leaving the task of extending and consolidating the dominions of his house in India to his young son Akbar (*q.v.*), the real founder of the "Moghul" empire of India.

Afghanistan was then divided, Kabul remained a province of India, and Herat a province of Persia; Balkh fell to the Uzbeks of Transoxiana, and Kandahar, after remaining for a time in

the possession of the Timurids, was taken by the Persians. Akbar's grandson, Shah Jahan, recovered Balkh and the surrounding country which he held for another ten years till Uzbeg pressure finally caused the Moghuls in 1648, to relinquish hold of their provinces beyond the Hindu Kush.

In 1708 the Ghilzais of Kandahar, who perhaps represented the Khalaj, provoked by the oppressive rule of the Persian governor, Shahnava Khan, a Georgian prince of the Bagratid house, rose under Mir Vais and expelled the Persians. Mir Vais defeated the Persian armies sent against him and established his independence, but died in 1715. His son Mahmud, carrying out a project of his father's, invaded Persia, besieged Isfahan and in Oct. 1722 compelled Shah Husain, the feeble Safavid, to surrender his crown to him, but the rule of the Ghilzais in Persia was brief—Mahmud died mad and his successor, Ashraf, was defeated by Nadir Kuli, the Afshar, who shortly afterward ascended the throne. In 1737–38 Nadir Shah, one of Persia's greatest monarchs, recovered Kandahar and conquered the Indian province of Kabul, but conciliated the Afghans and enlisted many in his army—among them Ahmad Khan, a young chieftain of the Sadozai family of the Abdali tribe. Ahmad Khan rose to high rank in the Persian army, and after the assassination of Nadir Shah in 1747 was chosen by the Afghan chiefs at Kandahar as their leader and assumed the royal title. Among his titles was that of *Durr-i-Dauran*, "the Pearl of the Age," from which his tribe received the name of Durani.

The land of the Afghans had been successively a congeries of petty states, the centre of great empires ruled by foreigners and a dismembered country, furnishing provinces to three monarchies. It now became, for the first time, a distinct political entity, ruled by an independent native sovereign.

Ahmad Shah Abdali extended his kingdom westward nearly to the Caspian and eastward over the Punjab and Kashmir, which he wrested from the feeble successors of Babur on the throne of Delhi. He claimed and commanded the allegiance of Sind, which had been ceded by Mohammed Shah of Delhi to Nadir Shah. His northern boundary was the Oxus, and Baluchistan and Khurasan were tributary states of his kingdom. At the third battle of Panipat, fought on Jan. 14, 1761, he inflicted on the confederate Maratha chiefs, who were then at the zenith of their power and were the real masters of the great empire founded by Babur and Akbar, a crushing defeat, and with inferior numbers nearly annihilated their great army.

Foreign Influences.—Ahmad Shah died in 1773 and was succeeded by his son Timur, who transferred his residence from Kandahar to Kabul. In his reign Sind was lost, Balkh and other districts in Afghan Turkistan became virtually independent, and the seeds of revolt were sown in Khurasan and Kashmir. He died in 1793, leaving 23 sons, of whom the fifth, Zaman Mirza, by the help of Payinda Khan, head of the Barakzai family of the Durani ascended the throne. His reign was short and troubled and was marked by one act destined to have momentous consequences—the grant of Lahore, in 1799, to the Sikh adventurer, Ranjit Singh. In the following year Mahmud, another son of Timur, ousted Zaman Shah and ascended the throne, but in 1803 was deposed by conspirators who placed his brother, Shuja-ul-Mulk, on the throne. In 1809 the East India company's government in India, alarmed by the intrigues of Napoleon in Persia, sent Mountstuart Elphinstone as envoy to Shah Shuja at Peshawar, but Napoleon's ambitious eastern schemes came to nought, and the British mission at Peshawar was unable to effect anything, for Shah Shuja's rule was unpopular, and while his army was engaged in quelling a rebellion in Kashmir his deposed brother, Mahmud, rose in rebellion, defeated him and put him to flight, and ascended the throne for the second time. In 1815 Shah Shuja took refuge in India and remained a pensioner of the Indian government until, at a later date, a use was found for him. Mahmud ruled until 1818 but the real ruler of the kingdom was Fath Khan the Kingmaker, the eldest son of Payinda Khan Barakzai. It was he who recovered Herat, which had been seized by the Persians, and in the insolence of his power he ventured to offer a gross outrage to the Sadozai

family. Mahmud, already chafing under Fath Khan's yoke, avenged the insult by causing him to be blinded, and Mohammed Azim and Dost Mohammed, the minister's brother and half-brother, rose in arms against Mahmud, who retorted by causing Fath Khan to be put to death with torture. The Barakzais prevailed and in 1818 drove Mahmud from Kabul and dethroned him. A period of anarchy then ensued. Mohammed Azim ruled Kabul, but his brothers and other Afghan chiefs, the provincial governors, withheld their allegiance from him and the kingdom fell to pieces. Herat, always a Persian rather than an Afghan town, was alienated; Afghan Turkistan and Badakhshan regained their independence, and Ranjit Singh, who had already conquered Kashmir, Multan, Dera Ghazi Khan and Attock, was threatening Peshawar, which he secured by defeating the Afghan army at Naushahra in 1823. In the same year Mohammed Azim died, and the remaining Barakzai brothers plunged into a fratricidal war. Three years later Dost Mohammed established himself in Kabul, Ghazni and Jalalabad, and, having secured this fragment of the Afghan kingdom, assumed the title of amir, after having, in 1835, defeated an attempt by Shah Shuja to regain his throne.

Russia had succeeded France as the bugbear of British administrators in the east, and the fear of Russian intrigue, as well as the prospect of active hostilities between the Amir Dost Mohammed and Ranjit Singh, induced the company's government to despatch an envoy, Sir Alexander Burnes, to the court of the amir. His mission was ostensibly commercial, but he was instructed to oppose the attempt of the shah of Persia to recover Herat. He was well received, but the amir was disappointed by his refusal to pledge his government to aid him against Ranjit Singh, and consequently held himself in no way bound to refuse to receive Captain Vikovitch, a Russian officer who then arrived in Kabul. The governor-general, Lord Auckland, peremptorily demanded his dismissal and the renunciation of all claims to the Punjab and Kashmir, which Ranjit Singh had recovered from the Afghans, and rashly decided to make Dost Mohammed's natural refusal of these demands a *casus belli*, and to attempt to restore the fugitive Shah Shuja, who had already been tried and found wanting. Ranjit Singh, whose material interests were involved, bound himself to co-operate with the British, but when all was ripe for the invasion declined even to permit British troops to cross his territories, though a Sikh force, with Sir Claud Wade and a small British detachment, advanced through the Khyber pass.

The "Army of the Indus," numbering 21,000, assembled in upper Sind in 1838 and advanced through the Bolan pass under the command of Sir John Keane. It met with hardly any resistance and in April 1839 occupied Kandahar, where Shah Shuja was crowned in his grandfather's mosque. On July 21 Ghazni was taken by storm and Dost Mohammed, deserted by his troops, fled northward. On Aug. 7 Shah Shuja, escorted by the British army, entered Kabul. It was believed that the war was over, and Sir John Keane, who received a peerage for his services, returned to India with the greater part of the army, leaving Sir William Macnaghten as envoy and Sir Alexander Burnes as his colleague, with 8,000 British and company's troops and the contingent which had been raised for the service of Shah Shuja for their protection. The trouble was in fact only beginning, for the best of rulers is not acceptable to a free people when imposed upon them by foreign arms, and Shah Shuja had already rendered himself odious to the Afghans. He now, acting on the advice of the British resident, attempted to raise a regular army to take the place of the tribal militia under its hereditary leaders; but the opposition of the chiefs, who apprehended the diminution of their own power and influence and the extinction of their country's independence, ensured the failure of this design. Shah Shuja was obliged to rely more and more upon British assistance, and his rule grew daily more unpopular. A danger was removed by the surrender of Dost Mohammed, who was sent to India, but it was impossible to save Shah Shuja, and in Nov. 1841 discontent at Kabul culminated in a revolt in which Burnes and other officers were massacred. Akbar Khan, the son of Dost

Mohammed, placed himself at the head of the national party, and at a conference with the British authorities stabbed Sir William Macnaghten with his own hand. The British agreed to evacuate the country, and, in accordance with a convention with the Afghans, the garrison, then reduced to 690 British and 3,810 Indian troops, with the enormous number of 12,000 followers, marched out of Kabul on Jan. 6, 1842. The Afghans made no pretense of observing the terms of the convention, and the retreat of the demoralized army in the depth of a severe winter was a scene of confusion and massacre. On Jan. 13 the survivors of the force mustered at Gandamak only 20 muskets, and Dr. William Brydon, the sole survivor of the army of Kabul, except those whom the Afghans had captured, reached Jalalabad alone. The garrison of Ghazni had been obliged to surrender, but Kandahar was held by General William Nott and Jalalabad by General Robert Sale. In April 1842 Shah Shuja was assassinated.

Preparations were made in India to avenge these disasters and to recover the prisoners. In April 1842 General George Pollock forced the Khyber pass and relieved Jalalabad, and in September reoccupied Kabul, where he was joined by General Nott from Kandahar, who had recaptured and dismantled Ghazni. The prisoners were recovered from Bamiyan, where the Afghans had lodged them, and the army evacuated Afghanistan in Dec. 1842 after destroying the citadel and the central bazaar of Kabul. Dost Mohammed was permitted to return to his country and assumed the government, with the title of amir.

In 1848, during the second Sikh war, Dost Mohammed was induced to go to the aid of the Sikhs. The adventure was unfortunate for him, for at the battle of Gujarat, in Feb. 1849, his cavalry was ignominiously routed and pursued as far as the hills, and the Peshawar territories were annexed to British India and thus lost to Afghanistan. Balkh was recovered in 1850 and Kandahar in 1855, in which year also a treaty of peace was concluded between him and the British government at Peshawar. In 1856 the Persians captured Herat but were obliged to surrender it to an independent ruler after the British expedition to Persia. In 1857 the amir met, at Peshawar, Sir John Lawrence, who promised him arms and a subsidy to aid him in defending his country against Persia, and a British mission under Major Lumsden was received at Kandahar. During the Indian mutiny the amir declined to listen to those who instigated him to aid the rebels, and remained faithful to his alliance.

In 1863 Dost Mohammed captured Herat after a long siege, and, dying almost immediately afterwards, was succeeded by his son Sher Ali Khan, the early years of whose reign were disturbed by contests with his brothers. Early in 1873 the British government succeeded in obtaining from the Russian government a declaration that Afghanistan was beyond the field of Russian influence, and the recognition of the Oxus as the northern frontier of the state. Later, the amir's failure to secure a British guarantee for his sovereignty and family succession, and his refusal to admit British agencies into Afghanistan led to estrangement between him and the British government, and when, in July 1878, he ostentatiously received a Russian mission at Kabul and shortly afterward refused to permit a British mission to cross the frontier, his attitude was regarded as definitely hostile. After some warnings the government of India delivered an ultimatum, his disregard of which led to the decision to invade Afghanistan. In Nov. 1878 the British forces inflicted severe defeats on the Afghan troops and occupied the Khyber pass and the Kurram valley, and early in 1879 occupied Kandahar, Kelat-i-Ghilzai and Girishk. The amir, with the Russian mission, had fled from Kabul, and he died, a fugitive, in March 1879. His second son, Yakub Khan, who was recognized by the people of Kabul as amir, voluntarily visited the British camp at Gandamak in May 1879 and there concluded a treaty, by the terms of which he ceded the Kurram valley, Pishin and Sibi, and the control of the Khyber and Michni passes and of the tribes in their neighbourhood. He also agreed to receive a British resident at Kabul and to subordinate the foreign affairs of Afghanistan to British influence. Major Sir Louis Cavagnari was well received by him as resident, but the amir was either unable or unwilling

to control the fanatical element in Kabul, and in Sept. 1879 the residency was attacked by a mob of townspeople and soldiers, and the resident and his escort were murdered after a gallant defense.

Abdur Rahman Khan.—The Kandahar force then concentrated at Kandahar, and a force under General (afterwards Field-Marshal Earl) Roberts advanced through the Kurram valley, defeated an Afghan force at Charasia and occupied Kabul on Oct. 12, 1879. Yakub Khan, having entered the British camp, abdicated, and was sent to India, where he lived for the rest of his life. The British force under Roberts remained at Kabul, and in July 1880 the British government recognized a new amir, Abdur Rahman Khan, a grandson of Dost Mohammed and nephew of Sher Ali.

Sardar Sher Ali Khan, a Barakzai of Kandahar, had already been recognized as independent ruler of that province, but in July 1880 Ayub Khan, a younger brother of Yakub Khan, advanced from Herat, inflicted a crushing defeat on a brigade of British troops at Maiwand and invested Kandahar. On Aug. 8 General Roberts left Kabul with a relieving force, which reached Kandahar on Aug. 31, and on Sept. 1 defeated the besiegers and captured their camp, artillery and baggage. Ayub Khan fled with a few followers, and, peace having been restored in southern Afghanistan, the British forces evacuated the country in 1881. Sher Ali was unable to maintain his authority in Kandahar and retired to India, where he ended his days as a pensioner. Ayub Khan again took the field, defeated Abdur Rahman's troops, and occupied Kandahar, but in Sept. 1881 Abdur Rahman utterly defeated him and drove him to seek refuge in Persia. In 1888 he went to India, and lived there as a pensioner of the British government until his death.

Abdur Rahman had been recognized as amir of Kabul only, but within a year of ascending the throne had made himself master of Kandahar and Herat also, and he succeeded in quelling tribal disturbances and in establishing his rule on a firm basis. No attempt was made to fetter his independence except with regard to his foreign relations, which he agreed to conduct subject to the control of the government of India, from whom he received an annual subsidy to be devoted to the payment of his troops and the defense of his northwestern frontier, and considerable supplies of war material, together with facilities for importing arms through India at his own cost.

In 1884 it was agreed that a joint commission of British and Russian officers should demarcate the northern boundary of Afghanistan, but the Russian commissioners did not immediately arrive on the scene, and in March 1885 while the amir was conferring with Lord Dufferin, the viceroy of India, at Rawal Pindi, Russian troops attacked and drove from Panjdeh, a small town on the frontier, an Afghan force. In 1888 the amir's authority was seriously menaced by the revolt of his cousin, Ishak Khan, who held a quasi-independent position as governor of Afghan Turkistan and caused himself to be proclaimed amir, but the rebellion was crushed. Ishak was expelled and settled at Bukhara as a pensioner of the Russian government, and Abdur Rahman's authority was established in the northern province. In 1895 he completely subjugated Kafiristan, a wild mountainous tract to the northeast of Kabul, the inhabitants of which had hitherto successfully resisted all attempts to destroy their independence.

In 1893 encroachments by the amir into the country adjoining the settled districts of India caused the Indian government to negotiate a line of demarcation (known as the Durand line) defining the limits of the amir's authority on his eastern and southern borders.

In 1901 Abdur Rahman died, after a reign of 21 years, in the course of which he gave Afghanistan a government such as it had never known before. This he effected, first, by substituting for a feudal militia under tribal chiefs a standing army, well trained, well armed and regularly paid, owing allegiance to none but himself. By means of this force he was able to establish an efficient central administration, retaining all power in his own hands, and to improve the public revenues not only by increasing

the burden of taxation, but by ensuring the collection of all assessed taxes. He was harsh and ruthless, but he relieved his subjects from the petty tyranny of local chieftains, and he suppressed highway robbery and violent crime. It is probable that he fully appreciated the advantages which his country might gain from projects of a commercial or strategic nature, such as railways, telegraphs and mines; but it was his settled conviction that these advantages would be purchased at too high a price by the necessary employment of large numbers of foreigners, whose activities in the country might have amounted to peaceful penetration and menaced Afghan independence.

Habibullah.—Two days after the death of Abdur Rahman his eldest son was recognized as his successor. Habibullah introduced the reduction of taxation, the establishment of a council of state for tribal affairs and the association of tribal chiefs with provincial governors for the adjudication of tribal cases. He also inaugurated military reforms. He loyally observed the condition regarding the control of the foreign affairs of Afghanistan on which the government of India had recognized his father as amir, but on all questions relating to the development of his country's trade and more intimate relations with the government of India he proved to be as wary and suspicious as his father had been. He consented, indeed, to receive a special mission under Sir Louis Dane, foreign secretary to the government of India which reached Kabul in Dec. 1904, but the mission failed to obtain any concessions, and the result of its work was merely the confirmation and ratification of existing agreements and the concession to him in the treaty of the title of "Majesty." After the failure of this mission an endeavour was made to remove his prejudices and to enlarge his mind by arranging for him a visit to India, in the course of which he could meet the leading administrators of the country. His acceptance of the invitation was viewed with disfavour by the more bigoted and ignorant of his subjects, but the manner of his reception by Lord Minto in Jan. 1907, and the good will displayed towards him, undoubtedly did much to improve the relations between the two governments.

By the Anglo-Russian convention signed on Aug. 13, 1907, Great Britain disclaimed any intention of altering the political status of Afghanistan, and Russia declared Afghanistan to be beyond her sphere of influence.

Habibullah, though as suspicious as his father, was more susceptible to modern influences, and among the many mixed blessings of civilization which he introduced into an unappreciative country were motorcars, telephones, newspapers, an hydroelectric scheme and the Habibia college, a high school in Kabul, the staff of which was chiefly composed of teachers from India. Many of these were regarded by the ignorant clerics of Afghanistan as inventions of the devil and the seed of infidelity, and it was partly from a sense of the antagonism which their introduction had aroused and partly with a view to conciliating the hereditary enemies of his house that Habibullah treated with great and unusual leniency the Ghilzais and Mangals of Khost, the district lying immediately to the west of the Kurram valley, who in 1912 had been goaded into rebellion by the rapacity of the local governor.

World War I.—On the outbreak of World War I in 1914 the amir declared his intention of abiding by his agreement with the British government and maintaining the neutrality of his country, but the entry of Turkey, the chief Islamic power, whose ruler was regarded by many Moslems as their caliph, encouraged the anti-British party in Afghanistan and induced the amir to receive a German mission, which contrived to reach his western frontier by way of Persia and entered the country as fugitives, having left in the hands of the Russians their confidential papers and that which was most likely to make them welcome in Afghanistan, their gold. They were admitted to Kabul, but their manners and bearing were not calculated to conciliate their hosts. They were regarded as state prisoners rather than as guests, and, in 1916, becoming apprehensive, on misleading information, of the amir's intentions toward them, they retired hastily from Afghanistan, and some of them, falling into the hands of the Russians, were treated as prisoners of war. Habibullah preserved his

neutrality until the end of the war, and would doubtless have received substantial recognition of his loyalty, in most difficult circumstances, to his obligations, had he not been assassinated on Feb. 20, 1919. His brother Nasrullah Khan, caused himself to be proclaimed amir, but after a reign of six days was ousted by his nephew, Amanullah, who was recognized by the nobles and people as king.

Amanullah.—The new ruler's position however was not secure and in May 1919 he adopted the expedient of consolidating his power by declaring war on his neighbour, Great Britain, timing his action to coincide with an expected outbreak in India. His information was faulty and his attempted invasion failed. After a few weeks of sporadic fighting during which British and Indian forces occupied Dacca beyond the Khyber, and Spin Baldak opposite Chaman, the amir sued for peace which was granted in a treaty signed at Rawal Pindi on Aug. 8, 1919. By the terms of this treaty the amir lost the British subsidy granted to his predecessors, but obtained freedom from control of his relations with foreign states. He had thus secured his main objective, and fortified by the prestige accruing to him as liberator of his country, he lost no time in entering into relations with foreign governments. His envoys signed treaties with Russia (Feb. 1921) and Turkey (March 1921), while a further treaty to regulate his relations with Great Britain was signed in Kabul in Nov. 1921. Treaties with France, Italy, Germany, Iran and several minor European states followed while an envoy was despatched to Washington, D.C., to endeavour to arrange an exchange of diplomatic representation with the United States. A convention with Great Britain arranging for the free import through India of goods as well as munitions followed in June 1923. An exchange of diplomatic representation with Great Britain, Russia, Turkey, Iran, France, Germany and Italy took place, and by the end of 1923 Afghanistan may be fairly said to have joined the comity of nations.

But Amanullah's government did not prosper. The ruler himself was a headstrong reformer, and though a zealous worker he had neither the understanding nor the experience to appreciate the necessity for caution in planning the progress of his backward and fanatical people. His zeal for reforms soon brought him into conflict with his subjects. A rebellion which broke out early in 1924 in the turbulent Southern province and lasted for nearly a year showed up the weakness of his army, exhausted his revenues and severely impaired the stability of the state. Matters went from bad to worse in the years that followed. The king ignored or sent into exile his more sober advisers, neglected his army and made little or no attempt to adjust the economic affairs of his country to the changed conditions of the world in which it now found itself. His attitude toward his immediate neighbours showed that he had little appreciation of his obligations to maintain and foster good relations with the powerful states which surrounded him.

The end came shortly after his return in June 1928 from a prolonged tour of Europe and the near east. Dazzled by his experiences he attempted to emulate the reforms, the success of which he had witnessed in Turkey and Iran. A series of ill-considered measures, which included the education of women, alienated the powerful priestly class, and drove the country to open rebellion. In Jan. 1929 Amanullah was forced to flee the country.

Habibullah Ghazi.—The capital, Kabul, where the ill-paid army had little stomach for a fight, fell into the hands of a brigand named Bacha-i-Saqao (son of the water carrier) who took the name of Habibullah. He maintained a precarious hold over Kabul and the surrounding country, and also in Herat and the northern provinces for a matter of nine months, but was defeated and executed by Sirdar Nadir Shah in Oct. 1929.

Nadir Shah.—The new ruler who ascended the throne with the title of king (Ala' Hazrat) was a direct descendant of a brother of Amir Dost Mohammed and cousin of Amanullah. He had previously been commander in chief of the Afghan army, but had been in exile in France from 1924. Taking over the reins of government he was faced with a desperate situation. Apart from the few thousand tribesmen who had helped him to defeat Habibullah

he had no army, the treasury was empty, Herat had formed a semi-independent administration and the tribes having once tasted of complete freedom were disinclined to submit to authority. He set to work however, ably assisted by his brothers, to bring the country under control, to remake an army and to repair the economic situation. Two serious rebellions were quelled in the first year of his reign, and in the second a formidable brigand chief was driven from the northern provinces. Aided by some timely assistance from the British government he reformed his army, and by 1932 stability was sufficiently restored to enable him to turn his attention to economic reforms. While devoting much of his time to the study of industrial development and financial equilibrium he was yet able to turn his attention to such matters as the improvement of irrigation, and the development of communications. But he had many enemies and his determination to abide by his treaty undertakings with Great Britain undermined his influence with the tribes. The party of ex-King Amanullah was active, and in 1932 a plot to foment rebellion in the Southern province was discovered. The rebellion was suppressed and its leaders executed, but a year later in Nov. 1933 King Nadir was assassinated by the son of one of them, a student at the German school in Kabul.

Zahir Shah.—The accession of the new king who was the son of Nadir Shah and 19 years of age at the time of his father's death was accomplished without difficulty, chiefly owing to the support afforded him by his uncles, the prime and war ministers. After a brief pause while the country recovered from the shock of Nadir's death, the task of prosecuting the plan of reconstruction laid down in the previous reign was resumed. While the greatest care was taken not to incur the charge of unorthodoxy which had caused Amanullah's downfall, the general line of policy provided for the material and moral advancement of the country toward a more civilized way of life. Economic measures took a prominent place. Industrial development was ensured by means of long term credits negotiated chiefly with Germany for the purchase of machinery and the construction of factories. Considerable quantities of munitions were purchased from Europe. Education was developed by the establishment throughout the country of primary schools.

Relations with foreign countries continued satisfactorily, though fear of communist penetration was always latent, and with Britain some friction was manifest over border disturbances, connected particularly with a notorious firebrand, the Faqir of Ipi.

In 1934 Afghanistan joined the League of Nations, and in 1937 close association with Turkey caused her to become a signatory of the Sa'adabad pact. Japan, the United States, Iraq and Egypt established legations in Kabul.

In 1937-38 disturbances among the powerful Ghilzai clan caused some anxiety to the government, but the country as a whole under the wise direction of the prime minister, Sirdar Hashim Khan, was progressing peacefully when in 1939 war broke out in Europe.

World War II.—Afghan economic dependence on Germany and her reluctance to be drawn into a distant conflict which did not appear to concern her caused Afghanistan to declare neutrality in Sept. 1939. This policy was rigidly followed till Oct. 1941 when on the advice of Great Britain and Russia the Afghan government decided to remove all Axis nationals, except members of diplomatic missions, from the country. This departure from neutrality which was ratified by the Great Assembly (*Loe Jirga*) was accompanied by a renewed pronouncement of Afghan determination to maintain in future her neutral status. This determination was unchanged at the close of the European phase of the war with the result that Afghanistan was one of the few states to whom invitations were not issued to take part in the international conference to establish a world security organization which opened at San Francisco on April 25, 1945.

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AFGHAN LANGUAGE: see PUSHTU.

AFGHAN TURKISTAN, province of Afghanistan, bounded east by Badakshan, north by the Oxus river, northwest and west by Russia and the Hari Rud river, and on the south by the Hindu Kush, the Koh-i-Baba and the northern watershed of the Hari Rud basin. It is 500 mi. long, northeast to southwest, and averages 114 mi. in width between the Russian frontier and the Hindu Kush. The area is about 57,000 sq.mi.—two-ninths of Afghanistan. The population is about 800,000, mainly cultivators in towns and villages, the chief being Mazar-i-Sharif (30,000), the modern supplanter of Balkh. The lowland has much loess and the riverine lands of the Oxus are highly cultivated, but to the west the Turkoman area is waste, and to the south are rough mountains. The people are Persian and Uzbek with Turkoman, Hazara (Mongol) and Hindu elements. Ancient Balkh or Bactriana belonged to the Achaemenian empire. About 250 B.C. Diodotus (Theodotus), governor under the Seleucidae, made himself independent and founded the Graeco-Bactrian dynasties which succumbed to Parthian and nomad movements about 126 B.C. The succeeding Buddhist era has left us huge sculptures at Bamian and the rock-cut topos of Haibak. Jenghiz Khan laid waste the land; later it belonged for a century to the Delhi empire, then became Uzbek, and in the 18th century came under Ahmad Khan and his son Timur (Durani Afghans). Next the Khanates fell apart during strife between Timur's sons, and the Uzbek khans came under the rule of Bokhara. Under Dost Mohammed (1850–1859) the Afghans occupied the province, and boundary disputes were settled (1873) by the Anglo-Russian agreement awarding Andkhui, Shibarghan, Saripul and Maimana to Afghanistan. The Russo-Afghan commission delimited the boundary in 1885.

AFIUN QARAHISAR or AFYON KARAHSAR, popular name of Kara-hissar Sahib, the chief town of a vilayet in Asiatic Turkey, nearly 200 mi. east of Smyrna, and 50 mi. south-southeast of Kutaiah. Pop. (1940) 25,897. Called Nicopolis by Leo III after his victory over the Arabs in 740, its name was changed by the Seljuk Turks to Kara-hissar. It stands partly on level ground, partly on a declivity, and above it rises a precipitous trachytic rock (400 ft.) on the summit of which are the ruins of a Byzantine castle. The town is an important centre of trade. Opium in large quantities is produced in its vicinity and forms the staple article of its commerce; and there are, besides, manufactures of black felts, carpets, arms and saddlery. Afiun contains several mosques (one of them a very handsome building). The town is connected by railway with Smyrna, Konia, Angora and Istanbul.

See V. Cuiet, *Turquie d'Asie* (Paris, 1894), vol. iv.

A FORTIORI (Lat. "from a stronger [reason]"), a term used of an argument in which the conclusion is supported by a ground that is stronger than another that has already been accepted, or is commonly accepted, as sufficient justification for asserting the predicate of the conclusion of that kind of subject. For example, if in a right-angled triangle the side opposite the right angle must be greater than either of the other sides (because the right angle is greater than either of the other angles),

"how much more so" (*a fortiori*) must this be the case in an obtuse-angled triangle (which is even greater than a right angle).

AFRANIUS, LUCIUS, Roman general, lived in the times of the Sertorian (79–72 B.C.), third Mithridatic (74–61 B.C.) and Civil Wars. In 60 B.C., chiefly by Pompey's support, he was raised to the consulship. In the following year, while governor of Cisalpine Gaul, he obtained a triumph, and on the allotment of Spain to Pompey (55 B.C.), Afranius and M. Petreius were sent to govern it as legates. On the rupture between Caesar and Pompey they were compelled, after a short campaign in which they were at first successful, to surrender to Caesar at Ilerda (49 B.C.), and were dismissed on promising not to serve again in the war. Afranius, however, joined Pompey at Dyrrhachium, and at the battle of Pharsalus (48 B.C.) had charge of Pompey's camp. Despairing of pardon from Caesar, he went to Africa, and was present at the disastrous battle of Thapsus (46 B.C.). He was afterwards taken prisoner and handed over to Caesar, whose veterans put him to death.

See Hirtius, *Bell. Afric.*, 95; Plutarch, *Pompey*; Dio Cassius xxxvii., xli–xliii.; Caesar, *B.C.* i. 37–87; Appian, *B.C.* ii.; CAESAR and POMPEY.

AFRANIUS, LUCIUS, Roman comic poet, flourished about 94 B.C. He dealt chiefly with everyday subjects from Roman middle-class life, and tells us that he borrowed freely from Menander and others.

See Horace *Epp.* ii. 1.57; Cicero, *Brutus*, 45. *de Fin.* i. 3; Quintilian x. 1. 100; fragments, about 400 lines, in Ribbeck *Scenicae Romanorum Poesis Fragmenta*, ii. (1898).

AFRICA, the name of a continent which is the largest of three great southward projections of the main land-mass of the earth's surface, joined to Asia by the isthmus of Suez, 80m. wide. From its northern extremity, Ras ben Sakka, a little west of Cap Blanc in 37° 21' N. to the southern, at Cape Agulhas, 34° 51' 15" S., it is about 5,000m. long while west to east it is about 4,600m. from Cap Verde, 17° 33' 22" W., to Ras Hafun, 51° 27' 52" E. Length of coastline is 16,100m. for a mainland area of 11,262,000 square miles.

GEOGRAPHY

Africa is largely a plateau, broken and elevated in the south and lower towards the north, with fold mountains adhering to the northern flank, and it thus contrasts very strikingly with Euro-Asia in which fold mountains of successive series in diverse stages of denudation occupy a large proportion of the surface. The mean elevation of Africa is about 2,000ft., that of Asia 3,117ft. Asia has much quite low as well as very high land. Africa, as a plateau, has little at either extreme and in particular the land over 10,000ft. in Africa is merely small groups of peaks.

The high southern part of the plateau reaching north almost to lat. 10° S. has sharp slopes around its edges on the west, south and east, with a narrow coastal plain below, broadening in the north-west and especially the north-east in Angola and Portuguese east Africa respectively. Towards the south this plateau has a high rim, over 6,000ft. above sea near Windhoek in the west and in Basutoland on the south-east. The southern edge is stepped, with the Nieuwveld range above the Great Karroo, the Little Karroo as the step next below and the coastal plain next below that. Within the high rim are considerable areas of centrally placed lower land, the South Kalahari in the south, the depression draining into Lake Ngami (now practically dry) and the Barotse-land depression, but all keep above the 1,500ft. contour and each is a local depression in a table-land most of which is at more than 3,000ft. above the sea. Generally speaking the plateau-edge dips down, with a small coastal ledge, into fairly deep water, but towards the Cape of Good Hope there is a fair area of shallow water off-shore.

The steepness of the edge of the plateau is important as a determinant of the character of the rivers, long sections of which flow in deep slots cut back into the plateau from its edge. The Orange river is fed from the rains that fall on the Drakenberg range and flows west through lands of drought; the Limpopo and Zambezi, the two largest on the east flow out to the broad sandy alluvial flats of Portuguese East Africa and the slot-like character

of a large part of the Zambezi-channel is generally known from the occurrence of the famous Victoria Falls. In the south-west the Zambezi system interlaces with that of the Taukhe or Tioghe and receives surplus water from it at times. The rest of the Taukhe water loses itself in the swamps and salt pans of the former Lake Ngami basin. The lower parts of the three great rivers have contributed to the lowering of considerable areas of the plateau below the 3,000ft. level. The Zambezi river, about 2,000m. long, drains an area of half a million square miles, the Orange river, about 1,300m. long and with a drainage area of about 170,000sq.m. but more than that amount must be added if we define the basin orographically and so include in it larger waterless tracts. Towards the north this southern plateau tends to run rather higher and there is a continuous belt of highland across the continent from the coastal plain on the west to Lake Nyasa on the east, in which region the typical form of the southern plateau is interfered with by important rifts to be considered next. Allowing for complexities the southern plateau of Africa is thus essentially an elevated surface with still higher edges for the most part and with, also, considerable depressions, usually desertic in character, near the median north to south axis of the plateau. North of this southern plateau, on the west, is the basin depression, largely floored by younger rocks and now occupied by the Congo and its numerous feeders. The basin is almost enclosed by land over 1,500ft. in height, for the main river escapes through a deep cut between the hills out to sea; there is general agreement that the basin is a depression in the original plateau surface that has been an inland sea. To the east of the basin are series of physical features that together constitute one of the major physical problems of the earth's surface. They are collectively designated the Rift valley system and have been the subject of much discussion, for which reference may be made especially to the files of the *Geographical Journal* (London, especially 1916-21) and to Krenkel *Geologie Afrikas* (1925). In this region in later tertiary and early Pleistocene times great movements occurred and earthquakes are still a feature. Often a block has sunk between parallel fractures and thence has come the name of Rift valley. A western rift may be traced from Lake Nyasa via Tanganyika and Lake Albert to Gondokoro. Many of the fractures run either north-west to south-east (the so-called "Erythraean" direction) or, in the north, north-east to south-west (the "Somali" direction). A middle rift line goes north-north-east from Nyasa via Lake Nai-

Many portions of these lakes have sharp walls and are obviously filling depressed zones. The western rift is the youngest and sharpest; the most important movements may have been as late as the Pleistocene period. The rifts all show volcanic activity which is most marked along the eastern sides of the middle one, where occur the great peaks of Kenya (17,007ft.) and Kilimanjaro, on which Kibo peak (19,321ft.) has long been held to be the culmination of Africa but Nilsson (1927) claims to have found points on Kilimanjaro 13ft. and 17ft. higher, respectively, than the highest previously known. Ruwenzori, on the eastern side of the western rift is 16,794ft. high and has a block structure apparently with faulted sides; interestingly enough it is in about the same latitude as the other great peaks mentioned and they are all on a belt of land, higher than most of the flanking territory, that stretches from the volcanic Cameroons (*v. inf.*) to the east coast. This cross-line scheme is noticeable in great basins (Niger, Chad and Bahr-el-Ghazal) to the north-west and is evidently of some importance in the story of the deformations that Africa has undergone.

It seems clear that at Lake Albert there was faulting on a large scale both before and after the country was arched up into a wrinkled dome while, farther east, the middle rift may be connected with faulting near the median axis of a long arch. Faulting of domed and arched structures, supplemented by vulcanicity on a large scale, both occurring so recently as to leave features extremely sharp, are thus the characteristics of the country. Between the arched areas of Lake Albert and the middle rift in a downfold lies Lake Victoria of area approximately 26,000sq.m. and more or less rectangular but fractures determine only a small part of its outline and its shores are not high-cliffed. Unlike the rift lakes, it is less than 50 fathoms deep. It is at 3,720ft. above sea-level.

It is well known that the zone of fractures extends northwards marking the east and west edges of the Abyssinian highland, the series of cliff lines bordering the Gulf of Aden and the Red Sea, and the rift lines along the Gulf of Aqaba to the Dead Sea and the Jordan valley. All through this zone one finds systems of parallel fractures and a considerable number are north-west to south-east, others are north-east to south-west, others apparently north to south.

The relations of land and water, both inland waters and the ocean, have naturally varied a lot with the great changes of land levels, but apparently since present levels were reached, and therefore probably well on in the Pleistocene period, lakes of immense size existed in the rift valleys of East Africa. Shore lines 600ft. above present water-levels have been traced over long distances and there is not much doubt that during the major glacial phases of the Pleistocene ice age in Europe the mountains of East Africa were glaciated much farther down than at present.

The northern extension of the rift system to Lake Rudolf and beyond it north-westwards to the lowlands of the White Nile divides east Africa from Abyssinia and Somaliland. The latter is a plateau sloping south but broken sharply on the north, where a steep slope marks the coast of the Gulf of Aden, and less sharply on the south-east to the Indian Ocean as well as on the south-west towards the Juba river basin which may be described as a widening of the coastal plain. Socotra is essentially a broken off projection of Somaliland. Abyssinia on the other hand is a remarkable mountain land bounded east and west by great fractures of remarkable sharpness giving steep cliffs down to the Red Sea and to the White Nile lowland. The rift system of the Red Sea and that of the Gulf of Aden both enter into relationship with an Abyssinian rift which runs from the sea to Lake Rudolf and divides Abyssinia from Somaliland. Abyssinia differs entirely from any folded mountain range; it is a high and deeply dissected block full of evidences of volcanic activity and provided with powerful rivers, feeders of the White Nile (Sobat, etc.) the Blue Nile and the Atbara, indicating its high (largely summer monsoonal) rainfall. It lies for the most part more than 5,000ft. above sea-level and reaches up to nearly 15,100ft. at Ras Dashan in the north. Lake Tana (Tsana) in the highlands is actually 5,690ft. above sea-level.



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NATIVES OF WEST AFRICA ENGAGED IN MAKING SPOONS IN THEIR TRADITIONAL MANNER

vasha to Lake Rudolf, with branchings and changes *en route*; though its general direction is north to south, its component fractures are generally north-west to south-east and north-east to south-west, with some north to south ones in the north. The easterly rift line is less important and goes on the whole north-eastwards from about the middle of Lake Nyasa. In the floors of the rifts lie the long narrow lakes, Nyasa 1,645ft. above sea-level but with a maximum depth of 2,580ft. so part of its floor is over 900ft. below sea-level, Tanganyika, also very deep and normally 2,624ft. above sea-level but this level is so variable that the outflow from Tanganyika is quite intermittent, and Rudolf at only 1,180ft. Some other lakes are small; that of Naivasha is over 6,100ft.

The Nile may be said, in a way to begin as the Kagera, the chief feeder of Lake Victoria. It leaves that lake on the north and after passing through the lake swamp of Kioga it goes to the north-eastern end of Lake Albert. Issuing again from the northern end of that lake, it emerges in due course from the rift system into a great flat area less than 1,500ft. above sea-level and framed by higher land save in the north-east and giving so little fall on the river that it becomes obstructed by floating vegetation. It is noteworthy that this upper Nile basin, the Lake Chad basin and the main Niger basin, all more or less enclosed, are nearly in the same latitude, with the still more enclosed basin of the Congo to the south. Basins of this kind are thus a marked feature of the geography of the old block of Africa. After the Nile (Bahr-el-Jebel) has received the Sobat from the east it flows north through increasingly barren country into a slot cut in the great desert. The transition from the fertile slot up the, often steep, slope to the desert plateau is a very sharp one and the river has no tributaries in its desert section. It thence follows that, though the Nile is 4,000 mi. long from the Kagera source to the sea, its basin-area is only 1,107,227 sq.mi., whereas the Congo, rather under 3,000 mi. long but very rich in tributaries, has a basin area of about 1,425,000 square miles.

North of the Congo basin one may go from the Gulf of Guinea across to the extreme east without touching a point less than 1,500ft. above sea. This rise or swell of the land surface has, on its north-west border, the high line (north-east to south-west) of the Cameroons, apparently an old mountain structure rejuvenated by volcanic outpourings. On this line stands the great peak of the Cameroons (13,370ft.) at the corner of the Gulf of Guinea, and it is continued into the sea giving the island of Fernando Po (Spanish) and those of S. Thomé and Príncipe (Portuguese). On Fernando Po, Clarence Peak is over 9,000ft. high.

North of the Gulf of Guinea the land soon rises above the 600ft. level and towards the west there is a fairly marked slope up from the sea to over 1,500ft. above its level, the slope faces south-west and above it towards the north is a patch above 3,000ft. in height while one small area near the northeast border of Liberia reaches nearly 10,000ft. This region, with a heavy, monsoonal, summer rainfall is the birthplace of the feeders of the Niger. Thence that river flows north-east demonstrating the general slope of the land down to the Sudan and Sahara, then east and south-east and south to reach the gulf in the lowland between the eastern end of the West African coastal edge and the highland of the Cameroons. Its length is about 2,600m. and basin-area about 800,000 square miles.

Between the main Niger basin and that of the Bahr-el-Ghazal and White Nile lies a basin of internal drainage with the shallow, shrinking Lake Chad in its southern half and a depressed area with some swamps in the north-east. Lake Chad is about 850ft. above sea-level, and receives drainage from the south-east and west. The other depressed area is, in parts, less than 600ft. above sea but the drainage to it is of very small account. North of the Niger and Chad basins is the immense arid belt of the Sahara. It reaches the Atlantic along a low practically waterless coast 1,000m. long from the mouth of the Senegal to the streams of the Atlas. The western part of the Sahara is generally low and has no heights reaching 1,500ft. but in the northern centre is the Ahaggar plateau, connected with the eastern end of which are north-west to south-east lines of higher land one going north-west to the Gulf of Qabes and one south-east crowned by the Tibesti highlands. Eastward, heights diminish again but there is practically a continuous cliff edge along the Nile slot on both sides and the continuation of the desert plateau on the east stands for the most part more than 1,500ft. above sea with a considerable area over the 3,000ft. line.

The desert has large sandy areas especially in the west with regions of stony desert (*hammada*) in the northern centre and a good deal of stony desert to the east. A number of oases break the monotony of the desert, some being north of Lake Chad; some of the land around the Tibesti highland (reaching 8,000ft.) also gets more moisture and has a population aggregated in certain centres. Wadis from the Ahaggar plateau and elsewhere in the desert are

interesting evidences of a former greater rainfall and from a study of animal remains as well as of finds of human implements it seems that the Sahara was more or less a grassland during some phases at any rate of the early ages of man. The probability is that periods of greater rainfall in the Sudan more or less coincided with periods of Pleistocene glaciation in Europe. The desert area is estimated at 3,500,000 square miles. The Nile slot cuts the desert without modifying it appreciably, and opens out north to the famous delta west of which the coast is not high save in the Barca or Cyrenaica plateau which reaches 1,500ft. not far from the sea.

The Atlas range, the north-western part of the continent, is orographically a part of the mountain arcs that frame the basins of the western Mediterranean. It reaches a height of 14,000ft. at Bu Uriul and Ari Aiaschi and runs, generally, east-north-east to west-south-west. The eastern half has the Tell Atlas on the north and the Sahara Atlas on the south side with the plateau of the Shotts, several lakes without outlets, between them. The western region has the Mid Atlas continuing the first and the Great Atlas continuing the second; the Anti Atlas is parallel to and south of the Great Atlas. To the north of the Mid Atlas the separate coastal mountain range of Er Rif curves north-west to the Strait of Gibraltar beyond which the curved high line is continued in the Sierra Nevada of southern Spain.

South of the eastern ends of these highlands is a more or less east to west line of low land containing the Shott el Jerid (about 52ft. above sea-level) and the Shott Melrir (nearly 100ft. below sea-level) both without outlet. Africa is remarkable for the extent of land, 3,750,000m. in basins of inland drainage.

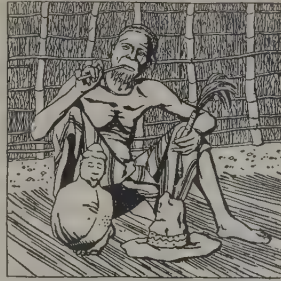
Africa is singularly poor in islands. Madagascar 299,820sq.m., is one of the large islands of the world (smaller than New Guinea and Borneo); it is separated from Africa by the rather deep Mozambique Channel and in structure it resembles Africa. Biologically it has links both with Africa and with the East Indian archipelago. Socotra, east-north-east of Cape Guardafui, a continuation of the Somaliland plateau is the only other African island of any size. The Canary and Cape Verde archipelagoes of the north-west and the Comoro archipelago of the east are volcanic (but pebbles of continental, or plutonic, material have been sent to Europe from Anjovan, one of the lesser Comoro Islands); the Seychelles are a continental remnant. There are coral islets between the Comoros and the Seychelles. Mauritius, Reunion and Rodriguez, the two last entirely, the first mainly volcanic, lie in the Indian Ocean east of Madagascar; Ascension, St. Helena and Tristan da Cunha in the south Atlantic far to the west. (X.)

CLIMATE

Extending from latitude 37° N. to 35° S., the greater part of Africa lies within the tropics, and except on mountains and plateaux the average annual temperature is high, ranging from 62° at Cape Town to 86° at Massaua on the Red Sea. On the other hand there are great extremes of rainfall; in the Egyptian desert appreciable falls occur only once in a number of years, while the western slopes of the Cameroon mountains are among the wettest parts of the world, Debundscha at the foot of Cameroon Peak having an average of 369in. a year. Africa may be conveniently divided into five climatic divisions, of which four run roughly parallel with the lines of latitude, while the fifth occupies a large part of the eastern coastal districts. On either side of the equator is a belt of heavy rainfall which is distributed fairly uniformly throughout the year, but with a tendency for April and October to be the wettest months, those following the annual passage of the sun across the equator. This belt roughly coincides with the Congo valley and Gabon. Northwards the first rainy season is retarded into May and June, while the second rainy season is advanced into September and August, giving a long dry season, a principal wet season, a short dry season and a secondary wet season which is not much inferior in intensity to the first. In latitude 8° or 9° N. these two rainy seasons coalesce into one wet season lasting from May or June until September, while the rest of the year is dry; at the same time the total rainfall decreases. North of 15° N. the rainfall is small and irregular and

we pass into the belt of desert which includes the Sahara and Sudan. This extends to the Mediterranean in the north-east, but in the north-west there is a coastal strip in Algeria and Morocco which has a long dry summer but an appreciable winter rainfall and forms part of the Mediterranean climatic province.

In South Africa there is a similar succession, the April rainfall maximum of the equatorial belt advancing into March and February, while the October maximum is retarded into November and December, until the two coalesce into the summer rainfall region of the southern hemisphere, which includes Angola and southern Rhodesia. South of this is the Kalahari desert, the counterpart of the Sahara, while in the extreme south-west is a small area round Cape Town with a dry summer but appreciable rainfall in winter (April to September). This zonal division does not apply to eastern Africa south of the equator, which has summer monsoon rains and a winter dry season over its whole extent.



BY COURTESY OF THE AMERICAN BOARD OF FOREIGN MISSIONS

A RAIN-MAKER, AN IMPORTANT MEMBER OF WEST AFRICAN COMMUNITIES, WITH THE REQUISITES OF HIS MAGIC

The Equatorial Rainfall Belt.—This region includes the greater part of the Congo basin above Leopoldville, Gabon, Cameroon and the coast of Nigeria as far as the mouth of the Niger. Its characteristics are uniformly high temperature and humidity, a large amount of cloud and a rainfall generally exceeding 60in. a year and rarely falling below 2in. in any month. The temperature is rarely extreme, and probably many parts of the region have never reached the Greenwich maximum of 100°, but on the other hand the temperature rarely falls below 60° on the low ground. The annual average may be taken as 80°, rising to 87° during the day and falling to 73° at night. The hottest months generally fall in the early part of the year, while July and August tend to be coolest, but the annual range is rarely as much as 10°. The relative humidity averages 80%, and this continual moist heat is very enervating to Europeans. The greater part of the region is densely forested.

Savanna Belts.—North and south of the equatorial rain forest is a zone of moderate rainfall, the whole of which falls in a short summer rainy season, while the remainder of the year is dry. These belts may be regarded as extending as far as the isohyet of 20 inches. The northern belt includes Senegal, Bathurst, Sierra Leone, the Gold Coast, Dahomey, the greater part of Nigeria, the Sudan and Abyssinia. The rainfall varies greatly, rising to as much as 154in. a year at Sierra Leone, but even there the months of December to March are almost rainless. The drier parts are occupied by open grass-land but the wetter areas are forested. The rainy season from May or June to September inclusive, in spite of being summer in the astronomical sense, is the coolest part of the year, the temperature being kept down by the great cloudiness and heavy rainfall. This season is unpleasant because of the high humidity, the small daily range of temperature and the frequent thunderstorms and tornadoes, especially at the beginning and end of the season. The prevailing wind is south-westerly at the surface, but is very light; at a height of a few thousand feet the wind becomes north-easterly, and the thunderstorms advance from the north-east. From late October until the end of February is the most pleasant season, with hot days but cool nights, dry air and clear skies; the prevailing wind is north-easterly except on the coast, where sea-breezes occur during the day. Over the interior the wind is often laden with penetrating fine dust (Harmattan wind). In March, April and the beginning of May, the temperature is very high, maxima sometimes exceeding 100° even on the coast, and reaching 110° in the interior. The humidity of the air is still low but is rising steadily, and the wind is light and variable. The rainfall of the Abyssinian plateau is of great importance as the source of the annual Nile floods, and so of the fertility of Egypt. The annual rainfall of

Addis Ababa averages 50in., but more than three-fifths of this amount falls in July, August and September, while October to January inclusive are almost rainless. In spite of the position of Abyssinia near the eastern margin of Africa, it is believed that most of the moisture which falls as rain is derived from the Atlantic ocean, and is carried across the whole width of the continent by the south-west winds, and that only a comparatively small part of the rainfall is derived from the Indian Ocean. The southern savanna belt includes Angola and Rhodesia; the climate is generally similar to that of the northern belt, but the summer rainy season occurs from December to February. The rainfall nowhere exceeds 60in. and owing to the generally high elevation the climate is comparatively pleasant and healthy. The amount of cloud is comparatively small, and the lowest temperatures occur in winter and not, as in the north, in the rainy season.

Deserts.—The greater part of Africa north of 16° N. is occupied by an arid climate which gives rise to the deserts of the Sahara and Egypt. The rainfall is less than 10in. a year, and over a large part of the area is probably less than an inch, being confined to a few drops once or twice a year and isolated heavy falls at intervals of many years; under these conditions the term "average" has no meaning. The temperature is very high in summer, the average in July exceeding 90° over a large part of the interior; it remains very hot from April to September inclusive, but the winter months are relatively cool. The daily range of temperature is very great, exceeding 30° at many places; for example at El Obeid in the Anglo-Egyptian Sudan in January the mean daily maximum is 86° and the mean daily minimum 52°, and frosts are occasionally experienced. Very high maxima are recorded in summer, exceeding 110° on the coast and 120° in the interior, while at Azizia, in Tripoli, a shade temperature of 136° has been recorded, the highest known on the earth's surface. The air over the interior is dry, less than 40% average humidity for the year, and figures of 2 or 3% have been recorded. On the coast special conditions prevail, which will be referred to later. The amount of cloud is very small, generally less than one-fifth of the sky covered, while in parts of the Egyptian desert no cloud is seen for months together. The winds are generally light and irregular over the Sahara, but dust storms, sand pillars and other local violent winds occur. In the Nile valley the prevailing wind is southerly from November to February and northerly from April to September and reaches considerable strength in the midsummer months, greatly moderating the temperature; occasional very hot, dry, dust-laden southerly winds are known as the Khamsin; these are very unpleasant, especially when accompanied by sand storms. Similar winds from the desert occur also under local names in Tripoli, Tunis and Algeria; they frequently cross the Mediterranean to southern Italy as the scirocco. A severe form is the dreaded simoom or samun, a hot blast of air (125° or more), often accompanied by heavy clouds of dust or sand. Land and sea breezes are well developed on the coast of Tripoli, Tunis and Algeria, but not of Egypt. The corresponding desert of southern Africa, the Kalahari, is of much less extent, being limited to the western half of the continent, and the heat and dryness are not so excessive as in the Sahara.

The climate of the coast of the Red Sea and Gulf of Aden is peculiar. The rainfall is exceedingly scanty, the sky almost cloudless, and the temperature very high, but this is associated with an abnormally high humidity, the moisture being derived from the warm waters of the Red Sea, which reach 90°. The highest known temperature of the wet-bulb thermometer, 100°, has occurred at Kamaran island and Berbera; this moist heat is very unpleasant. Where the Sahara and Kalahari meet the Atlantic, different conditions occur; here the presence of cold currents makes the surface of the sea very cold, while the land a few miles inland is very hot; these regions have a very small rainfall, clear skies but frequent fogs over the sea, and a moderate temperature which changes very little throughout the year. The rainfall of the South African west coast from 17 to 28° S. is less than an inch a year.

Mediterranean Climate.—Morocco, northern Algeria and northern Tunis have pleasantly mild, rather rainy winters and

long, hot, dry, almost cloudless summers. The annual rainfall averages about 30 in., but is very variable. The mean temperature is between 50° and 60° in January and about 80° in July and August; the daily range is about 15°. A similar climate is found over a small area near Cape Town, which has a temperature ranging from 55° in July to 70° in January and February, and a rainfall of 25 in. falling mainly from May to September inclusive.

Eastern Africa.—Kenya Colony, Tanganyika, Uganda, Nyasaland and Portuguese East Africa have an equable climate with a temperature between 75° and 80° near sea-level and a rainfall of 30 to 60 inches. There is generally a fairly well-marked rainy season; near the equator this occurs in April and May with a minor rainy season in November and December, but further south there is only one rainy season, falling in summer. Thus at Zanzibar the rainiest months are April, May and November, in that order, and at Nairobi, April, November and May, but at Lourenço Marques in 26° S., January and February. The dry season or seasons are not so extreme as in West Africa; months entirely without rain are rare and the relative humidity remains fairly high throughout the year. The prevailing winds are easterly. Thunderstorms are very frequent during the rainy season, recurring with great regularity almost every afternoon. The low-lying coastal areas are enervating and in places unhealthy, but large parts of the interior, including the whole of Uganda, form plateaux with an elevation of several thousand feet, and as the average temperature decreases upwards at a rate of about 3° per 1,000 ft., these uplands are much cooler and more bracing than the coastal regions, while their distance from the sea makes them somewhat drier except on slopes directly exposed to the rain-bearing easterly winds. These plateaux are rather more suitable for European habitation than the coastal areas. Natal and the eastern parts of the Cape Province have warm, rainy summers, with a temperature of 70° to 75°, and moderately cool winters, relatively dry but very seldom rainless. The annual rainfall is between 30 and 40 in.; the average July temperature is 63° at Durban and 59° at East London, but over the high ground of the interior frosts are sometimes experienced in winter. This is one of the finest and healthiest climates in Africa. (C. E. P. B.)

FAUNA

Africa, together with the Deccan and West Australia as well as Brazil, forms part of the old continental mass of Gondwanaland, whatever view one may take of the process of separation of each from the others. Gondwanaland seems to have persisted through much of the Mesozoic era, during which these southern lands were separated from the northern ones by the broad sea of Tethys, along which later uprose the great fold mountain ranges that stretch from the Pyrenees to the Malay. The southern lands thus show resemblances in their forms of life that are due to these old links. Another factor of the history of life within them is the stability of their conditions as contrasted with the wide variations that have occurred in the orography and climate of the northern lands. Those wide variations have been reflected in evolutionary changes among living things and thus the northern lands have become in a large measure the homes where new forms are born, while the southern ones are largely refuges of early strays from the north, or places where certain types immigrating since connections were made have had a great career. The Sahara desert-barrier is largely a modern (post-glacial) hindrance to immigration of animals, the Rift system a partial but serious hindrance also relatively recently established.

The isolation of Africa is far less than that of Australia, and, whereas Australia retains the two lowly egg-laying mammals (*Ornithorhynchus* and *Echidna*) and is the great home of the marsupials, and of no other truly native mammals save bats, an indication of its long separation, Africa retains neither the egg-laying mammals nor the marsupials. The lowliest order of truly placental mammals, the so called Edentata, absent from Australia, occurs in South America, Africa and south-east Asia. Its great home is South America, but the armadillo (Cape ant-eater) is peculiar to Africa and *Marmosa* (the scaly ant-eater) has species both in Africa and in south-east Asia. It is an interesting fact that the order,

though an ancient one is absent from Madagascar. The primates offer a contrasted distribution. Among them the lemurs are ancient forms of known fossil from the northern lands but now surviving in Africa, Madagascar and south-east Asia; Africa has many more forms than south-east Asia and Madagascar many more still. From the lemurs have descended monkeys and apes; the platyrrhine monkeys are American, the catarrhine, African and Asiatic, including, among anthropoid apes, the orang-utan and the gibbon of south-east Asia and the gorilla and chimpanzee of intertropical Africa. It is generally thought that the survival of lemurs in Madagascar is a result of its separation from Africa before the great carnivores had spread thither. The absence of elephants, rhinoceros and anthropoid apes from Madagascar is noteworthy. The most important African carnivore is the lion, also found in parts of Arabia, Persia and western India and formerly more generally distributed in south-west Asia and north-east Africa until man restricted its range. The leopard (panther) and hyena are the other large carnivores. Madagascar has very primitive carnivores only, one of which was formerly said to be closely related to a West Indian form though the resemblances seem better interpreted by the fact that both are ancient types. The African elephant is a species distinct from the Indian one; the distribution of the genus was of course far wider until postglacial times. The hoofed animals of Africa are of some interest. Of even-toed forms Africa alone preserves the hippopotamus which ranged widely in northern lands until a late phase of the ice age; remains of a small hippopotamus species have been found in Madagascar which also possesses a river hog (*Potamochoerus*). It is thought that they may have swum across from Africa before the separation between continent and island became very marked. The giraffe and okapi are another family of hoofed animals found in East Africa only. The rhinoceros has east African and south-east Asiatic species. The single humped camel is now a feature of the steppes and deserts of north Africa but only as a domesticated animal introduced from Arabia. Deer are absent from Africa save for a few forms in French Africa, north of the Sahara, just as bears and wolves do not occur south of the desert. On the other hand the immense warm African grasslands are overrun by many antelopes, and the zebra and formerly the quagga. Africa thus, along with a number of old fashioned forms has several relatively new fashioned ones, but the absence of true cattle, pigs, goats, sheep and camels until man brought them is a striking fact. Of the genus *Bos*, nevertheless, South Africa possesses a representative in the Cape buffalo (*Bos capensis*). Africa has many birds peculiar to it but we need only notice the ostrich family of birds that run over grassland and desert border; extinct running birds of great size (*Aepyornis*) lived in Madagascar apparently not very long ago. Some African reptiles (e.g. *Amphisbaena*) appear closely related to South American forms, others to those of northern lands, the abundance of crocodiles is a feature and so are the chameleons, which especially abound in Madagascar. The python and puffadder are notable among African snakes. Monitor lizards, abundant in Africa and elsewhere, have not reached Madagascar. The Amphibians of Madagascar include several species also found in south-east Asia and this may be a result of an ancient land connection, and analogous arguments could be given concerning the land snails. Africa has the disastrous fate of being the one home of the tse-tse fly. (X.)

FLORA

The character of the vegetation of Africa is largely determined by the distribution of heat and moisture coupled with the great range in altitude. Phytogeographically the continent may be primarily divided into three sections: (1) a northern extratropical region, bordering the southern shores of the Mediterranean and gradually fading into the northern Sahara desert with a very scanty flora; (2) a tropical African region, bounded approximately on the north by the Tropic of Cancer; and (3) a South African region, reaching as far north as the Limpopo, Lake Ngami and southern Angola. According to Thonner (*Fl. Pl. of Africa*, 1913), there are in Africa about 3,712 genera and over 40,000 species of flowering plants, a number constantly being added to.

The Northern Area.—The northern area contains a considerable proportion of genera and species common to the south of Europe, besides a large number of endemics in and south of the Atlas mountains and in Morocco. In the Atlas mountains the Atlantic cedar (*Cedrus atlantica*) is a characteristic tree, and is very closely related to species in Asia Minor and the western Himalayas, some authorities having considered them all to be forms of one variable species. The flora of Morocco is related to that of the Canary islands, whilst the somewhat meagre indigenous vegetation of Egypt is largely the same as that of Palestine and Persia.

The tropical African flora may be roughly divided into four regions: (1) a northern desert or semi-desert region; (2) a savannah region; (3) a high mountain region; and (4) the tropical rain forest. The first type is characterized by a very scanty rainfall, and its flora consists largely of plants which are short-lived, such as annuals, or those specially adapted to resist long periods of drought. These include the date-palm (*Phoenix dactylifera*) which grows where other vegetation is practically non-existent. The transition from the semi-desert to that of the savannah is usually gradual with an increase in annual rainfall and pronounced wet and dry seasons. In the savannah the low, thorny bushes of the desert are replaced by scattered trees and shrubs, giving the country a park-like appearance, with an undergrowth of grasses and herbaceous flowering plants, including numerous annuals and species with underground root-stocks. This vegetation is typical of the elevated plateau-region which occupies a large portion of the continent. Characteristic trees are the baobab (*Adansonia digitata*), the shea butter tree (*Butyrospermum Parkii*), *Anogeissus Schimperi*, *Azelia africana*, *Entada sudanica*, *Parkia filicoidea*, the fan-palm (*Borassus flabellifer*), etc.

In general it may be stated that the desert type is steadily encroaching on the savannah, which in turn is gradually penetrating the northern limits of the forest region, a condition resulting from a combination of desiccating winds during the prolonged dry period and of human agency (shifting cultivation and burning of the grass). In the drier parts of the savannah, for example in the eastern Sudan, large areas are covered by species of thorny acacia, including *A. arabica*, producing gum-arabic. In somewhat less arid but similar country farther south, in Rhodesia, south-east Belgian Congo and parts of Angola, another leguminous genus, *Bracnystegia*, is very plentiful, and forms almost pure low forest, whilst in the drier semi-desert areas of south Angola and Damaraland a unique example of the vegetable kingdom, *Welwitschia mirabilis*, is found. In the savannah and neighbouring forest regions there are numerous plants with edible fruits and not a few poisonous plants such as species of *Dichapetalum* (*Chailletiaceae*), the arrow-poison (*Akokanthera*), *Lasiosiphon Kraussianus*, *Strophanthus*, etc.

The high mountains capping the savannah region, such as the Cameroon mountains, Mt. Elgon, Mt. Kenya, Mt. Ruwenzori, Mt. Kilimanjaro, etc., carry a flora of great interest. On one or other of these mountains it is possible to traverse almost as varied a succession of types of vegetation as might be encountered in a journey from the equator to the vicinity of either of the poles. Many of the genera found on their slopes are represented elsewhere only in the temperate regions of the northern or southern hemispheres. Some of the better known examples are berberis, cornus and anemone, whilst outliers from the Cape region occur, such as *Protea*. The weird forests of tree-groundsel (*Senecio*) and the giant species of lobelia are characteristic features of the East African mountains.

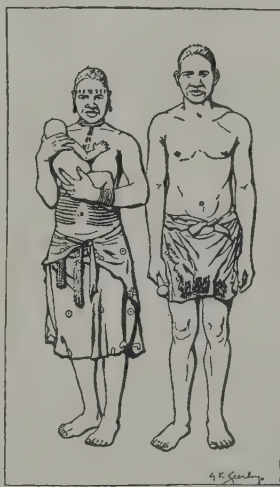
The evergreen forest occupies mainly the low-lying country with a high rainfall distributed throughout the year, and extends in an ever-widening belt from the colony of Sierra Leone to the Cameroons, whence it spreads out over a great part of the Belgian Congo and the Gabon as far as the Victoria Nyanza. This forest sometimes penetrates for a considerable distance into the savannah regions along the banks of rivers. It is particularly rich in endemic species of trees, shrubs and woody climbers, some of which are of great commercial value. The most important timber trees are the African mahoganies (*Khaya*, *Pseudocedrela*, *Entandrophragma*, etc.) and numerous trees of the families Caesalpini-

aceae, Combretaceae, Simarubaceae and Euphorbiaceae. Amongst ornamental shrubs the numerous species of *Mussaenda* (*Rubiaceae*), with enlarged, brightly coloured calyx-lobes, and the brilliant-flowered combretums, are conspicuous. The silk-cotton or kapok tree (*Ceiba pentandra*), with its enormous buttressed trunk, often attains gigantic proportions, whilst in West Africa especially the valuable oil-palm (*Elaeis guineensis*) is abundant. As many of the peculiar genera found in this primeval forest, especially in the Cameroons and Gabon regions, are also found in the Guianas and Brazil on the opposite side of the Atlantic, it seems probable that it is but the remains of a once much more extensive and continuous tract of forest. Apart from Madagascar, the connection between the East African forests and those of tropical Asia is not nearly so marked.

South African Flora.—The South African flora, broadly speaking, consists of two main types: the typical Cape or south-western region occupies a narrow strip within the southern coast line. In some respects it resembles certain features of the Australian flora, the peculiar families Proteaceae and Restionaceae and certain groups of Leguminosae being common to the two areas and rare in other parts of the world. The vegetation of this coastal area is of a marked xerophilous character and bears a superficial resemblance to that of certain parts of the Mediterranean. It is of the so-called bushwood type, and here and there are tracts of grassland. Intermingled with the shrubs are numerous annuals, herbaceous perennials, succulents, etc. Farther inland, between the ranges of mountains, much of the surface is occupied by the "rhenosterbosch," *Elytropappus rhinocerotis* (*Compositae*). True forests occur only towards the eastern part of the region, in the districts of Knysna and Humansdorp, and the trees composing them nearly all belong to tropical genera. In the north-west a few trees of a conifer, *Callitris juniperoides*, are found, being the sole remains of a once extensive forest. The silver-tree, *Leucadendron argenteum*, is now confined to the Cape peninsula, which harbours as many as a hundred species of Erica. Other striking plants in the same district are the brilliant scarlet *Disa uniflora* and the blue *D. graminifolia*, two beautiful ground orchids. There are also numerous species of the geranium family and many beautiful

oxalis, large numbers of which are in cultivation.

Of the remainder of the South African regions perhaps the most interesting and remarkable is the Karroo, which occupies a broad belt in the hinterland of the south-western coast region. It is mainly a vast shallow basin which in former times was the bed of a large lake. Its altitude, according to Bolus, ranges from 1,800–2,500ft., the mountains on the northern margin reaching 8,000ft. altitude. The vegetation is of an intensely xerophytic type, being composed mainly of succulents of weird and diverse form, thorn-bushes and numerous plants with bulbous and tuberous root-stocks. Trees are almost entirely absent. The predominant families in this region are Compositae, Leguminosae and Ficoideae, the last-mentioned being almost entirely represented



A FAMILY OF MAKALANGA NATIVES
The Makalanga are a branch of the Bantu race of southern Africa—an agricultural people and more civilized than the tribes of the interior

by about 70 species of the genus *Mesembryanthemum* and its segregates. In this area the exotic *Opuntia* from Central America has become a pest.

The upper and Kalahari regions distinguished by Bolus may for convenience be treated as one. Whilst the families mentioned above are still highly represented, the grass family, Gramineae, takes a very high place, much of the country being grassland (high veld). Here also there is a considerable influx of families and

genera characteristic of the tropical regions to the north. Amongst the Compositae the everlastings (*Helichrysum*) are conspicuous.

The south-eastern coast region is bounded on the south-west by the Van Stadens mountains and extends northwards east of the Drakenberg as far as the tropic into which it gradually merges. It is essentially a southerly extension of the tropical flora of East Africa, and contains a large number of such tropical families as Asclepiadaceae, Acanthaceae, Rubiaceae, etc. True rain-forest occurs in Natal. The plants so characteristic of the south-western coast region diminish rapidly northward. Some of the most striking plants in the area are a large tree-euphorbia (*E. grandidens*) and several species of *Eucephalartos* (Cycadaceae) and numerous species of aloe. Although nearly opposite the island of Madagascar, there is scarcely anything in common between the two floras.

As in the case of the tropical flora, it seems clear, judging by the history of the vegetation, that the climate of South Africa is gradually becoming drier. (J. Hu.)

GEOLOGY

Africa has a simpler geological structure than any other continent, although it has many unique features and formations. It consists essentially of a plateau of which the rocks have not been bent into steep folds by compression since primaevial times, except for a strip in Cape Colony, which was part of an ancient southern continent, and for the Atlas Mountains, which are geologically and biologically European. The continent between these remote chains of fold mountains has undergone no close folding, and most of it has remained above sea level since the time of the oldest known fossils. The margins have been repeatedly reached by the sea, which has submerged the coastal plains and occasionally extended inland up the valleys. The plateau has been fractured and cleft by earth movements which occasioned widespread volcanic eruptions; but the plateau surface has remained a land area on which plants and animals have evolved continuously, subject to the stimulus of changing climate, but never interrupted by submergence. Africa is part of an ancient continent which included most of South America, India and Australia. This southern continent, Gondwanaland, was separated from the contemporary northern land of Eurasia, except for an occasional isthmus, by a sea, the Tethys, which extended from central America through the Mediterranean and across southern Asia to the Eastern Archipelago. The range of this southern continent is best established in Carboniferous times; by the Jurassic its disruption had begun by subsidences which formed the Atlantic and Indian oceans, introduced great changes in its biological relations, and repeatedly caused widespread volcanic eruptions.

The foundation of the continent consists of a vast slab of rocks belonging to the Primaevial or Pampalaeozoic era. They are exposed over about one-third of the continent. They outcrop from Cape Town to southern Egypt, and from the Gold Coast on the west to Somaliland, the eastern horn of Africa. Most progress in the classification of these rocks has been made in South Africa, where they have great mineral wealth. They are divided into three main divisions. The lowest, the Swaziland system, consists of gneisses and coarse schists; in addition to the typical areas in South Africa, it forms most of Africa, including Nubia, the highlands along the eastern and Atlantic coasts, and the Sudan from Abyssinia to Nigeria and the Gold Coast. This division corresponds to the old gneiss of other lands, such as the Laurentian of Canada and the Lewisian of Britain.

The second division consists of sedimentary rocks, including quartzites, limestones, dolomites and slaty schists, with vast sheets of volcanic rocks. They are classified in South Africa as the Witwatersrand, Ventersdorp and Transvaal systems. Some of the rocks are so little altered that they have been expected to yield fossils; but none has been found and the *Orthoceras*, said to prove the Ordovician age of the Otavi dolomite, was based on cylindrical concretions. Some of these beds were regarded as Lower Palaeozoic; but they are probably earlier owing to the absence of fossils, and their resemblance to the pre-Cambrian rocks of other continents. The representatives of this division include important cop-

per, lead and zinc mining fields in northern Rhodesia and the Congo basin, the goldfield of Kilo in the eastern Belgian Congo, the goldfields of the Gold Coast Colony and the less important gold occurrences that have been discovered in Tanganyika Territory and Kenya Colony.

The third division includes sandstones that are so little altered that they have been persistently regarded as the inland continuation of the Devonian red sandstones of the coast at Cape Town. The chief member is the Waterberg sandstone of the northern Transvaal, which is probably represented in Uganda by part of the Karagwe series (most of which is referable to the second division), and in Angola by the Oendolongo series. These sandstones are probably the equivalent of the Torridonian of Britain and the Keweenaw of the United States and Canada.

The Palaeozoic era began with apparently the whole of Africa as part of a continent, for the only Cambrian beds known in it are in Morocco near Tetuan, though the sea came close to the eastern coast in Sinai. No certain Ordovician rocks are known, though they have been doubtfully recorded from the Atlas mountains. Many beds in Africa have been called Ordovician and Silurian on inadequate evidence, but some Silurian beds with graptolites occur in the central Sahara.

The Devonian is the oldest African system with widespread fossiliferous beds. It includes the Bokkeveld beds in Cape Colony, and has a wide extent in the Sahara, Libya and the western Sudan, and it reaches the Atlantic on the Gold Coast; marine representatives occur of the lower, middle and upper divisions. Marine Carboniferous rocks occur to the north of the Devonian beds in Cape Colony and limestones with crinoids and *Productus* show that a contemporary sea covered part of Egypt. The Lower and Middle Carboniferous are widely developed in the northern and north-western Sahara, and in south-western Tripoli; and there are small outcrops by the Gulf of Suez. The Carboniferous land deposits are extensive. The lowest part of the Karroo system of southern Africa is Upper Carboniferous and includes the glacial Dwyka Conglomerate and rich coal seams. Coal is also found in southern Rhodesia, Tanganyika Territory and Lake Nyasa. The glacial deposits of this period extend northward into the Congo basin and southern Madagascar. The later divisions of the Karroo system range from the Permian to the Lower Lias and are represented in equatorial Africa; they have yielded many remarkable fossil reptiles. The Permian beds (Lower Beaufort) are represented by shales of freshwater origin with *Palaeonodonta* on the Sabaki in Kenya Colony, and the Trias (Upper Beaufort) by the Tanga beds and part of the Buruma sandstone, of which the fossil *Dadoxylon* forest may be the equivalent of that of the Molteno beds of South Africa. In the Congo there are large areas of sandstones, the Lualaba and Lubilache series, which, judging from their sparse fossils, are Permian and Trias.

There is no established marine Trias in Africa, except for a small development in southern Tunis and along the Atlas of beds like those in Andalusia; though the sea lay a little north in the Mediterranean, most of the Triassic beds of Algeria and Tunis are of the continental type, like those of England and Germany. The breaking up of Gondwanaland had nevertheless probably begun in the Trias, and in the next period, the Jurassic, marine beds were deposited along parts of the east African coast. An arm of the sea then ran up the Mozambique channel between Madagascar and the mainland. The eastern part of Madagascar consists of the primaevial gneisses and schists, on which rest some Karroo beds; the western slope consists of marine Jurassic, Cretaceous and Kainozoic beds, with some volcanic rocks. The Jurassic beds of Madagascar and Tanganyika Territory range from the Lias to the end of the system; further north, in Kenya Colony and Somaliland, the horizons established represent from the Bathonian to the Tithonian. In Tanganyika Territory the Upper Jurassic beds (Corallian to Tithonian) in Tenduguru are famous for their fossil reptiles, of which *Gigantosaurus* is the largest known animal.

The advance of the sea during the Jurassic received in East Africa a check in the Cretaceous; for though a Neocomian gulf ran northward from Uitenhage in Cape Colony past Madagascar, the lowest Cretaceous series is barely represented in Kenya and

its occurrence in Abyssinia is probably due to a gulf from the Mediterranean. The widespread Cretaceous rock of eastern Africa is the Nubian sandstone (possibly partly Upper Jurassic), a land deposit which extends from Egypt to Abyssinia and Somaliland. In Egypt an arm of the Mediterranean sea deposited Cretaceous beds, which represent all the series from the Lower Cenomanian to the Danian.

A Cretaceous strait in the Upper Albian and Senonian extended from the Mediterranean across the Sahara, past Lake Chad and along the Benue valley as far south as Angola. The Cretaceous in Africa is best represented in Tunis, Algeria and Morocco. At the beginning of the period the sea covered a narrow strip of land from the coast to just south of Tunis and Oran; but by the Middle and Upper Cretaceous compact limestones were deposited over much of northern Algeria, and the Cenomanian lagoons lay along the front of the Sahara.

In the same region the Cretaceous sea was succeeded directly by that of the Lower Eocene, wherein were deposited the phosphatic limestones that are the most valuable mineral deposit of northern Africa. A still wider submergence in the Middle Eocene formed the Nummulitic limestone, which ranges across northern Africa from Cairo through Cyrenaica and along the Atlas Mountains to Morocco; and a gulf southward extended on to some of the lower parts of the Sahara. A strait from this gulf continued to the Niger valley and covered the district of Sokoto, and reached the Gulf of Guinea in southern Nigeria and the Cameroons. The Oligocene saw a general retreat of the sea from northern Africa, but beds with small Nummulites were deposited in bays. The freshwater lakes of the Oligocene have yielded at Fayum the fossils which revealed to C. W. Andrews the story of the origin of the elephants from the primitive *Moeritherium*.

The Miocene sea along the Atlas was restricted to a strait from Oran to central Tunis, which was one of the passages that connected the Atlantic and the western Mediterranean. A renewed uplift at the end of the Miocene of the channel reduced these straits, though that south of the Riff in Morocco was apparently still occupied by the sea. In other parts of Africa the marine Cainozoic deposits are scanty. The sea occasionally reached the tropical coasts. A full series of Eocene limestones occur in Somaliland, with also the Upper Oligocene. Eocene and Miocene deposits occur both on the coasts of Kenya Colony and in Tanganyika Territory at Lindi; Miocene limestone occurs in the island of Pemba. The marine Pliocene of the Mediterranean is represented in Algeria and Egypt, while marine Pliocene deposits allied to those of the Persian Gulf also occur, notably in Zanzibar island and at Mombasa.

Africa, therefore, has a long stable development, which was occasionally interrupted by volcanic outbreaks connected with the fractures made by the foundering of the adjacent ocean basins. The eastern half of Africa appears to have been slowly upraised during the Mesozoic into a broad, flat arch contemporary with the formation of a great sea-filled trough along the East African coast. The wider subsidence that formed the Indian Ocean led to the giving way of the eastern side of the arch, and the infall of its roof formed the Great Rift valley, which extends from Mozambique throughout eastern Africa and along the Red Sea to the Jordan valley. The fractures connected with its formation were accompanied by great volcanic eruptions, and the Kapitan phonolites of Kenya Colony are probably contemporary with the Decan traps of north-western India. The earth movements connected with the formation of the Great Rift valley lasted from the Oligocene to the Pleistocene, and they were accompanied by repeated volcanic eruptions. They built up the two highest of African mountains—Kilima Njaro, which still has a crater upon its summit, and Kenya, which is the denuded neck of an old volcano. Subsidences around volcanic centres formed great cauldrons, such as Ngorongoro in Tanganyika and Menengai in Kenya Colony. Volcanoes along the fractures connected with the formation of the Atlantic produced the shonkinite vent at Chieuea in Angola, the volcano of the Cameroons, which is still active, while eruptions along a fracture parallel to the coast formed the islands of the Guinea Gulf, Fernando Po, San Thomé, Principé and

Annobon. The deepest subsidences along the Rift valley in Africa formed the lake basins of Tanganyika, Nyassa, the Albert Nyanza and Lake Rudolf.

The economic geology of Africa is connected mainly with its rich mineral fields, especially of gold and diamonds in South Africa, southern Rhodesia and the Gold Coast; of gold at Kilo; of diamonds, copper, zinc and lead in Northern Rhodesia and Katanga. Tin and platinum are found in the Transvaal, and chromium in southern Rhodesia. The most important phosphate deposits are along the Atlas Mountains. The only productive African oil-field is on the coast of the Gulf of Suez; oil-shale is known in South Africa, Nigeria and elsewhere; rich coal-fields are worked in the Transvaal, Natal and Southern Rhodesia; and coal also occurs in Tanganyika Territory, Nyassaland and Nigeria. Iron ores are widespread, as are also deposits of bauxite and manganese, which are most extensively worked on the Gold Coast. The chief African mica mines are in Tanganyika Territory.

TABLE OF FORMATIONS

CAINOZOIC

<i>Pleistocene.</i>	Raised coral reefs. Alluvial river and lake plains. Moraines on Kilima Njaro, Kenya, and Ruwenzori. Elephant beds in Zululand. Lavas and tuffs of recent volcanoes. Gravels, desert sands, etc., with Neolithic and Palaeolithic implements.
<i>Pliocene.</i>	Marine beds in Tunis and Algeria. Sands with <i>Clypeaster</i> in Egypt. Limestones of Zanzibar, Pemba and Mombasa. Naivashan lavas in Kenya. Bone beds at Homa, Omo Valley, etc. Lavas in Atlantic islands, Aden, etc.
<i>Miocene.</i>	Marine limestones in Algeria and Tunis. Limestones of Pemba and Tanganyika coast. <i>Dinotherium</i> beds of Victoria Nyanza. Limestones of Egypt with oil-field of Gulf of Suez.
<i>Oligocene.</i>	In former bays along Mediterranean coastlands. Dubar limestone of Somaliland. Limestones N. of Mombasa and at Lindi. Lake beds of Fayum. Early faulting of Great Rift valley.
<i>Eocene.</i>	Nummulitic limestone of N. Africa coastlands; in Sokoto, northern Nigeria; Somaliland; Coasts of Kenya Colony. Tanganyika Territory. Sheringoma in S. Mozambique. <i>Aturia</i> beds of S.W. Africa. Widespread volcanic eruptions in Kenya.

MESOZOIC

<i>Cretaceous.</i>	Neocomian to Up. Cretaceous along eastern coast of S. Africa. Neocomian-Cenomanian in Mozambique; Urgovian-Senonian in Tanganyika Territory. Cenomanian-Danian Egypt. Lower to Up. Cretaceous along the Atlas mts. Albian in Angola. Turonian, Benue valley. Kapitan Phonolites of Kenya Colony. Nubian sandstone in Nubia, Abyssinia, and Somaliland.
<i>Jurassic.</i>	Upper.—Meragalleh limestone in Somaliland and Kimmeridgian-Purbeckian, with giant reptiles and marine beds, in Tanganyika Territory. Ammonite beds near Mombasa. Middle.—Kenya and Tanganyika Territory. Lower.—Bathonian and Bajocian limestones in Tanganyika Territory, Kenya (Kambe limestone), Somaliland, and Madagascar.
<i>Trias.</i>	Lias. Tanganyika Territory and Jubaland. Rhaetic. Drakenberg lavas. Upper Tanga beds with plants. Coal series in Natal. Marine. Terrestrial Trias in S.S. Tunisia and Atlas Cave sandstone and Moltano beds. Mazeras sandstone with <i>Dadoxylon</i> forest in Kenya coastlands. Upper Beaufort. Kenya coastlands. Burghersdorp beds of S. Africa. Lubilache sandstones of Congo basin.

PALAEOZOIC

<i>Permian.</i>	Lower Beaufort in S. Africa. Tanga beds. Sabaki shales with <i>Palaeonodonta</i> . Tanga beds. Upper Lualaba sandstones of Congo.
<i>Carboniferous.</i>	Upper Uralian. Ecca beds with coal-fields of Transvaal and glacial Dwyka conglomerate in S. Africa. Wankie coal in S. Rhodesia. Coals in Tanganyika Territory and Congo. Glacial beds in Congo and Madagascar. Middle.—Absent. Lower.—Witteberg series of Cape Colony. Crinoid and <i>Productus</i> limestone in Egypt.
<i>Devonian.</i>	Bokkeveld series of Cape Colony. Marine beds of Sahara, Libya, and Sudan. Table Mountain sandstone.

Karoo System.

Silurian. Central Sahara.
Ordovician. Absent.
Cambrian. N.W. Morocco and Gulf of Akaba.

PAMPALAEZOIC (PRIMAEVAL)

Upper Division. Waterberg sandstone of S. Africa. Oendolongo beds, Angola.

Middle Division. Transvaal, Ventersdorp, and Witwatersrand systems in Transvaal and S.W. Africa with representatives in Rhodesia, southern Congo. Lepi series of Angola. Kandelurgu and Karagwe quartzites of Tanganyika and Uganda. Banket series of Gold Coast.

Lower Division. Swaziland system with gneiss Schists of the main foundation of the African continental plateau.

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ANTHROPOLOGY AND ETHNOLOGY

North Africa and Egypt.—Apart from Egypt and the Nile Valley the divisions of Africa north of the Sudan are in the main political and from the anthropological standpoint almost entirely artificial. Not only are the Egypto-Tripolitan and the Morocco-Algerian frontiers entirely conventional, but even the Libyan-Tunisian frontier lacks the ethnic significance it might possess if instead of leaving the Mediterranean in the neighbourhood of Cape Roux it ran almost due south from the Gulf of Gabes. The political divisions of the western portion of North Africa—Africa Minor—thus stand in sharp contrast to its natural unity, so well-defined between the desert and the Mediterranean that the early Arab geographers named it *Geziret el Magreb*, "the Western Island." It is also necessary to realize that the predominantly Arab complexion of North Africa and the general substitution of Hamitic languages by Arabic began little more than 1000 years ago, while to appreciate the vast area of country over which the spread of Arab influence has obliterated or modified the earlier Berber tongues reference should be made to some such linguistic map as that given by Meinhof in *Die moderne Sprachforschung in Afrika* (Berlin 1910).

The Berbers and Their Position in North Africa.—While Sergi (*Antropologia della Stirpe Camitica*, Turin, 1897) regards the Berbers as the northern branch of the Hamitic stock (the Eastern Hamites being typically represented by proto-Egyptians, Beja and Galla), Keane (*Man, Past and Present*, Cambridge, 1920) quotes T. A. Joyce to the effect that it is impossible to prove the connection between Eastern and Northern Hamites, and that the latter should be regarded as the African representatives of the Mediterranean race. The question is largely a matter of terminology, since we cannot doubt the close relationship of the groups commonly termed Mediterranean, proto-Egyptian, and Beja.

The term Moor, which is often applied to the townsmen of Morocco, is here purposely avoided, and with Collignon and Deniker ("Les Maures du Senegal," *L'Anthropologie*, 1896) is restricted ethnically to a group of peoples lying between the Senegal River and Morocco and extending east to the Tuareg country.

Egypt.—For Egypt alone in North Africa it is possible to construct a connected anthropological record, which, in spite of gaps, reaches back to the very dawn of history. Some forty years ago Flinders Petrie and J. E. Quibell discovered at Naqada and Ballas in Upper Egypt a series of cemeteries belonging to a people with a mode of life and habit of burial utterly different from those of the dynastic civilization previously known in Egypt. Their discovery was followed up and extended by de Morgan, who recognized that Petrie's "new race" preceded even Mena, traditionally the first ruler of a united Egypt, whose tomb he found and excavated. Unfortunately de Morgan applied the term "neolithic" to this newly discovered people, a complete misnomer—though still used in French works—since detailed archaeological examination indicates that copper occurs in the earliest graves in

these cemeteries. These early inhabitants of the Nile Valley are now known as the predynastic or proto-Egyptians, terms which respectively emphasize their position in time and their ethnic relation to the other inhabitants of the Nile Valley.

The Pre-dynastic Egyptians.—The proto-Egyptians have been best described by Elliot Smith, who writes of them (*The People of Egypt*, Address to Cairo Scientific Society, 1909) as a people slightly below the average size of mankind, with muscular development so feeble that it may be difficult to determine to which sex an isolated skull belongs. In physical character they exhibit a remarkable degree of homogeneity. Their hair was dark, and either straight or wavy, never woolly. In the men apart from a chin-tuft beard there was the scantiest development of facial hair. These proto-Egyptians had long narrow heads with a narrow forehead and prominent occiput, so that the skull when viewed from above presents a characteristic form which has been termed "coffin-shaped." The face was a moderately long and narrow ellipse, and the chin was almost always pointed. More precisely, they were longheaded, with a cranial index of 73 (Naqada) and a mean height estimated at a little under 65 inches for men and about 60 inches for women, and though there can be no direct evidence as to skin and eye colour there is no doubt that they had dark eyes and skins of a yellowish brown or pale copper colour.

The Dynastic Egyptians.—All this applies only to the population of Upper Egypt; knowledge is lacking of the inhabitants of the delta at this early period, as of the whole of Lower Egypt until the time of the pyramid builders. Among the skeletons of this date from the neighbourhood of the pyramids Elliot Smith found a considerable number in which the skeleton was more robust, with a bigger and especially a broader skull without the angularity and the projecting occiput of the proto-Egyptian type; there are modifications in forehead, orbits and nose, with particularly obvious differences in the jaw, in fact the type of man buried round the pyramids belonged to that well characterized group known as the dynastic Egyptian, which in antiquity is represented by the Saqqara "Scribes" and the Sheikh el Belled, and is essentially that of the peasant Egyptians, the *fellahin* of the present day. For a detailed account of skeletal material, and especially of crania, throughout the dynastic period see A. Thomson and D. Randall-Maciver *The Ancient Races of the Thebaid* (Oxford 1905). Elliot Smith (*The Ancient Egyptians*, 1923, chapter 7), arrays evidence that long before the New Empire, Egypt was permeated from end to end by this foreign element, which in his opinion carries the physical traits of the Armenoid race. There is however one difficulty in accepting this view, which does not arise from any examination of the skeletal remains but results from the large number of portrait statues which the Egyptians have left to us, namely, that although so many of these statues exhibit the broader face and heavier jaw brought in by the alien race, not one of them exhibits any approach to the typical Armenoid, so-called "Jewish," nose. If therefore the foreign element is to be termed Armenoid it can only be called by this name so long as it is realized that this does not imply the presence of one of the most characteristic features of that race as known at the present day. The difficulty is not lightened by the fact that less than 1000 years later at Beni Hassan there are excellent representations of the Aamu, a people of the eastern desert with typical Armenoid noses.

Contemporary Representations of Beja.—The proto-Egyptian type persists to the present day among the southern Beja (*q.v.*), tribes of the Anglo-Egyptian Sudan. It also occurs, though probably in less typical form, among the Ababda of the Eastern (Egyptian) Desert and the riverain settlements in the neighbourhood of the first cataract. We have direct evidence dating from about 2000 B.C. of the existence of the pure proto-Egyptian type among a people wearing their hair in the same fuzzy mop as the Beja of the present day on the eastern border of Egypt. Among the wall paintings of the 12th Dynasty in the tombs at Meir (A. M. Blackman, *The Rock Tombs of Meir*, vol. ii., Pl. xxx., London, 1915), is one that undoubtedly represents a Beja. The long thin figure and limbs, with broad chest, narrow

flanks and retracted abdomen, are no doubt conventional and exaggerated representations of the characters of the lean pastoral desert men as they appeared to the agricultural Egyptians, but there can be no criticism of the splendid naturalism of the lined face, the thin pointed nose and the mop of hair projecting over the forehead and standing out stiffly over the whole head to the nape of the neck. The beard is the usual chin tuft of the Beja tribes, and comparison with modern Beni Amer clinches the identity of the two peoples, living in the same desert area but separated by 4,000 years. Confirmatory evidence of the proto-Egyptian characters of the inhabitants of the eastern desert and of their civilization is offered by the discovery by G. W. Murray of a burial of late pre-dynastic date, with characteristic grave goods, near Ras Samadi on the Red Sea Coast, in lat. 24° 59' N. (*Man* 1923, 81). The skull accorded well with those of the pre-dynastic Egyptians.

The desert must indeed be regarded as a reservoir not only of early archaic physical types no longer preserved in the richer Nile lands but also of ancient ideas and appliances, *e.g.*, the camel stick of the Ma'aza of the Eastern Desert is no other than the *Uas* sceptre of ancient Egypt applied to a new use.

The Arab Element.—The Arab conquest, which politically altered the whole history of Egypt, had no appreciable influence on the physique of its inhabitants. While in part this may be due to a certain physical resemblance between Arabian and Egyptian the numerical inferiority of the conquerors must be held to be the determining cause. The nature of the invasion may be best illustrated by considering the history of the Juhaina (Sudanese, Guhayna). The tribesmen took a prominent part in breaking the power of the Christian kingdom of Nubia; yet in spite of their importance in the past, at the present day few groups that may fairly be called Arabs exist except in association with the desert. Such are the fisher folk of Lake Menzaleh, who trace their origin to Sinai; the Harabi of the Fayum, extending into the Tripolitan desert, still pastoral nomads; the Aulad Ali of the Behera district of the Delta, no longer nomads; and the practically sedentary Howeitat of Matarieh; all dolichocephals or low brachycephals. In the Eastern Desert the only important Arab tribe is the Ma'aza, about whom very little is known, described by Chantre (*Recherches Anthropologiques en Egypte*, Lyon, 1904), as short dolichocephals.

Besides these more or less well-defined groups there is in upper Egypt a small number of people, generally mobile in their habits, living along the edge of the cultivation. These folk generally keep goats and often own a few palm trees, and formerly may have been of more importance as charcoal burners. Somewhat in the position of gypsies in England fifty years ago, they are generally unpopular with the *fellahin*, on whom they levy a certain amount of blackmail. Such groups as the Bili, near Baliana, and the Aleiqat, of whom there are a considerable number near Qus, do not come into this category.

In Sinai, with a total population of some 10,000, the chief tribes are the Howeitat, the Tiyaha and Terabin, in the North; in the South the Tawara (*i.e.*, the people of Tor), who include the Aleiqat, the Sawalha and Muzeina.

The Modern Egyptian.—Passing to the *fellahin*, the modern Egyptian, the most important of the numerous studies that have been made are those of C. S. Myers ("Contributions to Egyptian Anthropology," in vols. xxxv., xxxvi., and xxxviii. of the *Journal of the Royal Anthropological Institute*) and of J. R. Craig ("Anthropometry of Modern Egyptians," *Biometrika*, vol. viii., 1911). Omitting the province of Aswan and the town dwellers, these papers, which must be regarded as complementary, indicate that the Egyptian peasant has a stature of approximately 65½ in., showing no sharp division between Upper and Lower Egypt; he is longheaded, with a cephalic index of about 75, the cephalic index—again omitting Aswan—being about a unit higher in Lower than in Upper Egypt. There is no evidence that the natives of various provinces differ in variability, nor is it possible to resolve distribution curves, whether of measurements or indices, into components corresponding to hypothetical underlying ethnic types, though it seems that passing from Lower to Upper Egypt

eye and skin colour darken and the proportion of unusually broad noses increases as does the frequency of spiral and crisp hair, all evidences of increased though still well diluted negro blood in the population.

The position of the Copts (the Christian population of the present day, and therefore with insignificant exceptions the descendants of the Egyptians who refused to relinquish their faith at the Conquest or during the succeeding centuries) is particularly interesting. The observations available refer to Coptic peasants, not town dwellers, and so far as these go the remark commonly made by Europeans that they can distinguish at sight between Muslim and Copt is not borne out. No significant deviation from the general Muslim population is found as regards head measurements or facial characteristics, though the nose is slightly less broad and the lip slightly thinner, with eye and skin colour a trifle lighter. Thus, diagnosis at sight between Copt and Muslim, if really practicable, cannot rest on easily defined physical characteristics but must be attributed to such other factors as gait, dress, etc.

The measurements and photographs of natives of Kharga Oasis published by Hrdlicka (*The Natives of Kharga Oasis, Egypt*, Washington, 1912) show that its inhabitants are Egyptians, differing in no essentials from the inhabitants of the Nile Valley. The inhabitants of Siwa speak a Berber dialect, akin to Tuareg, with many Arabic loan words, some so profoundly modified that their origin is not immediately apparent. Jaghub (Jarabub), in Italian territory, is believed to have been uninhabited before its occupation by the Senussi, whose capital it now is.

Disposition of the Fellahin.—Difficult as it is to sum up the temperament or disposition of a people it is probably true to say that the *fellahin* are in the main good natured, cheerful and excitable, genuinely religious but not generally fanatical, though certain centres such as Tanta have a bad reputation in this respect. They are liable to occasional bursts of ferocity (such as distinguished the rioting of 1919), and inter-village enmities, leading to fights with iron-shod staves, were formerly fierce and persistent. Nothing approaching an adequate account of the beliefs and customs of the *fellahin* has yet been written, for Lane's *Modern Egyptians*, first published in 1836 before western influence had contaminated Egyptian habits and modes of thought, though giving an invaluable account of Cairene life and manners cannot be held to apply except in somewhat general terms to the habits and beliefs of the peasants, which even preliminary inquiry will show to vary not only from those of the towns but as between Upper and Lower Egypt. Meanwhile the work of Miss Winifred Blackman (*The Fellahin of Upper Egypt*, 1927) avowedly only a preliminary account, contains much useful information.

Tattoo, etc.—Tattooing is the most obvious, common and widespread method of bodily enhancement and mutilation. Lane mentions the simpler designs—dots, lines and circles—common in women and refers to the "extremely displeasing" habit of the women of Upper Egypt of discolouring their lips with tattoo. C. S. Myers ("Contributions to Egyptian Anthropology, Tattooing," *J.R.A.I.*, vol. xxxiii, 1903) found that of about 400 male subjects nearly 100 were tattooed, the designs falling into two main classes, namely simple, generally geometrical, designs, and pictorial representations, e.g., the façade of a mosque or the Persian lion with sword. Local examples of the type prevailing throughout North Africa form the first class while the latter are derived from eastern sources. Circumcision is universal; clitoridectomy, though far less recognized by Europeans, is customary

in cities, at least among the poorer class, and may be equally common among the Fellahin. Both long antedate Islam, circumcision being represented in a tomb of the pyramid age at Saqqara, while clitoridectomy or a similar operation is alluded to by Strabo—*Circumcidunt etiam mares et foeminas excidunt.*

Survivals from Ancient Egypt.—One of the most interesting features of present day Egypt is the persistence in popular belief of ideas traceable to ancient Egypt, especially intricate ceremonies connected with mourning, the survival of the belief in *ka* or double, the persistence of a ceremony in which a sacred boat takes a prominent part, and the superstitions connected with particular days in the calendar. The boat ceremonies are particularly important, since these exist widely in Asia outside the Near East (e.g., in Ceylon) and it seems probable that their distribution has been to a considerable extent brought about from Egypt by the spread of Islam. Nearly 20 years ago the writer observed a full-sized river boat suspended in a tree outside Luxor; enquiries showed that once a year this was placed in a cart, filled with children and dragged round the fields. Actually there are three boat processions every year in Luxor, the most important being observed in honour of Abu'l Heggag, the patron saint of Luxor. The substitution of Amon and his sacred barque by Abu'l Heggag and his Nile boat is suggested by the popular belief at Karnak that on certain nights the golden boat of Amon may still be seen to emerge from the waters of the sacred lake, steered, as of old, by the Pharaoh.

The calendar customs are a striking example of how beliefs attached to a particular day may last for over 3,000 years, persisting through a complete change in the mode of reckoning time, as well as the introduction of new beliefs. The Salier papyrus, which dates from the time of Rameses II. or possibly his successor, gives an account of the lucky and unlucky days in the year, and describes in some detail the quality of the good and bad luck, with instructions for behaviour on each of these days. It may first be noted that the five epagomenal days of the old Egyptian year were unlucky. In modern Egypt the epagomenal days are still observed to the extent that neither sowing nor planting should be undertaken, mares and cattle should not be covered lest their offspring be misshapen, and it is even believed that children begotten during these days will show some abnormality. A still more interesting example perhaps is that afforded by a day near the end of the old Egyptian month of Choiak; the Salier Papyrus marks the 26th of this month as most unlucky, and of this day it is written, "Do not eat fish. Those residing in the midst of Tattu turn themselves into the fish An." The mythological allusion cannot be explained, but the modern popular calendar, such as is hawked about the Bazaars, notes that on the 11th of Moharram (corresponding to the 26th day of the Coptic month Kyhak) "the eating of pigeons is liked, that of fish disliked."

The Beja Tribes of Egypt.—Of the Beja tribes of the eastern desert the Ababda (*q.v.*) fall wholly within Egyptian territory; the Bisharin extend some 80 miles south of the boundary and occupy a strip of territory stretching along the right bank of the Atbara. While the physical characters of both tribes have been studied by E. Chantre (*Recherches Anthropologiques en Egypte*, Lyons, 1904) and the mode of life of the Bisharin described by Linant de Bellefonds (L'Etbnay, 1858), two recent papers by G. W. Murray ("The Ababda," *J.R.A.I.*, vol. liii, 1923, and "The Northern Beja," vol. lvii, 1927) constitute by far the most valuable account of these people. The Ababda inhabit the eastern desert from the Sudan frontier to north of the Kena-Kuseir road, and there are isolated colonies along the edge of the cultivation from Assiut to Korosko. In the time of Bruce their southern range was limited by the 'Atawna (Arabs) who have now vanished from the desert. Earlier yet Makrisi records the Beli (Bili) a tribe of which scattered groups still exist along the edge of the cultivation—as being in possession of parts of the desert now belonging to the Ababda. The desert Ababda intermarry with the Bisharin, and those settled in the Nile Valley with the Fellahin, but they do not appear to intermarry with any Arab tribes still carrying the desert tradition. Like other Beja tribes the Ababda wear the *dirwa*, the shock head-dress of hair



BY COURTESY OF NORTHERN BAPTIST CONVENTION

A NATIVE OF BELGIAN CONGO

Of powerful physique and expert huntsmen, a few of the tribes in the Belgian Congo persist in cannibalism

besmeared with mutton fat, though this custom is gradually dying out. Unlike their Beja neighbours to the south the Ababda speak Arabic, but coloured by Bedaue (*To-Bedawi*) words, while transposition of consonants—a Hamitic rather than a Semitic feature—often occurs.

In physique the Ababda resemble the Beni Amer, and therefore the predynastic Egyptians, *i.e.*, they are longheaded with a cephalic index of 73.6 and a stature of 1.63 metres. The Bisharin on the other hand present two types, those of the Red Sea coast with a cephalic index of 74.7, and those living inland with a cephalic index of 78.4, the latter substantially identical with the index given by Chantre, presumably derived from individuals living in or near the Nile Valley. (Murray, *op.cit.*)

Tripoli.—Westwards beyond the Egyptian frontier knowledge of the physical anthropology of Tripoli is but slight. At the extreme west of Italian territory, *i.e.*, in the area surrounding Tripoli city, the systematic observations of Bertholon and Chantre show that the population is predominantly long-headed and of rather low stature (below 1.654m.) but there is an island of high brachycephaly in the immediate area of Bu Ajilat, though these brachycephals exhibit no marked departure from the general low stature of the area. Throughout the rest of Tripoli but few observations have been made, certainly not enough to permit of any connected anthropological history or description of the country. The observations of the late Oric Bates at Mersa Matruh, not far east of the Egyptian frontier (*"Archaic Burials at Mersa Matruh"* *Ancient Egypt*, 1915, Part IV., p. 158) suggest that at a period possibly as remote as that of the pyramid builders the population of the coastal plain was not unlike that of the proto-Egyptians, and presumably a people of some such type long continued to form the basis of the population of the coastal plain. Evidence such as that afforded by the ram of Bu Hamama (in Algiers) crowned with the sun-disk and uraei, as well as the presence of the sun-disk on Carthaginian coins, indicates the very considerable cultural influence exercised by Egypt along the north African littoral in late dynastic times, but so far there is no direct evidence of Egyptian influence on the physical anthropology of the country. Nor is there any knowledge in this sense of the effect of the Roman occupation. Herodotus, however, describes the Libyans east of Lake Tritonis, *i.e.*, the inhabitants of Tripoli, as nomadic and thus differing from the settled agricultural peoples of what is now predominantly Algeria, although it is clear that many of these people were in fact no more than semi-nomadic; the Nasamones for instance with their main settlements on the Syrtic shore, left their herds in summer and went up to Aujila for the date harvest, just as some "nomad" Arab tribes of the present day sow their crop in the oases in the autumn, leading a more or less wandering life until the spring.

Apart from the littoral belt the greater portion of Tripoli is desert or poor steppe, for the most part with an annual rainfall varying from three to less than ten inches, such a country can never have been densely populated or have offered any great temptation to highly civilized folk. The position is different with regard to nomads or semi-nomads; here is a sparsely inhabited area which could scarcely fail to attract the Arab tribes that poured into north Africa after the conquest of Egypt under the Khalif Omar, and again in the eleventh century when, in 1048, the Wazir of the Fatimid Khalif Mustansir launched a number of the nomad tribes of Upper Egypt, including the Beni Halal, against his master's orthodox vassals of the northern African States. Each man was given a camel and a gold piece on condition that he would settle in Maghreb, with the result that within two years Cyrenaica had been pillaged and Kairwan captured. But the western movement of the Hilali invasion did not stop here, for while the majority of the Beni Hilal settled in Tripoli and Tunis, and the Athbej passed into what is now Algeria, as far as the Aures mountains and the river Zab, the Makil pressed westwards as far as the high plateau of Morocco-Algeria. Beneath this flood the Berber tongue largely disappeared, and except among the Beni M'zab, the Abadite schism was almost wiped out.

At the present day the population of the coastal plain may for practical purposes be regarded as Arab, and since with the excep-

tion of the towns and the oases of the far south the coastal plain—never more than 20 miles in width and generally less than this—constitutes almost the whole of the available territory suitable for agriculture, the Arab tribes of this area form the predominant factor in the population of the country. Of these tribes the Awlad Ali may be taken as the type. Extending from the outskirts of Alexandria to the neighbourhood of Tobruk they grow a considerable amount of barley, and (at any rate before World War I) possessed horses, sheep and camels, the latter constituting their main wealth. Predominantly sedentary, and horsemen rather than camel-men, they yet live in tents. Their tribal organization is into sections and divisions as among the Arabs of the Sudan, whom (*e.g.*, the Kababish) they closely resemble physically to judge from the measurements given by Chantre. But not all the folk who have been described as Tripolitan Arabs are long-headed; an examination by Mochi (*"Presentazione di crani d'indigeni di Tripoli"* *Archiv. per l'Antrop. e la Etnol.*, Florence XL, 1912, p. 381) of the skulls from Tripoli in the National Museum at Florence indicates that they contain at least one hyperbrachycephalic group. Remarkable as is this fact, its significance becomes clear in the light of a series of skulls described by Giuffrida Ruggeri (*"I Crani Egiziani antichi e Arabo-Egiziani dell' Università di Napoli," Atti della Società Romana di Antropologia*, XV., 1910, pp. 112 *et seq.*) from an ancient Arab cemetery at Abassieh near Cairo, with an average cranial index (13) of 85.3. The significance of these skulls and their relation to definite areas of round-headedness in Tripoli has been studied by Seligman (*"The Physical Character of the Arabs," J.R.A.I.*, vol. xlvii., 1907), who points out that their characters indicate that the Abassieh skulls belonged to natives of Southern Arabia, that brachycephaly prevails both in southern Arabia and in the Levant, and that both these areas have contributed to the population of North Africa.

Barbary (Tunis, Algeria, Morocco).—Tunis, Algeria and Morocco, are but artificial political divisions of one natural area, which from the anthropological as well as the geographical aspect might still be called by its old name of Barbary. Its inhabitants, the Berbers, are commonly regarded as aborigines, and apart from immigrant stocks this seems to be true as far back as the end of the palaeolithic period. The physical anthropology of the natives of Eastern Tripoli, Tunisia and Algeria, has been exhaustively studied by Bertholon and Chantre (*Recherches anthropologiques dans la Berberie Orientale Tripolitaine, Tunisie, Algérie*, Lyon, 1912). The following facts give a rough idea of the progressive weakening of Arab influence, passing from East to West, and the physical characteristics of the three main groups generally recognized.

In Tunis, with a total Islamic population of something over two millions, there are about half a million Berberized Arabs and less than 100,000 Berbers, forming for the most part two isolated masses, the Matmata in the far south in the neighbourhood of Jebel Nefusa, and a group mainly of the Abadite (Kharijite) heresy in the island of Jerba. Passing westwards to Algeria there are pure Berber groups in the Kabyle hills and in the Aures mountains. Apart from these two areas the remainder of the province of Constantine may be regarded as inhabited by Arabized Berbers except for a few Arab coastal areas. Numerically some 75% of the inhabitants of the province may be regarded as Berber or Berber-speaking, the remainder Arabs or partially Berberized Arabs. In the department of Algiers Arabs mixed with Arabized Berbers preponderate, while in Oran the Arab element is frankly dominant. In Morocco on the contrary the Berbers are not only in great numerical majority but socially form by far the most important groups. Here it is calculated that not more than five per cent of the population are Arabs, with perhaps another five of Berberized Arabs, the remainder of the population being fairly equally divided into pure Berbers and Berbers with a tinge of Arab influence. Nothing would be gained by attempting to enumerate the "Berber" and "Arab" tribes of Morocco. Westermarck (*The Moorish Conception of Holiness*, Helsingfors, 1916) divides the Berbers into five groups:—(1) the Ruāfa—the Berbers of the Rif—whose country extends along the

Mediterranean coast from the neighbourhood of Tetuan to the Algerian frontier; (2) the Berâber, who inhabit the mountain regions of Central Morocco and the eastern portion of the Great Atlas; (3) the Shleuh, inhabiting the western part of this range, and to the south of it in the province of Sûs a territory with an eastern frontier running from Demnat in a south-easterly direction and a northern frontier uniting Demnat with Mogador on the Atlantic coast, following more or less closely the foot of the mountains; (4) the Dra'a, who inhabit the valley of the Wad Dra'a in the extreme south of Morocco; (5) various tribes living in the neighbourhood of Ujda, in the north-east of the country. The so-called "Arabs" are the Jebala, the mountain-dwelling tribes of Northern Morocco, with their centre in the area between the Rif and Fez and extending westwards of the latter.

Physical Characteristics of the Berbers.—Morocco, is from the standpoint of physical anthropology for the most part unexplored. Three physical types of Berber are, however, generally recognized: (1) tall men, with a stature of about 1.70m., dolichocephalic, with strongly marked supraorbital ridges, the face long, tending to oval, the cheek bones by no means prominent, nose long and narrow, chin square and rather scant beard. This type appears to form perhaps half the population of Tunisia and is widespread in Algeria. (2) The second type is short, with a stature of about 1.63m., longheaded, with a prominent occiput so that the head when viewed from above is distinctly pentagonal; the face is short and broad, the cheek bones well developed, the nose tends to be broad, the chin prominent and often well bearded, the lips full. This type is to be found in the mountains of central Tunisia, in the neighbourhood of Gabes and of Algiers, in the south of Algeria, as well as all over Morocco. It seems to be generally accepted that the skulls found in the megalithic monuments of this part of Africa belong to one or other of these types. (3) The third group is of moderate stature, 1.64m. to 1.65m., and brachycephalic. The face is broad and short, the forehead round (*bombé*), nose short and broad. This type is specially present in the Island of Jerba and in the oasis of M'zab; it is also found in the hills to the south of the Gulf of Gabes, western Tripoli, and on the Algerian littoral, as well as among the Kabyles and the inhabitants of the Aures hill. Many of the M'zab have a skin so pale that they burn wheaten colour rather than brown in the sun.

While the number of the blonde Berbers certainly varies locally and their proportion has no doubt often been exaggerated (at least in Algeria), a competent anthropologist, the late Anthony Wilkin, specially studying the problem, has recorded that of the observed population of El Arbaa fully 20% were "fair men" (*Among the Berbers of Algeria*, 1900, p. 77). Good observers always lay stress on the essentially white quality of the skin of the pure Berber tribes. The origin of this blonde element has been much discussed; it is no doubt foreign—presumably Nordic, with perhaps Alpine admixture—and it existed in Libya as long ago as the New Empire, as is shown by contemporary paintings in Egyptian tombs.

Cultural Characteristics of the Berbers.—On the psychical side some of the main Berber characteristics can perhaps be best appreciated by contrasting them with those of the Arab; moreover such a comparison is particularly useful since apart from the Nile Valley it in some sense embodies an epitome of the history for some 1,200 years of the whole of North Africa.

The Berber is essentially an agriculturist, with a passionate love of the soil upon which he has been born, though a keen trader, often willing to take service abroad but always anxious to return to his village in his old age or when he has amassed a competence. He is a stern fighter, often a determined brigand and in religious matters a born sceptic, while his strong democratic tendencies are indicated by his social organization in which leadership is usually a matter of election, though raiding and war may give real authority to individual strong men which may to a limited extent pass to their descendants. In contrast, the Arab is typically a nomad pastoralist, whose attitude to agriculture is mirrored in the proverb that shame enters with the plough, a poor worker, whose real courage is less likely to be shown when raiding than on a point

of honour or as an expression of his religious faith. Moreover, Arab society is essentially aristocratic; the Arab is, and always has been, ruled by hereditary leaders, and his struggles when he does revolt are spasmodic, and directed against the individual rather than the system. With this aristocratic and religious bias there exists a strong contempt not only for the stranger but for Muslims of other sects, and here again he stands in strong contrast to the Berber. These contrasts are of course not absolute; there are nomad Berbers, and many sedentary Arabs; some Berbers become really good Mohammedans, though generally there is much truth in the epigram that the Berber is not a Mohammedan but only thinks he is. Moreover, in the West, *i.e.*, in Algiers and Morocco, there is always the difficulty of knowing whether a given people not obviously Berber or Arab should be regarded as Arabized Berbers or Berberized Arabs. Here social organization and history rather than language seem to be the best guides.

Political and Social Organization of the Berbers.—In spite of the religious and cultural influence of Islam the social organization of the Berbers differs in every essential from that of the Arabs. The following outline (*see* MacIver and Wilkins, *Libyan Notes*, London, 1901), in principle valid throughout Barbary, applies specifically to the Kabyle Hills. The Berbers are typically hillmen, living in isolated villages, formerly often well fortified or with a central citadel, and, while possessing flocks and herds which in particular instances may regulate their mode of life, are essentially skilled agriculturists, who have long practised irrigation and are quick to take advantage of every scrap of cultivable ground in the difficult and often sterile hills among which they live.

The unit of government is the village, each possessing complete autonomy. A number of villages form the tribe, the connection being administrative and not regulated by kinship. A union of several such tribes may be termed a Confederation; the bond is looser than in the lower federative grade and the confederation never interferes in the affairs of its tribes unless directly appealed to or when vitally necessary. In time of war a head is appointed for each of the tribes and for the confederation. The tribe has deliberative and administrative duties, such as the determination of questions of peace and war, the making of roads, and manages tribal property such as mosques, tombs of saints, and educational establishments; it is concerned with the levying of taxes necessary for these purposes, and may act as arbiter between villages. A general assembly of the tribe is almost unknown, its affairs being managed by a deputation of the chief men from each of the villages composing it.

Every village is brought into contact with its neighbours by means of its *sof*, of which there are always two, the term signifying a group whose members covenant to render mutual aid to one another in cases of necessity. In each village the two *sof* are in some sense opposed, and each *sof* will be allied with similar fraternities in neighbouring villages, the ramifications of the *sof* organization extending through entire districts. Within the village the members of each *sof* are united by the closest bonds, the obligations ranking above all personal interests and even ties of kinship. Nevertheless, though loyal to his *sof* while he is a member of it, the Kabyle thinks little of transferring his allegiance from one *sof* to another if he thinks he will gain thereby, and outside the village the members of a *sof* though willing to assist their fellows with provisions and even with money would expect to be paid for any active armed assistance they might give. The funds of the *sof* are raised by subscription from members and are administered by the heads of the organization, usually men of powerful families and of private wealth, who may disburse considerable sums on secret services without rendering account to the members.

Within the village affairs are controlled by the *jemâa*, the general assembly of the citizens, of which every adult man is a member though in practice only the old men and heads of families exercise the right to speak. Nothing which concerns the welfare of the village escapes the control of the *jemâa*—it exercises judicial authority, makes laws, levies taxes and administers the public property. Decisions are not taken by a majority of votes



BY COURTESY OF (4) CHARLES PARTRIDGE, FROM (1, 2) KAMMERER, "ESSAI SUR L'HISTOIRE ANTIQUE D'ABYSSINIE," BY COURTESY OF PAUL GEUTHNER, LIBRAIRIE ORIENTALISTE, (5) TONGUE, "BUSHMAN PAINTINGS" (CLARENDON PRESS), (6) E. E. EVANS-PRITCHARD

CARVED AFRICAN MONUMENTS AND CAVE WALLS

1. Phallic monoliths, Sidamo, southern Abyssinia
2. Swords and other low relief stone carvings found in southern Abyssinia
3. Carved monoliths, Cross river, southern Nigeria
4. Megalithic circle of Lotuko tribes, Mongalla Province, Anglo-Egyptian Sudan
5. Bushman painting in a cave at Zuurfontein, Cape Colony, showing a man, oxen, roebucks, elands and a vulture in colors, which are as bright as when first made
6. Dolmen, 2-3 ft. high, over modern burial, Moro tribe, Anglo-Egyptian Sudan



BY COURTESY OF (2) L'ACADÉMIE DES INSCRIPTIONS ET BELLES LETTRES AND THE LIBRAIRIE ERNEST LEROUX FROM "MONUMENTS ET MÉMOIRES DE LA FONDATION EUGÈNE PIOT," (3) THE TRUSTEES OF THE BRITISH MUSEUM; PHOTOGRAPHS, (1, 4, 5) LEVY AND NEURDEIN

ARCHAEOLOGICAL DISCOVERIES IN NORTH AFRICA

1. The ruins of the capitol at Sbeitla (Sufetula), an ancient Roman city of Tunisia, founded at the beginning of the first century A.D.
2. A mosaic portrait of Virgil, found in Tunis, and dating probably from the first century A.D.
3. Bronze head of a young man of the great Berber tribe of North Africa, with the typically fine features of the early Hamites, to which race he belongs
4. Street of Decumanus Maximus in Timgad (Thamugas), Algeria, a ruined Roman city, in a remarkable state of preservation. It was founded in the second century, passed from history in the seventh and lay unnoticed in the middle of the Sahara until the eighteenth century
5. A Byzantine wall in Tebessa (Theveste), Algeria, dating from the sixth century A.D., with the Roman triumphal arch of Carsoalla built into it



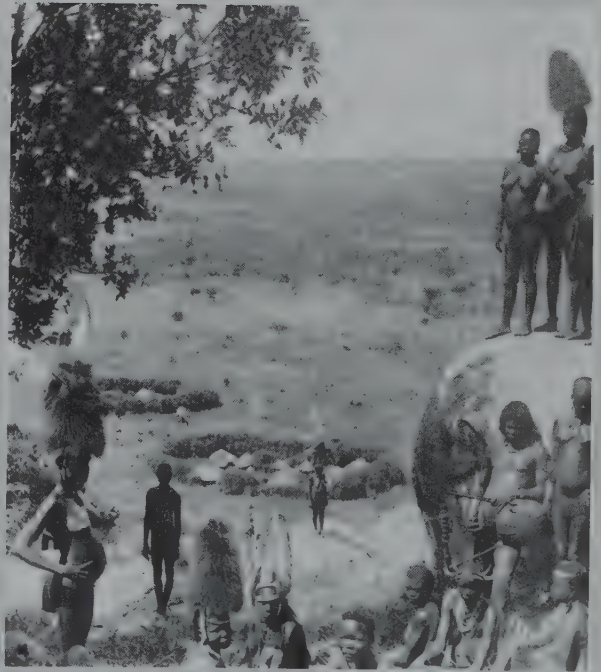
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PHOTOGRAPHS (1, 2) VISUAL EDUCATION SERVICE, CHICAGO, (3) UNDERWOOD PRESS SERVICE

HABITATIONS OF MIDDLE AFRICA

1. Basket granaries mounted on racks as protection against animals and wet ground. At the left, framework for a thatched hut. Angola
2. A different method of storing grain, adjacent to a village. Angola
3. Masai women building huts of branches and skins, with their husbands

- looking on. The Masai are nomadic herders in Kenya and Tanganyika, East African plateau
4. Village compounds on the grassland of Interior Africa. The hill of bare rock is typical



BY COURTESY OF M. FORTIER

NATIVES OF WEST AFRICA

1. An inhabitant of Diola, in Senegal, with ornaments and jewellery
2. Men of Mankena, Senegal, in traditional West African garb. Most Senegalese wear the flowing robes introduced from the Levant by Moslem conquerors
3. A Fula woman of French West Africa, in festive attire
4. A group of Moroccan nomads before their black tent made of skins
5. A flotilla of fishing canoes on a broad river in West Africa
6. Tuareg men at the gate of a city in the western Sudan. Their camel mounts and their dark blue veils are distinguishing features
7. Canoe makers sewing pieces of wood together at a river town in the Sudan, a region where trees are small. (Dugout canoes are the rule in forested parts of Africa)



BY COURTESY OF (1, 5) THE SOUTH AFRICAN RAILWAYS; PHOTOGRAPHS, (2, 4, 6) UNDERWOOD PRESS SERVICE, (3) E.N.A.

AFRICAN HABITATIONS MADE OF LOCAL MATERIALS

1. Interior of a Zulu house, showing tree trunk uprights and rafters and primitive utensils around the fireplace
2. Mud granary of upper Niger region with projecting steps on the sides which the natives mount in order to pour the grain through the opening at the top
3. An ornamented building of adobe in Kano, N. Nigeria. The flat roof and

- small high windows are typical in cities north of the rain forest
4. Native house in the Congo region constructed of grass and fronds of palm trees
5. Exterior of hut and kraal constructed of reeds and grasses in Zululand
6. A common village arrangement in parts of Nigeria where the communities are under the rule of small chieftains



PHOTOGRAPHS BY COURTESY OF DERWENT WHITTLESEY

THE BLENDING OF AFRICAN AND EUROPEAN PRACTICES

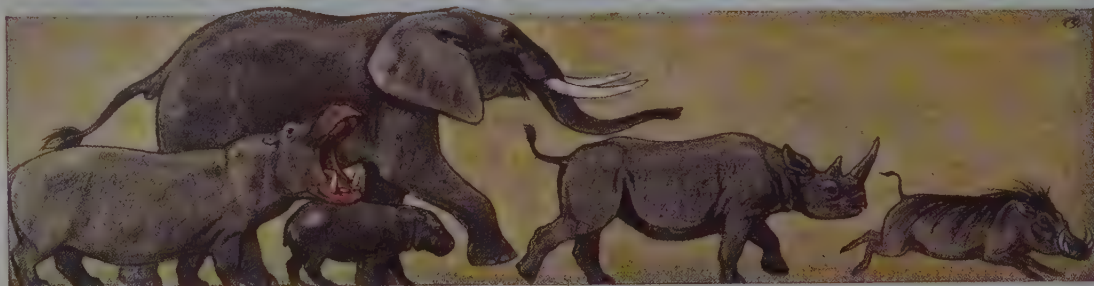
1. Gourd utensils, handmade in the traditional African manner, awaiting rail shipment to the dry interior. Ibadan station, Southern Nigeria
2. African pottery and (Sudanese) cattle, and European lanterns, knives and graniteware for sale in a village market at Akanban, Southern Nigeria. Shelters are roofed with either native thatch or imported sheet iron
3. Ferry on a main motor road of French Sudan, crossing a tributary of the Niger river at Laboue, site of a radio station. The road is surfaced with laterite macadam
4. Cacao drying in the sun at a collecting station in Southern Nigeria. Africans bring their crop to be inspected under the thatch pavilions by government officers, and weighed and purchased by agents of European chocolate firms that own the iron-roofed warehouses
5. A roadside rest camp for European wayfarers, designed and thatched in the local style, but with concrete floors and walls. French Sudan
6. Surf boats being landed and launched in the lee of a jetty at the season of least surf. The pier, for use at the season of maximum surf, projects beyond the breakers and clears the highest rollers. Accra, Gold Coast



BY COURTESY OF (3) W. MCGREGOR ROSS; PHOTOGRAPHS, (1, 2) BY MARY LIGHT IN R. U. LIGHT, "FOCUS ON AFRICA," PUBLISHED BY AMERICAN GEOGRAPHICAL SOCIETY, (4) E.N.A., (5) TOPICAL PRESS AGENCY

GENERAL VIEWS OF URBAN AND RURAL AFRICA

1. Air view of a riverside Bari village, Anglo-Egyptian Sudan, during the dry season
2. Detail of a circular village comprising 1,000 huts belonging to the cattle-rearing Ila people, near Namwala, Northern Rhodesia
3. Ripon Falls, the outlet of Lake Victoria into the Victoria Nile, Uganda
4. Outer wall of the city of Timbuktu, on the Great Bend where the Niger valley penetrates into the Sahara. Camels and asses are the pack animals most widely used in desert transportation
5. Cairo, Egypt, the largest city in Africa, located at the head of the Nile delta. The skyline shows the domes and minarets of some of its 260 mosques



PAINTED FOR THE ENCYCLOPÆDIA BRITANNICA

AFRICAN MAMMALS, BY PAUL BRANSON

Upper panel: Antelopes. There are about 150 kinds of antelopes, some nine-tenths of which are found in Africa. In size they range from pygmy forms, as the dik-dik, only about a foot high, to oxlike species, as the eland, which attains a weight of 1,500 pounds. Left to right: Springbuck; Sable Antelope; Kudu; Beatrix Antelope; Eland; Dik-dik.

Centre panel, top row, left to right: Giraffe, the tallest of living animals, sometimes 18 ft. high measured from its head to the ground; Hartbeest; Waterbuck; Grant Zebra; Roan Antelope (between zebras); Palla or Impia; White-bearded Gnu; White-tailed Gnu. Of these the hartbeest, waterbuck, palla and the gnus are forms of antelopes. Right centre: Cape

Buffalo, a powerful animal allied to the ox, dangerous when wounded. Lower row, left to right: Lion and lioness, the most powerful of African beasts of prey; Grey Jackal; Spotted Hyena.

Lower panel, left to right: Hippopotamus, the largest aquatic hoofed mammal, sometimes reaching a weight of four tons; African Elephant, the largest land mammal, differing in appearance from the Asiatic elephant chiefly in its much larger ears; Pygmy Hippopotamus, about 2½ ft. high, native to Liberia; Black Rhinoceros, a fierce fighter when brought to bay; African Wart-hog, a grotesque kind of wild swine, taking its name from the presence of large warty protuberance on the face.

but unanimity is required, and if the assembly fails to arrive at an agreement the discussion may be adjourned, or reference made to an arbiter chosen from among its members or from another village. The executive head of the Assembly is the Amin, sometimes called *amekkeran* (chief) or *amrân* (old man), usually a member of one of the leading families, a man of wealth and able to rely absolutely on the support of his *sof*. He is put forward by the influential persons of the village, the appointment being ratified by the Assembly. His duties include public finance, but except in small matters he has no independence or initiative and cannot act without the consent of the *jemâa*, over whose meetings he presides. He has assistants who are in some sense "police," supervising the various quarters of the village and giving information of all that passes.

Although emphasis must be laid on the agriculture and even the horticulture of the Berbers—the Shawia of the Aures Mountains and the Kabyles being regarded as typical—the Berbers are also pastoralists, and in the higher mountains the seasonal change of pasture-land (*cf.* French *transhumance*), plays an important part in their social life. Thus in the Middle Atlas, a tract of plateaux and peaks some 7,000 feet high merging in the west into the Tadla plain and in the south into the High Atlas, there is a heavy winter snowfall as low as 3,000 feet, which determines a transhumance of the winter type (as in Europe in the Carpathians and Balkans), the flocks being driven down to the lowlands. The familiar summer type of transhumance of the Mediterranean valleys also occurs in the Middle Atlas, the animals leaving the dried sun-parched valleys for mountains; indeed in the Middle Atlas some tribes—as the Beni Mgild—practise both forms, and such tribes when the winter movement leads them far into foreign territory do in fact approach a nomadic life. The so-called nomadism of the Berbers in Morocco should not, therefore, be classed with the wanderings of such true nomads as, *e.g.*, the Berber-speaking Tuareg.

Arts and Crafts.—The Berbers are good craftsmen. The best Kabyle silver work is probably as good as any made by Africans, many of their tribes make excellent carpets, and in studying their decorative art it is possible to make the generalization that apart from Arab influence their limiting lines are straight, not circular or even arcs of circles. This is particularly obvious in their architecture, even when advanced, as in the minarets of their finest mosques, *e.g.*, in Marrakesh, Rabat (and even in Seville) the mosque towers are square in section, or sometimes hexagonal, contrasting notably with the rounded minarets of Egypt and the Near East generally. So too the designs woven into their carpets by the more typically Berber peoples of Morocco is geometrical, often rectangular, and always made up of straight lines. Nevertheless, Arabic influence has brought in the arc and the cupola, the latter as common in the *Qubba* (saints' tombs) of the countryside as in Egypt.

The hand made pottery of the Berbers of Algeria, and especially of the Kabyles has excited much interest; it was even suggested that it betokened a direct and somewhat close relationship between the ancient inhabitants of Algeria and the proto-Egyptians, (MacIver and Wilkins, *op. cit.*, give good coloured pictures of Kabyle pottery; see also papers by MacIver and by J. L. Myres in *J.R.A.I.*, vol. xxxii., 1902). It is now generally held that the red-faced pot fabrics of Kabylia descend directly from the widespread red-ware of the Neolithic period, so that their resemblance to certain types of pottery of pre-dynastic Egypt is secondary. As regards the characteristic geometric designs, usually black on white or yellow, of the area, these too descend from the endemic geometrical art of north Africa, though affected by Mediterranean influences, especially Aegean. Further, since the Punic settlers of the early Iron Age used the wheel, the survival of hand-made fabrics in the mountains is of interest as defining the rather limited quality of outside influences to which the mountaineers have been subjected.

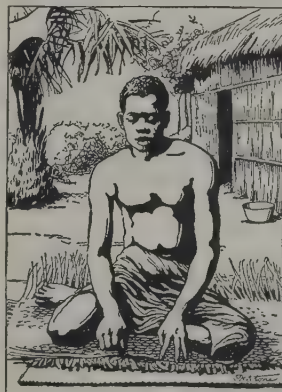
Medicine and Surgery.—By far the greater part of medicine proper is little more than magic, but there is evidence that, in spite of the recognized danger of the necessarily large doses, henbane (*Hyoscyamus albus*) may be used before operations

for its sedative and alleged paralytic and anaesthetic qualities, while in surgery trepanning is successfully performed for fractured skulls. The *dura mater* is never incised—indeed every attempt is made to avoid touching it—and the danger of the brain bulging through the wound (*hernia cerebri*) is appreciated and special means taken to prevent it. As might be expected, dead bone is freely removed when necessary, but the repair of limbs does not stop here; bone grafting is practised, grafts taken from a dog being most approved, and the cases recorded seem to indicate that the operation may be successful. Other operations include the removal of pterygium from the eye, and, it is said, occasionally lithotomy.

Berber Folklore.—The folk beliefs and customs of the Berbers are particularly well known as the subject of the classical works of Doutté (*Magie & Religion dans l'Afrique du Nord*, Alger, 1908) and, especially, Westermarck (*Marriage Ceremonies in Morocco*, 1914, *Ritual & Belief in Morocco*, 2 vols., 1926). Among outstanding examples of the successful study of the magic and superstitions (in the sense of unorthodox beliefs) of a barbaric people, may be mentioned the ceremonial use during the *ashura* ceremony (*i.e.*, the festival held on the tenth day of Moharram, the first month of the Muslim year) of two figures, male and female, called by the names *Yaghussa* and *Yauka*, who according to local popular belief were idols of olden days. These can be none other than the pre-Islamic gods *Yaghüth* and *Ya'uq* mentioned in the Koran (*sura lxxi*, v. 23). The extreme rarity of the persistence of the names of pre-Islamic deities makes this of particular interest, and suggests the early date at which Arab influence began to be felt.

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Sudan.—The Anglo-Egyptian Sudan, including Darfur, incorporated in 1916, has an area of over a million square miles, measuring roughly 1,300 miles from north to south (lat. 22° N.



BY COURTESY OF THE PRESBYTERIAN BOARD OF FOREIGN MISSIONS

MAT WEAVING, A COMMON INDUSTRY AMONG THE TRIBES OF SOUTHERN AND CENTRAL AFRICA

to lat. 4° N.) and at its greatest breadth over 1,000 miles from east to west (long. 21° 30' E. and long. 30° E.). It is divided into fifteen Provinces and one Military District, the latter the Sobat-Pibor between the Nile and the Abyssinian frontier. Although a number of these Provinces are well characterized units from the historical or geographical standpoint, they are not generally delimited on lines of ethnic significance, and no attempt to hold to them will be made in the following account.

The population of the Anglo-Egyptian Sudan may most conveniently be considered under two headings, Northern or Mohammedan, and Southern or Pagan. The former embraces the peoples of the dry regions of the north, Islamic in religion and culture, predominantly Arab in language, and at least in part Arab in origin. The Pagans include the great mass of the negro or negro-tribes of the south, though nowhere are the two zones clearly defined by any single degree of latitude.

Even the northern area has no ethnic unity: in the east the Red Sea and Kassala provinces are in the main Hamitic, and many of the riverain Arabs of the White and Blue Niles carry at least as much negro as Arab blood, both superimposed upon older Hamitic stocks which were predominant in the land before the

introduction of Islam. In the south, although the negro has given his name to the Sudan (*Bilad el-Sudan*, the Land of the Blacks of mediaeval Arab authors) and has excited the greatest interest from mediaeval times onwards, yet adequate knowledge is lacking of the habits, customs and religion of any one tribe.

The tribes of the Northern area belong to two great families, (a) Hamite, and (b) Arab. The Hamites proper include the group of tribes known historically as the Beja (*q.v.*) inhabiting the Red Sea Province and outside the Anglo-Egyptian Sudan extending into Eritrea. Less purely Hamitic, but none the less to be classed as Hamites, are the inhabitants of Nubia, commonly called Berberines or Barabra (*q.v.*), for, in spite of much negro blood and a language which is commonly regarded as negro, history indicates that fundamentally they are of Hamitic origin, while their civilization is not and seems never to have been negro in character. (See ARABS; BARABRA; BEJA.)

The true negro undoubtedly represents one of the most primitive of the African stocks. His main physical characteristics are tall stature, a "black" skin, woolly hair and moderate dolichocephaly, a flat broad nose and thick and often everted lips, prominent cheekbones and a varying degree of prognathism. With these qualities there go certain cultural characteristics. Such true negroes are found in the far western Sudan and the Guinea Coast, but hardly in the valleys of the Nile or of its affluents where as far as many of its most characteristic groups are concerned there is evidence of old Hamitic mixture. It is indeed scarcely possible to go further than this at the present time. In a classification proposed by Westermann, based on linguistic criteria, the term Nilotic is used in a sense so wide that it seems to signify no more than related to the Nile valley, but within it three groups are constituted, "High," "Middle" and "Low" Nilotic, which in part at least may be natural.

1. The High Nilotic group, comprising Mittu, Madi, Abukaya, Abaka, Luba, Wira, Lendu and Moru.

2. The Middle Nilotic group, comprising Shilluk, Anuak, Beir, Jur, Belanda and many of the peoples of Eastern Uganda, the Acholi, Lango (*q.v.*), Aturu and Jaluo.

3. The Low Nilotic group, comprising Dinka and Nuer.

This classification, though of wider geographical scope, embraces the whole of the Anglo-Egyptian Sudan, but the Bari with their numerous constituent "sub-tribes" are not mentioned, nor are the Lotuko-speaking tribes. Westermann places the former in his Nilotic-Hamitic group, *i.e.* with the Masai, Turkana, etc. to which the Lotuko-speaking tribes may also be assigned. For descriptive purposes, the following scheme is proposed:

A. Tall "black" dolichocephals, comprising Dinka, Shilluk, Nuer, Anuak, with perhaps some others as yet unclassified. These are the typical Nilotes of most writers, and in this article the term will be confined to this group. The mesaticephalic Acholi no doubt arose within this group, which probably also gave origin to the Belanda and the (Shilluk-speaking) Jur.

B. Tall "black" mesaticephals (probably sometimes brachycephals) comprising some Nuba and probably a number of the little-known tribes of Dar-Fung, including the Barun.

C. Medium statured "black" dolichocephals, comprising the Bari (but probably not the majority of the Bari-speaking tribes of the west bank), the Lotuko-speaking tribes and perhaps some of Westermann's High Nilotic group.

D. Short mesaticephals, with skin showing a coppery tinge—the Azande—or with blacker skins as the Bongo, Mittu and probably a number of the tribes now constituting the Azande nation. Knowledge of this group is very limited.

This classification by no means includes all the tribes of the Sudan. Many of the peoples of the Bahr-el-Ghazal Province are quite unknown ethnologically, *e.g.* the Moro, the Kaliko, the Bukuru (Babukur) and the Liggi, and even the relations of such important Bari-speaking tribes of the west bank as the Mandari, Kuku, Kakuak, Nyangbwara and Fajelu, are far from clear. Nor is there any substantial knowledge of the Madi, who in the south cross the political boundary into Uganda. In the east, on the borders of Uganda and Abyssinia, are groups of unknown tribes, some of which may constitute ethnic units, *e.g.* Didinga, Longarim,

Murle, with perhaps further north and nearer the Nile the Beir (Ajiba), all said by J. H. Driberg (unpublished information) to speak dialects of one language. The position of the Dongotono is obscure, while Driberg considers the Lorwama to be a section of Lotuko-speaking Lango. (C. G. S.)

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EAST AFRICA

The geographical area which is included under this designation extends roughly from the north frontier of Kenya Colony as far south as the Zambezi, and includes Kenya Colony, the Uganda Protectorate, Tanganyika Territory, Nyasaland and Portuguese East Africa.

We cannot say for certain who were the original inhabitants of this vast territory, for as yet our archaeological data are too scanty, but a number of tribes preserve in their mythology and legends recollections of what may have been a bygone autochthonous race. Thus the Akikuyu tell of cannibal dwarfs known as Maitochiana, and both the Nandi and Masai have traditions of fantastically shaped ogres with cannibalistic instincts. Probably the nomads, who still exist under a variety of names wherever the natural conditions permit, represent the earliest inhabitants of whom we can have any knowledge. In this area they occupy a subordinate, almost a servile position, live by trapping and hunting, or by collecting roots and berries, are often shy, elusive creatures of the forest, rarely seen, and at other times are engaged in what their neighbours consider the menial task of blacksmiths, and always dreaded for their knowledge of poisons and witchcraft. Excluding these nomads, the races of East Africa fall into the following groups: (1) Bantu; (2) Nilotic; (3) Nilo-Hamitic. The Bantu are subdivided into Lacustrians and eastern Bantu. The classification is really linguistic, but happens to be sufficiently valid in this case as a cultural criterion. Thus by Bantu are meant all those peoples of Africa who use the root *ntu* or some similar word to express human being. *Ba-* is the plural personal prefix of which *mu-* or *omu-* is the singular. Thus we speak of *Muganda*, a Ganda person and *Baganda*, Ganda people. As the prefix is really redundant we shall refer to the Bantu tribes without the prefix and speak of Ganda, Nyoro, Swahili and so on.

The history of East Africa is the history of the Hamites, for the various groups are differentiated by the degree and nature of their Hamitization. The Bantu-speaking peoples are an early mixture of negroes and Hamites, and a series of later waves from the north-east, culminating in the great upheaval of the 16th century, of which the Galla expansion under Mohammed Granye and his invasion of Abyssinia in 1537 was a symptom, profoundly affected East African cultural relations. The Lacustrians were further Hamitized and a Hamitic autocracy imposed itself on many of the conquered Bantu peoples to the north and west of Lake Victoria. The Nilotics or inhabitants of the Nile valley, a parallel fusion of negroes and Hamites, with possibly a Semitic element added as well, were dispossessed of their tribal territories in what is now the south-eastern Sudan and were dispersed by invaders from the east. The bulk of them moved northwards and became the modern Shilluk, Dinka and allied tribes, but a few followed natural lines southwards, and to-day are known as the Acholi, Lango, Alur, Jopalu and Jaluo. The invaders themselves were what are often known as "Half-Hamites," a rather meaningless term to which Nilo-Hamitic is preferable, as they are in fact increasingly Hamitized Nilotics. Southern Abyssinia and regions round Lake Rudolf have during the last 400 years witnessed a perpetual ebb and flow of immigrant peoples, more and more Hamitized, who were deflected by the Nile valley and moved southwards to populate the highlands of Kenya Colony and Tanganyika, until gradually the whole area from these highlands to the Horn of Africa was filled up with mainly pastoral peoples of Hamitic ancestry. This centrifugal movement southwards was

only checked by the intervention of western Powers in whose absence the process would undoubtedly have continued despite temporary checks such as the defeat of the Masai at the hands of the Bantu Hehe. This wedge of Nilo-Hamitics thrust southwards into Bantu areas appropriated the highlands to their pastoral requirements and separated the eastern Bantu from the Lacustrians. The eastern Bantu were agriculturalists and content with the lower highlands and the coastal regions, but under the stress of isolation came very much under the influence of their Hamitic neighbours, and though linguistically they remain Bantu they have assimilated many of the characteristic features of Hamitic culture.

The coastal belt and the adjacent islands, including Zanzibar and Pemba, are inhabited by the Swahili, whose language is morphologically Bantu and who are therefore generally classed as such. Culturally, however, they are not homogeneous and have few Bantu affinities. Since Abdul Malik bin Muriani brought his Syrian builders in A.D. 659 to found his African kingdom, a succession of colonizing waves from Persia and from the Oman established a Mohammedan empire over the whole coastal region from the Lamu archipelago to the Zambezi. These immigrants brought their own culture, interbred with and assimilated the local Bantu at each of their administrative and trading centres. Thus was gradually formed the Swahili language, largely Arabic in origin, though structurally Bantu; and this was the genesis of what are now known as the Swahili people, or more properly the Swahili-speaking peoples, a heterogeneous conglomerate of localized dialects and customs, based on the original Bantu tribes who both assimilated the alien Mohammedan culture and incorporated in it no inconsiderable portion of their own. There were early Chinese voyages to the east coast of Africa, relics of which in pottery and coins, have survived on the coast from Lamu southwards. The Mongoloid eye found sporadically throughout this area, may also be a survival of Chinese infiltration, though other explanations are possible.

The Lacustrian and eastern Bantu meet in Tanganyika Territory and gradually the typical Bantu characteristics reassert themselves, though now we find a social organization with a more pronounced military bias than we encounter farther north. Typical of such tribal polities are the Hehe of Tanganyika Territory and the Yao of Nyasaland, whose organization, though much the same as that of their neighbours the Anyanja, is more closely knit and adapted to the exigencies of war. This may in part be due to the influence of the Angoni, an offshoot of the Zulu who fought their way north and penetrated as far as the southern shores of Lake Victoria. They were finally conquered by the Nyamwezi, a tribe also Zuluized and organized for military purposes, and were permitted to settle in their present homes. The Simba appeared on the lower Zambezi in 1540 and triumphing over the Portuguese and their African allies pushed north-east and succeeded in capturing Mombasa, before they were finally defeated and apparently annihilated near Malindi. The whole of this southern area has for centuries been the battle-ground of warring tribes, marching and counter-marching in almost inextricable confusion, achieving an evanescent eminence and as rapidly fading to comparative insignificance. Consequently there are fewer individual characteristics, the distinctions are less clearly cut, and their affinities are southern and western rather than northern. They belong to the southern Bantu more than to the Lacustrians despite the common characteristics which are part of the Bantu inheritance as a whole. The Thonga of Portuguese East Africa, for instance, very definitely merge into the southern complex and in Nyasaland the Anyanja extend into Rhodesia and come into contact with distinct Zambezi affinities.

In an area so complex and so full of cultural conflict it would be difficult to summarize the salient characteristics both briefly and adequately. Overlapping between the different groups is inevitable owing to the diffusion of cultural elements from one to the other and emphasizes the impossibility of a rigid classification. A fair picture, however, may be obtained of tribal cultures (social organization, mode of life and religious beliefs) by a concise examination of representative tribes in each group, with allowance for individual variation from the norm. The nomads require

separate mention, and the Ganda and Ankole represent the Lacustrians. The Nyika group represent the eastern Bantu. The Hehe and Angoni represent the fusion of the Lacustrians and the eastern Bantu with their southern influences. Lango represent the Nilotics and Masai the Nilo-Hamitics.

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(J. H. D.)

WEST AFRICA

West Africa was inhabited in prehistoric times, ancient stone implements being found in Senegal, the Sudan, French Guinea, the Ivory Coast, Gold Coast and Nigeria, and sites are frequently found in the Sahara in regions now barren, but which no doubt anciently enjoyed different climatic conditions. North Africa was probably peopled by men of Mediterranean race, then by Eastern Hamitic people (dark-skinned, fine features, soft hair), the modern Berber resulting from their admixture. Later came the Jews and Arabs. The Pygmies or Negrilloes, were pushed back by negroes from Central Africa, and were established in the area lying between the Sahara and the Gulf of Guinea and between the Atlantic and Lake Chad. Negrilloes and negroes at first interbred among themselves, then mixed with Berbers and peoples of Hamitic and Semitic stock, thus giving rise to higher grade peoples such as the Bornuan, Kanuri, Hausa, Mandingo, Yoruba and Ashanti.

Principal Ethnic Groups.—The following provisory classification rests on physical, cultural and institutional data:

- I. White race: Berbers, Fulani
- II. Black race:
 - a) Senegalese-Guinea family
 - b) Nigerian Senegalese "
 - c) Volta "
 - d) Guinea "
 - e) Lower Nigerian "
 - f) Hausa "

Social Organization: General.—The social unit is the family in the strict sense, and more often the extended family, a group occupying the same enclosure whose members are divided into classes consisting of parallel generations having equal rights, with labour and ownership in common. Several related family groups form a village quarter. The distinct and organized clan is rare; more easily distinguished is the identity of the tribe and sub-tribe. Matriarchy is rare. Marriage is seldom exogamous, nearly always patrilineal; the children are attributed to the father, and descent is usually traced in the paternal line. Family authority devolves upon the father or the patriarch assisted by elders. Common ownership of family goods, with individual ownership of personal property, is almost universal. Women are usually at liberty to dispose of their own property. Succession to the family possessions, of which women form part, is vested sometimes in the brother and sometimes in the son of the deceased. On the Ivory Coast, in the Upper Volta and Nigeria, a husband allows his wife to cohabit with another man, the children belonging to him. Marriage between brothers-in-law and sisters-in-law is frequent. Personal possessions are heritable in the same way as family goods, but frequently men succeed to a man's goods and women to a woman's.

Government.—Many bush peoples (Liberia, Ivory Coast, Southern Nigeria) and peoples of the French Sudanese region (Gourounsi, Bobo, Lobi, Bari) live in small independent groups. Elsewhere kingdoms have been constituted, very often theocratic in character and ruled over by a priest-king or by a king and a priest reigning together (Nigeria, Dahomey, French Sudan, Upper Volta) and uniting the civil and magico-religious power. Ministers and councillors assist the sovereign. The Queen-Mother (Gold Coast, Nigeria) possesses authority. The heir to the throne is often chosen, by an electoral group, from certain families according to local hereditary laws.

Religion.—Islam spread, in particular, over Mauritania, Senegal, the Guineas, the Niger valley, the Hausa country, Bornu and Nigeria; elsewhere, there is general belief in a supreme deity, in a sky and an earth god, and in inferior gods. Respect is paid to ancestors. Gods and ancestors share in the life of the social group. Various methods of divination are in vogue to ascertain their will. Infraction of certain sacred inhibitions (murder, the shedding of blood) are displeasing to the gods and are regarded as sins and require compensation and expiation. Family and clan cults are found, more rarely tribal cults. Sacrifices, frequently of a seasonal character (altars, trees, stones, hills, streams), insure fertility and fecundity, there being a close association between magic and religion. The head of the family is the domestic priest, and the descendant of the first occupant of the country is the priest of the earth. Sacerdotal colleges, male and female, are frequent (Dahomey, Ashanti, Yoruba). Traces of totemism are found in French Sudan, Ashanti, Dahomey, Nigeria. Numerous tribal, clan, family, individual, occasional and professional tabus, probably of totemic origin, are recorded.

Belief in witchcraft is general, the sorcerers being supposed to be able to change themselves into animals, injuries to the animal inflicted during the metamorphosis appearing on the sorcerer's body. There are special laws and punishments for sorcery.

Initiation of members of the social group is by successive degrees in secret ceremonies to adolescents, adults and men of full experience. They seclude the grades in the forest or in sacred groves. The neophyte is considered to have died and to have been reborn with a new personality, and receives instruction (moral, religious, technical, aesthetic). His position in the group depends on initiation. There are similar but less complicated ceremonies for women.

In Nigeria the king was frequently slain after he had reigned for a certain period, or when he grew old (Yoruba, Jukun, Hausa); the same custom appears to have existed in the French Sudan (Mandingo, Dogon).

Cannibalism and head-hunting have almost disappeared, but existed on the Ivory Coast, in Liberia, Dahomey and Nigeria. In former times human sacrifices were followed almost everywhere by a feast at which the victim was eaten. (H. LAB.)

SOUTH AFRICA

The natives of Africa south of the Kunene, Okavango and Zambezi rivers fall into three main divisions, known respectively as Bushmen, Hottentots and Bantu. These divisions represent a series of successive waves of southerly migration by which the peopling of the country has been effected. The Bushmen, a race of short yellowish-brown nomad hunters, are the earliest human inhabitants of South Africa of whom there is any reliable historical record. Recent archaeological research, however, has established clearly that they were not the first to occupy the country, but are an invading people who superseded the original inhabitants of this part of South Africa. From the evidence afforded by their cultural remains it seems likely that at a very early time they occupied the hunting grounds of tropical East Africa and gradually passed southwards until, when the written history of the country begins, they were roaming all over the territory south of the Zambezi river.

By this time they were already being encroached upon by the Hottentots, who resemble them greatly in racial characters and in language, but are a pastoral people with a more complex material culture and social organization. The Hottentots seem to have sprung out of a mixture of the old Bushman population of East Africa with an early migration of Hamites from whom they obtained their cattle and certain elements of their language. They migrated south later than the Bushmen, and after crossing the upper waters of the Zambezi passed on to the west coast and down to the south coast, where they were found by the first Europeans to touch at the Cape.

The Bantu peoples are the latest of the native inhabitants to have entered South Africa. They all speak languages belonging to the characteristic Bantu language family of Africa (see AFRICAN LANGUAGES), but in racial characters they vary considerably,

though certain negro characteristics predominate. They seem to have originated as a distinct variety somewhere in the neighbourhood of the Great Lakes and to have migrated South at various times between about the 12th and 15th centuries, each of their main groups (see below, *Principal Groups*) representing a different series of tribal movements.

The impacts upon one another of all these different peoples, and the later advance inland from the Cape of the European settlers, resulted in a complicated series of wars, migrations and exterminations, in which the Bushmen and the Hottentots were almost completely broken up, while the original distribution and condition of the Bantu were profoundly disturbed (see SOUTH AFRICA, *History*).



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A HAUSA HEADMAN

More Arab than negro, the Hausa peoples are intelligent, well developed physically and good traders

ful, and are increasing in numbers. They are divided into numerous small tribes which on the basis of cultural and linguistic differences, may be classified into the following groups:—

(a) Eastern, or Zulu-Xosa, which occupies the coastal region East of the Drakenberg mountains and South of the Sabi river. This group includes the so-called "Kafirs" of the Transkei (*i.e.*, the AmaXosa, AmaMpondo, AmaMpondomisi, and AmaTembu), the "Fingoes" of the Cape Province, who are the fugitive remnants of tribes broken up in Natal during the great inter-tribal wars at the beginning of last century, the Zulu peoples of Natal and Zululand, with their offshoot the Matabele (AmaNdebele) of Southern Rhodesia, the AmaSwazi of Swaziland, and the BaThonga (AmaTonga) and kindred tribes of Portuguese East Africa.

(b) Central, or Sotho-Chwana. This group occupies the greater portion of the interior plain North of the Orange river, and includes among many others the BaTauana about the Botletle river and Lake Ngami, the BaMangwato of North Bechuanaland, the degraded BaKalahari of the Kalahari desert, the BaKuena, BaNgwaketse, BaRolong and BaTlaping of Central Bechuanaland, the BaHurutse, BaPedi, BaKgathla and kindred tribes of West and Central Transvaal, the BaVenda of the North East Transvaal and the celebrated Basuto of Basutoland.

(c) The so-called "Mashona" peoples of South Rhodesia, including the BaNyai or BaRoswi and the AbeNanswa immediately South of the Zambezi river, the MaKaranga (MaKalanga), WaManyika and BaZezuru of Mashonaland and the VaNdau of Portuguese East Africa.

(d) South-western, comprising the OvaHerero and the OvaMbo peoples of South West Africa. They are each divided into various tribes which between them occupy the northern half of the region between the Western fringe of the Kalahari desert and the Atlantic ocean.

Another distinct, though less important, division of the natives of South Africa is constituted by the Bergdama (Haukhoïn), who inhabit the coastal region of South West Africa. Their racial history is still far from clear. Physically they are a true negro people, yet they are isolated far from others of their kind; they

live an extremely primitive life, and speak the language of the Naman, to whom they have long been in subjection.

Social Organization.—Both the Bergdama and the Bushmen have very simple forms of social structure. Among the Bergdama the social units are small, independent local groups, each consisting of a patriarchal family, together with any relatives who may put themselves under the protection of its head, and sometimes including a certain number of dependent families who do not feel capable of founding a settlement of their own. The Bushmen are divided into small hunting bands, each of which owns a definite hunting territory over which it wanders and out of which it may not venture except with the permission of the neighbouring group. Within this territory members of the band are free to go where they like. The organization of the band is of the loosest kind. There is no chief, but skilled hunters and the older, more experienced, men in general have a great influence in directing social affairs. The only other structure of any importance is the family, consisting of a man and his wife, or wives, with their dependent children. Marriage within the band appears to be forbidden. A wife generally joins her husband's people, although in some of the northern tribes the young couple remain with the wife's parents until after the birth of the first child.

Of the Hottentots the only section whose social organization has been studied are the Nama, comprising several tribes, each of which has its own territory, name and chief. The tribe, however, is not a centralized body, but is made up of a rather loose aggregation of clans with the chieftainship hereditary in one of them. The authority of the chief is slight. The heads of the other clans act as his council, and he cannot do much without their co-operation. Each clan consists of a number of families claiming descent from some remote ancestor in the male line after whom they are named, and marriage within the clan is strictly forbidden. Polygamy was formerly practised, but monogamy is now the rule.

Among the Bantu peoples considerable variation exists in details of social organization, but certain general features prevail. Each tribe occupies its own territory under its own chief. His authority is generally considerable, but his actual power is somewhat modified by a council consisting of some of his relatives and the more influential heads of families. The family or household group is always of great social importance. It is normally polygamous, and generally forms a distinct local unit, except among the central tribes, where there is a tendency for different household groups to collect together in villages. Even here, however, each household is distinctly marked off from the rest. Within the household each wife has her own hut; and with her children constitutes an economic unit with well defined legal rights. Marriage is patrilocal, and is legalized by the payment of a bride-price (*lobola*), generally in the form of cattle. There exists also an organization of the people into clans, which, except in the eastern group, are associated with totemism. Clan exogamy is customary, but does not obtain among the Sotho-Chwana tribes. Membership of the clan is determined by descent through the father, except among the OvaMbo, who are matrilineal people, while the OvaHerero have a double system of clans, one set with patrilineal descent, the other with matrilineal (*see later, General Features of Note*).

Mode of Life.—Levels of culture differ considerably. All the Bushmen in their original condition are hunters and collectors. They practise neither agriculture nor pastoralism, but derive their subsistence entirely from the game they hunt and from the wild vegetable foods which the women collect. Their chief hunting weapons are the bow and small arrows with detachable poisoned points, but they also make use of throwing-sticks, pitfalls, traps and snares of all kinds, while the women have pointed digging-sticks, which are sometimes weighted with perforated stones. They are a nomadic people, confined in the dry season to places well supplied with water-holes, but, when the rainy season comes, wandering about freely within the limits of their hunting territory. Their encampments are temporary, and their dwellings crude shelters of rush or reed. The Bergdama on the whole lead a similar mode of life, although many of them also keep goats.

The Hottentots are chiefly a pastoral people, with herds of long-horned cattle and flocks of fat-tailed sheep. Sour milk forms

a staple element of their diet; and in contrast to all the Bantu except the OvaHerero, it is not the Hottentot men, but the women, who do the milking. Hunting also plays an important part in their economic life, their methods of hunting and their weapons being practically identical with those of the Bushmen. To some extent they are also nomadic, as fresh pastures for their herds are necessary from time to time. Their encampments, however, are less impermanent than those of the Bushmen. They live in beehive huts, covered with reed mats, and their settlements are arranged in circular form, leaving in the centre an open space in which the cattle are collected at night. Their material culture is on the whole superior to that of the Bushmen; in particular they smelt iron for the manufacture of their implements and weapons, while the Bushmen barter with the neighbouring Bantu peoples for whatever iron they require.

With the exception of the OvaHerero who are a purely pastoral people, all the Bantu tribes practise both hoe-culture and pastoralism. The eastern tribes are more predominantly pastoral, the others more agricultural, but all have this combined means of subsistence. Each household group has its own cattle and goats, as well as its own fields. The cattle are the concern of the men (except among the OvaHerero, where the women do the milking), the fields that of the women. The food supply is derived mainly from sour milk and from crops of millet and maize, supplemented in minor forms by pumpkins, peas, beans, etc., while for meat they rely chiefly upon the game hunted by the men. Cattle are never slaughtered for food except on ceremonial occasions. The life of the people is more or less sedentary. The eastern and south-western tribes live in beehive huts of thatch, the central and Mashona tribes in circular huts with conical roofs. The settlement is always arranged on the circular principle already noted among the Hottentots. All the industries are essentially domestic, practically everything required by the household being made within it. The one exception is in the case of iron implements and weapons, for which there are special workers, who barter their products for cattle and grain.

Religion, Special Features.—In religious beliefs there are certain fundamental features which appear to be common to both the Bushmen and the Hottentots, but there is also considerable variation in several important details. All Bushmen pray to the moon and other celestial bodies, and have an extensive series of myths and legends relating to them. They believe also in certain mythical beings, known variously to different tribes as Cagn (the mantis), Huwu, Tora, Gauna, etc., who appear to be personifications of natural forces, especially those producing the rain, and are frequently invoked. These mythical beings are credited with creative powers, and are met with in various myths of origin. From references in their myths and folk-tales it appears that the Bushmen have further a well developed system of ritual relating to animals and other sources of food, but it is not known in any detail what that ritual is or was. There seem also to be certain beliefs and practices connected with the spirits of the dead, but concerning these the information available is vague.

The religious cult of the Hottentots seems in general to consist mainly in the worship of mythical heroes derived partly from animistic beliefs and partly from the personification of the natural forces producing rain. In their general attributes these beings, chief of whom are Tsui-goab, Heitsi-Eibib and Gaunab, strongly resemble those of the Bushmen. The worship of the moon also seems to have been prevalent among the Hottentots at one time, judging from the records of prayers made to it for food and rain. There is further an extensive ritual relating to the cattle, which, as the chief source of food, are of paramount importance to the well-being of the community; while water, another extremely important factor in the economic life of the Hottentots, also plays a part in numerous ceremonial performances and taboos. One of the chief functions of the medicine-men, as among the Bushmen, is always the making of rain.

Among the Bantu, the religious cult is very largely a strongly developed form of ancestor worship. This is primarily a domestic cult, each family through its eldest male representative worshipping its ancestors in the male line. On important tribal occasions

the chief also prays to his ancestors on behalf of the tribe as a whole. The ancestors are regarded as guiding the destiny of their living descendants, and are propitiated by means of sacrifices offered on ceremonial festivals such as birth and marriage and on other special occasions. All the Bantu have also some conception, often rather vague, of a power in the universe which is not connected with the ancestors. This power is often associated with the sky, but shows itself most impressively in the phenomena of the weather, and hence rain, lightning and thunder are considered its manifestations. It is also sometimes looked upon as the creator of all things and the moulder of destiny. It is met with under various names (such as Tilo among the BaThonga, Unkulunkulu and Inkosi among the Zulu, Modimo in the central tribes and Nzame among the OvaMbo), and the beliefs and customs relating to it differ considerably from tribe to tribe. There is further an extensive ritual relating to agricultural life and to the cattle (the OvaHerero have a sacred herd of cattle), while traces of a totemic cult are found in all the tribes except the eastern. Magic and witchcraft play an extremely important part in the lives of the people, and in connection with this shamanism has developed to a high degree, so that there are many different kinds of medicine men with special functions, such as rain-making, divining, "doctoring" the crops, purifying the army, healing disease, etc.

General Features of Note.—In physical appearance there are many features which readily distinguish the Bushmen from all other inhabitants of South Africa, save the Hottentots. They are typically short in stature, but not dwarfish. Their limbs are slight and finely shaped, the hands and feet being especially small; but there is a curious curvature of the spine which gives a great prominence to the buttocks, where also a great accumulation of fat (steatopygia) sometimes occurs in the women. The skin is yellowish-brown in colour, and wrinkles very easily. The hair is woolly and sparse, commonly very short, and is scattered on the head in little tufts, or "peppercorn" fashion. The head is small and markedly low in the crown, the face broad, with prominent cheek bones, bulging forehead and convex upper lip, the nose extremely flat, the eyes narrow and often slightly oblique; frequently there is no lobe to the ear. In the more northern and eastern tribes there is a distinct tendency towards greater stature, darker colour and better muscular development, while the head and face are longer and higher. These divergent characters are the result of intermixture with the neighbouring Bantu peoples.

The culture of the Bushmen is noted for the highly artistic paintings and engravings which they executed on the walls of caves and rock-shelters. The subjects portrayed are chiefly animals, human beings, hunting, battle and dancing scenes, and the representations are remarkable for their fidelity to nature. The practice of the art seems to have died out, but it proves a most important link in the chain of evidence connecting the Bushmen of South Africa with the Palaeolithic cultures of the peoples of Europe.

Of the social customs of the Bushmen, especially those connected with birth and marriage, little is known. Initiation ceremonies at puberty are common to all Bushmen. On reaching her first menstrual period a girl is secluded in her hut and has to observe various food taboos. In the northern tribes a special religious dance, known as the "eland bull" dance, is added in her honour. Initiation ceremonies for boys seem to be restricted to the northern tribes. The special tribal marks are cut by the medicine men between the eyebrows of the boys, who are then kept in a secluded spot for about a month. During this time they are instructed in the lore of the tribe, and religious dances are held in which animal masquerades predominate. The Tati Bushmen practise circumcision as part of the initiation ceremony, but they are the only Bushmen of whom this is known, and have probably adopted the custom from the Bechuana among whom they live. At death the corpse is usually buried lying on one side with the knees drawn up against the breast. The group then removes to another site.

The Hottentots resemble the Bushmen closely in appearance, and it is only in certain characters that there are any noticeable differences. They are taller than the Bushmen, and have dis-

tinctly longer and narrower heads. Their skull is also higher and the face more prognathous. They have, however, the same prominent cheek bones, small chin, flat nose and peculiar eyes as the Bushmen, while their ears are often also lobeless. Their hair and their skin colour are the same as in the Bushmen, and steatopygia is often more marked.

An important feature in their culture is the great prominence of the communal meal in their ceremonies. It is a means of curing a sick person by aggregating him to the group of those who have had the disease and recovered; of introducing young men and women to the life of full members of the tribe; of bestowing on a young mother the solidarity of the group of mothers with strong and healthy children; of welcoming a widow, or widower, into the group of the widowed, and so giving them a new place in the society as a whole. The part water has come to have in their ceremonial life because of its extreme value in their economic life is also noteworthy. In addition to there being a great annual rain-making ceremony, water plays an essential part in many religious ceremonies, is endowed with a special protective power in some cases, and is considered extremely dangerous in others. Rain, as the source of water, is also held sacred, and the natural forces producing it are even personified and worshipped.

The Bergdama are of considerable interest, as they appear to be the most primitive negro people known, apart from the Congo pygmies. They are of medium height, strong, even coarse, build, with long rather thick skulls, prognathous faces, broad noses, very dark, even black skin, and all the features typical of the true West African negro. What their original language was is not known, for they have been so long enslaved by the Hottentots that they have completely adopted the Hottentot language. Yet in ceremonial their lives appear to have been but little influenced by the Hottentots, and among them there is found what appears to be a very important feature of many Bantu cultures, the sacred fire round which the whole life of the society centres. Each little group has a sacred fire which must never be allowed to go out, but which must be guarded day and night by the chief wife of the patriarch. Day by day, when the members of the group go out to seek for food, the head of the group and the old men sit guarding the fire, and as long as that is aglow and respected by all, the hunters and collectors will find food for the day. All game must be laid by the sacred fire, and certain portions of it must be eaten ceremonially by the elders of the group. Each kind of berry and root, as it ripens, must be brought to the sacred fire before it can be eaten. All good, all evil hangs upon the guarding of the fire from all impurities, which come from breaches in the regulations as laid down in the traditions of the tribe.

Racially the Bantu peoples present a great variety of types. They are fundamentally negro peoples, mixed with Hamitic, negrito and other types. The skin is usually less dark, stature lower, head less elongated, forehead flatter, prognathism less marked, nose generally more prominent and narrower than in the true negro. The Hamitic strain often shows itself clearly among the Zulu and allied tribes in a relatively narrow nose. The hair is uniformly of the ordinary negro type, the skin all shades from yellowish-brown to the black of the AmaSwazi, usually a reddish ground tint, dark chocolate colour being the prevalent hue. The Eastern tribes are on the whole taller and more dolichocephalic than the Central, while the South-western tribes are more typically negro than the rest.

The political organization of these peoples is well developed, and they have an elaborate system of laws regulating their social life. Among the OvaMbo blood revenge is still practised, but among the Central and Eastern tribes the tribal authority is supreme. All members of the tribe are regarded as belonging to the chief; an injury to them is, therefore, an injury to him, and compensation for death or injury must be paid to him. The AmaZulu and AmaXosa are renowned as fighting tribes, none of the rest being specially war-like; and among the former a strict disciplinary system was established by the great chief Chaka, who abolished the throwing spear, which is the typical weapon of this area, and introduced the short stabbing spear. By this reform he forced upon his warriors the necessity of coming to close quarters,

and from that time the Zulu became a dominant people and were able to found and develop a great military kingdom in South East Africa.

The initiation ceremonies at puberty of the Eastern and Central tribes are of some importance. The boys are initiated in groups, which are kept secluded in a special "lodge" for about three months, during which they are taught their tribal history, the moral and religious code of the society and its social etiquette. The ceremony itself consists in circumcision, performed by a special medicine man. These initiation "schools" are held every year in some tribes, in others at intervals of from four to five years. In each case the group of initiates is usually given a special name by which it is known throughout life. These groups play an important part in the tribal organization, and form, the nucleus of the military system. The Zulu do not have initiation schools, nor do they practise circumcision, but the system of initiation groups has persisted in the formation at regular intervals of military regiments comprising boys of about the same age. Girls are also initiated in groups at the time of puberty, and are not considered marriageable till they have passed through the ceremony.

The Central tribes have remains of a tribal totemism. Each independent section of the people, which may at one time have represented a clan, has a *siboko* or laudatory name, taken from some animal or some natural phenomenon. In former times there was a definite ritual connected with the species of animal so used. Nowadays, however, the main division of the people is into patrilineal clans, and the possession of a common *siboko* is no bar to marriage. In the Eastern tribes all traces of totemism, if it was ever present, have disappeared. They are all divided into clans each with its own *isibongo* (laudatory name) which is generally the name of the ancestor from whom the clan is thought to have sprung. Marriage between people with the same *isibongo* is not permitted. Very often, however, a clan will split up, a younger branch taking some more immediate ancestor as its *isibongo*, while the older branch preserves the more ancient *isibongo*, and intermarriage between the two branches is then permissible.

The OvaHerero clan system is a combination of the patrilineal and matrilineal systems. The people are divided in the first place into clans with matrilineal descent, called *eanda*, and then into clans with patrilineal descent, called *oruzo*. Every person belongs to the *eanda* of his mother, and the *oruzo* of his father. Both the *eanda* and the *oruzo* are totemic and exogamous. Each of these clan divisions has a different function. The *eanda* is associated with economic relationships, so that inheritance is in the female line. The religious life, on the other hand, is almost entirely connected with the *oruzo*, and is a developed form of ancestor worship, so that a man prays always to the ancestors of his father. Here again, the sacred fire is very prominent. At the chief's village the ancestors of the chief are worshipped, and represent the ancestors of the whole tribe. In addition the sacred fire is found in the kraal of each head of a family, lighted, in the first instance, from that of the chief. None of these fires must ever be allowed to go out. To this fire the women bring the milk each night and morning to have it blessed by the kraal head and the ancestors.

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ARCHAEOLOGY AND ANTIQUITIES

The boundary between Negro Africa and "White" Africa, *i.e.*, Egypt and the northern and north-western portions of the continent, must be both conventional and provisional. The explorations of Reisner at Kerma in Nubia (between the third and fourth cataracts) and of Garstang at Meroe, have carried Egyptian influence so far south in the Nile valley that these sites, although inhabited by peoples of mixed culture, must from the archaeological standpoint be referred rather to Egypt than to the Sudan.

No such line of division exists in the west between the North African cultures and those of negro-land; indeed Gautier ("*Études d'ethnographie saharienne*," *L'Anthropologie*, 1907) has shown that there is good reason to suppose that the latter has advanced perhaps as much as 1,000 km. at the expense of the former, during the last 2,000 or 3,000 years. Moreover, Meroe itself does not accurately represent the southern limits of the mixed civilization to which it has given its name; some 12 mi. south of Khartum on the right bank of the Blue Nile are the remains of Soba, a Meroitic site, later the capital of the Christian kingdom of 'Alwa (the Alut of the hieroglyphs), which Meroitic remains have been recently discovered 200 mi. south of Khartum.

Yet Meroe, which lies in the neighbourhood of the 17th parallel of north latitude, may well stand as the main southern bastion of Egyptian influence, and the area with which this writer will deal is that part of Africa lying south of 16° north, which will be divided into three provinces, eastern, western and southern.

The Nile-Congo watershed, a natural feature of geographical and ethnic importance, constitutes part of the dividing line between the eastern and western areas, which continues northwards along the broad ridge of relatively high land that roughly divides the territories of the Anglo-Egyptian Sudan from those administered by France. Thus the boundary line somewhat closely follows the western confines of Darfur, while south of the Nile-Congo watershed it coincides with the boundary between the Belgian Congo and British territories to the east, both eastern and western provinces being limited to the south by a line roughly following the 10th parallel of south latitude.

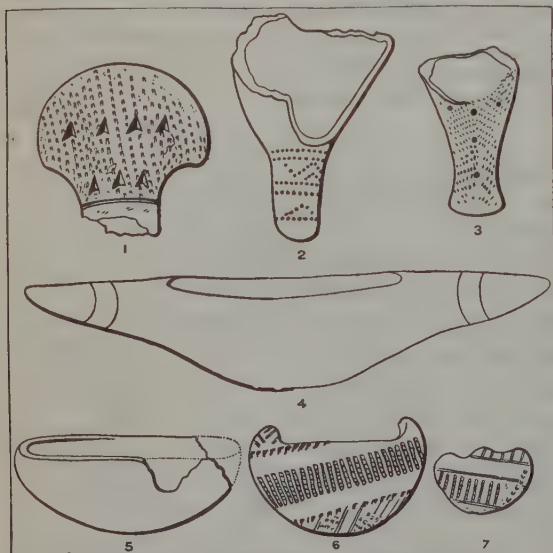
THE EASTERN PROVINCE

Palaeolithic Artifacts.—Here discoveries have so far been limited to the Sudan, Uganda, Somaliland and Kenya Colony, while surprisingly little is yet known of the early pre-history of even these territories. Except possibly in the extreme north, within a few miles of Halfa, no implement of River-drift type is known to have been found in the Sudan. This fact may be due to incomplete exploration, but is of some significance considering the abundance of specimens which have been found on the surface in Egypt and Libya, in Somaliland (where H. W. Seton-Karr has collected countless specimens of River-drift and Mousterian types), South Africa, and recently, in deposits, by Wayland in Uganda, though the majority of the implements he discovered are perhaps to be associated with the Le Moustier *facies* rather than that of the River-drift. Be this as it may, Wayland has collected Chellean hand-axes in gravels, considered of Pleistocene date, capping quartzite hill-tops some 300ft. above the present level of the lake, and also implements of a well-developed Mousterian type, including "points, side-scrapers, flake knives, tortoise cores and tortoise points," as well as two typical side-scrapers in a cave under some five feet of cave earth. (A. A. Smith and E. J. Wayland, *Some Primitive Stone Implements from Uganda*; Uganda Protectorate, Geological Survey Dept., 1923.)

No typical Mousterian specimens have yet been found in the Sudan, but certain specimens collected from two sites, namely, Jebel Katul in north-west Kordofan, and Jebel Gule in Dar Fung, are considered by the Abbé Breuil to belong to the Mousterian period. So far as is known no implements attributable to the latter part of the Palaeolithic age have been found anywhere in the Eastern Province, certain pygmy implements which will be mentioned later being regarded as Neolithic. (C. G. Seligman, "A Neolithic Site in the Anglo-Egyptian Sudan," *J.R.A.I.*, vol. 40, 1910.)

Neolithic Age.—Evidence concerning the Neolithic age is furnished by a number of finds made on widely scattered sites in the Sudan, Uganda and Kenya Colony, and there are hints that in parts of Negro Africa, which nowhere had a Copper or Bronze age, stone implements may have persisted to within the last few centuries and the use of iron be quite recent. The distribution of the most typical of Neolithic implements, the ground stone axe, makes it necessary to refer to the conditions prevailing north of latitude 16 degrees. Unknown in pre-dynastic Egypt polished axe heads are common in Nubia, where a number have been found in pre-dynastic and early dynastic tombs. Many examples have come from Meroe, and specimens probably occur on every site of Neolithic date in the Sudan; they have been found, e.g., at Jebel Geili, 90m. east of Khartum, at Jebel Gule, and at Faragab in northern Kordofan; moreover, the grooves in the rock faces on which they were ground exist both at Jebel Gule and Jebel Geili, while stone axes of a peculiar type have been found in western Darfur by D. Newbold. These facts all support the idea put forward (*Rep. Brit. Assn.*, Pres. Address, Section H, 1915) that the ground stone axes of the Nile valley are of negro origin, a view consistent with their occurrence in the Congo, and, in relatively enormous numbers, in the Gold Coast. Perforated discs or rings, and hollow conical and spherical stones, all ground in the usual Neolithic style, have been found at Meroe, on Jebel Haraza (Kordofan) and at Jebel Geili, where stone discs and axe heads can be definitely associated together and with Meroitic potsherds.

Besides the types already alluded to, Jebel Gule yielded a large number of pygmy implements of quartz, carnelian and hornstone (similar to those found in South Africa and attributed to Bushmen), and there is reason to believe that this industry also existed at Faragab, where these "points" were used to bore the innumerable disc heads of ostrich egg-shell which cover the ground. The British Museum has a number of beautifully worked *dos abattu*



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POTTERY FROM THE MOUNDS AT FARAGAB KORDOFAN

Figures 1, 2 and 3 are fragments of vessels; figure 4 is a reconstructed vessel of a type hitherto unknown in Africa; figure 5 is a bowl; figures 6 and 7, objects of unknown use

specimens of obsidian from the neighbourhood of Njoro in Kenya Colony; typical lunates, of jasper and of carnelian respectively, have been found in Uganda (Wayland), while to pass northwards of latitude 16°, G. A. Reisner (*Sudan Notes and Records*, vol. 2, No. 4, 1919) has found in tombs dating to the Egyptian 25th dynasty in Upper Nubia, perfect lunates of carnelian, in such numbers that there can be no question of their inclusion in the tombs being accidental.

This may close the account of stone implements which may be assigned to the Stone age cultures, so long as it is realized that the Neolithic certainly comes down to a period vastly more recent than the Neolithic of even northern Europe, and that in the Sudan, at least, it is overlapped by the Meroitic civilization, numerous outliers of which have been found, including those of Jebel Geili, another in the neighbourhood of the Makwar dam on the Blue Nile, notable for its Greco-Roman bronze vessels, and at Abu Sofian in western Kordofan. Although there is no evidence to show that they are Meroitic it will be convenient here to refer to the discoveries made by H. S. Wellcome at Jebel Moya near the Blue Nile and by Seligman in the mounds near Faragab, a village of sedentary Arabs some 20m. east of Bara in northern Kordofan. Though made about 1910 only the most meagre descriptions of the Jebel Moya discoveries have been published, although they are of prime importance to the history of the Sudan. Besides stone implements, were found beads and amulets, a number of scarabs and small plaques bearing Ethiopian and Egyptian cartouches, ranging from about 700 B.C. or perhaps going back to an even earlier date (*Brit. Assn. Reports*, 1912), while a paper by Prof. D. E. Derry (*Proc. 17th Internat. Congress of Medicine*, Sec. 1, Pt. 2, 1913), giving anatomical details of skeletons from graves at this site indicates that the inhabitants were tall negroes resembling in height and cephalic index some of the present day negroes of the hills of southern Kordofan (C. G. Seligman, *J.R.A.I.* vol. 40, 1910. Plate xxxv., figs. 8 and 9). At Faragab the mounds extend over acres and their surface and the areas between them are literally covered with disc beads of ostrich egg, fragments of bone debris and other foreign objects, including fragments of imported rocks. Two types of potsherds are of special interest, one consisting of a fabric bearing the impression of the string mat on which it was made (such mats are still used in the hills of northern Kordofan), and in this resembling the coarser wares found by Garstang in the graves of Meroe, the other oblong-oval in shape and rather shallow, often decorated with geometrical designs and produced at each end into a solid mass (handle?), its general appearance recalling that of many Melanesian wooden food bowls. This type seems to be hitherto unknown anywhere in Africa. The beads are of ivory, dolomite and scapolite; the single dolomite bead is definitely not of a type hitherto regarded as negro, while a single carnelian bead, if Egyptian, as no doubt it is, is regarded by Sir Flinders Petrie as certainly not later than 18th dynasty. (C. G. Seligman, "Prehistoric Site in Northern Kordofan," *Annals of Archaeology and Anthropology*, vol. 7, 1915.) The presence of many pieces of worked ivory is noteworthy. Of Meroitic monuments of any size, apart from those found at Soba, e.g., the "lamb" now in the Palace gardens at Khartum, the rock drawings discovered by Crowfoot at Jebel Geili, representing a king wearing the uraeus crown worshipping a rayed solar divinity, which may be taken to be of late Meroitic date, is of special interest.

Rock Drawings.—The rock drawings of the Sudan are in Kordofan and Darfur. Generally they are outlined in red or blackish pigment, but examples roughly graved on masses of granite also occur in the Jebel Haraza *massif*. Drawings with pigmented outlines are found on Jebel Haraza and Jebel el 'Afarit, and seem to form two groups. (H. A. MacMichael, "Rock Pictures in North Kordofan," *Journ. Roy. Anthropol. Inst.* vol. xxxix., 1909, pp. 562-68.) To the first belong rough but spirited sketches of men on horseback, camels and giraffes. The workmanship of the second group is rougher and much less vigorous; it includes representations of camels, men on horseback and men marching or dancing, carrying the small round Hamitic shield. This, together with their general resemblance to the "Libyo-Berber" rock pictures of the southern Sahara, indicates a comparatively recent date. Moreover, the work is faint and indeterminate, and there is no trace of graving; in other words the Neolithic tradition has not persisted. Probably the drawings are more recent than the stone discs and hollow conical and spherical stones found on Jebel Haraza, already mentioned.

It is as yet too early to estimate the significance of the objects found by D. Newbold (*Sudan Notes and Records*, vol. 7, 1924) on his recent journey from Bara in Kordofan to the international

boundary (long. 24° E.) between the Sudan and French Equatorial Africa. Evidence of former occupation of the country, now desert or the poorest steppe, was abundant, including cairns, pottery (some Meroitic), a small brick pyramid at Abu Sofian (16° N., 28° E.), and five ground axes of glauconite of hitherto unknown type from the Wadi Hawa. Drawings roughly incised on boulders, e.g., at Sobat el Hammad, showed tailed and phallic men, elephants, giraffes, ostriches, oryx, cattle and several other animals which could not be identified. At Umm Tersawen there were also a number of human figures, some tailed, some armed with bows. "At Abu Sofian two groups of pictures, obviously of the same date and 'school,' were within a day's march of one another. Here the drawings were incised on rough boulders, and were very numerous. Camels are shown literally in hundreds; giraffes and ostriches still appear; but the cattle dwindle in numbers, while the elephant is not represented, and the bowmen give place to men armed with spears and carrying shields." The latter armament appears to bring these drawings into the Libyo-Berber class.

Megalithic Monuments.—Megalithic stone monuments occur in the Sudan, some of the present day, others certainly recent, a few apparently of some antiquity, though as to these our knowledge is of the slightest. In the northern Sudan the Beja tribes surround the graves of their dead with a circle of upright stones; round some of the older graves individual stones were occasionally taller than a man, and it is probably the persistence of such stones after their smaller neighbours have disappeared that has given rise to monoliths such as that some two metres high (to which the Prophet, according to the accepted tradition, tied his horse) overlooking the Khor Arab near the Sinkat-Erkowit road in the Red Sea Province.

Another monolith of much the same dimensions has been described and figured by J. W. Crowfoot from Assarema Derheib, inland from 'Aqiq (*Geog. Jour.*, May 1911), and in this instance there seems nothing to suggest its origin in a Beja grave. Farther south megalithic monuments have been reported from the Madi, while stone circles are made by the Lotuko-speaking tribes wherever stone is abundant, as squatting places for the men, though in no case could evidence be obtained of stones large enough being carried even a few miles. Again, although megalithic structures occur among the Lotuko and the Bari-speaking tribes of Mongalla Province, it is certain that some are recent erections over graves, e.g., the examples discovered by E. E. Evans-Pritchard among the Moro of the eastern Bahr el Ghazal. Although megalithic neither in structure nor form there is a type of stone monument some 80 ft. long and about 5 ft. high occurring in some number in the neighbourhood of Erkowit. These (*Jour. Egypt. Archaeology*, vol. 2, 1915) are constructed without any cement or mortar; the face consists of a limiting wall of more or less flat slabs of local rock, while the spaces between the containing walls are filled in. Each monument may be considered as of three main elements, viz.: (1) an oblong rectangular portion, (2) two oval masses, to each of which is attached an expansion shaped somewhat like a fish's tail and (3) the curved walls uniting the other elements. Their orientation seems to have been toward the rising sun, while each oval element is interrupted at a constant point in its circumference by the interposition of from two to four upright slabs. There is no chamber or space behind these stones, but from their constant presence and the uniformity of their position it is obvious that they must have had a perfectly definite significance to the builders, indeed they recall the false doors of Egyptian monuments. J. W. Crowfoot found human bones under the filling of the rectangular portion but no objects with them. They may provisionally be regarded as mediaeval, but as antedating the spread of Mohammedan influence which was becoming dominant towards the middle of the 15th century.

Abyssinia.—Although the monuments dating from the 4th century A.D. discovered at Aksum by Theodore Bent (*The Sacred City of the Ethiopians*, 1896) are still the most important, interest will for some time tend to centre round the many new discoveries of "prehistoric" date, including some presumably of no great age, made by the Rev. Father Azais.

Littman, the leader of the German expedition to Aksum, holds

that the carved and decorated monuments generally termed "obelisks" are in fact stelae (of huge dimensions it is true, e.g., from 15 to 33 metres) and therefore each to be regarded as part of a tomb, a point of view rendered the more probable by the presence at their base of stone slabs, often carved, which have every appearance of being altars. All this seems to imply a cult of the dead, but, apart from this, inscriptions dating from the 1st and 4th centuries record the names of the gods of the Semitic conquerors of northern Abyssinia. A Greek inscription of Adulis, no longer in existence but copied in the 6th century by Cosmos Indicopleustes, states that the king of Aksum of the 1st century, who caused this record to be cut, worshipped Zeus, Ares and Poseidon. A later document of King Aizanas (about A.D. 350) is in Greek, Sabaeo and old Ethiopic. An analysis by Littman of this inscription, together with one dating from about a century later, indicates that worship was rendered to Heaven, Sea and Earth, together with Mahren "who begat the King," the latter being identified with Ares. Other monuments include rude monoliths, some ornamented with bands, and a most spirited rock-carving of a lioness in low relief.

The recent work of Father Azais shows that Abyssinia is remarkably rich in stone monuments, of types hitherto unsuspected. The following is derived from the well illustrated, but summary, account of the rev. father's investigations given by A. Kammerer (*Essai sur l'Histoire antique d'Abyssinie*, Paris, 1926). Most of the discoveries were made in an area stretching southwards from Addis Ababa beyond Lake Zwai to the neighbourhood of Lake Margherita. Large tumuli, some surrounded by a circle of megaliths, and a number of dolmens in excellent preservation, were found about room. south-east of Harrar, i.e., on the edge of the Ogaden Somali country. These dolmens are said to be of the same general type as is found in western Europe. One which was systematically explored yielded, besides human remains, potsherds, a silver ring and a heavy metal bead.

Menhirs are particularly abundant in Sidamo Province, where they are generally of dressed stone, phallic in form, and may attain a height of 20 feet. A number of menhirs with anthropoid designs in low relief were found near Silte, the capital town of Guragwe. Further south, not far from Lake Margherita, statue menhirs carved in the round occur. These may show geometric designs which suggest tattoo or cicatrices, while to the west and north-west of Lake Zwai, hundreds of short stout uprights of dressed stone, "stunted menhirs," have been discovered, each bearing in relief representations varying in number from one to 13 of a short broad-bladed sword which vaguely suggests the short Roman sword. In this district, too, were found several stele bearing Arabic inscriptions in the Nasri script.

Recent Discoveries in Kenya and Tanganyika.—Important (and at the time of writing unpublished) discoveries have been made in East Africa. In 1913 a human skeleton was found by Dr. Hans Reck at Oldaway, in northern Tanganyika, on the borders of the Serengeti plain. This lay some three metres deep, in undisturbed deposits of the last Pluvial period, associated with a fauna of which more than 50% represents extinct species, including *E. antiquus Reckii*, *Hipparion* sp., and an extinct sheep (*Pelorovis oldawayensis*). The skull from this skeleton is said to resemble that from Elmenteita, found by L. S. B. Leakey, whose important discoveries in Kenya in the neighbourhood of Lake Nakuru may provisionally be summarized as follows:—

A partial excavation of a flat-topped kopje at Eburu yielded crouched burials of a people with long slender limb bones and long narrow skulls, probably Negro-Hamitic. There was an iron toe-ring on one of the skeletons. At Nakuru a series of forcibly contracted burials was found along the side of a cliff; the skulls which are not negro—it is too early to discuss whether they are in any degree negroid—are long and massive with a long face and well developed and narrow nose. The muscular impressions are well marked, the longbones long and relatively slender. With these skeletons were found obsidian microliths, including lunates, small *dos abattu* blades, stone bowls and mortars, grinding-stones, pottery, simple bone tools and two beads of foreign origin which may possibly date about 2,000 B.C. At Elmenteita, near the Makalia

river, there were found bones, including skulls, probably representing burials disturbed by flood, and some of these bones are definitely fossil. Here the skulls are of more than one type, (1) strongly built, dolichocephalic, and, apart from the lower jaw, somewhat resembling the Combe Capelle skull, (2) smaller, brachycephalic, represented only by women. The associated industry consists of fair-sized flakes, lunates and end-scrapers of obsidian, ostrich-shell beads and pearl shell pendants, as well as at least three types of pottery. Besides the effects of flood this site was disturbed some ten years ago, so that the original stratification may have become confused and the associated objects be of different ages.

THE WESTERN PROVINCE

Palaeolithic Remains.—It is only recently that stone implements of River-drift type, and therefore to be regarded provisionally as of Palaeolithic age, have been discovered in West Africa. In the British Museum there is a series of massive implements of Chellean type, consisting of quartz porphyry, which on the surface have weathered to the softness of chalk. These come from the alluvial deposits of the Bauchi plateau, as do a smaller number of implements of Mousterian type of the same mineral, and one very steep end-scraper of a more homogenous stone showing no surface weathering. (These implements are described by H. J. Braunholtz in *Occasional Paper No. 4* of the Geological Survey of Nigeria.) There is also in the national collection a number of short stumpy implements of Drift type of a reddish quartzite, for the most part with unworked butt, found on the golf links of Accra (Gold Coast). Similar specimens have been found in the local gravels, the actual specimens in the museum having apparently been washed up from the beach.

Neolithic Age.—Polished axe-heads of ordinary Neolithic type are by no means uncommon in West Africa and the Congo valley. They are found in Northern Nigeria, especially in the Bauchi Plateau gravels, where it is said that they overlap to some extent the Drift types. They are, however, of a different stone, for the most part of dolerite. In the Gold Coast Colony they are found in large numbers, as are perforated quartz discs, while a few bossed spheres about 2 in. in diameter, of anomalous appearance and unknown use, have been recovered. A collection of Neolithic implements from Calabar include stone axes, unusual in that they possess a definite tang for hafting.

Under the title "Tumbakultur" Oswald Menghin (*Anthropos*, 20, 1925) has described a culture characterized by series of implements, widespread in the Lower Congo area, which he tends to approximate, though with difficulty, to the Campignian of Europe. Be this as it may, Menghin finds a long series of artifacts passing insensibly from implements of coup-de-poing type, Campignian *pics*, flattened ovals of almost laurel-leaf type, to notched and roughly cruciform spear or arrowheads, some, though larger and coarser, irresistibly recalling the "freak" forms from Breonio in Italy. Apart from these, many ground stone axes have been found in the Congo area.

Megalithic Monuments.—Megalithic monuments are distributed widely in West Africa in the form of stone circles and standing stones. In Gambia both classes of monuments have been carefully described by the late Henry Parker in a paper published after his death (*Jour. Roy. Anth. Inst.*, vol. 53, 1923):—

"The circles themselves are generally found in groups or clusters comprising from two to nine, but single circles are met with. With one possible exception there are no uncompleted circles, except those formed by concentric outer pillars standing round an inner circle. . . . The groups of circles are arranged in single straight lines; in nearly parallel lines consisting of two, three or four circles; or in pairs; but never in triangles or pentagons. Many stones are prostrate and . . . almost invariably these fallen pillars . . . are at least partly buried by the soil. . . . Some have their upper face almost level with the ground, and as a rule the others are half or three-quarters covered by the earth. . . . Superficially considered this is the only indication of the age of these structures, and . . . it would be of great value if we knew the rate of elevation of the soil. Without such knowledge it is only possible to draw the conclusion from this evidence that both

the circles and the menhirs must have been erected many centuries ago.

"In addition to the concentric outer pillars, there are several instances where the outer pillars are arranged on the eastern side of the circle in a straight line, or even in two parallel lines, in a north and south direction. Such lines are invariably to the east of the circle. . . ."

The circles are considered sacred to the Earth Spirit, and ceremonies are performed in them to propitiate the latter, as also for the protection of the crops. It does not, however, appear that Parker excavated in them, and their date and purpose must be left for further exploration, though in the light of information received on the spot the contents of the circle (human remains, spearheads, copper armlets) dug by J. L. Todd and G. B. Wolbach (*Man*, No. 96, 1911) suggest that in recent times these monuments were the sites of sacrifice for success in warfare.

In some of the northern villages of the Cross River Division of Nigeria, *i.e.*, in the villages of the Akayu, Indem and Atam districts (on the left bank of the Awewayong river) there are stone circles, the stones often more or less conical and carved to represent the human body from the waist upwards. These have been described and figured by C. Partridge (*Cross River Natives*, 1905, pp. 268-599); the navel is specially prominent, and cicatrices seem to be reproduced. At Agba village the circle surrounds an old tree, and the grove of the great chief who erected the circle. The tree is sacred, and of the stones it was said by the ancestors "these stones are your forefathers, your very great chiefs; every year you must sacrifice to them" (p. 271).



BY COURTESY OF THE PRESBYTERIAN BOARD OF FOREIGN MISSIONS

WOMEN SERVE AS CARRIERS IN AFRICA, COVERING 35 MILES A DAY

Beads.—In the past, claims of high antiquity have been made on behalf of the so-called "aggr" beads that have been found in West Africa. Yet as stated by Sir Hercules Read, with the single exception of the necklace to be discussed immediately none of these beads shows features not to be found in mediaeval or later beads from the factories of Venice. The necklace, presented to the British Museum by L. P. Davies, was obtained from the grave of "a renowned chief" at Mansu, a town on the route from Elmina to Kumasi. It is described in detail in *Man* (1905, 1).

For present purposes interest centres in some 20 beads of crystalline glass, irregular-faceted, and especially one bead of crystalline glass moulded like a mulberry. Sir Hercules Read writes of these as being in a state of iridescent decay, the surfaces being in many cases deeply pitted and presenting exactly the same appearance as beads of the same kind from the Mediterranean area. He points out that the crystalline glass in this necklace is identical in appearance with those from the tombs at Karneiros in Rhodes, dating from the 6th century, and goes on to suggest, but "without insisting too strongly on this point," that here are "glass beads of classical style found for the first time in West Africa, and presenting features that in point of date may justifiably be associated with the name and time of the Carthaginian Hanno, a name often invoked when objects of indeterminate age are found on the African coast."

Though probably not of any great age, reference must be made to the soap-stone carvings of human heads or figures (occasionally animal figures) found in the ground, sometimes apparently in pits, in certain districts of Sierra Leone, where they are used as agricultural charms. These figures are for the most part roughly carved, the work being well within the scope of present-day Africans, and Joyce (*Man*, No. 57, 1905, and No. 40, 1909), points out that there is really no reason to see in them—as has been proposed—evidence of foreign, *i.e.*, Egyptian or Carthaginian influence. The objects described by Frobenius from Old Ife (*The*

Voice of Africa, 1913, vol. i, chap. 14; "The Archaeological Finds"; and *Das Unbekannte Africa*, Munich, 1923), the ancient capital of the Yoruba, are also probably of no great age; there do not seem to be any which the 16th century Benin civilization might not have produced.

Possibly of about the same date are a number of bronze and silver objects, now on deposit in the British Museum, from a sandy mound (no doubt a grave) at Tumuni in the Sokoto Province of Northern Nigeria. Sir Hercules Read holds that they exhibit features and analogies which are unusual in negro African metal work, pointing to artistic or commercial relationship with the culture of the Mediterranean area, doubtless at a period remote from the date of the manufacture of the relics themselves.

The most important pieces are a bucket with incurved sides and lugs, and a barrel-shaped armlet (?) for wear on the bicipital region. The lines and casting of both, and the geometrical patterns tooled on their surfaces, are good and careful work. While the find as a tomb-group may date to A.D. 1480, as suggested by H. R. Palmer, yet, as stated by Read, they are of unusual interest from the analogies they present with the early Mediterranean cultures, and we may have here a distant echo of the early art of the Bronze age. At the same time there is no reason to think that the actual objects are anything but local productions, though they may differ from those of more recent date.

THE SOUTHERN PROVINCE

Palaeolithic Implements.—Artifacts of rude Chellean type, often larger than the corresponding implements of western Europe, are found over the greater portion of South Africa, nor does there seem to be any reason why these should not be regarded as true palaeoliths perhaps of an age comparable to those of Europe. One of the most satisfactory finds of this order is constituted by a considerable number of implements of chalcedony, quartzite, etc., exactly similar to types characteristic of the River-drift Period of western Europe and Great Britain, associated with and evidently forming part of ancient terrace gravels deposited as drifts by the Zambezi (in the neighbourhood of Victoria Falls) at a remote period. The position of these terrace gravels and surface drifts in regard to the Batoka Gorge indicates their real antiquity, since they must have been deposited by the river when the latter was covering the old valley floor more than 400ft. above its present level. Here Henry Balfour excavated several implements from undisturbed gravel deposits at depths varying from 6in. to 2ft., some greatly water-worn and heavily patinated.

Recently A. J. H. Goodwin ("South African Archaeology," *Man*, 1927, 14, and "Caspian Affinities of S. A. later Stone age Culture," *South African Journal of Science*, vol. xxii, 1925) has summarized South African history on the following lines:—

The terms Palaeolithic and Neolithic are dropped, the two main periods being termed the Earlier Stone age and the Later Stone age, Péringuey's name for the main *coup-de-poing* culture of the Earlier Stone age, the Stellenbosch industry, being retained. A second culture, the Victoria West industry, centres round Victoria West in the south-central Karroo, running north into the Free State and west to Nakob on the S.-W. African border; the *coup-de-poing* occurs, but the main implement appears to be a core similar to the European Acheulean tortoise-core, but some 8in. or so in length. It is not clear whether core or flake was the desired element, but secondarily worked flakes of this industry have not been found. The last culture of the Earlier Stone age is that of Fauresmith in the Orange Free State, with a flake worked to resemble a *coup-de-poing* as the characteristic tool.

There is no evidence of the Earlier Stone age developing into the Later Stone age, indeed they probably overlapped. The earliest industry of the Later Stone age is that of Still bay (near Mossel bay) covering most of the eastern part of the Union and extending into the Free State and to Okahandja in South-West Africa. This culture somewhat resembles the Solutrean of Europe, with lanceolate implements (usually small) as well as tanged forms, sometimes with serrated edges.

The Still bay culture was followed by two probably contemporaneous industries which extend into modern times, termed from

sites in the Orange Free State the Smithfield and Wilton cultures respectively. The Smithfield culture includes end-scrapers, thumb-nail and horse-shoe scrapers, trimmed points (of Chatelperron type), handpicks, bored stones, ostrich eggshell beads, ground stone rings, pottery and human remains. The human remains are of the "Bushman" type, and in a general way this culture is similar to the Caspian or the Aurignacian of Europe. The Wilton industry is very similar; the chief implements are pygmy lunates, thumbnail, and end-scrapers, as well as geometrical forms; the pottery is similar to that of Smithfield; bone arrowheads and link-shafts occur; burials are flexed, with skeletons of the same general type as the Smithfield specimens. Slate "palettes" are also found, and the culture is definitely associated with the cave paintings. Goodwin considers this culture as identical with the last phases of the Caspian of Spain and North Africa, a point of view confirmed by I. Schapera ("Some Stylistic Affinities of Bushman Art," *South African Journal of Science*, vol. xxii, Nov. 1925, pp. 504-15), who, as the result of a careful comparison of European Palaeolithic and Bushman art concludes that the Caspian art of Spain shows most affinity with that of the Bushmen.

Information supplied by Goodwin indicates the existence of a true Mousterian—the Glen Grey industry—with high-backed as well as the more usual flat points similar to those found in North Africa and Europe, while in the Later Stone age the recent discovery at Howieson's Poort of a number of true graving points (*burin*) is important, both in itself and as further suggesting contact with the north.

Pottery.—It is not clear that examples of pottery of any considerable age exist. Those figured by Péringuey (*Annals of the South African Museum*, vol. viii, 1911), provisionally assigned to Bushmen, Strandloopers and Hottentots, are of the rudest type, predominantly ovoid with conical bottoms, sometimes ornamented, the kneading and baking being very poor.

The Bushmen.—No apology seems necessary for considering the "archaeology" of the Bushmen with that of the kindred Strandloopers (no longer to be regarded as a distinct race, the name describing a mode of life and not implying a constant physical difference), for even though the former are not utterly extinct, the few survivors no longer pursue their characteristic arts of painting and graving on rock. It is generally admitted that the Bushmen stock came into South Africa from the north, and Stow was of the opinion that there were two great divisions, each with its characteristic mode of life and art, viz.: (1) cave-dwellers (painters), and (2) kopje-dwellers (sculptors), the latter producing their works by "pecking" the rock face on which they worked. This view does not seem to be generally accepted, perhaps it only emphasizes differences in technique due preponderantly to environment.

The paintings of the Bushmen, naturalistic monochrome and polychrome studies of high artistic merit, for the most part record the animals which they hunted and upon which they subsisted. But paintings of the carnivora are not absent, and cattle raids, dances and magico-religious (?) scenes are also portrayed. Belonging no doubt to the latter class are the fairly numerous examples of animal-headed human figures—representations of masked dances—not to be confused with the wearing of animal skins as a hunting ruse to admit approach to the game, as in the famous picture in the Hershel district of Cape Colony of a Bushman wearing an ostrich skin while stalking a flock of these birds.

The character of Bushman paintings has been well summed up by Henry Balfour:—

They are "remarkable not only for the realism exhibited by so many, but also for a freedom from the limitation to delineation in profile which characterizes for the most part the drawings of primitive peoples, especially where animals are concerned. Attitudes of a kind difficult to render were ventured upon without hesitation, and appreciation even of the rudiments of perspective is occasionally to be noted, though only in a crude and uncertain form. The practice of endeavouring to represent more than could be seen at one time . . . is far less noticeable in Bushmen art than might have been expected from the rudimentary general culture of these peoples, and one does not see instances of *both eyes*

being indicated upon a profile face, or a mouth in profile on a full face. . . . The colours were usually laid on uniformly over the surface which they individually covered, but a shading off is sometimes exhibited." (*Bushman Paintings*, 1909, p. 9.)

Dr. K. M. Barnard points out that examples similar in execution to those described by L. Péringuey (*Trans. S. Afr. Philos. Soc.*, 16, 1906, and 18, 1909) have been discovered at various places in South-west Africa, the farthest north being in the Grootfontein district. In addition to the usual animals there are representations of the human foot, and the spoor of various bucks, while from the position in which these latter occur the explanation that they are "sign-posts" to water cannot be maintained.

Major F. J. Bagshawe (see *Man*, 1923, 92) has discovered in Tanganyika Territory rock-paintings of Bushmen type of so high an artistic quality that their origin can only be referred to this race, an extension northwards which goes well with the distribution of the Bushmen *kwe* (digging-stick weight), of which specimens, known in Tanganyika, have been discovered in Uganda (Wayland) and even among the Bari of the Southern Sudan (Seligman). The Tanganyika rock-paintings include an eland, cow, ostriches, giraffe and antelope.

Strandloppers.—The Strandloppers are a people of whom, apart from their skeletal characters, we know little, though concerning these there is a fair volume of reliable if not always consistent data. Their cultural attainments may be judged, e.g., from the remains found in the caves and rock-shelters of T'zitzikama cliffs, about 100 m. to the west of Port Elizabeth. One of these shelters explored by F. W. Fitzsimons (described by Sir Arthur Keith, *The Antiquity of Man*, I, 1925), contained deposits some 30 ft. deep. The lower 5 ft. and the upper 6 ft. were sterile; below this latter layer was a stratum some 7 ft. thick in which numerous Strandlopper burials were encountered amidst remains of fireplaces, broken pottery, implements and ornaments in stone and bone. Then came the third stratum, over 6 ft. in thickness. While removing this stratum and working at a depth of 15 ft. below the original floor of the shelter, Fitzsimons found graves containing remains which differed from those he had met with in the stratum above. Unfortunately the bones in the lower stratum were imperfectly preserved. The graves had been partly protected by slabs of stone some of which had been rudely engraved with human figures. There were lumps of red ochre, necklaces of shell and bone and tools of stone and bone. In a still deeper stratum, also about 6 ft. in thickness, there were traces of burials and hearths, the human remains being fragmentary, but considered to belong to individuals of the Boskop type.

Mediaeval Remains in Rhodesia.—The conclusions of D. Randall-MacIver (*Mediaeval Rhodesia*, 1906) that the Zimbabwe and similar ruins in Rhodesia are negro in origin and modern in date, though not generally accepted in South Africa, have not been disproved. For though there is no inherent improbability in the early Semitic origin of these ruins, it seems unnecessary to seek a foreign colonization where the facts in no way contradict a local origin. No authentic inscriptions have been found, and no objects discovered in the Great Zimbabwe, around which the controversy has chiefly centred, need be more than a few centuries old, while those that are not foreign imports (porcelain, etc.) are of African type. Moreover, a re-examination of the evidence, including unpublished material in the library at Lisbon, has led Father Schebesta (*Mitt. der Anthrop. Ges. in Wien*, 1922-23) to the conclusion that not only is the Zimbabwe a product of the indigenous kingdom of Monomotapa described by the Portuguese, but that its builders culturally resembled the Baganda, and probably certain other of the more advanced peoples of Central Africa.

For bibliography, see the references in the text. (C. G. S.)

NORTH AFRICA

The archaeological documents of north Africa reflect the cultural conditions recorded in its ancient history, the imposition of successive alien civilizations by dominant Mediterranean Powers upon a receptive but resistant native population. The ancient invaders were (under their political names) Phoenicians, Greeks,

Romans, Vandals and Byzantines; the Arab invasions, which began in the 7th century A.D., belong to modern history.

Native Cultures.—The native Libyan and Berber (*q.v.*) elements, whether aboriginal or not, have persisted without visible change from the prehistoric period to the present day. Their most ancient handiwork is represented by stone implements and simple pottery found in cave-dwellings, figures of men and animals engraved on rocks, some fortress-walls and many sepulchral monuments of megalithic type, square and circular dolmens, cairns and cromlechs. This material is related on the one side to the most primitive remains of Spain and south France, on the other side to those of Egypt and Crete; but while neolithic culture in the Egyptian and European areas was superseded in the prehistoric age, the African stone implements seem to have remained in use in certain districts until very recent times. It is seldom possible to date these monuments even approximately. The Berber language was inscribed on stone, often in conjunction with Punic and Latin texts, in a local alphabet which is still current among the Tuaregs (*q.v.*) of the Sahara. Beside this backward element there was in historical times an urban population more or less civilized by contact with Greeks and Semites; but it does not appear to have developed a distinctive art. Its surviving monuments are mostly sepulchral: most notable are two pyramidal structures near Tipaza (anc. *Tipasa*) and Batna in Algeria. The former, called the Tomb of the Christian Woman (*Kbor er Roumia*), is evidently a royal tomb and perhaps that of Juba II, the philhellene king of Mauretania in the time of Augustus. The other, called the Medracen (*Madghasen*), is older, and may be the tomb of Massinissa, the Numidian ally of Rome in their last war with Carthage. Both are low cones of stepped masonry set on cylindrical bases which have cornices borne by engaged columns; their diameters measure about 200 feet. The form may have been derived from the native cairns, but it closely resembles the monumental tumuli of Italy and Asia. The architectural orders are Greek, with some archaisms and other peculiarities that indicate Punic influence.

Phoenician.—The Phoenician settlement, of which Carthage was ultimately the chief city, is assigned to the 12th century B.C., but its earliest known remains are not older than the 7th. At the time of its fall in 146 B.C. Carthage controlled nearly the whole of what is now Tunisia, and was in touch with the native kingdom of Numidia on the west, and through the Phoenician territory of Tripolitania with the Greek colonies of Cyrenaica on the east.

Nothing is left of the Punic city of Carthage and very little of its Roman successor, the colony which was founded as the capital of Africa after the destruction of the original Carthage. But its site is indicated by a zone of cemeteries, which lay outside the walls. It is a large semicircular area bounded on its short side by the sea; its central point, the modern St. Louis' Hill, was certainly the Punic citadel, the *Byrsa*, and the port was south of this, near the place where two lagoons now lie. These agree perhaps fortuitously with ancient descriptions of the commercial and war harbours, the latter having the Admiralty Island in its midst; but the coast has greatly changed even in the last century, and ancient lines of sea-walls and quays have been identified on the outer coast. The curse that Rome invoked upon the Punic site has operated on its own foundation. After the Arab sack, the city was abandoned by the conquerors, and became a quarry for Mediterranean masons of all later ages. The cathedral of Pisa is said to have been built with stones of Carthage. A few of the larger structures can be traced. On the *Byrsa* is a temple of Aesculapius; in the western plain, an amphitheatre; on either side of the northern hill, a theatre and an Odeum; in the eastern plain, the baths, better preserved in the Arab name of the locality (*Dermesh*) than in its soil. The waterworks have fared better: there are great vaulted reservoirs at Dermesh and La Malga, fed by an aqueduct from a copious source at Zaghouan, 100 miles away.

The Punic graves that have been found are not older than 700 B.C. They are mostly double chambers approached by shafts; burials were often made in stone coffins with lids carved

as recumbent human figures. There are numerous grotesque clay masks which were placed in the graves to keep evil spirits away. Personal trinkets and jewellery are the other furniture.

In a sanctuary of Baal at Dougga (*Thugga*) birds' bones were buried in jars. This temple, which was dedicated to Saturn under Roman rule, was enclosed in a square colonnade. A temple of Tanit-Caelestis at the same city stands in a semicircular court. A mausoleum built there in the 4th century B.C. and recently reconstructed was designed in Graeco-Phoenician style, and bore a bilingual inscription in Libyan and Punic. The art of Carthage was rapidly hellenized, probably by contact with Greek colonies in Sicily rather than with those of Africa.

Greek.—The largest Greek city in Africa was Cyrene, one of the greatest cities of the Greek world. Yet its famous and conspicuous site was almost inaccessible until the 20th century. In 1861 two young officers of the British forces at Malta, R. Murdoch Smith and E. A. Porcher, found and identified the temple of Apollo, sent to England a large series of sculptures, now in the British Museum, and excavated at other points outside and inside the city, but could not stay long enough to explore its topography more definitely. An expedition equipped by the Archaeological Institute of America made a good beginning in 1910, but met with organized hostility among the natives, and before its second season had begun the country was seized by Italy. All archaeological work in Cyrenaica and Tripolitania has since been directed by the Italian Government. The results at Cyrene show that the Roman city occupied the two hills that are the landmarks of the site. The western hill was the Greek acropolis and contained the agora; on the eastern hill is a Doric temple and a stadium; the residential quarters lay in the dividing valley and on the south-west slope of the eastern hill. At the north end of the valley, outside the city wall, the sanctuary of Apollo stands on a partly artificial platform below the fountain, Kyra. The low and narrow channel of this famous spring can be followed for a quarter of a mile inside the mountain; ancient inscriptions are scratched and moulded on the clay that covers its walls, and the mouth of the channel is an open chamber cut in the face of the cliff. Rows of chamber-tombs with elaborate architectural fronts are cut or built in the slopes of the plateau. It seems that the city when fully excavated will be another example of the conventional Roman splendour which is the characteristic element in north African antiquities; but the sanctuary is a new feature, preserving its original plan, and important remains of the Greek structures have been found beneath the Roman ornament. The sanctuary is a walled precinct like that of Delphi. It contains the temples of Apollo and Artemis, each with a great altar in front, and smaller shrines of lesser deities. A curious adjunct of the Artemisium is an underground Nymphaeum, apparently for purificatory rites. The Apollo temple has treasure-cists sunk in its floor. In Roman times two bath-establishments were intruded on the terrace, from one of which some 20 marble statues were recovered, including a headless Aphrodite now in the museum of the Terme at Rome. The rest of the material from Cyrene is at Bengazi. On the west side of the precinct is a Greek theatre. The Sacred Way leads from the sanctuary past the fountain to the agora, a colonnaded area of the usual Roman type containing the provincial *capitolium* and other official buildings. Among the Greek survivals here are the *heroön* and a small circular structure which was the tomb of the first Battos, founder of the city and of the dynasty which ruled it. The round tomb is apparently the base on which stood a column depicted on some Cyrenaic coins. Curious sepulchral monuments found in the rock-tombs are sculptured busts with heads in which the face was indicated by painting, or with tapering columnar necks instead of heads. Greek art is rare: a few archaic votive statues have been found and further excavation will doubtless produce others. The archaic strata should also help to determine the origin of the so-called Laconian or Cyrenaic pottery. (See POTTERY AND PORCELAIN: *Greek Pottery*.) A small bronze head of a bearded man (5th century B.C.) has been found by the Italians, and a marble head of Athena (said to be 4th century) was excavated by the American expedition, but the finest work of art from Africa is a Hellenistic bronze head of

a young Berber, which was found by Smith and Porcher in the temple of Apollo. It is also an anthropological document of great value. There are other Hellenistic pieces among the numerous marble statues from Cyrene, but the sculpture here as in other north African cities is generally of Roman date. The other cities of Cyrenaica have produced Greek terra-cotta statuettes and painted vases, mostly from tombs; among the vases are several oil-jars which were prizes in the Panathenaic games. The Punic colonies must have contained examples of Greek art, and the Mauretanian capital of Juba II. at Cherchel (*Caesarea*) was decorated with imported statuary, some fragments of which survive. Some good examples of Hellenistic sculpture have come from the sea. They were found in a sunken ship which was located in 1907 off Mahedia near the Lesser Syrtes, and are now in the museum of the Bardo at Tunis. The most important is a bronze herm signed by Boëthos of Chalchedon. There are many decorative bronzes belonging to furniture, and parts of large marble vases and candelabra in Neo-Attic style. The ship's hold was divided into three compartments, and the deck was laden with marble columns. The date of the wreck is placed in the 2nd century B.C. Two large bronze statuettes, a standing boy and a seated girl, came from the harbour of Bône (*Hippo Regius*) in 1912, and a bronze horseman, said to be of the 5th century B.C., was excavated at Ksar Farun (*Volubilis*) in Morocco.

Roman.—Most of the Roman cities are comparatively late foundations. The civilization of Africa was never finished, and its imperial history is a record of continual progress southwards and westwards from the original province to the Sahara and the ocean. Even the older Greek and Carthaginian cities, such as Cyrene and Thugga, and the native capitals of Cirta and Caesarea, were converted to the metropolitan Roman model in the mature imperial age. But the ordinary African township was a mushroom growth, built to an emperor's order and peopled with colonists from the army and the countryside. As the citizens were Romanized by the gift of the Latin name, so the dignity of their city was asserted in its public buildings. Theatres and baths were erected and adorned by the munificence of wealthy Africans, to whom and to Roman landowners and their agents belonged the luxurious villas that are scattered through the country districts. But the urban population in general was meanly housed. The best example of a new city is Timgad (*Thamugadi*) in south-east Algeria (*Numidia*), north of Mt. Aures. It was founded by Trajan as a colony in A.D. 100, and built by military architects and labour from the Legion III. Augusta, whose discharged soldiers were the colonists. The site is laid out on the lines of a military camp, a square cut up into small blocks (*insulae*) by intersecting streets drawn parallel to the enclosing ramparts. A monumental gateway (the so-called triumphal arch of Trajan) stands in the middle of the west side. At the central crossing of the two main streets (*cardo* and *decumanus*) is the *forum*, occupying the space of eight *insulae*, and next to the forum is a theatre. Other public buildings now inside the ramparts are a market-place, a library and baths. The city rapidly outgrew its walls; the later *capitolium*, more baths, a larger market, another triumphal arch, pagan temples and Christian churches were built outside, and as the town grew its formal character was lost. The camp in which the legion itself was permanently quartered is *Lambaesis*, 20m. W. of Timgad. It was established in the first half of the 2nd century, and consists of a fortified square intersected by the two main roads and containing military offices, barracks and baths. A great part of the site is covered by a modern prison. To the south lies the town that attached itself to the legion, entered through monumental arches and equipped with the usual apparatus of capitol and lesser temples, theatres, amphitheatre and baths. Lambaesis is a unique example of a permanent camp. *Cardo* and *decumanus* are paved with stone and bordered with colonnades, and south of their intersection stands nearly to its full height the four-arched entrance to the *praetorium*, leading to a court with porticoes behind which are the headquarters' offices, legionary shrines and armouries.

Other municipal foundations were built on the same model as Timgad, but not always with the formal plan that can only be

achieved on an empty site. The best preserved structures are probably those of Lebda (*Leptis Magna*) in Tripolitania. This was the native city of the emperor Severus, and was magnificently adorned by him. It has been covered by wind-borne sand, which overthrew whole walls with its weight and at the same time buried and protected their ruins. But many walls and columns are still standing with cornices and entablatures intact. At the other end of the Roman dominion, in Morocco, lies Ksar Farun (*Volubilis*) near Meknes, a solitary outpost of classical culture in a barbarous land. A triumphal arch and the remains of a basilica were visible before its excavation. The site was largely cleared by prisoners of war in 1915. Other well-preserved or excavated cities are, in Algeria, Jemila (*Cuicul*), Khamissa (*Thubursicum Numidorum*), and Tipaza (*Tipasa*); in Tunisia, Bou Grara (*Gighi*), Dougga (*Thugga*), Henchir Kasbat (*Thurburbo Maius*), Medéina (*Althiburus*), and Sbeitla (*Sufetula*), and Sabratha in Tripolitania. In all of these the usual public places are represented, the forum with its curia, basilica, and rostra, flanked by temples and porticoes which sheltered honorific statues. Khamissa has its table of standard measures still in place; Timgad, Lembaesis, Jemila, and Henchir Kasbat have markets appropriately fitted for various commodities. In the military foundations these lie just outside the gates, but Timgad has also smaller and perhaps later markets within the ramparts. There is also a library at Timgad, unique in Africa. Baths and triumphal arches (gateways) abound on these and many other sites, and each city has its theatre; those of Cherchel and Dougga are particularly well preserved. The finest amphitheatre is at El Jem (*Thysdrus*). The official sacred building of a provincial town was the *capitolium*, and was usually placed near the forum, but at Timgad it lies outside the walls. The regular tripartite plan is seen in this example. At Dougga the front columns with their pediment are still standing, and at Sbeitla the capitol consists of three separate shrines. A temple at Tebessa (*Theveste*) is nearly intact, and has an elaborately carved parapet but no pediment. A notable temple is that of Aesculapius at Lembaesis, which has a thermal establishment attached and is approached through an avenue of subsidiary chapels. Many miles of aqueducts are standing between the cities and the springs from which they drew their water. The supply of Carthage came from Zaghouan, where there is an elaborate *Nymphaeum*. Similar water-sanctuaries exist at Hammam Derraji (*Bulla Regia*), Khamissa and elsewhere; the aqueduct at Sbeitla is carried over the ravine on a massive bridge. Houses of Graeco-Roman design like those of Pompeii have been excavated on many sites: most famous is the House of Sertius at Timgad, but this does not belong to the original city. Bulla Regia has some underground houses, and there are catacombs at Sousse (*Hadrumentum*).

Large quantities of Roman sculpture have been found in these excavations, and are housed in the local museums, among them many imperial portraits and other pieces of historical value. Inscriptions also are abundant. But the peculiar artistic riches of north Africa are mosaic pavements, which have for their subjects, besides decorative patterns, seascapes and landscapes, historical and mythological scenes, and incidents of agricultural life, fishing, hunting and games. Among them are portraits of Xenophon from Sbeitla and Virgil from Sousse. A large and varied series comes from a villa near Zliten in Tripolitania.

Vandal and Byzantine.—Mosaic decoration is a prominent feature in the remains of Early Christian churches (basilicas); there are particularly fine examples in the baptisteries of Jemila, Sbeitla and Timgad. At the last place the church is attached to a monastery, as also at Tebessa. Some of the churches are Late Roman, others are Byzantine foundations. During the short interval of Vandal occupation (A.D. 439–533) there seems to have been no architectural activity, but some fortification and a good deal of military demolition date from this epoch. Examples of the latter are supplied by the theatres of Carthage, which were filled in with the ruins of their superstructures. The great fortress walls that dominate many sites are Byzantine. They were erected to hold the civilized country against native tribes, the same aggressors that the Roman conquerors had to face; and it is

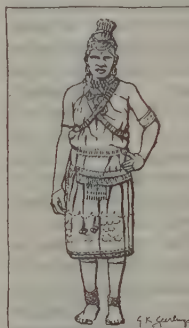
significant that the two most imposing Byzantine strongholds, at Haïdra and Tebessa, are on the sites of the first permanent camps that the Roman legion fortified on Mt. Aures (*Ammaedara* and *Theveste*). Haïdra is the type of a military fort, Tebessa of a fortified city. The fortress-walls were made of ancient materials, and often incorporate whole buildings of preceding ages. Triumphal arches at Tebessa are worked into the circuit of the ramparts; one at Haïdra was built up to make a tower; the capitol of Dougga and Sbeitla were turned into forts. The ruin of classical buildings involved in these defensive works was immense, and it has been justly said that the real vandals of north Africa were the Byzantines. Arab conquests, though fatal to town-dwellers, did no great damage to the structures. Indeed their subsequent desertion and neglect have been the means of preserving so many Roman cities to an extent unequalled in any other land. (E. J. F.)

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HISTORY

The ancient history of Africa is shrouded in mystery and the earliest records of that continent and its people are far from trustworthy. See AFRICA, ROMAN; EGYPT.

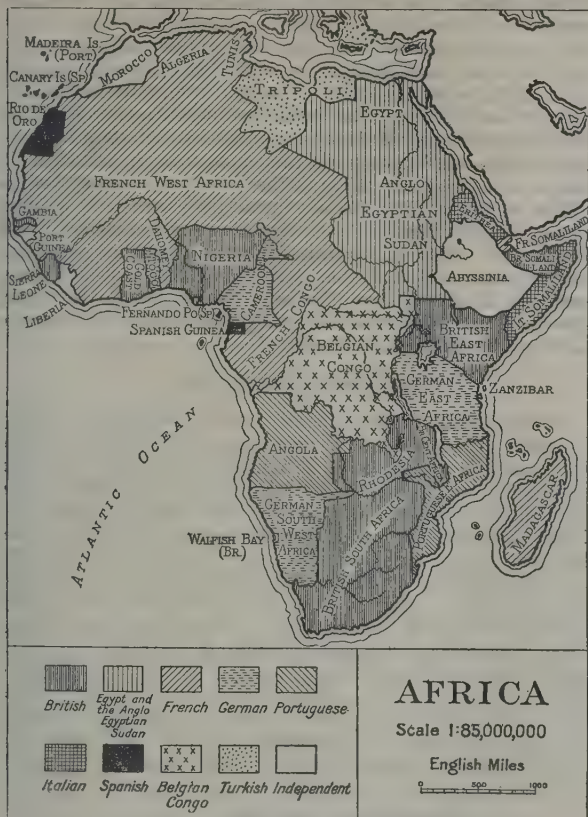
Phoenician and Greek Colonization.—The word Africa was applied originally to the country in the immediate neighbourhood of Carthage, that part of the continent first known to the Romans, and it was subsequently extended with their increasing knowledge. The Arabs still confine the name Ifrikiya to the territory of Tunisia. If ancient Egypt and Ethiopia (*q.v.*) be excluded, the story of Africa is largely a record of the doings of its Asiatic and European conquerors and colonizers, Abyssinia being the only State which throughout historic times has maintained its independence. The countries bordering the Mediterranean were first exploited by the Phoenicians. Carthage, founded about 800 B.C., speedily grew into a city without rival in the Mediterranean, and the Phoenicians, subduing the Berber tribes, who then, as now, formed the bulk of the population, became masters of all the habitable region of north Africa west of the Great Syrtis. Both Egyptians and Carthaginians made attempts to reach the unknown parts of the continent by sea. The west coast was well known to the Phoenicians as far as Cape Nun, and c. 520 B.C. Hanno, a Carthaginian, explored the coast at least as far as Sierra Leone.



A WOMAN OF ZULULAND

Meantime the first European colonists had settled in Africa. Greeks founded the city of Cyrene (c. 631 B.C.) and exerted a powerful influence in Egypt. To Alexander the Great the city of Alexandria owes its foundation (332 B.C.), and under the Hellenistic dynasty of the Ptolemies attempts were made to penetrate southward, and in this way was obtained some knowledge of Abyssinia. Neither Cyrenaica nor Egypt was a serious rival to the Carthaginians, but all three Powers were eventually supplanted by the Romans after the fall of Carthage in 146 B.C. Under Rome the settled portions of the country were very prosperous, and a Latin strain was introduced into the land. Though Fezzan was occupied by them, the Romans elsewhere found the Sahara an impassable barrier. The utmost extent of geographical knowledge of the continent is shown in the writings of Ptolemy (2nd century A.D.), who guessed the existence of the great lake reservoirs of the Nile and had heard of the river Niger. (For the history of Africa under the empire, see ROMAN EMPIRE, LATER.)

The Arab Conquest.—In the 7th century an Arab host, following the new faith of Mohammed, conquered the whole country from the Red sea to the Atlantic and entered Spain. Throughout north Africa Christianity well-nigh disappeared, save in Egypt (where the Coptic Church was suffered to exist), and Upper Nubia and Abyssinia, which were not subdued. In the 8th, 9th and 10th centuries the Arabs in Africa were numerically weak; but in the



POLITICAL DIVISIONS OF AFRICA IN 1910 AT THE CLOSE OF THE FINAL PHASE OF THE INTERNATIONAL "SCRAMBLE FOR TERRITORY"

Two further adjustments took place before the World War. By the 1911 agreement the Cameroon received two tongue-like extensions—one reaching to the Congo river, the other to the Ubangi. On Nov. 5, 1911, as the result of a brief war with Turkey, Italian sovereignty was extended over Tripoli

11th century there was a great Arab immigration. Even before this the Berbers had very generally adopted the speech and religion of their conquerors. Arab influence and the Mohammedan religion thus became indelibly stamped on northern Africa. Together they spread southward across the Sahara, and became firmly established along the eastern sea-board, where Arabs, Persians and Indians planted flourishing maritime and commercial colonies. Of these eastern cities and States both Europe and the Arabs of north Africa were long ignorant.

The first Arab invaders had recognized the authority of the caliphs of Baghdad. Early in the 10th century the Fatimite dynasty established itself in Egypt, where Cairo had been founded A.D. 968, and from there ruled as far west as the Atlantic. Later still arose other dynasties such as the Almoravides and Almohades. Eventually the Turks, who had seized Egypt in 1517, established the regencies of Algeria, Tunisia and Tripoli (between 1519 and 1551), Morocco remaining an independent Arabized Berber State under the Sharifan dynasty, which had its beginnings at the end of the 13th century. Under the earlier dynasties the spirit of adventure and the proselytizing zeal of the followers of Islam led to a considerable extension of the knowledge of the continent. This was rendered more easy by their use of the camel, which enabled the Arabs to traverse the desert. In this way Senegambia and the

middle Niger regions fell under the influence of the Arabs and Berbers, but it was not until 1591 that Timbuktu—founded in the 11th century—became Muslim. That city had been reached in 1352 by the great Arab traveller Ibn Batuta, to whose journey to Mombasa and Quiloa (Kilwa) was due the first accurate knowledge of those flourishing Muslim cities on the east African sea-board. Except along this sea-board, which was colonized directly from Asia, Arab progress southward was stopped by the broad belt of dense forest which, stretching almost across the continent somewhat south of 10° N., barred their advance as effectually as had the Sahara that of their predecessors, and cut them off from knowledge of the Guinea coast and of all Africa beyond. One of the regions which came latest under Arab control was Nubia, where a Christian civilization and State existed up to the 14th century.

For a time the Muslim conquests in south Europe had virtually made of the Mediterranean an Arab lake, but in the 11th century the Norman conquest of Sicily was followed by their descent on Tunisia and Tripoli. Somewhat later a busy trade with the African coast-lands, especially Egypt, was developed by the cities of north Italy. The Italians also, in the 14th and 15th centuries, traded with the countries of the Niger bend and were conversant with the routes across the Sahara. Some Europeans even traversed the desert; while one traveller—not a merchant—the Frenchman Anselme d'Isalguier reached Gao on the Niger, in 1405.¹ Meanwhile events were impending which were to have a profound effect on north-west Africa. By the end of the 15th century Spain had completely thrown off the Muslim yoke, but even while the Moors were still in Granada, Portugal was strong enough to carry the war into Africa. In 1415 a Portuguese force captured the citadel of Ceuta on the Moorish coast. From that time Portugal repeatedly interfered in the affairs of Morocco, while Spain acquired many ports in Algeria and Tunisia. Portugal, however, suffered a crushing defeat in 1578 at al Kasr al Kebir, the Moors being led by Abd el Malek I. of the Sherifan dynasty. By that time the Spaniards had lost almost all their African possessions. The Barbary States degenerated into mere communities of pirates, and under Turkish influence civilization and commerce declined. (X.)

MODERN HISTORY

The Portuguese.—But with the battle of Ceuta, Africa had ceased to belong solely to the Mediterranean world. Among those who fought there was Prince Henry "the Navigator," son of King John I., who was fired with the ambition to acquire for Portugal the unknown parts of Africa. Under his inspiration and direction was begun that series of voyages of exploration which resulted in the circumnavigation of Africa and the establishment of Portuguese sovereignty over large areas of the coast-lands. Cape Bojador was doubled in 1434, Cape Verde in 1445, and by 1480 the whole Guinea coast was known. In 1482 Diogo Cam or Cão discovered the mouth of the Congo; the Cape of Good Hope was doubled by Bartholomew Diaz in 1488, and in 1498 Vasco da Gama, after having rounded the Cape, sailed up the east coast, touched at Sofala and Malindi, and went thence to India. Over all the countries discovered by their navigators Portugal claimed sovereign rights, but these were not exercised in the extreme south of the continent. The Guinea coast, as the first discovered and the nearest to Europe, was first exploited. Numerous forts and trading stations were established, the earliest being São Jorge da Mina (Elmina), begun in 1482. The chief commodities dealt in were slaves, gold, ivory and spices. The discovery of America (1492) was followed by a great development of the slave trade, which, before the Portuguese era, had been an overland trade almost exclusively confined to Mohammedan Africa. The lucrative nature of this trade, and the large quantities of alluvial gold obtained by the Portuguese, drew other nations to the Guinea coast. English mariners went thither as early as 1553, and they were followed by Spaniards, Dutch, French, Danish, and

¹D'Isalguier afterwards wrote an account (never published) of his travels, which were made known in 1927 by Charles de la Roncière in vol. iii. of *La Découverte de l'Afrique au Moyen Âge*.

other adventurers. Much of Senegambia was made known as a result of quests during the 16th century for the "hills of gold" in Bambuk and the fabled wealth of Timbuktu, but the middle Niger was not reached. The supremacy along the coast passed in the 17th century from Portugal to Holland and from Holland in the 18th and 19th centuries to France and England. The whole coast from Senegal to Lagos was dotted with forts and "factories" of rival Powers, and this international patchwork persists though all the *hinterland* has become either French or British territory.

Southward from the mouth of the Congo¹ to the inhospitable region of Damaraland, the Portuguese, from 1491 onward, acquired influence over the Bantu-Negro inhabitants, and in the early part of the 16th century through their efforts Christianity was largely adopted in the native kingdom of Congo. An irruption of cannibals from the interior later in the same century broke the power of this semi-Christian state, and the Portuguese activity was transferred to a great extent farther south, São Paulo de Loanda being founded in 1576. The sovereignty of Portugal over this coast region, except for the mouth of the Congo, has been only once challenged by a European Power, and that was in 1640-48, when the Dutch held the seaports.

Neglecting the comparatively poor and thinly inhabited regions of South Africa, the Portuguese no sooner discovered than they coveted the flourishing cities held by Arabized peoples between Sofala and Cape Guardafui. By 1520 all these Muslim sultanates had been seized by Portugal, Mozambique being chosen as the chief city of her East African possessions. Nor was Portuguese activity confined to the coast-lands. The lower and middle Zambezi valley was explored (16th and 17th centuries), and here the Portuguese found semi-civilized Bantu-Negro tribes, who had been for many years in contact with the coast Arabs. Strenuous efforts were made to obtain possession of the country (modern Rhodesia) known to them as the kingdom or empire of Monomotapa, where gold had been worked by the natives from about the 12th century A.D., and whence the Arabs, whom the Portuguese dispossessed, were still obtaining supplies in the 16th century. Several expeditions were despatched inland from 1569 onward and considerable quantities of gold were obtained. Portugal's hold on the interior, never very effective, weakened during the 17th century, and in the middle of the 18th century ceased with the abandonment of the forts in the Manica district.

At the period of her greatest power Portugal exercised a strong influence in Abyssinia also. In the ruler of Abyssinia (to whose dominions a Portuguese traveller had penetrated before Vasco da Gama's memorable voyage) the Portuguese imagined they had found the legendary Christian king, Prester John, and when the complete overthrow of the native dynasty and the Christian religion was imminent by the victories of Mohammedan invaders, the exploits of a band of 400 Portuguese under Christopher da Gama during 1541-43 turned the scale in favour of Abyssinia and had thus an enduring result on the future of north-east Africa. After da Gama's time Portuguese Jesuits resorted to Abyssinia. While they failed in their efforts to convert the Abyssinians to Roman Catholicism they acquired an extensive knowledge of the country. Pedro Paez in 1615, and, ten years later, Jeronimo Lobo, both visited the sources of the Blue Nile. In 1663 the Portuguese, who had outstayed their welcome, were expelled from the Abyssinian dominions. At this time Portuguese influence on the Zanzibar coast was waning before the power of the Arabs of Muscat, and by 1730 no point on the east coast north of Cape Delgado was held by Portugal.

The English and the Dutch.—It has been seen that Portugal took no steps to acquire the southern part of the continent. To the Portuguese the Cape of Good Hope was simply a landmark on the road to India, and mariners of other nations who followed in their wake used Table Bay only as a convenient spot wherein to refit on their voyage to the East. By the beginning of the 17th century the bay was much resorted to for this purpose,

chiefly by English and Dutch vessels. In 1620, with the object of forestalling the Dutch, two officers of the East India Company, on their own initiative, took possession of Table Bay in the name of King James, fearing otherwise that English ships would be "frustrated of watering but by licence." Their action was not approved in London, and the proclamation they issued remained without effect. The Netherlands profited by the apathy of the English. On the advice of sailors who had been shipwrecked in Table Bay the Netherlands East India Company, in 1651, sent out a fleet of three small vessels under Jan van Riebeeck which reached Table Bay on April 6, 1652, when, 164 years after its discovery, the first permanent white settlement was made in South Africa. The Portuguese, whose power in Africa was already waning, were not in a position to interfere with the Dutch plans, and England was content to seize the island of St. Helena as her half-way house to the East.¹ In its inception the settlement at the Cape was not intended to become an African colony, but was regarded as the most westerly outpost of the Dutch East Indies. Nevertheless, despite the paucity of ports and the absence of navigable rivers, the Dutch colonists, freed from any apprehension of European trouble by the friendship between Great Britain and Holland and leavened by Huguenot blood, gradually spread eastward.

MODERN EXPLORATION

During the 18th century there is little to record in the history of Africa. The nations of Europe, engaged in the later half of the century in almost constant warfare and struggling for supremacy in America and the East, to a large extent lost their interest in the continent. Only on the west coast was there keen rivalry, and here the motive was the securance of trade rather than territorial acquisitions. In this century the slave trade reached its highest development, the trade in gold, ivory, gum, and spices being small in comparison. In the interior of the continent—Portugal's energy being expended—no interest was shown, the nations with establishments on the coast "taking no further notice of the inhabitants or their land than to obtain at the easiest rate what they procure with as little trouble as possible, or to carry them off for slaves to their plantations in America" (*Encyclopædia Britannica*, 3rd. ed. 1797). Even the scanty knowledge acquired by the ancients and the Arabs was in the main forgotten or disbelieved. It was the period when—

Geographers, in Afric maps,
With savage pictures filled their gaps,
And o'er unhabitable downs
Placed elephants for want of towns.

(*Poetry, a Rhapsody*. By Jonathan Swift.)

The prevailing ignorance may be gauged by the statement in the third edition of the *Encyclopædia Britannica* that "the Gambia and Senegal rivers are only branches of the Niger." But the closing years of the 18th century, which witnessed the partial awakening of the public conscience of Europe to the iniquities of the slave trade, were also notable for the revival of interest in inner Africa. A society, the African Association,² was formed in London in 1788 for the exploration of the interior of the continent. The era of great discoveries had begun a little earlier in the famous journey (1770-72) of James Bruce through Abyssinia and Sennar, during which he determined the course of the Blue Nile. But it was through the agents of the African Association that knowledge was gained of the Niger regions. The Niger was reached by Mungo Park, who travelled by way of the Gambia, in 1795. Park, on a second journey in 1805, passed Timbuktu and descended the Niger to Bussa, where he lost his life, having just failed to solve the question as to where the river reached the ocean. (This problem was ultimately solved by Richard Lander and his brother in 1830.) The first scientific explorer of South-East Africa, Dr. Francisco de Lacerda, a Portu-

¹This river was called by the Portuguese the Zaire. They appear to have made no attempt to trace its course beyond the rapids which stop navigation from the sea.

²France acquired, as stations for her ships on the voyage to and from India, settlements in Madagascar and the neighbouring islands. The first settlement was made in 1642.

³The Association, in 1831, was merged in the Royal Geographical Society.

guese, also lost his life in that country. Lacerda travelled up the Zambezi to Tete, going thence towards Lake Mweru, near which he died in 1798. The first recorded crossing of Africa was accomplished between the years 1802 and 1811 by two half-caste Portuguese traders, Pedro Baptista and A. José, who passed from Angola eastward to the Zambezi.

Although the Napoleonic wars distracted the attention of Europe from exploratory work in Africa, those wars nevertheless exercised great influence on the future of the continent, in both Egypt and South Africa. The occupation of Egypt (1798-1803) first by France and then by Great Britain, resulted in an effort by Turkey to regain direct control over that country,¹ followed in 1811 by the establishment, under Mohammed Ali, of an almost independent state, and the extension of Egyptian rule over the eastern Sudan (from 1820 onward). In South Africa the struggle with Napoleon caused Great Britain to take possession of the Dutch settlements at the Cape, and in 1814 Cape Colony, which had been continuously occupied by British troops since 1806, was formally ceded to the British crown.

The close of the European conflicts with the battle of Waterloo was followed by vigorous efforts on the part of the British Government to become better acquainted with Africa, and to substitute colonization and legitimate trade for the slave traffic, declared illegal for British subjects in 1807 and abolished by all other European Powers by 1836. To West Africa Britain devoted much attention. The slave trade abolitionists had already, in 1788, formed a settlement at Sierra Leone, on the Guinea coast, for freed slaves, and from this establishment grew the colony of Sierra Leone,² long notorious, by reason of its deadly climate, as "The White Man's Grave." Farther east the establishments on the Gold Coast began to take a part in the politics of the interior, and the first British mission to Kumasi, despatched in 1817, led to the assumption of a protectorate over the maritime tribes heretofore governed by the Ashanti.

An expedition sent in 1816 to explore the Congo from its mouth did not succeed in getting beyond the rapids which bar the way to the interior, but in the central Sudan much better results were obtained. In 1823 three English travellers, Walter Oudney, Dixon Denham, and Hugh Clapperton, reached Lake Chad from Tripoli—the first white men to reach that lake. The partial exploration of Bornu and the Hausa states by Clapperton, which followed, revealed the existence of large and flourishing cities and a semi-civilized people in a region hitherto unknown. The discovery in 1830 of the mouth of the Niger by Clapperton's servant, Lander, already mentioned, had been preceded by the journeys of Maj. A. G. Laing (1826) and René Caillié (1827) to Timbuktu, and was followed (1832-33) by the partial ascent of the Benue affluent of the Niger by MacGregor Laird. In 1841 a disastrous attempt was made to plant a white colony on the lower Niger, an expedition (largely philanthropic and anti-slavery in its inception) which ended in utter failure. Nevertheless, from that time British traders remained on the lower Niger, their continued presence leading ultimately to the acquisition of political rights over the delta and the Hausa states by Great Britain.³ Another endeavour by the British Government to open up commercial relations with the Niger countries resulted in the addition of a vast amount of information concerning the countries between Timbuktu and Lake Chad, owing to the labours of Heinrich Barth (1850-55), originally a subordinate, but the only surviving member of the expedition sent out.

Meantime considerable changes had been made in other parts of the continent, the most notable being the occupation of Algiers by France in 1830, an end being thereby put to the piratical proceedings of the Barbary States; the continued expansion southward of Egyptian authority, with the consequent additions to the knowledge of the Nile; and the establishment of independent states (Orange Free State and the Transvaal) by Dutch

¹The Mamelukes, whom the Turks had overthrown in the 16th century, had regained practically independent power.

²In imitation of the British example, an American society founded in 1822 the negro colony (now republic) of Liberia.

³The first territorial acquisition made by Great Britain in this region was in 1851, when Lagos Island was annexed.

farmers (Boers) dissatisfied with British rule in Cape Colony. Natal, so named by Vasco da Gama, had been made a British colony (1843), the attempt of the Boers to acquire it being frustrated. The city of Zanzibar, on the island of that name, founded in 1832 by Seyyid Said of Muscat, rapidly attained importance, and Arabs began to penetrate to the great lakes of East Africa,¹ concerning which little more was known (and less believed) than in the time of Ptolemy. Accounts of a vast inland sea, and the discovery in 1848-49, by the missionaries Ludwig Krapf and J. Rebmann, of the snow-clad mountains of Kilimanjaro and Kenya, stimulated in Europe the desire for further knowledge.

Livingstone and Stanley.—At this period, the middle of the 19th century, Protestant missions were carrying on active propaganda on the Guinea coast, in South Africa, and in the Zanzibar dominions. Their work, largely beneficent, was being conducted in regions and among peoples little known, and in many instances missionaries turned explorers and became pioneers of trade and empire. One of the first to attempt to fill up the remaining blank spaces in the map was David Livingstone, who had been engaged since 1840 in missionary work north of the Orange. In 1849 Livingstone crossed the Kalahari desert from south to north and reached Lake Ngami, and between 1851 and 1856 he traversed the continent from west to east, making known the great waterways of the upper Zambezi. During these journeys Livingstone discovered, Nov. 1855, the famous Victoria Falls, so named after the queen of Great Britain. In 1858-64 the lower Zambezi, Shiré, and Lake Nyasa were explored by Livingstone, Nyasa having been first reached by the confidential slave of Antonio da Silva Porto, a Portuguese trader established at Bihé in Angola, who crossed Africa during 1853-56 from Benguela to the mouth of the Rovuma. While Livingstone circumnavigated Nyasa, the more northerly lake, Tanganyika, had been visited (1858) by Richard Burton and J. H. Speke, and the last named had sighted Victoria Nyanza. Returning to East Africa with J. A. Grant, Speke reached, in 1862, the river which flowed from Victoria



FROM "HOW I FOUND LIVINGSTONE," BY H. M. STANLEY, BY PERMISSION OF SAMPSON, LOW, MARSTON & CO., LTD., AND OF CHARLES SCRIBNER'S SONS

STANLEY GREETES LIVINGSTONE WITH "DR. LIVINGSTONE, I PRESUME"
After a hazardous journey of 295 days Stanley, on Nov. 10, 1871, reached Ujiji, where he found Dr. Livingstone, sick, emaciated and depressed

Nyanza and, following it (in the main) down to Egypt, had the distinction of being the first man to read the riddle of the Nile. In 1864 another Nile explorer, Samuel Baker, discovered the Albert Nyanza, the chief western reservoir of the river. In 1866 Livingstone began his last great journey, in which he made known Lakes Mweru and Bangweulu and discovered the Lualaba (the upper part of the Congo), but died (1873) before he had been able to demonstrate its ultimate course, believing indeed that the Lualaba belonged to the Nile system. Livingstone's lonely death in the heart of Africa evoked a keener desire than ever to complete the work he left undone. H. M. Stanley, who had in 1871

¹As early as 1848 an Arab from Zanzibar journeying across the continent had arrived at Benguela.

succeeded in finding and succouring Livingstone, started again for Zanzibar in 1874, and in the most memorable of all exploring expeditions in Africa circumnavigated Victoria Nyanza and Tanganyika, and, striking farther inland to the Lualaba, followed that river down to the Atlantic ocean—reached in Aug. 1877—and proved it to be the Congo. In South Africa, Karl Mauch in 1871 discovered the ruins of the great Zimbabwe in Mashonaland; and in the following year F. C. Selous began his journeys over South Central Africa.

Explorers were active also in other parts of the continent. Southern Morocco, the Sahara, and the Sudan were traversed in many directions between 1860 and 1875 by Gerhard Rohlfs, Georg Schweinfurth and Gustav Nachtigal. These travellers not only added considerably to geographical knowledge, but obtained invaluable information concerning the people, languages, and natural history of the countries in which they sojourned.¹ Among the discoveries of Schweinfurth was one that confirmed the Greek legends of the existence beyond Egypt of a pygmy race. But the first discoverer of the dwarf races of Central Africa was Paul du Chaillu, who found them in the Ogowé district of the west coast in 1865, five years before Schweinfurth's first meeting with the pygmies; du Chaillu having previously, as the result of journeys in the Gabun country between 1855 and 1859, made popular in Europe the knowledge of the existence of the gorilla, perhaps the gigantic ape seen by Hanno the Carthaginian, and whose existence, up to the middle of the 19th century, was thought to be as legendary as that of the pygmies of Aristotle.

Stanley's great journey down the Congo in 1875-76 initiated a new era in African exploration, and since 1875 the map has been filled with authentic topographical details. Within their respective spheres of influence each Power undertook detailed surveys, and the most solid of the latest accessions to knowledge have resulted from the labours of hard-working colonial officials toiling individually in obscurity.

In 1877 an important expedition was sent out by the Portuguese Government under Serpa Pinto, Brito Capello, and Roberto Ivens for the exploration of the interior of Angola. The first named made his way by the head-streams of the Kubango to the upper Zambezi, which he descended to the Victoria Falls, proceeding thence to Pretoria and Durban. Capello and Ivens confined their attention to the south-west Congo basin, where they disproved the existence of Lake Aquilunda, which had figured on the maps of that region since the 16th century. In a later journey (1884-85) Capello and Ivens crossed the continent from Mossamedes to the mouth of the Zambezi, adding considerably to the knowledge of the borderlands between the upper Congo and the upper Zambezi. More important results were obtained by the German travellers, Paul Pogge and Hermann von Wissmann, who (1880-82) passed through previously unknown regions beyond Muata Yanvo's kingdom, and reached the upper Congo at Nyangwe, whence Wissmann made his way to the east coast. In 1884-85 a German expedition under Wissmann solved the most important geographical problem relating to the southern Congo basin by descending the Kasai, the largest southern tributary, which contrary to expectation, proved to unite with the Kwango and other streams before joining the main river. Further additions to the knowledge of the Congo tributaries were made at the same time by the Rev. George Grenfell, a Baptist missionary, who (accompanied in 1885 by K. von François) made several voyages in the steamer "Peace," especially up the great Ubangi, ultimately proved to be the lower course of the Welle, discovered in 1870 by Schweinfurth.

East Africa.—The first new journey of importance in East Africa was made (1873-80) on behalf of the British African Exploration committee by Joseph Thomson, who after the death of his leader, Keith Johnston, made his way from the coast to the north end of Nyasa, thence to Tanganyika, on both sides of which he broke new ground, sighting the north end of Lake Rukwa on the east. In 1882-84 the French naval lieutenant, Victor Giraud, proceeded by the north of Nyasa to Lake Bang-

weulu, of which he made the first fairly correct map. North of the Zanzibar-Tanganyika route a large area of new ground was opened in 1883-84 by Thomson, who traversed the whole length of the Masai country to Lake Baringo and Victoria Nyanza, shedding the first clear light on the great East African rift-valley and neighbouring highlands, including Mts. Kenya and Elgon. A great advance in the region between Victoria Nyanza and Abyssinia was made in 1887-89 by the Austrians, Count Samuel Teleki and Lieut. Ludwig von Höhnel, who discovered the large Basso Norok, now known as Lake Rudolf, till then only vaguely indicated on the map as Samburu. At this time Somaliland was being opened up by English and Italian travellers. In 1883 the brothers F. L. and W. D. James penetrated from Berbera to the Webi Shebéli; in 1892 Vittorio Bottego (afterwards murdered in the Abyssinian highlands) started from Berbera and reached the upper Juba, which he explored to its source. The first person to cross from the Gulf of Aden to the Indian Ocean was an American, A. Donaldson Smith, who in 1894-95 explored the head-streams of the Webi Shebéli and also explored the Omo, the feeder of Lake Rudolf.

In the region north-west of Victoria Nyanza the greatest additions to geographical knowledge were made by H. M. Stanley in his last expedition, undertaken for the relief of Emin Pasha. The expedition set out in 1887 by way of the Congo and made its way, encountering immense difficulties, through the great equatorial forest, the character and extent of which were thus for the first time brought to light. The return was made to the east coast and resulted in the discovery of the great snowy range of Ruwenzori or Runsoro, and the confirmation of the existence of a third Nile lake discharging its waters into the Albert Nyanza by the Semliki river.

North and West Africa.—Great activity was also displayed in completing the work of earlier explorers in North and West Africa. Morocco was in 1883-84 the scene of important explorations by de Foucauld, a Frenchman who, disguised as a Jew, crossed and re-crossed the Atlas and supplied the first trustworthy information as to the orography of many parts of the chain. In 1887-89 Louis Gustave Binger, a French officer, made a great journey through the countries enclosed in the Niger bend, and in 1890-92 Col. P. F. Monteil went from St. Louis to Say, on the Niger, thence through Sokoto to Bornu and Lake Chad, whence he crossed the Sahara to Tripoli. Meantime explorers had been busy in the region between Lake Chad, the Gulf of Guinea, and the Congo. The Sanga, one of the principal northern tributaries of the Congo, was reached from the north by Lieut. Louis Mizon, a French naval officer, who drew the first line of communication between the Benue and the Congo (1890-92). In 1890 Paul Crampel, who in the previous year had explored north of the Ogowé, undertook a great expedition from the Ubangi to the Shari, but was attacked and killed, with several of his companions, on the borders of the Bagirmi. Several other expeditions followed, and in 1896 Emile Gentil reached the Shari, launched a steamer on its waters and pushed on to Lake Chad. Early in 1900 Lake Chad was also reached by F. Foureau, a French traveller, who had already devoted 12 years to the exploration of the Sahara, and who on this occasion had crossed the desert from Algeria and had reached the lake *via* Air and Zinder.

Equatorial Africa.—The last ten years of the 19th century also witnessed many interesting expeditions in east Central Africa. In 1891 Emin Pasha, accompanied by Dr. F. Stuhlmann, made his way south of Victoria Nyanza to the western Nile lakes, visiting for the first time the southern and western shores of Albert Edward. Stuhlmann also ascended the Ruwenzori range to a height of over 13,000 feet. In the same year Dr. O. Baumann, who had already done good work in Usambara, near the coast, started on a more extended journey through the region of steppes between Kilimanjaro and Victoria Nyanza, afterwards exploring the head-streams of the Kagera, the ultimate sources of the Nile. In the steppe region referred to he discovered two new lakes, Manyara and Eiasi, occupying parts of the East African valley system. This region was again traversed in 1893-94 by Count von Götzen, who continued his route westwards to Lake

¹Another great traveller of this stamp was Wilhelm Junker, who spent the greater part of the period 1875-86 in the east central Sudan.

Kivu, north of Tanganyika, which, though heard of by Speke over 30 years before, had never yet been visited. He also reached for the first time the line of volcanic peaks north of Kivu, one of which he ascended, afterwards crossing the great equatorial forest by a new route to the Congo and the west coast. Valuable scientific work was done in 1893 by Dr. J. W. Gregory, who ascended Mt. Kenya to a height of 16,000 feet. In 1893-94 Scott Elliot reached Ruwenzori by way of Uganda, returning by Tanganyika and Nyasa, and in 1896 C. W. Hobley made the circuit of the great mountain Elgon, north-east of Victoria Nyanza. In 1890 Mt. Kenya was ascended to its summit by a party under H. J. Mackinder. The exploration of Mt. Kilimanjaro has been the special work of Dr. Hans Meyer, who first directed his attention to it in 1887. The region south of Abyssinia proper and north of Lake Rudolf, being largely the basin of the Sobat tributary of the Nile, was traversed by several explorers, among whom may be mentioned Capt. M. S. Wellby, who in 1898-99 explored the chain of small lakes in south-east Abyssinia, pushed on to Lake Rudolf, and thence traversed hitherto unknown country to the lower Sobat. Other valuable expeditions of exploration and surveying were conducted by Donaldson Smith (1899-1900), Maj. H. H. Austin (1899-1901), Maj. A. St. H. Gibbons (1895-96, 1898-1900), Commander B. Whitehouse (1904-06), Lieut. Boyd Alexander, Sir H. H. Johnston, Maj. Powell-Cotton, and the duke of Abruzzi.

The first journey through the whole length of the continent was accomplished in the last two years of the century when a young Englishman, E. S. Grogan, starting from Cape Town, reached the Mediterranean by way of the Zambezi, the central line of lakes and the Nile. Other travellers followed in Grogan's footsteps, among the first Maj. Gibbons.

Additions to topographical knowledge were made from about 1890 onwards by the international commissions which traced the frontiers of the protectorates of the European powers. The Anglo-French commission in 1903 traced the Nigerian frontier from the Niger to Lake Chad, and in 1903-04 the Anglo-German commission fixed the Cameroon boundary between Yola, on the Benue, and Lake Chad. In 1901-02 a German Congolese commission surveyed Lake Kivu and the volcanic region north of the lake, while the Anglo-German boundary commission of 1902-04 surveyed the valley of the lower Kagera and fixed the exact position of Albert Edward Nyanza.

At the same time administrative needs forced the governments concerned to take in hand the survey of the countries under their protection. Before the close of the first decade of the 20th century tolerably accurate maps had been made of the German colonies, of a considerable part of West Africa, the Algerian Sahara, and the Anglo-Egyptian Sudan, mainly by military officers.

PARTITION AMONG EUROPEAN POWERS

In the last quarter of the 19th century the map of Africa was transformed. After the discovery of the Congo the story of exploration takes second place; the continent becomes the theatre of European expansions. Lines of partition, drawn often through trackless wildernesses, marked out the possessions of Germany, France, Great Britain, and other Powers. Railways penetrated the interior, vast areas were opened up to civilized occupation, and from ancient Egypt to the Zambezi the continent was startled into new life.

Before 1875 the only European Powers with any considerable interest in Africa were Britain, Portugal, and France.

In North Africa the Turks had (in 1835) assumed direct control of Tripoli, while Morocco had fallen into a state of decay though retaining its independence. A remarkable change had taken place in Egypt, where the Khedive Ismail had introduced a somewhat fantastic imitation of European civilization. In addition Ismail had conquered Darfur, annexed Harar and the Somali ports on the Gulf of Aden, was extending his power southward to the equatorial lakes, and even contemplated reaching the Indian ocean. The Suez canal, opened in 1869, had a great influence on the future of Africa, as it again made Egypt the highway to the East, to the detriment of the Cape route.

In 1875 other European nations—with the occasional exception of Great Britain—were indifferent to Portugal's pretensions, and her estimate of her African empire as covering over 700,000 sq. m. was not challenged. But the area under effective control of Portugal at that time did not exceed 40,000 sq. miles. Great Britain then held some 250,000 sq. m., France about 170,000 sq. m., and Spain 1,000 sq. miles. The total area of Africa ruled by Europeans did not exceed 1,271,000 sq. m.; roughly one-tenth of the continent.

Egypt and the Egyptian Sudan, Tunisia, and Tripoli were subject in differing ways to the overlordship of the sultan of Turkey, and with these may be ranked, in the scale of organized governments, the three principal independent states, Morocco, Abyssinia, and Zanzibar, as also the negro republic of Liberia. There remained, apart from the Sahara, roughly one-half of Africa, lying mostly within the tropics, inhabited by a multitude of tribes and peoples living under various forms of government and subject to frequent changes in respect of political organization. In the whole of this vast region the negro and Negro-Bantu races predominated, for the most part untouched by Mohammedanism or Christian influences. The larger States and Sultanates possessed neither the means nor the inclination to extend their influence beyond their own borders. The exploitation of Africa continued to be entirely the work of alien races.

Leopold II.—The causes which led to the partition of Africa are to be found in the economic and political state of western Europe at the time. Germany, strong and united as the result of the Franco-Prussian War of 1870, was seeking new outlets for her energies—new markets for her growing industries, and with the markets, colonies. For different reasons the war of 1870 was also the starting-point for France in the building up of a new colonial empire. In her endeavour to regain the position lost in that war France had to look beyond Europe. To the two causes mentioned must be added others. Great Britain and Portugal, when they found their interests threatened, bestirred themselves, while Italy also conceived it necessary to become an African Power. The struggle was not, however, precipitated by the action of any of the great Powers but by the ambitious projects of Leopold II., king of the Belgians, who, in Sept. 1876, took what may be described as the first definite step in the modern partition of the continent. He summoned to a conference at Brussels representatives of Great Britain, Belgium, France, Germany, Austria-Hungary, Italy, and Russia, to deliberate on the best methods to be adopted for the exploration and civilization of Africa, and the opening up of the interior of the continent to commerce and industry. The conference was entirely unofficial. The delegates who attended neither represented nor pledged their respective governments. Their deliberations lasted three days and resulted in the foundation of "The International African Association," with its headquarters at Brussels. It was further resolved to establish national committees in the various countries represented, which should collect funds and appoint delegates to the International Association. The central idea appears to have been to put the exploration and development of Africa upon an international footing. But it quickly became apparent that this was an unattainable ideal. The national committees were soon working independently of the International Association, and the association itself passed through a succession of stages until it became purely Belgian in character, and at last developed into the Congo Free State, under the personal sovereignty of King Leopold.

Stanley's journey down the Congo had stirred ambition in other capitals than Brussels. France had always taken a keen interest in West Africa, and in the years 1875 to 1878 Savorgnan de Brazza had carried out a successful exploration of the Ogowe river to the south of the Gabon. In Portugal, too, the discovery of the Congo, with its magnificent unbroken waterway of more than a thousand miles into the heart of the continent, served to revive the languid energies of the Portuguese, who promptly began to furbish up claims whose age was in inverse ratio to their validity. In Jan. 1879 Stanley left Europe as the accredited agent of King Leopold and the Congo committee. De Brazza returned to Africa at the beginning of 1880, and while Stanley,

on behalf of King Leopold, was making treaties and founding stations along the southern bank of the river, de Brazza and other French agents were equally busy on the northern bank.

The Scramble for Territory.—Although the Transvaal between the years 1877 and 1881 had become and ceased to be British, in other respects British territory had been extended in South Africa. And in 1883, in order that the trade route to the interior might be kept open for British expansion northward from the Cape Colony, negotiations for the settlement of the western border of the restored republic were opened in London. The border was defined in the Convention of London (Feb. 27, 1884), and at the same time the Bechuana peoples were taken under British protection. Subsequently, March 23, 1885, the Bechuanaaland Protectorate was extended northwards to 22° S. latitude, and westward to 20° E. longitude. (See SOUTH AFRICA, TRANSVAAL, etc.) Before the convention was signed measures had been taken—without British opposition—at Berlin to establish German authority on the west coast between the Orange river and the Portuguese province of Angola; and on Sept. 8, 1884, the German Government intimated to the British Government “that the west coast of Africa from 26° S. latitude to Cape Frio, excepting Walfish Bay, had been placed under the protection of the German emperor.” In the same year, through the activities of Gustav Nachtigal, Togo and the Cameroon district were placed under German protection. Before either of these events had occurred Great Britain had become alive to the fact that she could no longer dally with the subject, if she desired to consolidate her possessions in West Africa. The British Government had again and again refused to accord native chiefs the protection they demanded. The Cameroon chiefs had several times asked for British protection, and always in vain. But at last it became apparent, even to the official mind, that rapid changes were being effected in Africa, and on May 16, 1884, Edward Hyde Hewett, British consul, received instructions to return to the west coast and to make arrangements for extending British protection over certain regions. He arrived too late to save either Togoland or Cameroon, in the latter case arriving five days after King Bell and the other chiefs on the river had signed treaties with Nachtigal. But the British consul was in time to secure the delta of the River Niger and the Oil rivers district, extending from Rio del Rey to the Lagos frontier, where for a long period British traders had held almost a monopoly of the trade.

Meanwhile the French Government was strenuously endeavouring to extend France's influence in West Africa, in the countries lying behind the coast-line. During the year 1884 no fewer than 42 treaties were concluded with native chiefs, an even larger number having been concluded in the previous twelve-month. In this fashion France was pushing on towards Timbuktu, in steady pursuance of the policy which resulted in surrounding all the old British possessions in West Africa with a continuous band of French territory. On the lower Niger, however, in 1877, Mr. Goldie Taubman (afterwards Sir George Taubman Goldie) conceived the idea of establishing a settled government. Through his efforts the various trading firms formed themselves in 1879 into the “United African Company,” and the foundations were laid of something like settled administration. An application was made to the British Government for a charter in 1881, and the capital of the company increased to a million sterling. Henceforth the company was known as the “National African Company,” and it was acknowledged that its object was not only to develop the trade of the lower Niger, but to extend its operations to the middle reaches of the river, and to open up direct relations with the great Fula empire of Sokoto and the smaller states associated with Sokoto under a somewhat loosely defined suzerainty.

In North and East Africa also events had moved since 1875. In 1881 France, with the consent of the Powers, undertook to reorganize the finances and administration of the meagre remains of the once splendid and powerful kingdom of Tunis. Two years later, with Lord Granville's circular despatch of Jan. 3, 1883, England's long and onerous tutelage of Egypt began. (See EGYPT.) In East Africa, north of the Portuguese possessions, where the sultan of Zanzibar was the most considerable native

potentate, Germany was secretly preparing the foundations of German East Africa. Italy, too, had obtained a footing on the African continent. The Rubattino Steamship Company as far back as 1870 had bought the port of Assab as a coaling station, but it was not until 1882 that it was declared an Italian colony. This was followed by the conclusion of a treaty with the sultan of Assab, chief of the Danakil, signed on March 15, 1883, and subsequently approved by the king of Shoa, whereby Italy obtained the cession of part of Abdis (Aussa) on the Red sea, Italy undertaking to protect with her fleet the Danakil littoral. One other event must be recorded. The king of the Belgians had been driven to the conclusion that, if his African enterprise was to obtain any measure of permanent success, its international status must be recognized; and negotiations for the purpose were opened with various governments.

The Berlin Conference 1884-85.—With these events there had grown up a general conviction that it would be desirable for the Powers interested in Africa to come to some agreement as to “the rules of the game,” and to define their respective interests as far as practicable. A treaty between Britain and Portugal, giving undue recognition to Portuguese territorial claims, which was signed by Lord Granville on Feb. 26, 1884, but not ratified in view of the protests it had evoked, brought this sentiment to a head; and it was agreed to hold an international conference on African affairs. The conference assembled at Berlin on Nov. 15, 1884, and after protracted deliberations the “General Act of the Berlin Conference” was signed by the representatives of all the Powers attending the conference, on Feb. 26, 1885. The Powers represented were Germany, Austria-Hungary, Belgium, Denmark, Spain, the United States, France, Great Britain, Italy, Holland, Portugal, Russia, Sweden and Norway, and Turkey. Ratifications were deposited by all the signatory Powers with the exception of the United States. The General Act dealt with six specific subjects: (1) Freedom of trade in the basin of the Congo, (2) the slave trade, (3) neutrality of territories in the basin of the Congo, (4) navigation of the Congo, (5) navigation of the Niger, and (6) rules for future occupation on the coasts of the African continent. For the present purpose, however, the results effected by the Berlin Act may be summed up as follows. The signatory Powers undertook that any fresh act of taking possession on any portion of the African coast must be notified by the Power taking possession, or assuming a protectorate to the other signatory Powers. It was further provided that any such occupation to be valid must be effective. It is also noteworthy that the first reference in an international act to the obligations attaching to “spheres of influence” is contained in the Berlin Act.

Before the General Act was signed the International Association of the Congo was recognized by all the signatory Powers, with the not very important exception of Turkey. Two months later, in April 1885, King Leopold, with the sanction of the Belgian legislature, formally assumed the headship of the new state; and on Aug. 1 in the same year his Majesty notified the powers that from that date the “Independent State of the Congo” declared that “it shall be perpetually neutral” in conformity with the provisions of the Berlin Act. Thus was finally constituted the Congo Free State, under the sovereignty of King Leopold, though the boundaries claimed for it at that time were considerably modified by subsequent agreements.

Partition Treaties.—In the 15 years that remained of the 19th century the work of partition was practically completed. The international agreements which determined in the main the limits of the possessions of the various powers are:—

I. The agreement of July 1, 1890, between Great Britain and Germany defining their spheres of influence in East, West, and South-west Africa. This agreement was the most comprehensive of all the “deals” in African territory, and included in return for the recognition of a British protectorate over Zanzibar the cession of Heligoland to Germany.

II. The Anglo-French declaration of Aug. 5, 1890, which recognized a French protectorate over Madagascar, French influence in the Sahara, and British influence between the Niger and Lake Chad.

III. The Anglo-Portuguese treaty of June 11, 1891, whereby the Portuguese possessions of the west and east coasts were separated by a broad belt of British territory, extending north to Lake Tanganyika.

IV. The Franco-German convention of March 15, 1894, by which the Central Sudan was left to France (this region by an Anglo-German agreement of Nov. 15, 1893, having been recognized as in the German sphere). By this convention France was able to effect a territorial junction of her possessions in North and West Africa with those in the Congo region.

V. Protocols of March 24 and April 15, 1891, for the demarcation of the Anglo-Italian spheres in East Africa.

VI. The Anglo-French convention of June 14, 1898, for the delimitation of the possessions of the two countries west of Lake Chad, with the supplementary declaration of March 21, 1899, whereby France recognized the upper Nile valley as in the British sphere of influence.

The Congo State.—The Congo Free State, which occupied, geographically, a central position, may serve as the starting-point for the story of the partition after the Berlin Conference. By his will, dated Aug. 2, 1889, King Leopold made Belgium formally heir to the sovereign rights of the Congo Free State. Proposals for Belgium to assume responsibility for its administration were made unsuccessfully in 1895 and 1901. Later, the agitation in Great Britain and America against the Congo system of government and the admissions of an official commission of enquiry concerning its maladministration strengthened the movement in favour of transfer, until in 1905 Leopold II. was forced to yield, and the annexation treaty was approved by the Belgian parliament. Thus the Congo state, after an existence of 24 years as an independent power, became a Belgian colony. (*See CONGO, FREE STATE AND BELGIAN CONGO.*)

French and British Rivalry.—After the capture of Khartum and the death of Gen. C. G. Gordon, the Sudan was abandoned to the dervishes. The Egyptian frontier was withdrawn to Wadi Halfa, and the vast provinces of Kordofan, Darfur, and the Bahr-el-Ghazal were given over to dervish tyranny and misrule. It was obvious that Egypt would sooner or later seek to recover her position in the Sudan, as the command of the upper Nile was recognized as essential to her continued prosperity. But the international position of the abandoned provinces was by no means clear. The British Government, by the Anglo-German agreement of July 1890, had secured the assent of Germany to the statement that the British sphere of influence in East Africa was bounded on the west by the Congo Free State and by "the western watershed of the basin of the upper Nile"; but this claim was not recognized either by France or by the Congo Free State. From her base on the Congo, France was busily engaged pushing forward along the northern tributaries of the great river. The desire of France to secure a footing in the upper Nile valley was partly due to her anxiety to extend a French zone across Africa, but it was also to a large extent attributable to the belief, widely entertained in France, that by establishing herself on the upper Nile France could regain the position in Egyptian affairs which she had sacrificed in 1882.

In June 1896 Capt. J. Marchand left France with secret instructions to lead an expedition into the Nile valley. On July 10, 1898, he reached Fashoda, having established a chain of posts *en route*, and here the French flag was at once raised, and a "treaty" made with the local chief. Meanwhile, in 1896, an Anglo-Egyptian army, under the direction of Sir Herbert (afterwards Lord) Kitchener, had advanced southwards for the reconquest of the Egyptian Sudan. On Sept. 2, 1898, Khartum was captured, and the khalifa's army dispersed. It was then that news



BY COURTESY OF NORTHERN BAPTIST CONVENTION

NATIVE CHIEF IN ROYAL ATTIRE, BELGIAN CONGO
When a chief dies, selected members of his retinue are killed, and buried with him; the village is then abandoned

reached the Anglo-Egyptian commander, from native sources, that there were white men flying a strange flag at Fashoda. The sirdar at once proceeded in a steamer up Nile, and courteously but firmly requested Capt. Marchand to remove the French flag. On his refusal the Egyptian flag was raised close to the French flag, and the dispute was referred to Europe for adjustment between the British and French Governments. A critical situation ensued. Neither Government was inclined to give way, and for a time war seemed imminent. Happily Lord Salisbury was able to announce, on Nov. 4, that France was willing to recognize the British claims, and the incident was finally closed on March 21, 1899, when an Anglo-French declaration was signed, by the terms of which France withdrew from the Nile valley and accepted a boundary line which satisfied her earlier ambition by uniting the whole of her territories in North, West, and Central Africa into a homogeneous whole, while effectually preventing the realization of her dream of a transcontinental empire from west to east.

British and Portuguese Spheres Defined.—In the southern half of the continent, between the years 1885 and 1891, the Portuguese possessions on the west and east coasts were delimited, and Matabeleland and Mashonaland were occupied by the British South Africa Company. (*See RHODESIA.*) The relations between the British and Portuguese territories were determined by the treaty of June 11, 1891. Apart from defining the British and Portuguese spheres both south and north of the Zambezi, it contained many other provisions relating to trade and navigation, providing, *inter alia*, a maximum transit duty of 3% on imports and exports crossing Portuguese territories on the east coast to the British sphere, freedom of navigation of the Zambezi and Shire for the ships of all nations, and stipulations as to the making of railways, roads, and telegraphs. Portugal was given both banks of the Zambezi to a point ten miles west of Zumbo—the farthest settlement of the Portuguese on the river. The boundary between the Portuguese sphere of influence on the west coast and the British sphere of influence north of the Zambezi was only vaguely indicated; but it was to be drawn in such a manner as to leave the Barotse country within the British sphere. Before the conclusion of the treaty the British Government had made certain arrangements for the administration of the large area north of the Zambezi reserved to British influence. On Feb. 1 Sir Harry Johnston was appointed imperial commissioner in Nyasaland, and a fortnight later the British South Africa Company intimated a desire to extend its operations north of the Zambezi. Negotiations followed, and the field of operations of the Chartered Company was, on April 2, 1891, extended so as to cover (with the exception of Nyasaland) the whole of the British sphere of influence north of the Zambezi (afterwards Northern Rhodesia). On May 14 a formal protectorate was declared over Nyasaland, including the Shire highlands and a belt of territory extending along the whole of the western shore of Lake Nyasa. The name was changed in 1893 to that of the British Central Africa Protectorate, for which designation was substituted in 1907 the more appropriate title of Nyasaland Protectorate.

British and German Rivalry.—In July 1890, the British and German Governments came to an agreement upon the limits of their respective spheres of influence in various parts of Africa, and the boundaries of German South-West Africa were fixed in the position they now hold as those of the territory mandated to the Union of South Africa. These Powers were also the two great rivals on the east coast. Germany, on Dec. 30, 1886, and Great Britain, on June 11, 1891, formally recognized the Rovuma river as the northern boundary of the Portuguese sphere of influence on that coast; but it was to the north of that river, over the vast area of east or east central Africa in which the sultan of Zanzibar claimed to exercise suzerainty, that the struggle between the two rival powers was most acute. By an exchange of notes in Oct.-Nov. 1886, to which the sultan adhered on Dec. 4, 1886, the British and German Governments determined what territories were to be assigned to the sultanate of Zanzibar and agreed to a delimitation of their respective spheres of influence in East Africa. On Sept. 3, 1888, the British East Africa Association

received a charter and became the Imperial British East Africa Company. Shortly afterward the German colony of East Africa was founded. (See KENYA COLONY AND PROTECTORATE.)

Meanwhile, in the country to the west and north of the British sphere of influence a contest for Uganda had arisen between Karl Peters and the British East Africa Company. The contest was decided in favour of the latter by the Anglo-German Agreement of July 1, 1890. The provisions relating to East Africa were these:—In return for the cession of Heligoland, Lord Salisbury obtained from Germany the recognition of a British protectorate over the dominions of the sultan of Zanzibar, including the islands of Zanzibar and Pemba, but excluding the strip leased to Germany, which was subsequently ceded absolutely to Germany. Germany further agreed to

withdraw the protectorate declared over Witu and the adjoining coast up to Kisumu in favour of Great Britain, and to recognize as within the British sphere of influence the vast area bounded, on the south, by the frontier line laid down in the agreement of 1886, which was to be extended along the first parallel of south latitude across Victoria Nyanza to the frontiers of the Congo Free State, on the west by the Congo Free State and the western watershed of the Nile, and on the north by a line commencing on the coast at the north bank of the mouth of the River Juba, then ascending that bank of the river until it reached the territory at that time regarded as reserved to the influence of Italy¹ in Gallaland and Abyssinia, when it followed the frontier of the Italian sphere to the confines of Egypt. To the south-west of the German sphere in East Africa the boundary was formed by the eastern and northern shore of Lake Nyasa, and round the western shore to the mouth of the Songwe river, from which point it crossed the Nyasa-Tanganyika plateau to the southern end of the last-named lake, leaving the Stevenson road on the British side of the boundary. The effect of this treaty was to remove all serious causes of dispute about territory between Germany and Great Britain in East Africa. It rendered quite valueless Peter's treaty with Mwanga and his promenade along the Tana; it freed Great Britain from any fear of German competition to the northwards, and recognized that her influence extended to the western limits of the Nile valley. But, on the other hand, Great Britain had to relinquish the ambition of connecting her sphere of influence in the Nile valley with her possessions in Central and South Africa. On this point Germany was quite obdurate; and an attempt subsequently made (May 1894) to secure this object by the lease of a strip of territory from the Congo Free State was frustrated by German opposition. (See UGANDA; KENYA COLONY AND PROTECTORATE AND TANGANYIKA TERRITORY.)

On March 31 the union jack was raised, and on May 29 a fresh treaty was concluded with King Mwanga placing his country under British protection. A formal protectorate was declared over Uganda proper on June 19, 1894, which was subsequently extended so as to include the countries westwards towards the Congo Free State, eastwards to the British East Africa protectorate and Abyssinia, and northwards to the Anglo-Egyptian Sudan. The British East Africa protectorate was constituted in June 1895, when the Imperial British East Africa Company relinquished all its rights in exchange for a money payment, and the administration was assumed by the imperial authorities. On April 1, 1902, the eastern province of the Uganda protectorate was transferred to the British East Africa protectorate, which thus secured control of the whole length of the so-called Uganda railway, and at the same time obtained access to the Victoria Nyanza.

¹At this period negotiations between Great Britain and Italy had begun but were not concluded.



BY COURTESY OF FRED B. PATERSON

A SWAHILI ELEPHANT TRACKER DRESSED IN SKINS. THESE MEN ARE EXPERTS IN DISTINGUISHING ALL VARIETIES OF SPOORS

Italy.—Early in the 'eighties as already seen, Italy had obtained her first formal footing on the African coast at the Bay of Assab (Aussa) on the Red Sea. In 1885 the troubles in which Egypt found herself involved compelled the khedive and his advisers to loosen their hold on the Red Sea littoral, and, with the tacit approval of Great Britain, Italy took possession of Massawa and other ports on that coast. In May 1889 the Italians concluded with the negus Menelek the Treaty of Ucciali which, besides settling the frontiers between Abyssinia and the Italian sphere, contained the following article:—

XVII. His Majesty the King of Kings of Ethiopia consents to avail himself of the Italian Government for any negotiations which he may enter into with the other Powers or Governments.

In Italy and by other European governments this article was generally regarded as establishing an Italian protectorate over Abyssinia; but this interpretation was never accepted by the emperor Menelek, and at no time did Italy succeed in establishing any very effective control over Abyssinian affairs. By May 1894 under various agreements, the Italian and British Governments had fixed the northern limit of the Italian sphere as running from Ras Kasar on the Red Sea to the intersection of the Blue Nile with 35° E. longitude, and settled the boundary between their respective spheres on the Somali coast. But while Great Britain was thus lending her sanction to Italy's ambitious schemes the Abyssinian emperor was becoming more and more incensed at Italy's pretensions to exercise a protectorate over Ethiopia. In 1893 Menelek denounced the Treaty of Ucciali, and eventually, in a great battle, fought at Adowa on March 1, 1896, the Italians were disastrously defeated. By the subsequent Treaty of Addis Ababa, concluded on Oct. 26, 1896, the whole of the country to the south of the Mareb, Belesa, and Muna rivers was restored to Abyssinia, and Italy acknowledged the absolute independence of Abyssinia. By later negotiations with his European neighbours, the emperor Menelek secured boundaries on the south and west more favourable to Abyssinia than those assigned under the Anglo-Italian agreement. And Italian Somaliland, bordering on the south-eastern frontier of Abyssinia, became limited to a belt of territory with a depth inland from the Indian ocean of from 180 to 250 miles.

Anglo-French Rivalry in West Africa.—In West Africa the real struggle was between France and Great Britain, and France played the dominant part, the exhaustion of Portugal, the apathy of the British Government and the late appearance of Germany in the field all being elements that favoured the success of French policy. Two phases may be distinguished: the first dealing with the coast colonies, the second with the middle Niger and Lake Chad. On the coast France was wholly successful in her design of isolating all Great Britain's separate possessions in that region, and of securing for herself undisputed possession of the upper Niger and of the countries lying within the great bend of that river. At the date of the Berlin Conference the present colonies of Southern Nigeria and the Gold Coast constituted a single colony under the title of the Gold Coast colony, but on Jan. 13, 1886, the territory comprised under that title was erected into two separate colonies—Lagos and the Gold Coast (the name of the former being changed in Feb. 1906 to the colony of Southern Nigeria). In Aug. 1896, following the destruction of the Ashanti power and the deportation of King Prempeh, as a result of the second Ashanti campaign, a British protectorate was declared over the whole of the Ashanti territories and a resident was installed at Kumasi. But no northern limit had been fixed beyond the 9th parallel, and the countries to the north—Gurunsi (Grusi), Mossi and Gurma—were entered from all sides by rival British, French, and German expeditions. A few days before the meeting of the Berlin Conference Sir George Goldie had succeeded in buying up all the French interests on the lower Niger. The British company's influence had at that date been extended by treaties with the native chiefs up the main Niger stream to its junction with the Benue, and some distance along this latter river. But the great Fula states of the central Sudan were still outside European influence; and the German Government made efforts to secure a footing on the lower Niger until the fall of Prince Bis-

marck in March 1890. On the failure of the half-hearted attempt made later to establish relations with Gando from Togoland, Germany dropped out of the competition for the western Sudan and left the field to France and Great Britain. After its first great success the National African Company obtained a charter from the British Government, and on July 10, 1886, it became "The Royal Niger Company."

Notwithstanding her strenuous efforts, France, in her advance down the Niger from Senegal, did not succeed in reaching Sego on the upper Niger, a considerable distance above Timbuktu, until the winter of 1890-91, and the rapid advance of British influence up the river raised serious fears lest the Royal Niger Company should reach Timbuktu before France could forestall her. In 1892, however, after a troublesome war, France annexed some portion of Dahomey on the coast and declared a protectorate over the rest of the kingdom. Thus was removed the barrier which had up to that time prevented France pushing her way Nigerwards from her possessions on the Slave Coast, as well as from the upper Niger and the Ivory Coast. Henceforth her progress from all these directions was rapid, and in particular Timbuktu was occupied in the last days of 1893. It then appears to have been suddenly realized in France that, for the development of the vast regions which she was placing under her protection in West Africa, it was extremely desirable that she should obtain free access to the navigable portions of the Niger, if not on the left bank, from which she was excluded by the agreement of Aug. 5, 1890, then on the right bank, where the frontier had still to be fixed by international agreement. On Feb. 13, 1895, a French officer, Commander Toutée, arrived on the right bank of the Niger opposite Bajibo and built a fort. His presence there was notified to the Royal Niger Company, who protested to the British Government against this invasion of their territory; and eventually Toutée was ordered to withdraw, and the fort was occupied by the Royal Niger Company's troops. In 1897 the attempt was renewed in the most determined manner. In February of that year a French force suddenly occupied Bussa, and this act was quickly followed by the occupation of Gomba and Illo higher up the river. In Nov. 1897 Nikki was occupied. The situation on the Niger had so obviously been outgrowing the capacity of a chartered company that for some time before these occurrences the assumption of responsibility for the whole of the Niger region by the imperial authorities had been practically decided on; and early in 1898 Capt. F. D. (afterwards Lord) Lugard was sent out to the Niger with a number of imperial officers to raise a local force in preparation for the contemplated change. The advance of the French forces from the south and west was the signal for an advance of British troops from the Niger, from Lagos, and from the Gold Coast protectorate. The situation thus created was extremely serious. The British and French flags were flying in close proximity, in some cases in the same village. Meanwhile the diplomatists were busy in London and in Paris, and in the latter capital a commission sat for many months to adjust the conflicting claims. Fortunately, by the tact and forbearance of the officers on both sides, no local incident occurred to precipitate a collision, and on June 14, 1898, a convention was signed by Sir Edmund Monson and M. G. Hanotaux which practically completed the partition of this part of the continent. (See NIGERIA.)

Thus in its broad outlines the partition of Africa was begun and ended in the short space of a quarter of a century. The result was to divide the continent among the Powers as follows:—

	Square miles.
British Africa	2,101,411
Egyptian Africa	1,600,000
French Africa	3,866,950
German Africa	910,150
Italian Africa	200,000
Portuguese Africa	787,500
Spanish Africa	79,800
Belgian Africa	900,000
Turkish Africa	400,000
Independent Africa	613,000

11,458,811

Anglo-French Declaration, 1904.—There were still many finishing touches to be put to the structure, but a large contribution to the process was made by the Anglo-French declaration of April 8, 1904, when a series of agreements relating to several parts of the globe were signed in London by Lord Lansdowne, the foreign secretary, and M. Paul Cambon, the French ambassador, on behalf of their respective Governments. With regard to Egypt the French Government declared "that they [would] not obstruct the action of Great Britain in that country by asking that a limit of time be fixed for the British occupation or in any other manner." To understand the equivalent engagement taken by Britain, it must be recalled that to consolidate her position in north-west Africa France desired to make her influence supreme in Morocco. In April, 1902, it had been agreed between the French and Shereefian Governments to co-operate in establishing order in the frontier districts of Morocco and Algeria. Meanwhile in the northern districts of Morocco the unrest under the rule of the young sultan, Abd-el-Aziz IV., was attracting attention in Europe and evoking demands for its suppression. It was in these circumstances that in the declaration of April 1904 the British Government recognized "that it [appertained] to France, more particularly as a Power whose dominions [were] continuous for a great distance with those of Morocco, to preserve order in that country, and to provide assistance for the purpose of all administrative, economic, financial, and military reforms which it may require." Both parties, however, "inspired by their feeling of sincere friendship for Spain, [took] into special consideration the interests which that country [derived] from her geographical position and from her territorial possessions on the Moorish coast of the Mediterranean"; and in these interests the French Government undertook "to come to an understanding with the Spanish Government." The understanding was reached later in the same year, and thus Spain secured a sphere of interest on the Moroccan coast immediately facing the Spanish peninsula. Here it may be added that the protectorate of Spain over certain territories on the west coast of Africa, south of Morocco, had been notified to the Berlin Conference, and that by an agreement made with France in 1900 some 70,000sq.m. of the western Sahara were recognized as Spanish; while at the same time France admitted the claim of Spain to the ownership of the district around the Muni river to the south of Cameroons. The action taken by France in Morocco in accordance with the policy marked out in the Anglo-French declaration aroused the resentment of Germany, but on July 8, 1905, the republic secured from the German Government formal "recognition of the situation created for France in Morocco by the contiguity of a vast extent of territory of Algeria and the Shereefian empire, and by the special relations resulting therefrom between the two adjacent countries, as well as by the special interest for France, due to this fact, that order should reign in the Shereefian empire." Finally, in Jan.-April, 1906, a conference of the Powers was held at Algeciras to devise, by invitation of the sultan, a scheme of reforms to be introduced into Morocco (*q.v.*). French capital was allotted a larger share than that of any other Power in the Moorish state bank which it was decided to institute, and French and Spanish officers were entrusted with the organization of a police force for the maintenance of order in the principal coast towns. The new régime had not been inaugurated fully, however, when a series of outrages led, in 1907, to the military occupation by France of Oudjda, a town near the Algerian frontier, and of the port of Casablanca on the Atlantic coast of Morocco.

LATER POLITICAL DEVELOPMENTS

The political map of Africa changed very considerably between 1910 and 1925. In 1910 the British self-governing colonies of the Cape, Natal, Transvaal, and Orange River were formed into the Union of South Africa, with a single government and one legislature. In 1911 a considerable area of French Equatorial Africa was transferred to German Cameroons and in return Germany acknowledged a French protectorate over the greater part of Morocco. On March 30, 1912, a protectorate treaty between France and the sultan was signed at Fez; and by a Franco-Span-

ish convention of Nov. 27 the Spanish zones in Morocco were defined. In 1912, also, Italy annexed the Turkish vilayets of Tripoli and Bengasi (Cyrenaica), to which the common name of Libya was given. In Dec. 1914 a British protectorate over Egypt was proclaimed, but by a declaration of Feb. 1922 Great Britain acknowledged the independence of Egypt. The status of the Anglo-Egyptian Sudan remained unchanged.

In June 1919, by the Treaty of Versailles, Germany renounced possession of all her overseas protectorates in favour of the principal Allied and Associated Powers. These territories, which had all been conquered by the Allies during the World War, were placed under mandates. The Union of South Africa became mandatory for German South-West Africa; Togoland was divided between France and Great Britain; and France became mandatory for Cameroons, except for a small portion which was placed under the administration of British Nigeria. Britain became mandatory for German East Africa, renamed the Tanganyika Territory, but by subsequent Anglo-Belgian agreements Belgium became mandatory for the provinces of Ruanda and Urundi. In 1920-25 Italy gained additions to Tripoli and Cyrenaica by arrangements with France and Egypt and to Italian Somaliland by arrangement with Great Britain. In 1936, Italy annexed Abyssinia.

As a result of these changes Africa was divided among the following Powers. The territories governed under mandate are reckoned in the possession of the Power named:—

France	4,200,000	Italy	1,030,000
Great Britain	3,984,000*	Egypt	350,000
Belgium	930,000	Spain	140,000†
Portugal	788,000	Liberia	40,000

*Including Anglo-Egyptian Sudan.

†Including the Spanish zones in Morocco.

These figures give a total of 11,462,000 sq.m. as the area of Africa. In the absence of definite surveys of large areas of the continent this may be regarded as a close approximation to accuracy.

German Policy.—The extinction of Turkish rule in North Africa had long been foreseen and was no matter for regret. It ended a connection which had lasted five centuries and had been almost wholly evil in its effects. German sovereignty in Africa had only dated from 1884 and had been rapidly enlarged. Endeavours to extend it further had been a prominent factor in German policy for a decade before the World War. Germany desired a footing on the African coast of the Mediterranean and a port on the Atlantic coast of Morocco. These desires conflicted with Italian and French ambitions, and in 1911 the issue on both points was decided against Germany. As to Morocco, a Franco-German convention of Feb. 9, 1909, had recognized the privileged position of France in Morocco, but not a French protectorate over that country, and the sending of the German gunboat, "Panther," to Agadir, in July, 1911, was a protest against what Germany considered an unwarranted extension of French influence in Morocco, and an intimation that if German treaty rights in Morocco were to be renounced, France must make compensation. The intervention of Great Britain on the side of France put an end to a dangerous situation; Germany, by a convention concluded Nov. 4, 1911, accepted compensation in Central Africa and withdrew opposition to the establishment of a French protectorate in Morocco.

While the Franco-German negotiations were in progress Italy abruptly declared war on Turkey and invaded, and held, Cyrenaica and Tripoli. Thus Germany, who had designed to exploit those vilayets through the medium of an Austro-Hungarian chartered

company, was deprived of her last opportunity—short of war—of gaining a foothold in the Mediterranean. She turned her attention to the development of a *Mittel Afrika* policy. This policy aimed at securing Germany's supremacy, primarily economic and ultimately political, in central equatorial Africa. The aim was to reserve the Belgian Congo, Angola and Mozambique, north of the Zambezi, as a German sphere, and thus to link up Cameroons with the South-West and East Africa protectorates. German industries had need of the raw material tropical Africa produces, and, moreover, southern Angola was a good field for European settlement.

British statesmen were not unfavourable to German expansion in equatorial Africa, so long as it was confined to the economic sphere. In 1898 an agreement, signed by Mr. A. J. (afterwards Lord) Balfour and Count Hatzfeldt, had divided Angola and Mozambique into spheres in which Great Britain and Germany respectively were to give financial and economic help to the Portuguese. This was followed in 1899 by the Treaty of Windsor, the object being to reassure Portugal that the Balfour-Hatzfeldt agreement was not in derogation of her sovereign rights in Africa. Neither the agreement with Germany nor the treaty with Portugal was published.

After the settlement of the Morocco crisis, Germany reopened negotiations with Great Britain in respect of Portugal's African colonies, and Prince Lichnowsky (the German ambassador) and Sir Edward (afterwards Lord) Grey reached a new agreement, which was ready for signature in 1913. Nearly all Angola was recognized as a German economic sphere, as well as the northern part of Mozambique. The rest of Mozambique, including Delagoa Bay and the Zambezi valley, was to be a British economic sphere. Sir Edward Grey made it a condition of signing that the 1898 and 1899 documents should be published. The German foreign office raised objections, Herr von Jagow (then foreign minister) stating that the German Press would regard the terms of the Treaty of Windsor and the Lichnowsky agreement as contradictory. In July 1914, however, German consent to publication had been given, but before the new agreement could be signed the World War had broken out.

The World War.—During the progress of the campaigns in Africa the whole of the continent, except Abyssinia and the Spanish protectorates, became involved in the struggle. The conquest of the German colonies was foreseen in the negotiation which preceded Italy's entry into the war, and Article 13 of the agreement signed in London on April 26, 1915, between France, Russia, Great Britain, and Italy, laid down that:—

In the event of France and Britain increasing their colonial territories in Africa at the expense of Germany, those two Powers agree in principle that Italy may claim some equitable compensation, particularly as regards the settlement in her favour of the questions relative to the frontiers of the Italian colonies of Eritrea, Somaliland and Libya, and the neighbouring colonies belonging to France and Great Britain.

Italian Ambitions.—Italian ambitions had gone beyond the readjustment of frontiers; in particular Italy wished to acquire Jibuti, the port of French Somaliland and the starting place of a railway to Abyssinia. As Jibuti was the only French port on the Suez canal route to the East and to Madagascar, as well as the only approach to Abyssinia that France possessed, she declined to entertain proposals for its surrender.

Italy, however, obtained from France a welcome rectification of the Tripoli-Tunisia frontier, as well as valuable concessions in Tunisia.

In regard to the Cyrenaica-Egyptian frontier, the British Government, in 1919, offered Italy a readjustment of territory in the Libyan desert. The negotiations had not been concluded when Egypt was granted independence and after that time they were conducted directly between Italy and Egypt. They turned largely on the possession of the oasis of Jaghbug, a place of some strategic importance, where is also the tomb-mosque of the founder of the Senussi sect. On Dec. 6, 1925, an Italo-Egyptian agreement was signed, by which Jaghbug was included in Cyrenaica. The wells to the west of El Sollum were included in



Egyptian territory, thus giving El Sôllum a needed water supply. South of Siwa the frontier was drawn along longitude 25° E. to the boundary of the Anglo-Egyptian Sudan in latitude 22° North.

Meanwhile Mussolini pressed again for a sphere of influence in Ethiopia. Notes were exchanged with England in 1925 undertaking to support the latter's request for the right to build a dam at Lake Tana in return for support for Italy's demand for a sphere in western Ethiopia. When England, seeing an opportunity to get the dam built by Egyptian and American interests, dropped the Italian cause, Mussolini turned first to France and then in 1935 to direct aggression upon Abyssinia (*q.v.*). The war of conquest by Italy stirred the entire world. It was a direct assertion of white supremacy over a native and independent sovereignty which, in Sept. 1923, had been admitted to the League of Nations. In May 1936 Abyssinia was subdued and annexed. With Eritrea and Italian Somaliland, this ancient kingdom is included in an East African dependency over which the King of Italy has been declared Emperor.

France and Spain.—In the same year (1912) that France obtained her protectorate in Morocco she concluded an arrangement with Spain whereby a Spanish protectorate was set up in the northern part of the sultanate, the port of Tangier and a small area around it being made, however, an international zone. In the French protectorate Marshal Lyautey, the resident-general, adopted a bold and conciliatory policy and won the confidence and respect of the Moors. He was succeeded in 1925 by M. Theodore Steeg, the governor-general of Algeria. In their zone the Spaniards met with determined opposition, largely owing to the uprising of a Moor, styled Abdel-Krim. In the territory known, somewhat vaguely, as Er-Rif, there seems to have been, as in the coastward portions of Algeria and Tunisia, a much more marked Iberian element in the population than there is in the south of Morocco, and this part of northern Morocco had shown a great hatred of European interference. The Spaniards suffered a severe reverse in 1921 and there was again heavy fighting in 1924 and 1925. In the last-named year the Rifs invaded the French zone, but were defeated and driven back. In the next year the insurrection was successfully quelled; and in 1927 the king and queen of Spain were cordially received. In Southern Rhodesia the growth of a vigorous white community led to that country being made, in 1923, a self-governing colony of the British Empire, and with the assumption of direct imperial control of Northern Rhodesia in 1924 chartered-company rule in British Africa came to an end. In East Africa another vigorous and vocal white community made its influence felt, namely the settlers in the British East Africa Protectorate, which protectorate was annexed to the British Crown in 1920 and renamed Kenya Colony.

A subject which raised large issues was the position of Indians in South and East Africa, but it was of less importance than the growth of race consciousness among the Bantu and the negroes. Increase of education and of Christianity, the employment of large numbers of Africans in industries, and the lessons taught by the World War were among the factors which intensified the feeling of racial unity and led to manifestations of a new anti-white movement. This movement was different from the simple objection to interference by Europeans, or Arabs, previously displayed, and had a consciousness of the need of self-development.

France in North Africa.—Apart from the awakening of the African peoples to race-consciousness, two recent developments in the European occupation of the continent are noticeable. France has shown definite progress in the task of restoring north-west Africa to the place in Mediterranean civilization which it held from the 6th century B.C. to the 7th century of the Christian era, when the Mohammedan conquest began. Under British administration the peoples of East Africa have emerged rapidly since the World War to industrial and political advancement. Since 1912, when she acquired the protectorate of Morocco, the authority of France has become increasingly effective in the fertile littoral and high plateaux of the western half of North Africa. The political and economic development of this Mediterranean area upon European lines has been assured by the expan-

sion of Algeria southward and the subsequent linking up of Saharan Algeria with the western Sudan, the French west coast colonies, and French Congo in a vast and coherent African empire. Barely a century ago the French expeditionary force landed at Sidi Ferruch on June 14, 1830. The declared purpose of the French cabinet was "to abolish slavery and piracy, to re-establish the security of navigation in the Mediterranean and open up its southern coasts anew to agriculture, civilization, commerce, and the free access of all nations." In the interval the "restricted occupation" of the coast towns has become the "total occupation" of Algeria, and the conquest of "the South"; while the incorporation of Northern Algeria into France has been followed by the protectorates of Tunis (1881) and Morocco (1912). Within these hundred years the European element in North Africa has risen from a handful of consular officials and merchants to well over a million residents, or approximately to one-tenth of the total population. Great European towns have been built. Agriculture and stock-raising have become infinitely more productive, minerals have been found and worked and new industries introduced. Order and public security have been established in regions to which Rome never sought to penetrate and over peoples that the legionaries strove in vain to subdue. The increasing throng of tourists who yearly traverse North Africa by rail and car from Algiers to the Saharan oases and from Carthage to Marrakesh, and the frequency and regularity of the steamship services which maintain intercourse between the European and African shores of the Mediterranean, are evidence of the success with which France has fulfilled her primary task of re-opening to Europe this lost province of the Graeco-Roman world.

British Development.—After the World War appreciable progress was made in the construction of development works and in production in Uganda, Kenya, and Tanganyika (formerly German East Africa); and with a view of increasing further the economic capacity of these and the neighbouring territories of Zanzibar, Nyasaland, and Northern Rhodesia, the possibility of administrative co-operation between the several governments concerned came under consideration. As the result of conferences on this subject held in 1927 the colonial office appointed the Hilton Young Commission to inquire into the question of the federation, or other union, of the British territories from Northern Rhodesia to Uganda. And, by the desire of its ministry, Southern Rhodesia (which became self-governing in 1923) was included in the scope of the commission. The project of an administrative union, of which this official enquiry into the views of the several governments and populations concerned was the first step, acquires a special interest from the character and geographical position of the colonies affected. Both the East, and the South African colonies are mixed African and European states, in which, although the mass of the inhabitants are African, the European minority is politically dominant. But while, broadly speaking, in the former the numerical predominance and economic importance of the African population are such that the interests of this population have priority in the eyes of the administration over those of the European, in the latter, with the exception of the native territories of the high commission, the European population and its economic importance are so relatively great that European interests stand first. In the East Coast colonies, however, African interests are not so predominant as they are in the (British) West Coast colonies; and in this respect these East Coast colonies hold a position midway between the frankly African West Coast colonies and the frankly European Union of South Africa and Southern Rhodesia. The federation, if effected, of a group of colonies of this intermediate type, by showing whether a central administration is a more effective medium for arriving at a due balance between African and European interests, may be expected to provide data germane to the whole subject of the European tutelage of African peoples. And in particular, as the result of the inclusion of Southern Rhodesia in the purview of the commission and the consequent possibility of Northern Rhodesia or its western portion being incorporated into Southern Rhodesia, it is probable that the question whether Northern Rhodesia, with its large area of 300,000 sq.m., is to be

administered as a "plantation" colony or to become a new centre of British population will be at length determined.

Tangier.—The status of the Tangier International Zone was regulated by the Act of Algeciras (April 7, 1906), until modified by the conference which formulated the Tangier Statute in 1923. Although certain Powers signatory of the Algeciras Act, notably Italy, withheld their adhesion, this protocol came into force on June 1, 1925. But Spain continued to maintain that the only satisfactory arrangement was the incorporation of Tangier in the Spanish Zone by which it was encircled: while France insisted that her position in Morocco required that Tangier and its communications should be under her control. The visit of a division of the Italian navy to Tangier in Oct. 1927, emphasized Italy's refusal to recognize the statute. On March 3, 1928, agreement was reached between France and Spain. At a second conference (March 20) of France, Spain, Italy and Great Britain the Franco-Spanish Agreement of March 3, was adopted, the statute was modified, and the claims of Italy to participate in the government of Tangier were satisfied (July 17).

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(J. S. K.; H. H. J.; F. R. C.; W. B. W.)

RECENT EXPLORATION

Progress Since 1910.—The largest unknown area of Africa in 1910 was in the Sahara desert; the greatest gaps on the map were in the Libyan desert. In 1920-21 Mrs. Rosita Forbes took an expedition across the Libyan Desert to Kufra, the headquarters



A ZULU WARRIOR IN FULL BATTLE ARRAY

Carefully trained in military tactics, the Zulu warrior was feared by his neighbours as a formidable enemy

of the Senussi Tariq. In 1922-23 Ahmed Bey Hassanein, who had accompanied her, led an expedition through Kufra and the southern oases to Darfur. Mrs. Forbes has made further journeys through Abyssinia, the western Mauretanian desert and western Arabia. Hassanein Bey in 1923 journeyed through the Libyan desert into Darfur and Kordofan. Previous explorations by the French (1912-17) had increased knowledge of the eastern limits of the Chad basin, and had definitely proved its distinction from the western basin of the Nile. Col. Tilho's expeditions had revealed altitudes in Tibesti of 11,200ft. and the height of Mt. Tusi as 10,700ft.; lesser altitudes of 9,800ft. were determined at Jebel Marra, in Darfur, and of 4,000 to 5,000ft. on the western borders of the Sudan. The Tibesti belt of highland probably played a great part in southward spreads of fauna and flora in Miocene and Pliocene times. In the Nilotic Sudan, east of the main Nile, altitudes of 10,000ft. were discovered in 1911-12 by Col. H. D. Pearson. In 1916 Maj. Cuthbert Christy made an interesting journey along the south-western limits of the Nile basin, traversing the ironstone region where adjoining head-streams flow either southwards into the Mbomu and its affluents (Congo basin) or north-east into the Nile basin.

French officers, notably Capt. Augiéras, have conducted (from 1904) a scientific survey of the western Sahara, from southern Morocco to the Senegal river and the northern Niger. Augiéras has shown how the intense "desert" conditions of the western Sahara with few oases except on the periphery, accompany the extreme temperatures of the low-lying dunes, which quickly lose heat. The great Juf depression remained unexplored up to 1922; but since then the Citroën expedition from the latitudes of Insalab and Ahaggar in southern Algeria has increased our knowledge of this area. Portuguese Guinea, with its large rivers, has been partly explored, and since 1921 the vast southern part of the Niger basin, and the Black and White branches of the mighty Volta river, have become better known. Northern Togoland, Dahomey, southern Nigeria and the basin of the great Benue river have been mapped in detail.

East and Central Africa.—Much intensive work has been done in East and Central Africa. I. N. Dracopoli in 1912-1913 explored part of Jubaland; he reached the Lorian swamp, which receives the waters of the Uaso Nyiro, and showed its connection with the Juba river in Italian Somaliland. In April 1912 G. F. Archer (later Sir) completed surveys connecting the triangulation of British East Africa with the Abyssinian boundary survey. A survey by Capt. E. M. Jack, in 1911, of the region between Lakes Kivu and Victoria added to the knowledge of the Mufumbiro range of active volcanoes; Karisimbi was found to be 14,780ft. high. Since that time the Mufumbiro region and western Uganda have been surveyed in considerable detail. In 1927 geologists of the Swedish Institute found three series of sloping beaches along

the Rift valley between Menengai and Longonot, and also collected much data relative to the glaciation of Mt. Elgon and Kilimanjaro, and to the glacial geology of East Africa in general.

The first survey along its whole length of the Congo-Zambezi watershed was made in 1911-14 by Anglo-Belgian and Anglo-Portuguese boundary commissions. Many rivers run for considerable distances parallel to the divide, which is largely bush-covered. Maj. Reginald Walker, one of the British commissioners, discovered that the Luapula, a main headstream of the Congo, did not issue from Lake Bangweulu, but was a continuation of the Chambezi, which passes through the great swamp south of Bangweulu.

Results of the War.—During the World War, needs of campaigning led to many additions to the knowledge of the topography of inter-tropical Africa, partly through use of aircraft for survey purposes. Thus very useful maps were made of the northern part of Portuguese East Africa. In 1920 Dr. P. Chalmers Mitchell, who flew over the Nile basin proved the value of air reconnaissance to geology by the discovery in the Bayuda desert, north of Khartoum, of the volcanic character of a range of hills. A little later the French began to use aeroplanes for survey purposes in the Sahara. (X.)

AFRICA, ROMAN, comprised the whole of the continent known to the ancients, except Egypt and Ethiopia. The official and administrative language used the word Africa in a narrow sense, as noticed below. The term was borrowed by the Romans from the language of the natives. In Latin literature it was employed for the first time by the poet Ennius, who used it of the territory of Carthage and the eastern group of the Atlas. Numerous conjectures have been made as to the etymology of the term Africa; the best is that of Charles Tissot, who sees in the word "Africa" the name of the great Berber tribe, the Aourigha (whose name would have been pronounced Afarika), the modern Aouraghen, in ancient times the principal indigenous element of the African empire of Carthage (Tissot, *Géogr. comp.* i. 389). Africa was, in the eyes of the Romans and Carthaginians alike, the country inhabited by the great tribe of Berbers or Numidians called Afarik.

At the time of the Third Punic War the Africa of the Carthaginians was but a fragment of their ancient native empire, the rest of Africa having passed into the hands of the kings of Numidia, who were allies of the Romans.

After the capture of Carthage by Scipio (146 B.C.) this territory became a Roman province, and a trench, the *fossa regia*, was dug to mark the boundary of the Roman province of Africa and the dominions of the Numidian princes. The remains of this ditch, protected by a low wall or a stone dyke, have been discovered (1907); some of the boundary stones which marked its course, and inscriptions mentioning it, have also been found. From Testur on the Mejerda the *fossa regia* can be followed by these indications for several miles along the Jebel esh-Sheid. The ditch ran northward to Tabarca and southward to Tina. The ditch which in later times divided the provinces of *Africa vetus* and *Africa nova* was at the time of the Third Punic War the boundary of Carthaginian territory. The government of the Roman province thus delimited was entrusted to a *praetor* or *propraetor*. The towns which had fought on the side of the Romans during the Third Punic War were declared *civitates liberae*, and became exceedingly prosperous, e.g., Utica, Hadrumetum and Thapsus.

After the Jugurthine war in 106 B.C. the whole of the *regio Tripolitana* on the littoral of the two Syrtes, was annexed to the Roman province. The battle of Thapsus in 46 B.C. made the Romans definitely masters of Numidia which was converted into a new province called "*Africa Nova*": the old province of Africa was known as "*Africa Vetus*."

In 31 B.C. Octavius gave up Numidia, or *Africa Nova*, to King Juba II. Five years later Augustus gave Mauretania and some Gaetulan districts to Juba, and received in exchange Numidia, which thus reverted to direct Roman control, no longer forming a distinct government, but attached to the old province of Africa. From 25 B.C. the Roman province of Africa comprised

the region between the mouth of the Ampsaga (Wad Rummel, Wad el Kebir) on the west, and the two tumuli called the altars of the Philaeni, the immutable boundary between Tripolitana and Cyrenaica, on the east (Tissot ii. 261). In the partition of the government of the provinces of the Roman empire between the senate and the emperor, Africa fell to the senate, and was henceforth administered by a proconsul.

The province of Africa was the only senatorial province whose governor was originally invested with military powers. The proconsul of Africa had command of the *legio III. Augusta* and the auxiliary corps. But in A.D. 37 Caligula deprived the proconsul of his military powers and gave them to the imperial legate (*legatus Augusti pro praetore provinciae Africae*), whose special duty it was to guard the frontier zone (Tacitus, *Hist.* iv. 48; Dio Cass. lix. 20). The headquarters of the imperial legate were originally at Cirta and afterwards at Lambaesa (Lambessa). The military posts along the frontier of the desert formed an immense arc extending from Cyrenaica to Mauretania. A network of military routes, constructed and kept in repair by the soldiers, led from Lambaesa in all directions, and stretched along the frontier as far as Leptis Magna. The powers of the proconsul scarcely extended beyond the ancient *Africa Vetus* and the towns on the littoral. Septimius Severus detached from the province of Africa the greater part of Numidia to constitute a special province governed by a *procurator*, subordinate to the imperial legate and resident at Cirta (Tissot ii. 34). This province was called Numidia Cirtensis.

In Diocletian's reform, the whole of Roman Africa, with the exception of Mauretania Tingitana (which was attached to the province of Spain), constituted a single diocese subdivided into six provinces. Changes were necessitated by the wars with the Moors and the Vandals. By a treaty concluded in A.D. 476, the Emperor Zeno recognized Gaiseric as master of all Africa. Reconquered by Belisarius in 534, Africa formed, under the name of *praefectura Africae*, one of the great administrative districts of the Byzantine empire. In A.D. 647 the Arabs penetrated into *Ifrikia*, which was destined to fall for ever out of the grasp of the Romans. In A.D. 697 Carthage was taken.

The population of Roman Africa was composed of three chief elements: the indigenous Berber tribes, the ancient Carthaginians of Phoenician origin and the Roman colonists. The Berber tribes, whose racial unity is attested by their common spoken language and by the Berber inscriptions that have come down to us, bore in ancient times the generic names of Numidians, Gaetulians and Moors or Maurusiani. Besides the Afri (Aourigha) of the territory of Carthage, the principal tribes that took part in the wars against the Romans were the Lotophagi, the Garamantes, the Misulani or Musulamii, the Massyli and the Massaeyli. African epigraphy has revealed the names of some of their deities: *deus invictus Aulisiva*; the god Motmanius, associated with Mercury; the god Lilleus; *Kautus pater*; the goddess Gilva, identified with Tellus (Tissot i. 486). There were also local divinities in all the principal districts. The rock bas-reliefs and other monuments showing native divinities are rare, and give only very summary representations.

During the Roman period the ancient Carthaginians of Phoenician origin and the bastard population termed by ancient authors Libyo-Phoenicians, formed the predominant populations of the towns on the littoral, and retained the Punic language until the 6th century of the Christian era. The municipal magistrates took the title of *suffetes* in place of that of *duumvirs*, and in certain towns the Christian bishops were obliged to know the *lingua Punica*, since it was the only language that the people understood. Nevertheless, the Roman functionaries, the army and the colonists from Italy soon brought the Latin element into Africa, where it flourished with such vigour that, in the 3rd century A.D., Carthage became the centre of a Romano-African civilization of extraordinary literary brilliancy, which numbered among its leaders such men as Apuleius, Tertullian, Arnobius, Cyprian and Augustine.

Carthage regained its rank of capital of Africa under Augustus, when thousands of Roman colonists flocked to the town. Utica

became a Roman colony under Hadrian, and the *civitates liberae*; *municipia*, *castella*, *pagi* and *turres* were peopled with Latins. The towns of the ancient province of Africa which received *coloniae* were very numerous.

The province of Numidia was at first colonized principally by the military settlements of the Romans. Cirta (Constantine) and Bulla Regia (Hammam Darraj), its chief towns, received *coloniae* of soldiers and veterans, as well as Theveste (Tebessa) and Thamugas (Timgad). The fine ruins which have been discovered at the last-mentioned place have earned for it the surname of the African Pompeii.

AFRICAN LANGUAGES. Language and race have not necessarily common boundaries, but in classifying a group of languages the relation between the two must not be ignored. Apart from recent European immigration, Africa has four main types of people: Pygmy-Bushman, Negro, Hamitic and Semitic. These four races correspond to four types of languages, though the Negro group was later subdivided into two different units, viz., Sudanic and Bantu.

There is a certain unanimity regarding the main divisions, and the five groups: Bushman, Sudanic, Bantu, Hamitic, Semitic, may be considered as finally settled. Problems on which no agreement has been arrived at are: the position of Bushman (and Pygmy), the unity of the Sudanic languages, the relation between Sudanic and Bantu, and the comprehension of the term Hamitic languages.

Semitic Languages.—These tongues are spoken in Abyssinia, probably as a result of colonization from southern Arabia. Ge'ez is extinct, Amharic (*q.v.*) is in part a modern representative of Ge'ez. Out of Amharic two new languages have evolved: Tigre and Tigrinya. Other dialects are those of Gurage and Harar. Of greater importance is Arabic, which is the ruling language in north Africa and in parts of eastern Sudan; through Islamic influence it has become a literary idiom in east Africa and the Sudan.

Bushman Languages.—The Bushman tribes speak a number of languages, which, however, are all allied and may be divided into three groups, southern, central and northern. Phonetically they are remarkable for the occurrence of the so-called clicks (*q.v.*). Another feature, not only in Bushman languages, but also in Hottentot, Sudanic and Bantu, is intonation.

Each syllable, and sometimes also a single-voiced consonant, has its own level of tone, which is as essential a part of a word as the sounds. Words with identical sounds, but differing in tone, have no etymological relation whatever to each other.

A number of the features of the Bushman languages are found in Sudanic languages, *e.g.*, intonation, monosyllabism, non-distinction between verb and noun in form, position of the genitive, formation of plural by "they" but as no etymological relations have as yet been ascertained it seems premature to ally the Bushman languages with the Sudanic group.

No Pygmy language is known. The Pygmies use their neighbours' speech. There seems to be evidence that some groups use a different mode of speech—yet unrecorded—in internal life.

Sudanic Languages.—This group is found, roughly speaking, in the stretch of the continent situated between the Atlantic ocean (Senegambia-Camerouns) and the western slopes of Abyssinia. Some enclaves, as Nuba and Kunama in the north, Gaya and Nyifwa-Kavirondo in east Africa, lie beyond this region.

This large group, stretching through the whole breadth of the continent, does not form a unit in the same sense as do the Bantu languages. It is broken up into numerous subdivisions, each of which has evolved its own type, and in the case of some tongues the divergences are so great that up to the present time, their relationship with others has not been demonstrated. The Sudan has been invaded over its whole area from time immemorial by peoples and languages from north and east. Linguistic conditions to-day are the result of this constant movement and shifting, which modified or destroyed original units and created new ones. Languages, probably whole groups of languages, have perished, or scanty remains have been embodied in new formations. As the invading tongues were largely of types differing radically from the Sudanic, these changes were radical and deeply influenced the original character of the language. Thus languages like Kanuri,

Wolof and others, have been so transformed that as yet their inclusion in the Sudanic group may seem to be merely theoretical.

Common Substratum.—While it is thus necessary to emphasize the highly complicated linguistic situation in the Sudan, and the present incomplete exploration of many problems involved, yet the Sudanic group as a whole shows certain common characteristics in phonology and structure, and there are also etymological relationships. There exists a common substratum of Sudanic speech, which is strongest where the original Negro element is strongest in population. This common substratum justifies the use of the term Sudanic languages. Some illustrations may be given: (1) the prevalence of intonation. (2) Monosyllabic stems (Ewe *ku* "death," Nuba *tu* "belly"). (3) Nouns are formed from verbs by a vocalic or nasal prefix (Yoruba *ra* "to buy," *o-ra* "buyer," Shilluk *bugo* "to press the bellows," *o-buk* "bellows"). (4) Plural of nouns is formed by adding to the noun a plural noun or pronoun (Ewe *ati* "tree," *ati-wo* "trees," Nuer *chak* "tick," *ke-chak* "ticks," *-wo* and *ke-* are the pronouns of the third person plural in Ewe and Nuer). (5) Plural of nouns is formed by adding *i* or *a* (Ibo *o-ru* "slave," *i-ru* "slaves"; Nuer *bel* "artist," *bel-i* "artists"; Edo *o-ya*, pl. *a-ya* "man"; Zande *boro*, pl. *a-boro* "man"). (6) Distinction between inanimate things and animate beings (or persons), the latter in most cases having the affix *o* (Twi *o-nipa* "man"; in Shilluk *o* designates persons as descendants of other persons: *nayo* "the mother's brother," *o-nayo* "the mother's brother's child"). There is no grammatical sex-distinction. (7) In genitive relation the possessor precedes the possessed (Twi *nipa dua* "a man's figure," Kunama *Ila masa* "Ila's lance"). (8) There is no formal distinction of case. The dative form is circumscribed by the verb "to give" (Ewe *edi'ga na fofo* "he sought money gave father": he sought money for the father. Nuba *ir iga tir onam* "you say give him": you say to him. (9) Postpositions, *i.e.*, space-denoting nouns, are used in the place of prepositions (Ewe *ati ta* "tree's head": on the tree; Nuba *ka tu* "house's belly": in the house. (10) Verbal combinations are frequent (Ewe *tso va na* "take come give": to bring to; Nuba *atta-den* from *ed-ta-den* "take come give": to bring to). (11) The verbal stem is not changed in conjugation; tenses and modes are expressed by adding grammatical form words which in many cases can be traced to original nouns or verbs (in Twi the future is formed by prefixing *ba* [from *bia*] "to come," in Nuba by prefixing *bi* "to come"). (12) Sounds peculiar to the majority of Sudanic languages are the labio-velar *kp* and *gb*. (13) A considerable number of word-stems are identical. The characteristics just mentioned are not found in each sub-group, but there is no group which does not possess a number of them.

Divisions.—The Sudanic family may be geographically divided into an eastern, a central and a western group. The largest section of the eastern group are the Niloto-Sudanic languages comprising Shilluk with its many subdivisions, Dinka, Nuer and probably also Burun between the White and Blue Niles. Nuba on the Nile, in the Nuba mountains and in Kordofan, is connected with the Nilotic group, while other languages of these mountain regions are of a distinct character, having a class division of the noun.

The central group stretches between the 30th and 10th degree east long, and is subdivided by Delafosse into (a) Nile-Congo group, which, however, contains languages that are more closely related to the eastern Sudanic group; (b) Ubangi group; (c) Shari-Wadai group; (d) Shari group; (e) Niger-Tshad group; (f) Niger-Camerouns group. Our present knowledge concerning the central Sudanic group is so insufficient that the grouping just given is only provisional.

The western Sudanic group is better known and the sub-groups are well-defined. They are the following: (1) *The Kwa languages*, spoken on the coast of Upper Guinea between the lower courses of the Niger and St. Paul's River in Liberia. Their sub-groups are: (a) Ewe-Akan group (Gold Coast, Togo, Dahome); (b) Lagoon group in the littoral regions of the Ivory Coast; (c) Kru group, reaching from the western Ivory Coast to the mouth of St. Paul's River; (d) Yoruba group; (e) Nupe group; (f) Ibo group; (g) Edo group; (h) Ijo (*d-h* in Nigeria). In the Kwa

languages the majority of word-stems consists of one consonant and one vowel. Akan *ka* "to remain," *wu* "to die." They have vocalic and nasal nominal prefixes, whose function is to form nouns out of verbs, and which are only absent in Kru. The prefixes do not form class divisions of the noun, except in rudiments.

(2) *Bénue Cross River languages*. They partly coincide with Delafosse's Niger-Cameroons group and with Johnston's group A in his Bantu and Semi-Bantu languages, group (b) including Johnston's groups B-G, and group (c) comprising Johnston's group H. The languages of this group have many stems which end in a consonant. Efik *wut* "to kill" against Ewe *wu* "to kill." They have the same nominal prefixes as in group (1) (Efik *fime* "to blow," *o-fime* "wind"), but some languages have a system of prefixes which forms classes. As the group lies on the borderline between Sudanic and Bantu, some of its languages represent a stage of transition between the two.

(3) *Middle Togo group*. Most of these occupy a very small area, being situated in the mountainous region between the 7th and 8th degree N. lat.; some of them are disappearing or have already disappeared, being absorbed by Ewe and Akan. Among those which continue to exist are Avatime, Likpe, Adele, Kposso, Kebu. The word-stems in this group consist mainly of one consonant and one vowel. Kposso *wu* "to kill." A class division of nouns is formed by prefixes; some languages use class-suffixes besides the prefixes. The group stands between groups (1) and (4), having distinct connections with both.

(4) *Gur (Goor) languages*, in the northern section of the Ivory and Gold Coast, of Togo and of Dahome, and in the adjacent parts of Haute Volta. They include the following sub-groups: (a) Mossi group (Mossi, Dagomba, etc.), (b) Grussi or Gurunsi group, (c) Tem group, (d) Bargu, (e) Gurma group, (f) Kilina, (g) Senufo or Siena group, (h) Songai. The latter is in fact an isolated language having its own type, but is remotely connected with the Gur languages. Stems of the form consonant plus vowel are very frequent, though perhaps not in the majority. Dyan *wu* "to kill." All have class division of nouns by suffixes; Gurma and Tem use prefixes and suffixes.

(5) *West Atlantic languages*. These are found in part of the territory between the Senegal and the Atlantic, with a number of enclaves farther east, and are sub-divided into an eastern group, comprising Temne, Bulom, Limba, Kissi, Gola and Adjukru, and a western group, represented by (a) Dyola, (b) the Bissao-Bolama cluster (Bola, Sarar, Pepel, Kanyop), (c) the Geba cluster (Biafada, Padjade), (d) Banyun, Nalu, Bulanda, (e) Konyagi, (f) Bidjogo, (g) Wolof and Serer. Neither in general type nor in phonology and etymology do the members of this group form such a close unit as those of the preceding group. Almost all have class division of nouns; some, as Bulom, Temne, Adjukru, by prefixes, Gola by prefixes and suffixes, Wolof and Serer have suffixes, but also change the beginning consonant, which perhaps points to prefixes. Stems consisting of a consonant and a vowel are frequent (Bulom *wu* "to die"), but they are in a minority.

(6) *Mandingo or Mande languages*, in the western Sudan between groups (4) and (5). They fall into two groups, named after the numeral for "ten" prevailing in each group: (a) *Mande tan*, with Bambara, Soninke, Malinke, Dyula, as main representatives, (b) *Mande fu*, comprising Susu, the Kpelle-Mende cluster, in Sierra Leone and Liberia (Mende, Kpelle, Gbande, Gbunde, Toma, Mano, Gio), Djalonka in French Guinea, and a number of small languages reaching as far east as the north-west corner of Nigeria (Boko-Busa). In the Mandingo tongues two-syllabic words prevail; many of these are compositions of two monosyllabic stems, each consisting of a consonant and a vowel. There are no word-forming prefixes, except in rudimentary forms. The word may often have a verbal and a nominal meaning: Bambara *ti* "thatch" and "to thatch."

Bantu Languages.—These, spreading through the southern half of the continent, form a closely united family with clearly defined features. Though the most prominent of these, the class division of nouns by prefixes, also exists in Sudanic groups, it has in Bantu reached a fuller development and has become the

dominating factor in their structure. These prefixes also form the plural; thus *m-swahili* a Swahili, *wa-swahili*, Swahili people, *ki-swahili* the Swahili language. The prefix belonging to a noun is repeated (though sometimes in a changed form) before every adjective, noun or pronoun agreeing with the noun; Swahili: *ki-su ki-kali ki-moja ki-me-potea* "knife sharp one has been lost": one sharp knife has been lost; *-su* "knife" has *ki-* as its class prefix, and this is repeated before every word agreeing with *-su*. The plural prefix corresponding to *ki-* is *vi-*; thus the plural of the preceding sentence is: *vi-su vi-kali vi-nane vi-me-potea* "eight sharp knives have been lost." The main nominal classes are: (a) for "man as an independent personality"; (b) for "man in dependent position" (slave, messenger, workman), also for physical agents, spirits, diseases, parts of the human body, animals, plants; (c) for objects existing in double or divisible form, the plural also designating collectives and liquids; (d) for "customs, usages, tools"; (e) for animals; (f) for individual objects and abstract nouns; (g) for diminutives; (h) for infinitives; (i) (or rather three) for locatives. Clicks (probably borrowed from Bushman and Hottentot) and lateral sounds are peculiar to some South African Bantu languages. Intonation is in most tongues not so important as in the Sudanic family. Stress accent is more developed than in the latter, the accent lying generally on the penultimate. Two-syllabic stems are prevalent. There is no grammatical gender, sex being indicated as in Sudanic languages, and no case inflection. The genitive follows the governing noun. The verb has a large number of derivative forms, which afford a remarkable richness in expression, e.g., Swahili *vunja* "to break," *vunjika* "to be broken"; *penda* "to love," *pendana* "to love each other"; *takata* "to be clean," *takasa* "to cleanse"; from *pata* "to obtain" the following derivatives may be formed: *patana* "make an agreement," *patanisha* "unite," *patia* "obtain for somebody," *patika* "be seized," *patilia* "reach out for something," *patiliza* "make one vexed," *patilizima* "vex each other."

It is more difficult to group the Bantu languages in subdivisions than the Sudanic languages, where the evolution of independent types is evident at first sight.

According to Homburger, Bantu is divided into the following groups (of the individual languages belonging to each group only a certain number can be mentioned here): (1) Northern or Ganda group (Ganda, Nyoro, Kerewe). (2) Ruanda group (Ruanda, Rundi). (3) North-eastern or Kilimanjaro group (Kikuyu, Kamba, Djagga, Moshi, Siha). (4) Northern group of the east coast (Taveta-Taita, Chassu, Pokomo, Nika, Shambala, Bondei, Zigula, Swahili, Comore, Zaramo, Kami, Matumbi). (5) East African group (Nyamwezi, Nyaturu, Gogo, Hehe, Pogoro, Kaguru, Konde, Yao, Nyanja, Sene, Tete, Chwabo or Kilimane). (6) South-eastern group (Makua, Ronga or Thonga, Gwamba or Hlengwe, Chopi or Lenge, Venda, Sotho, Kololo, Chwana). (7) Zulu group (Kafir or Xosa, Zulu, Tebele, Ngoni). (8a) Central group (Tabwa, Bemba, Mambwe, Bisa or Wisa, Lala-Lamba, Senga, Tonga, Subiya). (8b) Western group (Herero, Ndonga, Kwanyama, Nyaneke, Mbunda, Luyi, Umbundu, Kimbundu, Lunda, Luba or Lua). (9) Congo group (Congo, Kanioka, Kutsu, Kele, Lolo, Nkundu). (10) North-western group (Bangi, Teke, Kalai or Kele, Galoa, Duma, Benga, Noho, Basa, Duala, Bube, Kwiri, Isubu). This division appears to call for a new investigation based on a careful observation of sound-shifting, for which a good start has been made by van Warmelo in his study on South African Bantu languages.

Hamitic Languages.—These represent a linguistic type which is more closely allied with the Semitic than with any other group of African languages. Their main divisions are (1) Eastern Hamitic in north-east Africa, including, among others: Bedauey, Bogos, Danakil, Somali, Galla, Agau, Kaffitsho. (2) Niloto-Hamitic: Masai, Ndorobbo, Tatoga, Nandi, Suk, Turkana, Gimirra. (3) Western Hamitic: The Berber dialects from western Morocco to the oasis of Siwa, Tuareg, and probably the extinct language or languages of the Guanches on the Canary islands. Hausa (*q.v.*), may be called a remoter member of this sub-group. Though it has adopted many elements from neighbouring Sudanic tongues,

its Hamitic affinity cannot be doubted. Hottentot in South Africa also shows certain Hamitic features, but recent investigations, especially those undertaken by Schapera, reveal such undeniable affinities between the Hottentot and Bushman languages (*q.v.*), as can hardly be explained by borrowing, but seem to point to a genetic relation between the two. Distinction of sex, always one of the prominent reasons for including Hottentot in the Hamitic family, is also found in Naron, a Bushman tongue, being in both cases expressed by a suffix. Both Nama and Naron have a dual form besides singular and plural, *ǀxam* and *Nama* have inclusive and exclusive forms of the first person plural (including or excluding the person addressed). There are other common features in grammar and a considerable number of words common to both. Schapera's conclusion is "that in spite of the many noticeable differences between them the Hottentot and Bushman tongues must be regarded as belonging to one and the same family of languages."

The characteristic features of Hamitic speech are: (1) Grammatical gender. Shilh masc. *idilli*, fem. *t-idilli-t* "black," Masai *ol dia* "male dog," *es dia* "female dog," Nama *khoib* "man," *khois* "woman," Hausa *ya* "he," *ta* "she." (2) a richness in plural formation, which may form such distinctions as distributive, collective, general and universal plurality. Bilin *dimmū-rā* "an individual of the cat family," pl. *dimmū-t*; but: *dimmū* "cat," pl. *diamū* "cats." Chamir *ieslemā* "a Muslim," pl. *ieslem-en*, but *ieslem-en-t* "the Muslim world." In Hausa (*q.v.*), most nouns have several plural forms; *kumba* "finger-nail" has the plural forms *kumbōbi*, *kumbuna*, *kumbai*, *kumbaibai*. Here as in other Hamitic (and Sudanic) languages re-duplication is frequently used in forming the plural. (3) Inner vowel change (ablaut): Shilh *iliwi*, pl. *ilaw-an* "thorn"; *a-fult*, pl. *t-fel-en* "string" (the changes are, however, caused by vowel-assimilation, and are thus a phenomenon found likewise in Sudanic languages); in verbs: Shilh *of-aji* "I find," *ufi-ji* "I have found." (4) As in Bantu, the genitive follows the governing noun. In Hottentot, however, as in Bushman and Sudanic (and also Bedaue), the possessor precedes the possessed.

Fulfulde.—Meinhof includes Fulfulde, the language of the Fulbe, in the Hamitic family, but calls it Proto-hamitic or Pre-hamitic. Fulfulde has the usual Hamitic genitive position, in which the governing noun precedes the genitive, but other features regarded as Hamitic are absent. Fulfulde has no grammatical gender; there is no different plural form of nouns, and there is no inner vowel change. It is decidedly a class language, *i.e.*, like Bantu and many Sudanic languages it divides nouns into classes by affixes, and this fact separates Fulfulde from the Hamitic stock and draws it near Bantu languages and the Sudanic class languages. The connection between Fulfulde and Bantu is recognized by Meinhof, his opinion being that "originally in the whole of the present Bantu region languages of a Sudanic type were spoken, until from the north tribes with a language similar to Fulfulde penetrated and made themselves lords over the old inhabitants. The result of a mixture of these two elements was Bantu." (c D. Kolonial-Lexikon i. p. 133.) The essential identity of the class-affixes as used in Fulfulde, in Sudanic class languages and in Bantu, in their etymological form as well as in their function, is evident, while in point of vocabulary Fulfulde and Bantu differ widely.

On the other hand there is an original affinity between Bantu and Sudanic languages. This refers not only to class-affixes, but also and still more to etymology. The two families have a considerable number of word-stems in common, and also certain formative elements, apart from class-affixes, are identical in both families.

The situation may be summed up as follows: The Negro population of Africa, comprising the Bantu and the Sudanic speaking peoples, has in etymology and in a number of formative elements a common linguistic substratum. The class division of nouns existing in Fulfulde, in Bantu and in certain Sudanic languages is evidently of common origin, where or from what language it may have originated we do not know.

According to Struck, the number of African languages is as

follows: Bushman 11, Sudanic 264, Bantu 182, Hamitic 47, Semitic 10. Many of these occupy a small area, and perhaps not more than 12 are spoken by more than a million people. From the practical point of view, some of the most important African languages are (Semitic): Amharic, Arabic; (Hamitic): Hausa; (Bantu): Ganda, Kikuyu, Kongo, Luba-Lulua, Mbundi, Ngala, Nyanja, Sukuma-Nyamwezi, Ruanda-Rundi, Sotho-Pedi-Chwana, Swahili, Swina-Karanga-Ndau, Zulu-Xosa; (Sudanic): Akan, Dinka-Nuer, Efik-Ibibio, Ewe-Aneho-Dahome, Ibo, Kanuri, Kpelle-Mende, Malinke-Djula-Bambara, Mossi-Dagomba, Nupe-Gbari, Temne, Wolof, Yoruba, Zande.

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AFRICAN LILY (*Agapanthus Africanus*), a member of the family Liliaceae, a native of the Cape of Good Hope, from which source it was introduced at the close of the 17th century. It is a handsome greenhouse plant, which is hardy in the south of England and the warmer parts of the United States. The basal, tufted leaves are long, narrow, arching, $\frac{1}{2}$ to 2 ft. long. A central flowerstalk, 2 to 3 ft. high, ends in an umbel of bright blue, funnel-shaped flowers. The plants are easy to cultivate and are generally grown in large pots or tubs which must be protected from frost in winter. During the summer they require plenty of water and are very effective on the margins of lakes or running streams, where they thrive admirably. It may be propagated by dividing the rootstock in early spring or autumn. Dwarf and white-flowered forms are known in cultivation.

AFRICANUS: see *SCRIPTO*.

AFRICANUS, SEXTUS IULIUS, a Christian traveller and historian of the 3rd century, was probably born in Libya and lived at Emmaus. He may have served under Septimius Severus against the Osroenians in A.D. 195. He wrote a history of the world (*Χρονογραφία*, in five books) from the creation to A.D. 221, calculating the period between the creation and the birth of Christ as 5,499 years, and ante-dating the latter event by three years. This method of reckoning, known as the Alexandrian era, was adopted by almost all Eastern Churches. The history, which had an apologetic aim, is no longer extant, but copious extracts from it are to be found in the *Chronicon* of Eusebius. There are also fragments in Syncellus, Cedrenus and the *Paschale Chronicon*.

Eusebius also gives a letter to Aristeides, and one to Origen, imputing the authority of the book of Susanna. The ascription to Africanus of the *Keσtol*, a work on agriculture, natural history, military science, etc., has been disputed. Neander suggests that it was written by Africanus before he had devoted himself to religious subjects. For a new fragment of this work see *Oxyrhynchus Papyri* (Grenfell and Hunt), iii. 36 et seq.

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AFRIDI, the most powerful of the Pathān tribes inhabiting the mountains on the northwest frontier of Pakistan, though less numerous than the Wazīrs. They occupy the eastern spurs of the Safed Koh. Through the north of these runs the Khyber pass, and their centre is the great upland country called Tirah, 6,000 or 7,000 ft. above sea level, of which the Orakzais hold the southern half. The Afridi borders are the Peshawar district on the east and north, the Mohmands on the north, the Shinwāris on the west and the Orakzais and Bangash on the south, including the valleys of Bārā and Bāzār. The origin of the Afridis is unknown. They have a curiously Jewish cast of features, but have been supposed to be the Aparytai of Herodotus, though for more than 2,000 years their history is untraceable. It is, however, certain that about the 15th century they ousted the Tirahis, doubtless absorbing some of their elements; but their conquests were encroached upon by their neighbours, and it was not until Jahangir's reign that they retook half of Tirah from the Orakzais. Under Akbar they embraced the Roshania heresy, but after its suppression they enlisted freely in the Mogul armies and were subsidized to keep open the Khyber pass. But they failed to defend it against Nadir Shah, and were content to levy toll on such trade as filtered through it during the Abdālī and Sikh regimes. On the British annexation their independence was respected, in spite of their appeal to the Indian government to take Tirah, and they were subsidized to protect trading caravans travelling through the Khyber, but their internal feuds rendered it unsafe. In 1897 the Afridis enrolled in the Khyber militia made a gallant defense of Landi Kotal, but eventually surrendered. The defection of one of their most turbulent clans, the Zakka Khel, soon involved the whole tribe and the Orakzais as well. This necessitated a regular invasion of Tirah under Sir William Lockhart, and after much hard fighting every part of the country was traversed and surveyed, all the disaffected sections of the tribes being punished, the Zakka Khel being the last to submit. In 1908 an expedition had again to be launched against the Jawakki Khel. The Afridis are intensely democratic, the heads of clans having little authority, so that raiders cannot be brought to book or tribal engagements enforced. The tribe has furnished many good soldiers in the Indian army.

(H. A. R.)

Military Operations.—There were several British expeditions

against the separate clans:

1. Expedition against the Kohat pass Afridis under Sir Colin Campbell in 1850. The British connection with the Adam Khel Afridis commenced immediately after the annexation of the Peshawar and Kohat districts. Following the example of all previous rulers of the country, the British agreed to pay the tribe a subsidy to protect the pass. But in 1850 1,000 Afridis attacked a body of sappers engaged in making the road, killing 12 and wounding 6. It was supposed that they disliked the making of a road which would lay open their fastnesses to regular troops. An expedition of 3,200 British troops was dispatched, which traversed the country and punished them.

2. Expedition against the Jowaki Afridis of the Bori villages in 1853. When the Afridis of the Kohat pass misbehaved in 1850, the Jowaki Afridis offered the use of their route instead; but they turned out worse than the others, and in 1853 a force of 1,700 British traversed their country and destroyed their stronghold at Bori. The Jowaki Afridis are a clan of the Adam Khel, who inhabit country between the Kohat pass and the Indus.

3. Expedition against the Aka Khel Afridis under Colonel Craigie in 1855. In 1854 the Aka Khel, not finding themselves admitted to a share of the allowances of the Kohat pass, commenced a series of raids on the Peshawar border and attacked a British camp. An expedition of 1,500 troops entered the country and inflicted severe punishment on the tribe, who made their submission and paid a fine.

4. Expedition against the Jowaki Afridis under Colonel Maccatta in 1877. In that year the government proposed to reduce the Jowaki allowance for guarding the Kohat pass, and the tribesmen protested this by cutting the telegraph wire and raiding British territory. A force of 1,500 troops penetrated their country in three columns, and did considerable damage.

5. Expedition against the Jowaki Afridis under Brig. Gen. Sir Charles Paton Keyes in 1877–78. The punishment inflicted by the previous expedition did not prove severe enough, the attitude of the Jowakis continued the same and raids into British territory went on. A stronger force, therefore, of 7,400 British troops, divided into three columns, destroyed their principal villages and occupied their country for some time, until the tribe submitted and accepted government terms. The Kohat pass was afterward practically undisturbed.

6. Expedition against the Zakka Khel Afridis of the Bazar valley under Brig. Gen. John Adams Tytler in 1878. At the time of the British advance into Afghanistan, during the second Afghan War, the Zakka Khel opposed the British advance and attacked their outposts. A force of 2,500 British troops traversed their country, and the tribesmen made their submission.

7. Expedition against the Zakka Khel Afridis of the Bazar valley under Lieut. Gen. Sir Frederick Francis Maude in 1879. After the previous expedition the Afridis of the Khyber pass had continued to give trouble during the progress of the second Afghan War, so another force of 3,750 British troops traversed their country, and after suffering some loss the tribesmen made their submission. After this both the Khyber and Kohat passes were put on a stable footing, and no further trouble of any consequence occurred in either down to the time of the frontier risings of 1897, when the Afridis attacked the Khyber, which was defended by Afridi levies.

8. For the Tirah campaign of 1897 see **TIRAH**.

9. In Feb. 1908 the restlessness of the Zakka Khel again made a British expedition necessary.

During World War I the danger of a rising was averted by the decision to double the Afridis' allowances. They joined forces with the Afghans in 1919. After their submission in 1921 they co-operated in the construction of the Khyber railway.

See W. H. Paget and A. H. Mason, *Record of the Expeditions against the North-West Frontier Tribes* (London, 1884); Sir R. Warburton, *Eighteen Years in the Khyber* (London, 1900); C. C. Davies, "British Relations with the Afridis of the Khyber and Tirah," *Army Quarterly*, vol. xxiii, 2 (London, 1932).

AFRIKANDER BOND, a party, founded in Cape Colony by the Rev. S. J. du Toit in 1879, aiming at federating South Africa in one independent republic. The official optional use of



ORIENT AND OCCIDENT PHOTO
AN AFRIDI TRIBESMAN
ON THE INDO-AFGHAN
BORDER, WITH HIS HOME-
MADE "MAUSER"

Dutch in parliament and the law courts was secured, but under the leadership of Hofmeyr and the influence of Cecil Rhodes its anti-British sentiments were greatly modified. It was always, however, essentially an organization for the promotion of the political supremacy of the Cape Dutch. (See also HOFMEYR, JAN HENDRIK; CAPE PROVINCE; and SOUTH AFRICA, UNION OF.)

AFTERBIRTH, a term used to include the placenta, foetal membranes and umbilical cord. They are usually expelled from the womb in a single mass 15 to 30 minutes after the birth of the child. The placenta is a soft, beefy red disk, about 8 to 10 in. in diameter and 1 to 1½ in. in thickness. It is the organ by which the mother nourishes the child and is composed largely of capillary loops from mother and child, in close contact. While the mother's blood does not pass into the blood vessels of the child, the constituents necessary for growth pass through the capillary walls into the child's circulation by a process called osmosis, while the waste products in the foetal blood pass in the other direction and are eliminated by the mother. One surface of the placenta is attached to the inside of the womb, whence it draws its maternal blood. The other surface presents the branching blood vessels of the foetus which unite into one artery and two veins. These vessels form the umbilical cord, which usually starts from the middle of the placenta and enters the body of the foetus at the navel. It is about 22 in. long. Around the edge of the placenta can be found the thin torn membrane which envelops the foetus in the womb. It forms the water bag in which the foetus floats, and usually breaks shortly before the birth of the child. If, however, the child is born with the membranes intact, he is said to be born in a caul.

AFTERDAMP, in coal mining, a name given to the poisonous choking gas which forms after a mine explosion. It mainly consists of carbon dioxide, and is also known as choke-damp. (See CHOKEDAMP.)

AFTERGLOW, a broad high arch of radiance or glow seen occasionally in the western sky above the highest clouds in deepening twilight, or reflected from the high snowfields in mountain regions long after sunset. It is caused by very fine particles of suspended dust in the high atmosphere exercising a scattering effect upon the components of white light. After the eruption of Krakatoa in 1883, a remarkable series of red sunsets appeared all over the world. These were consequent on the spread by atmospheric currents of huge quantities of fine volcanic dust.

AFTERIMAGE, the immediate recurrence of a sensation, in like or opposite quality, after the removal of its stimulus. Afterimages are most prominent in vision. If a person gazes steadfastly at a small coloured object for half a minute and then turns his eyes away to a neutral background, he will notice a small coloured spot of complementary hue and brightness. These are called negative afterimages. If the object was red, the afterimage is bluish green; if it was emerald green, the afterimage is pink; if it was dark, the afterimage is light. Positive afterimages resemble the stimulus in brightness and hue and usually last only a few seconds. They are favoured by intense illumination in the stimulus, occurring after the eye has been in the dark. Positive afterimages occur from pressure, temperature and the sensations of bodily movement and posture. There are no afterimages from sounds or odours. (See VISION.)

AFZELIUS, ADAM (1750–1837), Swedish botanist, was born at Larf, Västergötland, Oct. 8. He founded the Linnaean institute at Uppsala in 1802, and in 1812 became professor of *materia medica* at the university. From 1792 he had spent some years on the west coast of Africa, and in 1797–98 he acted as secretary of the Swedish embassy in London.

Afzelius died at Uppsala in 1837.

In addition to his various botanical writings he published the autobiography of Linnaeus in 1823.

His brother **JOHAN AFZELIUS** (1753–1837) known as *Arvidson*, was professor of chemistry at Uppsala; and another brother, **PER AF** (1760–1843), who became professor of medicine at Uppsala in 1801, was distinguished as a medical teacher and practitioner.

AFZELIUS, ARVID AUGUST (1785–1871), Swedish poet, historian and mythologist. From 1828 till his death he was

parish priest of Enköping. He collaborated with the learned historian, Erik Gustaf Geijer, in the great collection of Swedish folk songs, *Svenska folksvisor från forntiden* (1814–16). He published also translations of the *Såmunder Edda* and *Herwara-Saga* and a history of Sweden to Charles XII (of which a German translation was published in 1842), as well as original poems.

AGA or **AGHA**, a word, said to be of Tatar origin, signifying a dignitary or lord. Among the Turks it was applied to the chief of the janissaries, to the commanders of the artillery, cavalry and infantry and to the eunuchs in charge of the seraglio. It was also employed generally as a term of respect in addressing wealthy men of leisure, landowners, etc.

AGADE, the capital city of "Sargon of Agade." The city is probably identical with Tal-ed-Deir, excavated by Sir E. A. Wallis Budge in 1891. The inscriptions suggest that it was near Sippar, and Langdon identifies it with Sippar-Yakhuru, admitting, however, that the identification is uncertain. At ed-Deir is a massive city wall forming two sides of a triangle; the third side was formed either by the Euphrates or by a canal. The main gate was at the western apex of the triangle. The city appears to have been constructed all at once, primarily as a fortress. Sargon, who is said to have been a gardener of Semitic origin at Kish, overthrew the Sumerian power of Kish and changed his capital to Agade.

BIBLIOGRAPHY.—E. A. Wallis Budge, *By Nile and Tigris* (1920); S. Langdon, *Excavations at Kish* (1924).

AGADIR, a town of French Morocco on the Atlantic coast, 6 mi. N. of Wadi Jus. Pop. 5,626. It was the scene of Portuguese fisheries from 1500 and became a commercial centre. It came into prominence during the Moroccan crisis of 1911; in 1912 it passed to France. It has the natural facilities for the best harbour on the Atlantic coast of Morocco, but these remain undeveloped.

AGA KHAN I, HIS HIGHNESS THE (1800–1881), the title accorded by general consent to **HASAN ALI SHAH** (born in Persia, 1800), when he settled in Bombay under the protection of the British government. He was believed to have descended in direct line from Ali by his wife Fatima, the daughter of the prophet Mohammed. Ali's son, Husain, having married a daughter of one of the rulers of Persia before the time of Mohammed, the Aga Khan traced his descent from the royal house of Persia from the most remote, almost prehistoric, times. His ancestors had also ruled in Egypt, as caliphs of the Beni-Fatimites for a number of years, at a period coeval with the crusades. Before the Aga Khan emigrated from Persia, he was appointed by Fateh Ali Shah to be governor general of Kerman and ruled with firmness, moderation and high political sagacity. At last, however, he incurred the mortal displeasure of Fateh Ali Shah. He fled from Persia and sought protection in British territory, preferring to settle down eventually in India, making Bombay his headquarters. In crossing over from Persia through Afghanistan the Aga Khan found opportunities of rendering valuable services to the British army in Afghanistan and thus cast in his lot with the British. A few years later he rendered conspicuous services in the course of the Sind campaign, when he helped Sir Charles Napier in the process of subduing the frontier tribes, a large number of whom acknowledged the Aga's authority as their spiritual head. When he finally settled down in India, his position as the leader of the large Isma'iliyah section of Mohammedan British subjects was recognized by the government, and the title of "his highness" was conferred on him, with a large pension. From that time until his death in 1881 the Aga Khan continued to discharge his sacerdotal functions, not only among his followers in India, but toward the more numerous communities which acknowledged his religious sway in Afghanistan, Khurasan, Persia, Arabia, central Asia, and even distant Syria and Morocco. He remained loyal to the British *raj*, and his vast and unquestioned influence among the frontier tribes on the northern borders of India proved of great service in the several expeditions led by British arms. He was also able to check the more turbulent Mohammedans in British India.

He was succeeded by his eldest son, **AGA KHAN II**. This prince continued the traditions and work of his father and was a member of the legislative council of Bombay.

AGA KHAN III (1877–) (Aga Sultan, Sir Mohammed Shah), only son of the foregoing, succeeded him in 1885. He was born in 1877 and, under the care of his mother, a daughter of the ruling house of Persia, was given not only the indispensable religious and oriental education but a sound European training. The Aga Khan headed the Moslem deputation in 1906 to the viceroy, Lord Minto, which submitted the case for encouraging abandonment of the studied aloofness of their community from Indian political life; and he was president of the All-India Moslem league, thereupon formed, during its first constructive years. He initiated the fund for raising the Mohammedan college at Aligarh to university status, which was effected in 1920. In the immediate prewar years he did much to soothe Indian Moslem sentiment in respect to the Italo-Turkish and two Balkan wars. He was touring among his followers in east Africa, when World War I broke out; immediately he cabled to the *jamats* or councils of the millions of Isma'ilihs within British territories and on their borders directing his followers to place themselves unreservedly at the disposal of the British authorities. When Turkey was drawn into the struggle the Aga Khan issued a stirring manifesto showing that the Allies had no overt designs on Islam and calling upon the Moslems of the empire to remain loyal and faithful to their temporal allegiance. His influence was reinforced by his intimate contact with leading Allied statesmen and the breadth and liberality of his outlook on the problems of reconstruction. His study of Indian and middle eastern affairs in *India in Transition* (1918) was not without considerable effect in the final shaping of reforms under the India act of 1919, and was consistent in broad principle with his postwar criticisms of the British government's Mesopotamian and Arabian policy.

The Aga Khan joined in many representations, public and private, both at the Paris conference and subsequently, as to the immense importance to Great Britain, the ruler of the greatest aggregation of Moslems in the world, of not depriving Turkey of a real independent existence. To the G.C.I.E. and the G.C.S.I. already conferred on him there was added in 1916 a salute of 11 guns and the rank and status of a first-class chief of the Bombay presidency, the only previous instance of the grant of a salute outside the Indian territorial ruling families being that of the first Salar Jung. In 1930 and 1931 he was chairman of the British Indian delegation to the Round Table conference held in London to discuss Indian constitutional development. He also represented India at the World Disarmament conference in Geneva in 1932. He led the Indian delegation to the League of Nations assembly from 1932 to 1937 and was the first Indian to be appointed president of the League assembly (1937). Known moreover to the public as a successful breeder and trainer of race horses, the Aga Khan won the Derby with Blenheim in 1930 and with Mahmoud in 1936; and in 1935 his horse Bahram won the Triple crown by carrying off the Two Thousand Guineas, the Derby and the St. Leger.

See N. M. Dumasia, *The Aga Khan and His Ancestors* (Bombay, 1939).

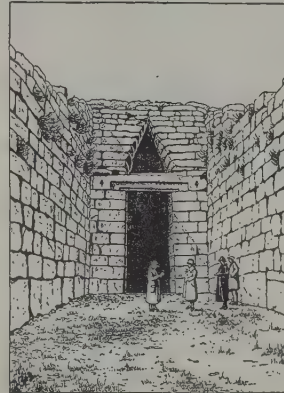
AGALMATOLITE, a soft variety of the mineral pyrophyllite (HAlSi_2O_6), also called *pagodite*, used by the Chinese for carving, especially into grotesque figures (whence called "figure-stone").

AGAMEDES, in Greek legend, king of Orchomenus in Boeotia. He and his stepbrother Trophonius were skilled architects and constructors of underground shrines and treasure houses. When building a treasure house for the Boeotian king, Hyrieus, the brothers fixed one of the stones in the wall in such a manner that they could remove it whenever they pleased and help themselves to the treasure. Hyrieus set a trap in which Agamedes was caught; Trophonius to prevent discovery cut off his brother's head and fled with it. He was pursued by Hyrieus, and swallowed up by the earth in the grove of Lebadeia. On this spot was the oracle of Trophonius in an underground cave; those who wished to consult it, first offered a ram and called upon the name of Agamedes. A similar story is told of the treasure of Rhampsinitus by Herodotus (ii, 121). The brothers built the temple of Apollo at Delphi. When they asked for a reward,

the god promised them one in seven days; on the seventh day they died.

AGAMEMNON, a Homeric hero, son of Atreus, and Aërope, grandson of Pelops, great-grandson of Tantalus and brother of Menelaus. After the murder of Atreus (*q.v.*), Agamemnon and Menelaus took refuge with Tyndareus, king of Sparta, whose daughters, Clytaemnestra and Helen, they respectively married. By Clytaemnestra, Agamemnon had three daughters, Iphigeneia (Iphianassa), Electra (Laodice), Chrysothemis, and a son, Orestes. Menelaus succeeded Tyndareus, and Agamemnon, with his brother's assistance, drove out Aegisthus and Thyestes, and recovered his father's kingdom. He extended his dominion by conquest, and became the most powerful prince in Greece. When Paris (Alexander), son of Priam, had carried off his brother's wife, he went around to the princes of the country and called upon them to unite in a war of revenge against the Trojans. He himself furnished 100 ships, and was chosen commander

in chief of the combined forces. The fleet, numbering 1,200 ships, assembled at the port of Aulis in Boeotia, but was prevented from sailing by calms or contrary winds. Calchas announced that the wrath of Artemis could only be appeased by the sacrifice of Iphigeneia (*q.v.*). The fleet then set sail.



BY COURTESY OF AMERICAN WOMEN'S HOSPITALS

THE TOMB AT MYCENAE, GREECE, KNOWN FOR YEARS AS THE TREASURE HOUSE OF ATREUS, AND CALLED THE TOMB OF AGAMEMNON

Little is heard of Agamemnon until his quarrel with Achilles (*q.v.*). After the capture of Troy, Cassandra, the daughter of Priam, fell to his lot in the distribution of the prizes of war. On his return, after a stormy voyage, he landed in Argolis. Aegisthus, who in the interval had seduced his wife Clytaemnestra, treacherously slew him with her help, Cassandra also perishing. The murder of Agamemnon was avenged by his son Orestes (*q.v.*). Agamemnon is quite possibly a more or less historical character, overlord of the Mycenaean or Achaean states of the Greek mainland. In Hellenistic times, at Sparta, he was worshipped under the title of Zeus Agamemnon. His tomb was pointed out among the ruins of Mycenae and at Amyclae.

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AGANA, the capital and largest of 15 cities of the island of Guam, is located on the central portion of the island's west coast, on a sandy beach surrounding Agana bay and at the mouth of the small Agana river. The city is about 5 mi. N.E. of Piti, the port of entry for water shipments with which it is connected by road. Before World War II about half of the population of Guam lived in Agana; the city's 1940 population was 10,004. During the war Agana and many other towns and villages were destroyed and their populations dispersed. The Guam Planning commission was established after the war to rebuild the capital. The city's non-American population is almost entirely Chamorro. The mean annual temperature is about 81° F., and is nearly constant throughout the year. The municipal government is headed by a chief commissioner, a native popularly elected for a four-year term. The city is divided into ten districts or *barrios*, each of which is a group of households with its own chapel and exercising certain powers of local autonomy. Agana was the seat of government under Spain, which ruled Guam for 300 years; the U.S., which acquired the island on Feb. 1, 1899; and Japan, which occupied Guam from 1942 to 1944.

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AGAPĒ, the early Christian love-feast (Gr. ἀγάπη, "Love"). The word seems to be used in this sense in Jude 12, but cf. 2 Pet. ii. 13, where the reading is ἀπάταις ("deceits") for ἀγάπαις. The history of the *agapē* coincides, until the end of the 2nd century, with that of the eucharist (*q.v.*), and Tertullian's detailed account (*Apology*, c. 39) of the *agapē* is not, perhaps, exclusive of an accompanying eucharist: "It is the banquet (*triclinium*) alone of the Christians that is criticized. Our supper (*coena*) shows its character by its name. It is called by a word which in Greek signifies love (*i.e.*, *agapē*). Whatever it costs, it is anyhow a clear gain that it is incurred on the score of piety, seeing that we succour the poorest by such entertainments (*refrigerio*). We do not lie down at table until prayer has been offered to God, as it were a first taste. We eat only to appease our hunger, we drink only so much as it is good for temperate persons to do. If we satisfy our appetites, we do so without forgetting that throughout the night we must say our prayers to God . . . After washing our hands and lighting the lamps, each is invited to sing a hymn before all to God, either taken from holy writ or of his own composition. So we prove him, and see how well he has drunk. Prayer ends, as it began, the banquet."

This evidence is good for Africa. But in Egypt about the same time (180–210), Clement of Alexandria (*Paedagogus*, ii. 1) condemns the "little suppers which were called, not without presumption, *agapē*." This word, he complains, should be used only for the eucharist, not for mere junketings, into which the love-feasts of the church had degenerated. Tertullian too in his tract on fasting (ch. xvii.) mentions grave scandals in connection with the *agapē*.

Ch. xiii. of the tract *About Virginity* (printed among the spurious works of Athanasius) describes a ritual meal which like that in 1 Cor. xi. is *agapē* and eucharist in one, and it is held in a private house, not in church, and the celebrants are holy women.

The historian Socrates (*Hist. Eccl.*, v. 22) records the survival (which he characterizes as singular), around Alexandria and in the Thebaid, of love-feasts combined with the eucharist. So Basil of Cappadocia (Ep. 93), c. 350, states that in Egypt the laity, as a rule, celebrated the communion in their own houses, and partook of the sacrament by themselves whenever they chose. In the old Egyptian church order, known as the *Canons of Hippolytus*, there are numerous directions for the service of the *agapē*, held on Sundays, saints' days or at commemorations of the dead. Chrysostom describes (homily 54, tom. v., p. 365) how after the eucharistic synaxis the faithful remained in church, while the rich brought out meats and drink from their houses, and invited the poor, and furnished "common tables, common banquets, common symposia in the church itself." The Council of Gangra (A.D. 343?) anathematized the over-ascetic people who despised "the *agapēs* based on faith." But the holding of *agapēs* in church was forbidden by the councils of Laodicea (363) and Carthage (under Aurelius, 388–423), and later by the council in Trullo (692). In the age of Augustine the *agapē* was frequent.

In the east Syrian, Armenian and Georgian churches, respectively Nestorian, Monophysite and Greek Orthodox in their tenets, the *agapē* was from the first a survival, under Christian and Jewish forms, of the old sacrificial systems of a pre-Christian age. Sheep, rams, bullocks and fowls are given sacrificial salt to lick, and then sacrificed by the priest and deacon, who has the levitical portions of the victim as his perquisite. In Armenia the Greek word *agapē* has been used ever since the 4th century to indicate these sacrificial meals, which either began or ended with a eucharistic celebration. The earlier usage of the Armenians is expressed in two rules recorded against them by a renegade Armenian prelate named Isaac, who in the 8th century went over to the Byzantine church (Combesius, *Historia Monothelitarum*, col. 317). Older mss. of the Greek Euchologion contain numerous prayers to be offered over animals sacrificed; and in the form of *agapē* such sacrifices were common in Italy and Gaul on the *natalis dies* of a saint, and Paulinus of Nola, in his Latin poems, describes them (c. 400) in detail. Gregory the Great sent to Mellitus, bishop of London, a written rite of sacrificing bulls for use in the English Church of the early 7th century. In Augustine's

work against Faustus the Manichean (xx. 4); the latter taxes the Catholics with having turned the sacrifices of the heathen into *agapēs*, their idols into martyrs, whom they worship with similar rites. The early Christian *agapē* admitted of adaptation to the older funeral and sacrificial feasts, and was so adapted. The association in the synoptics of the earliest eucharist with the paschal sacrifice provided a model, and long after the eucharist was separated from the *agapē* on other days of the year, we still find celebrated on the evening of Maundy Thursday the sacrifice of the paschal lamb, immediately followed by an eucharist. The council of Carthage enacted that the eucharist should be received fasting, except on the anniversary of the Lord's supper. It is clear that at an earlier date the *agapē* preceded the eucharist.

Pagan Analogues.—In ancient states common meals called *sussitia* (συσσίτια) were instituted, particularly in the Doric States; e.g., Lacedaemon and Crete. Plato advocated them, and perhaps the later Jews imitated the Spartan community. Trade and other guilds in antiquity held subscription suppers or *ἐπαροι*, similar to those of the early Corinthian Church, usually to support the needs of the poorer members. These *hetairiai* or clubs were forbidden (except in cities formally allied to Rome) by Trajan and other emperors, as being likely to be centres of disaffection; and on this ground Pliny forbade the *agapē* of the Bithynian churches, Christianity not being a lawful religion licensed for such gatherings. The custom which most resembles the eucharist and *agapē* was that known as *charistia* described by Valerius Maximus ii. 1. 8: a solemn feast for members of one clan, at which those who had quarrelled were at the sacrament of the table (*apud sacra mensae*) reconciled. Ovid alludes to it (*Fasti*, ii. 617).

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AGAPEMONITES or COMMUNITY OF THE SON OF MAN. A sect founded in 1846 by the Rev. Henry James Prince, a clergyman of the Church of England (1811–1899). He studied medicine, obtained his qualifications in 1832 and was appointed medical officer to the general hospital in Bath, his native city. Compelled by ill-health to abandon his profession, he entered himself in 1837 as a student at St. David's theological college, Lampeter, where he gathered about him a band of earnest religious enthusiasts, known as the Lampeter Brethren, and was eventually ordained to the curacy of Charltnh in Somerset, where he had sole charge in the illness and absence of the rector, the Rev. Samuel Starkey. His work at this period reveals an almost hypnotic power over his converts; but soon he was mastered by delusions. He persuaded himself that he had been absorbed into the personality of God and had become a visible embodiment of the Holy Spirit. During his illness Mr. Starkey read one of his curate's sermons, and was not only "cured" forthwith, but embraced his strange doctrines, and together they procured many conversions in the countryside and the neighbouring towns. Forbidden the right to officiate in the Church of England, Prince and Starkey established themselves at Weymouth. Money flowed in; and with these resources they obtained the house at Spaxton, which became the "Abode of Love."

On the death of "Brother" Prince, the Rev. T. H. Smyth-Pigott, pastor of the "Ark,"—a branch church established at Clapton, London—became the acknowledged head of the sect. He was born in 1832, of an old Somersetshire county family, and, after a varied career as university man, sailor before the mast, soldier, coffee-planter, curate in the Church of England and evangelist in the Salvation Army, was converted about 1897 to the views of Prince. For five years after this he was not heard of outside his own sect. In Sept. 1902, however, he began to make claims similar to those of his predecessor, and proclaimed himself to be Christ. By the outside world the affair was greeted with mingled ridicule and indignation, and the new Messiah had to be protected by the police from the violence of an angry mob. Scandal was soon renewed through Pigott's relations with his female followers; and in Aug. 1908, an attempt "to tar and feather" him resulted in two men being sent to prison. Later in the month proceedings were instituted against him by the bishop of Bath and Wells under the Clergy Discipline Act.

See Law Reports, Court of Chancery, June 4-8, 1860; art. "Agapemone" in Hastings' *Encyclopaedia of Religion and Ethics*.

AGAPETAE, a name given to female Christian ascetics who dwelt with men under a vow of continency. This practice essentially belongs to the history of Christian asceticism. Its beginnings can be traced in the earliest Christian times, but it was preserved in monasticism down to the early middle ages.

See Hastings, *Encyclopaedia of Religion and Ethics*, "Agapetae"; see also ASCETICISM.

AGAPETUS, the name of two popes:

AGAPETUS I., pope from 535 to 536, collaborated with Cassiodorus in founding at Rome a library of ecclesiastical authors. King Theodahad sent him on an embassy to Constantinople, where he died, after having deposed Anthimus, the Monophysite bishop of that town, and ordained Menas his successor.

AGAPETUS II., pope from 946 to 955, at the time when Alberic, son of Marozia, was governing the independent republic of Rome under the title of "prince and senator of the Romans." He did his best to restore church discipline and to regain temporal power. His appeal to Otto the Great to intervene in Rome remained without immediate effect, since Alberic's position was too strong to be attacked, but it bore fruit after his death. Agapetus died on Nov. 8, 955.

AGAPETUS, a deacon of the church of St. Sophia at Constantinople, and author of a series of exhortations on the duties of a Christian prince, addressed (c. 527) to the emperor Justinian. The work was often reprinted, and has been translated into Latin, French and English.

AGAR, or AGAR-AGAR, is a gelatinelike product of red seaweeds, made from *Gelidium* and other agarophytes (agar-bearing plants) such as *Gracilaria*, *Ahnfeltia* and *Pterocladia*. It is best known as a bacteriological culture medium, and is extensively used for food, as roughage, and in making jelly desserts, confectionery, icings, salad dressings, and dairy products. It is employed in canning meat and poultry, in laxative preparations, as a constituent of medicinal pills and capsules, in numerous pharmaceutical and cosmetic creams and jellies, as a dental impression mould base, and in wire-drawing lubricants. Agar is prepared by boiling the agarophytes in water and subsequently purifying and drying the product. It is produced chiefly in Japan, and also in China, Russia, the United States, Mexico, South Africa, New Zealand and Australia. It is amorphous and translucent, and may be found on the market in the form of powder, flakes, shreds, or bricks. Agar is insoluble in cold water, but swells considerably, absorbing as much as 20 times its own weight of water. It readily dissolves in boiling water, and is able to set to a firm gel at concentrations as low as $\frac{1}{2}\%$. Although a 1% agar sol solidifies at about 104° F., its gel does not melt until about 203° F., showing a striking case of hysteresis. Agar gels carry small negative electric charges. Like other gels, they exhibit syneresis. Chemically, agar is the sulphuric ester of a linear galactan, consisting of a long chain of *d*-galactose residues attached to each other by a 1,3-glycosidic linkage. This chain is terminated by one *l*-galactose residue which is attached to the rest of the chain through

carbon atom 4, and is esterified at carbon atom 6 with sulphuric acid. There are probably as many as 53 galactose units to each SO₃H group. In the natural state, agar occurs as a cell wall constituent of the agarophytes, probably existing in the form of its calcium salt, or a mixture of calcium and magnesium salts.

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AGARIC, the name applied to fungi with the spores borne on gills (mushrooms), from the generic name *Agaricus*. In pharmacology, a medicinal preparation derived from the fungus *Fomes officinalis*, a polypore growing principally on larch and pine.

AGASIAS. There were two Greek sculptors of this name. Agasias, son of Dositheus, signed the statue called the Borghese Warrior in the Louvre. Agasias, son of Menophilus, is the sculptor of another striking figure of a warrior in the museum of Athens. Both belonged to the school of Ephesus and lived about 100 B.C. (See Gardner, *Handbook of Greek Sculpture*, ii. p. 475.)

AGASSIZ, ALEXANDER EMANUEL (1835-1910), American man of science, son of J. L. R. Agassiz, was born in Neuchâtel, Switzerland, on Dec. 17, 1835. He came to the United States with his father in 1846; graduated at Harvard in 1855, subsequently studying engineering and chemistry, and taking the degree of bachelor of science at the Lawrence scientific school of the same institution in 1857; and in 1859 became an assistant in the U.S. coast survey. Thenceforward he became a specialist in marine ichthyology, but devoted much time to the investigation, superintendence and exploitation of mines, being superintendent of the Calumet and Hecla copper mines, Lake Superior, from 1866 to 1869, and afterwards, as a stockholder, acquiring a fortune, out of which he gave to Harvard, for the museum of comparative zoology and for furthering the study of biology at Harvard and elsewhere upwards of \$1,000,000. In 1875 he surveyed Lake Titicaca, Peru, examined the copper mines of Peru and Chile, and made a collection of Peruvian antiquities for that museum, of which he was curator from 1874 to 1885. He assisted Sir Wyville Thomson in the examination and classification of the collections of the "Challenger" exploring expedition, and wrote the *Revision of the Echini* (1872-74) in the reports. Between 1877 and 1880 he took part in the three dredging expeditions of the steamer "Blake," of the U.S. coast survey, and presented a full account of them in 1888. Of his other writings on marine zoology, most are contained in the bulletins and memoirs of the museum of comparative zoology; but he published in 1865 (with Elizabeth Cary Agassiz, his stepmother) *Seaside Studies in Natural History*, a work at once exact and stimulating, and in 1871 *Marine Animals of Massachusetts Bay*. He died at sea on the "Adriatic" bound for the United States on March 27, 1910.

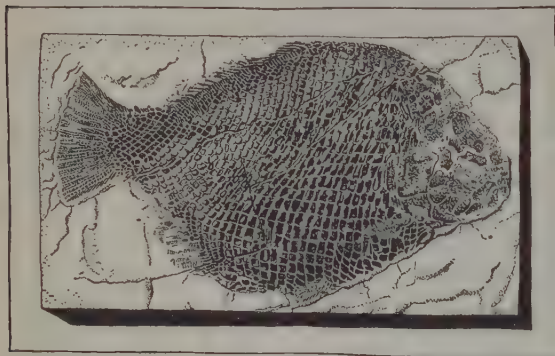
See G. R. Agassiz, ed., *Letters and Recollections of Alexander Agassiz; With a Sketch of his Life and Work* (Boston, 1913).

AGASSIZ, JEAN LOUIS RODOLPHE (1807-1873), Swiss-American naturalist, geologist and teacher, was born on May 20, 1807, the son of the Protestant pastor of Motier, on the shore of Lake Morat, Switzerland. His father was the last of a long line of clergymen, the first of the series having been driven from France by the revocation of the Edict of Nantes. His mother, Rose Mayor, was a gifted woman from whom especially he inherited his love of animals and plants. In boyhood he spent four years at the gymnasium in Bienne and later attended the academy at Lausanne. He then entered, successively, the universities of Zurich, Heidelberg and Munich. On completion of his academic courses, Agassiz took at Erlangen the degree of Doctor of Philosophy and at Munich that of Doctor of Medicine.

Although as a youth he gave some interested attention to the ways of the brook fish of western Switzerland, his permanent and lifelong interest in ichthyology arose from his being chosen to study the fishes of Brazil. In 1819 and 1820 two eminent naturalists of Munich, J. B. Spix and C. P. J. von Martius, had made an extensive tour in Brazil, bringing back a large collection of

fishes, mostly from the Amazon river. The classification of these species was begun by Spix; he died in 1826, however, and the whole collection was then turned over by Martius to Agassiz. The work was completed and published in 1829, as *Selecta Genera et Species Piscium*. This splendid accomplishment was a monument to youthful industry and enthusiasm, the author being at that time only 22 years old. The study of fish-forms became henceforth the prominent feature of Agassiz's scientific research. In 1830 he issued a prospectus of a *History of the Fresh Water Fishes of Central Europe*, a valuable contribution printed in parts from 1839 to 1842.

The year 1832 proved the most significant in Agassiz's early career, because it took him first to Paris, then the centre of



AFTER "RECHERCHES SUR LES POISSONS FOSSILES"

A FOSSIL FISH, ETCHED ON STONE UNDER AGASSIZ'S SUPERVISION.
AFTER A SPECIMEN DISCOVERED DURING HIS RESEARCHES AT NEUCHÂTEL

general scientific as well as medical research, and afterwards to Neuchâtel where he spent many years of amazingly fruitful effort. While in Paris he lived the life of an impecunious student of the *quartier latin*, supporting himself, helped at times by the kindly interest of friends, such as Humboldt, who soon secured for him a professorship at Neuchâtel, and Cuvier, the most eminent ichthyologist of his time. At Paris his scientific activities largely centred in the Natural History museum of the great park now known as the Jardin des Plantes.

Already Agassiz had become interested in the rich stores of the extinct fishes of Europe, especially those of Glarus in Switzerland and of Monte Bolca near Verona, of which only a few at that time had been critically studied. As early as 1829, Agassiz planned a comprehensive and critical study of these remains. To this end he gathered material wherever possible. His epoch-making work, *Recherches sur les Poissons Fossiles*, appeared in parts from 1833 to 1844. In it the number of named fossil fishes was raised to nearly 1,000, and the ancient seas were made to live again through disclosure of their inhabitants. The great importance of this foundation work rests on the impulse given to the study of extinct life itself. Turning his attention to other extinct animals found with the fishes, Agassiz published in 1839-40 two quarto volumes on the fossil echinoderms of Switzerland, and later (1840-45) his *Études Critiques sur les Mollusques Fossiles*.

From 1832 to 1846 he served as professor of natural history in the University of Neuchâtel, where may still be found evident traces of the activity and enthusiasm of its youngest and most eager teacher. In Neuchâtel he acted for a time as his own publisher, his private residence even becoming a hive of activities. Numerous young men were co-workers with him, dividing between themselves the scanty returns from his lectures and publications. He now began his *Nomenclator Zoologicus*, a catalogue, with references, of all the names applied to genera of animals from the beginning of scientific nomenclature, a date since fixed at Jan. 1, 1758. "This," said Agassiz, "is a work of patience. It is a barrier against the Babel of confusion which threatens to overwhelm the domain of zoological synonymy." The practical value of the compilation can hardly be overestimated.

In 1836 Agassiz began a new line of studies, that of the movements and effects of the glaciers of Switzerland. Several writers had expressed the opinion that these rivers of ice had once been much more extensive, and that the erratic boulders scattered over the region and up to the summit of the Jura mountains, were carried by moving glaciers. On the ice of the Aar glacier he built a hut, the "Hôtel des Neuchâtelois," from which he and his associates traced the structure and movements of the ice. In 1840 he published his *Études sur les glaciers*, in some regards the most important of all his works. In it he was able to show that at a period geologically recent Switzerland was covered by one vast ice-sheet. His final conclusion was that "great sheets of ice, resembling those now existing in Greenland, once covered all the countries in which unstratified gravel (boulder drift) is found."

In 1846 Agassiz was led to visit the United States for the general purpose of studies in natural history and geology, but immediately to give a course of lectures in the Lowell institute in Boston. These were followed by another series in Charleston, and afterwards by lectures both popular and technical in various cities, his brilliant and engaging personality at once winning all hearts. In 1848 he accepted a professorship of zoology at Harvard university, and from that time on became more and more enthusiastically American. Indeed, half his scientific career, and that not the least important, was lived in this country. "He came in a spirit of adventure and curiosity; he stayed because he loved a land where he could think and act as he pleased; a land where nature is rich but tools and workmen are few, and traditions none."

In America his chief volumes of scientific research were the following: *Lake Superior* (1850); *Contributions to the Natural History of the United States* (1857-1863, in several quarto volumes, the most notable being on the embryology of turtles); and the *Essay on Classification*, a brilliant production, which, however, failed to grasp the trend of modern zoology. Besides these extensive contributions appeared a multitude of short papers on natural history and especially on the fishes of America. His two excursions of highest importance were, first, to Brazil in 1865, and second, to California in 1871, the latter trip involving both shores of South America. *A Journey in Brazil* by Mrs. Agassiz and himself, published in 1868, gives a very interesting account of their experiences on the earlier voyage. His most important paper on American fishes dealt with the remarkable group of viviparous surf-fishes of California.

During many years, also, Agassiz was deeply absorbed in his cherished plan of developing at Harvard university a comprehensive museum of research in zoology. This institution, which was established in 1859 and ultimately grew into the present splendid museum of comparative zoology, enjoyed his fostering care during the rest of his lifetime. In America Agassiz's industry and devotion to scientific pursuits were as strongly marked as in Europe, but two other traits here assumed a much greater importance. As a teacher of science he was extraordinarily skilful, certainly the ablest America has ever known. In addition he was personally devoted to his students, who were in the highest sense co-workers with him—"the best friend that student ever had." His warmth of feeling moreover went out equally to colleagues and neighbours. It was said that "one had less need of an overcoat in passing Agassiz's house than any other in Cambridge." Such qualities, endeared him to all, while his amazing command of lucid and picturesque English impressed every listener. He was also as much at home before an audience of labourers or farmers as with the most erudite leaders of research.

Agassiz's method as teacher was to give contact rather than information. He discouraged the use of books except in detailed research. Among his favourite expressions were "If you study nature in books, when you go out-of-doors you cannot find her." "It's not text-books we want, but students. The book of nature is always open." "Strive to interpret what really exists." The result of his instruction at Harvard was a complete revolution in natural history study in America. The purpose came to be not a category of facts taken from others, but the ability, through contact, to gather the needed facts. As a result of his activities

every notable teacher of natural history in the United States for the second half of the 19th century was at some time a pupil of Agassiz or of one of his students.

In the interests of better teaching and of scientific enthusiasm, he organized in the summer of 1873 the Anderson school at Penikese, an island in Buzzard's bay. The details of this remarkable venture, brief in actual period but having a profound effect on science teaching and the precursor of all American summer schools and establishments for marine research, cannot be given here. But "the school of all schools which has had the greatest influence on science teaching in America was held in an old barn on an uninhabited island, 18 miles from the shore; it lasted but three months; it had virtually but one teacher. It existed in the personal presence of Agassiz. When he died, it vanished." (David Starr Jordan, *Agassiz at Penikese*.)

As Agassiz was beyond question one of the ablest, wisest and best informed of the biologists of his day, it is often asked why his attitude towards Darwinism was, throughout all his lifetime, cold and unsympathetic. It seems possible that his position was determined in part by a misunderstanding, but more particularly by his philosophy of biology. He seemed to regard Darwinism as a theory of continued progress instead of one of divergence, tempered by the weeding out of unadapted individuals. He failed to recognize the importance of separation and segregation in the development of new specific forms. He once said that in his studies of fossils he "was on the verge of anticipating Darwinism," but was withheld by the discovery that "we had the higher fishes first." In a sense this was true, for the brain development of the sharks is higher, as a whole, than that of the bony fishes. But the latter are far more specialized in fitness for aquatic life. More important to Agassiz was the fact that in his philosophy each species of animal or plant was in itself "a thought of God." Their homologies or fundamental unities were "associations of ideas in the Divine Mind." He had an intensely religious mind, although he was totally out of sympathy with sects and creeds and the outer shell of Christianity.

In physical appearance Agassiz was a striking figure, nearly six feet tall, compactly built, with noble head and broad handsome face, usually illuminated by an especially charming smile. This last, however, would suddenly turn into a frown in the presence of careless or trivial work or pretence on the part of a student. He married twice. His first wife, Cecile Braun, was the sister of an eminent botanist. In 1850, after his first wife's death, Agassiz married Elizabeth Cabot Cary, of Boston, well known as a writer and as a promoter of the education of women.

Agassiz died on Dec. 12, 1873. He was buried in Mt. Auburn at Cambridge, and by his grave stands a boulder from the moraine of the Lauteraar. At his death, Theodore Lyman, one of his students, wrote, "We buried him from the chapel that stands among the college elms. The students laid a wreath of laurel on his bier and their manly voices sang a requiem. For he had been a student all his life long, and when he died he was younger than any of them."

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(D. S. J.)

AGATE, a term applied, not to a distinct mineral species, but to a group of amorphous and crypto-crystalline forms of silica. According to Theophrastus the agate (ἀγάθης) was named from the river Achates, now the Drillo in Sicily, where the stone was originally found. Most agates occur in eruptive rocks or ancient lavas where they fill the cavities which were produced by the lib-

eration of gas during the solidification of the molten rock. These agates have a banded structure, successive layers being approximately parallel to the sides of the cavity. A number of varieties of agate are characterized by peculiarities in the shape and colour of the bands, which are seen in sections cut at right-angles to the layers. In riband-agate they are straight or slightly curved. Such an agate with cloudy bands alternating with bands of another colour, the two sets being sharply marked off from one another, is known by the general term onyx. A ring or eye agate is one in which the differently coloured bands are disposed in concentric circles. A Mexican agate, showing only a single eye has received the name of "cyclops." When the banding forms re-entrant and salient angles, its outline resembling that of the plan of a fortress, it is called fortification-agate. Certain agates also occur, to a limited extent, in veins, of which a notable example is the beautiful brecciated agate of Schlottwitz, near Wessenstein in Saxony—a stone mostly composed of angular fragments of agate cemented with amethystine quartz. A variety having included matter of a green colour, embedded in the agate and disposed in filaments and other forms suggestive of vegetable growth, is known as moss agate. Dendritic markings of black or brown colour, due to infiltration of oxides of manganese and iron, produce the variety known as Mocha stone.

It is probable that agates occurring in cavities in igneous rocks have been formed in a number of ways, and various theories of their origin have been proposed. The theory which is now generally accepted is as follows. During the solidification of the rock an accumulation of gas or steam causes a bubble to form. Long after, when the rock has solidified, water carrying silica in solution, probably as alkali silicate, penetrates into the region where the bubble is located. It then diffuses into the cavity and subsequently the solution coagulates to a silica gel. The alkali present with the silica attacks the iron-bearing rock surrounding the cavity, giving rise to iron salts. These diffuse into the silica gel and produce the regular layers of iron hydroxide after the manner of Liesegang's rings. Finally the whole mass gradually hardens with loss of water and crystallization of much of the silica as quartz or chalcedony. During the process of crystallization the coloured bands are not disturbed and hence we have the final agate as it is now found.

Agates are cut and polished chiefly in the Idar-Oberstein district situated on the Nahe, a tributary of the Rhine at Bingen. Here the industry grew up many centuries ago by reason of an abundance of agates in the amygdaloidal melaphyre of the district. The stones used now are mostly imported from Brazil (Rio Grande do Sul) and from Uruguay.

Most commercial agate is artificially stained so that stones naturally unattractive by their dull grey tints come to be valuable for ornamental purposes. The colouring matter is absorbed by the porosity of the stone, but different stones and different layers of the same stone exhibit great variation in absorptive power. To produce a dark brown or black colour, the stone is kept perhaps for two or three weeks in a saccharine solution, or in olive oil at a moderate temperature. After removal from the solution, the agate is well washed and then digested for a short time in sulphuric acid, which, entering the pores, carbonizes the absorbed sugar or oil. Certain layers of chalcedony are practically impermeable and these consequently remain uncoloured, so that an alternation of dark and white bands is obtained, giving rise to an onyx. Agate is stained red, to imitate cornelian and sardonyx, by means of ferric oxide. Other colours are detained in other ways.

Among the uses to which agate is applied may be mentioned the formation of knife-edges of delicate balances, small mortars and pestles for chemical work, burnishers and writing styles, umbrella handles, paper knives, seals, brooches and other ornaments. Real cameos are cut from banded agates, one layer forming the medalion, the other the design in relief.

Agates are found in England in the Cheviot Hills, in the neighbourhood of Bristol and at Lichfield in Staffordshire. In Scotland they occur at Montrose in Forfarshire, in Perthshire, and at many other localities. The majority of agates are produced in countries outside Europe, notably in South America, North America and India; they are also found in South Africa and Australia.

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(W. A. W.)

AGATHA, ST., the patron saint of Catania, Sicily, where her festival is celebrated on Feb. 5. The legend is that she was a native of Sicily (probably of Catania, though Palermo also claims her) of noble birth and great beauty. She repelled the advances of the Roman prefect, sent by the emperor Decius to govern Sicily, and was by his orders brutally tortured and finally sent to the stake. As soon as the fire was lighted an earthquake occurred and the people insisted on her release. She died in prison on Feb. 5, 251. The rescue of Catania from fire during an eruption of Mt. Etna was later attributed to St. Agatha's veil.

AGATHANGELUS, AGATHANGE or **AKATHANGELOS**, Armenian historian, lived during the 4th century, and wrote a *History of the Reign of Dertad, or Tiridates, and of the Preaching of St. Gregory the Illuminator*. This history was translated into several languages, and Greek and Latin translations are found in the *Acta Sanctorum Bollandistarum*, tome viii. The history consists of three parts, a history of St. Gregory and his companions, the doctrine of Gregory, and the conversion of Armenia to Christianity.

See V. Langlois, *Collection des Historiens anciens et modernes de l'Arménie* (Paris, 1868).

AGATHARCHIDES or **AGATHARCHUS**, of Cnidus, Greek historian and geographer, lived in the time of Ptolemy Philometor (181–146 B.C.) and his successors. Amongst other works, he wrote treatises on *Asia, Europe and the Red Sea*. Interesting extracts from the last, of some length, are preserved in Photius (cod. 213).

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AGATHARCHUS, the name of an Athenian painter of the 5th century B.C. He is said by Vitruvius to have been the first to paint a scene for the acting of tragedies.

AGATHIAS (c. A.D. 536–582), of Myrina in Aeolis, Greek poet and historian. He studied law at Alexandria, completed his training at Constantinople and practised as an advocate (*scholasticus*) in the courts. He wrote a number of short love-poems in epic metre, called *Daphniaca*. He next put together a kind of anthology, containing epigrams by earlier and contemporary poets and himself, under the title of a *Cycle of New Epigrams*. About a hundred epigrams by Agathias have been preserved in the *Greek Anthology*. After the death of Justinian (565), some of Agathias's friends persuaded him to write the history of his own times. This work, in five books, begins where Procopius ends, and is the chief authority for the period 552–558.

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AGATHO, pope from 678 to 681, was born in Sicily. He ordered St. Wilfrid to be restored to his bishopric at York in 679, and was the first pope to cease payment of the tribute hitherto paid on election to the emperor at Constantinople. Agatho died on Jan. 10, 681.

AGATHOCLES (361–289 B.C.), tyrant of Syracuse, was the son of a potter, born at Thermae Himeraeae (mod. *Termini Imerese*) in Sicily. He removed to Syracuse and served with distinction in the army. In 333 B.C. he married the widow of his patron Damas, a distinguished and wealthy citizen. He was twice banished for attempting to overthrow the oligarchical party in Syracuse (q.v.); in 317 B.C. he returned with an army of exiles and Campanian mercenaries. He banished or murdered some 10,000 members of the senate and the oligarchical party, proclaiming

himself the champion of the people, and thus made himself master of Syracuse. His tyranny was confirmed by a virtually unanimous vote of the people, and, despite his continuous wars, he seems to have been generally popular. He enriched Syracuse with many public buildings, and his reign was looked back to as a period of orderliness and tranquillity. His foreign policy was inevitably part of the almost continuous 200 years' war between the Sicilian Greeks and their secular enemy, Carthage (q.v.). In these wars Syracuse had always taken the lead, and Agathocles only continued the policy of Dionysius the Elder, Dionysius the Younger and Timoleon (qq.v.).

In 310 B.C. Agathocles, defeated and besieged in Syracuse, took the desperate resolve of breaking through the blockade and attacking the enemy in Africa. He besieged Carthage, which was at the time troubled by internal dissensions, but after several victories he was at last completely defeated (306) and fled secretly to Sicily. After concluding peace with Carthage, Agathocles styled himself king of Sicily and established his rule over the Greek cities of the island more firmly than ever. Even in his old age he displayed the same energy and is said to have been meditating a fresh attack on Carthage at the time of his death, which was followed by a recrudescence of Carthaginian power in Sicily. Agathocles was something more than the typical leader of mercenaries. He was a born leader, who knew how to inspire devotion.

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AGATHODAEMON, an early map designer of Alexandria, who probably lived in the 2nd century A.D. Some manuscripts of the *Geography* of Ptolemy contain 27 maps, which are stated to have been drawn by Agathodaemon of Alexandria, who "delineated the whole world according to the eight books of Ptolemy's geography." About 1470, Nicolaus Doris, a Benedictine monk, produced an edition of them in which the names were inserted in Latin instead of Greek.

See Bunbury, *History of Ancient Geography*, ii.

AGATHODAEMON, an important god in Greek mythology, the "good spirit" of cornfields and vineyards, protective spirit of individuals and the State. The Greeks drank a cup of pure wine in his honour at the end of each meal (Aristophanes, *Equitoes*, 106). Often accompanied by *Agathê Tuchê* (good fortune), he may be compared with the Roman *Bonus Eventus* (Pliny, *Nat. Hist.*, xxxvi., 23) and *Genius* (q.v.). He is represented in works of art in the form of a serpent, or of a young man with a horn of plenty and a bowl in one hand, and a poppy and ears of corn in the other.

AGATHON (c. 448–400 B.C.), Athenian tragic poet, friend of Euripides and Plato. He won his first victory in 416 (at the Lenaia), and his plays seem to have been successful, despite their artificial style. He appears to have been the first to invent an original plot, and to write choral odes unconnected with the plot. His effeminacy made him a butt of Aristophanes. Before 406 he retired to the court of Archelaus, where he died.

See Aristotle, *Poetica* 9, and 18; Aristophanes, *Thesmoph.* 59, 106, *Eccles.* 100; Plato, *Symp.* 198 c.; Plutarch, *Symp.* 3; Aelian, *Var. Hist.* iv. 13; Ritsch, *Opuscula*, i.; fragments in Nauck, *Tragicorum Graecorum Fragmenta*. See also Haigh, *Tragic Drama of the Greeks*.

AGATHYRSI, a people of Thracian origin, who in the earliest historical times occupied the plain of the Maris (Maros), in the region now known as Transylvania. They are described by Herodotus (iv. 104) as of luxurious habits, wearing gold ornaments (the district is still auriferous) and having wives in common. They tattooed their bodies (Virgil, *Aeneid*, iv. 136), degrees of rank being indicated by the manner in which this was done, and coloured their hair dark blue. Valerius Flaccus (*Argonautica*, vi. 135) calls them Thyrsagetae, probably in reference to their celebration of orgiastic rites in honour of some divinity akin to the Thracian Dionysus. In later times the Agathyrsi were driven farther north, and their name was unknown to the Romans in their original home.

See Pliny, *Nat. Hist.* iv. 12 [26], 88.

AGAVE, a large botanical genus of the family Amaryllidaceae, chiefly Mexican, but occurring also in the southern and western United States and in central and tropical South America. The plants have a large rosette of thick fleshy leaves generally ending in a sharp point and with a spiny margin; the stout stem is usually short, the leaves apparently springing from the root. They grow slowly and flower but once after a number of years, when a tall stem or "mast" grows from the centre of the leaf-rosette and bears a large number of short, tubular flowers. After development of fruit the plant dies down, but suckers are frequently produced from the base of the stem which become new plants. The

most familiar species is *Agave americana* (see fig.), a native of tropical America, the so-called century plant or American aloe (the Maguey of Mexico). The number of years before flowering, 5 to 60 or more, but usually about 10, depends on the vigour of the individual, the richness of the soil and the climate; during these years the plant is storing in its fleshy leaves the nourishment required for the effort of flowering. During the very rapid development of the immense peduncle, or flowering stalk, there is a rush of sap to the base of the young flower stalk; by removing this large bud just as it is ready to emerge and by scooping out a cavity in the heart of the plant, a large quantity of sweet sap is obtained; and this *aguamiel*, removed, carried in pig-skin bottles to the central repository, undergoes two kinds of fermentation, and when it has become thick, milky and more or less ropy (the sugars then being changed into alcohol) it is marketed as *pulque* (q.v.), the national drink of Mexico; notwithstanding its objectionable odor and consistency it is by some thought a wholesome and nourishing drink, and many train-loads are brought daily to Mexico City from the vast *pulque* plantations in the surrounding region. By distillation of *pulque fuerte*, or completely fermented juice, a very strong liquor, *mescal*, is obtained.

The leaves of several species yield commercial fibres: *A. rigida elongata* or *A. fourcroydes* is the henequen, or Yucatan sisal, formerly the principal sisal fibre (q.v.). *Agave sisalana* is the Bahama sisal, the culture of which is expanding greatly in East Africa and Haiti.

A. cantula is the Maguey, or Philippine sisal.

A. zapupe is the Mexican *Zapupe* fibre.

A. americana produces one of the *Pita* fibres, now grown in southern Europe and parts of the West Indies as well as in Mexico.

A. neglecta is the Florida sisal, one of the largest species, the flower-stalk of which may exceed 42 feet in height.

The firm white pith of the interior of the flowering stem of any of these species, when dried and cut in slices has a variety of uses—as natural razor-strops, as lining of insect-boxes, insulating material, etc. The gummy, soapy juice expressed from the leaves will lather like soap and may be used as a detergent where alkali would be injurious. The thick reddish roots of various species are reputed to have medicinal properties. The concentrated sap exuded into the scooped-out central bud cavity is also used as a medicine and is a source of agavose ($C_{12}H_{22}O_{11}$), one of the rare sugars. In the Madras Presidency the plant is widely used for

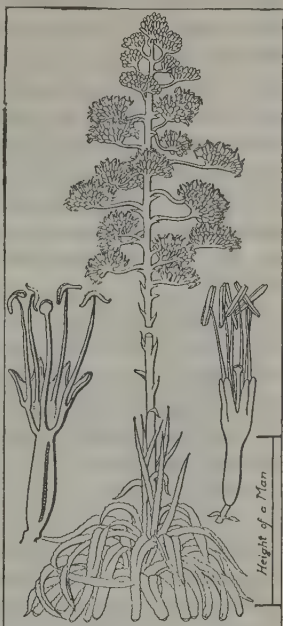
hedges along railroads. *Agave americana* was introduced into Europe about the middle of the 16th century and is now extensively cultivated for its handsome appearance; in the variegated forms the leaf has a white or yellow marginal or central stripe from base to apex. As the leaves unfold from the centre of the rosette the impression of the marginal spines is very conspicuous on the still erect younger leaves.

AGDE, a town of south France, in the department of Hérault, 2½ m. from the mouth of the Hérault, and 32 m. S.W. of Montpellier on the Southern railway. Pop. (1936), 8,546. It lies at the foot of an extinct volcano, the Montagne St. Loup, and is sur-named "La Ville Noire" from the dark volcanic basalt of which it is built. Agde is said to have been founded as a port by Phocæans under the name of *Agathe*. It was the seat of a bishop from 400 to 1790. Overlooking the river is the old Cathedral of St. Etienne, a grim fortress-like structure of the 12th century. The machicolations of the parapet are said to be the oldest existing instance of the kind. The *Canal du Midi*, uniting the Garonne with the Mediterranean, passes under the town walls. The maritime commerce of the town has declined, because Cette is near and the Hérault shallow, but the fishing industry is still alive. The town has a tribunal of commerce.

SYNOD OF AGDE (*Concilium Agathense*).—The 47 genuine canons of the synod (Sept. 11, 506), dealt with discipline, church life, alienation of ecclesiastical property and treatment of Jews. While favouring sacerdotal celibacy the council laid rather rigid restrictions on monasticism. It commanded that the laity communicate at Christmas, Easter and Whitsuntide. The canons of Agde are based in part on earlier Gallic, African and Spanish legislation; and some of them were re-enacted by later councils.

AGE. The subject of the duration of human and animal life does not fall within the scope of this article, and the reader is referred to LONGEVITY. But the word "age" has been used by physiologists to express certain natural divisions in human development and decay. These are usually regarded as numbering five, viz., *infancy*, lasting to the seventh year; *childhood* to the 14th; *youth* to the 21st; *adult life* till 50; and *old age*.

The division of human life into periods for legal purposes is naturally more sharp and definite than it can be for physiological purposes. In Roman law the legal divisions were (1) *infantia* lasting till the close of the seventh year; (2) the period between *infantia* and *pubertas*, males becoming *puberes* at 14 and females at 12; (3) *adolescentia*, the period between puberty and majority; and (4) the period after the 25th year, when males become *maiores*. By English law, life is divided into two main periods—*infancy*, which lasts in both sexes until the 21st year, and manhood or womanhood. The period of infancy, again, is divided into several stages, marked by the growing development both of rights and obligations. Thus at 12 years of age a male may take the oath of allegiance; at 14 both sexes are held to have arrived at years of discretion, and may therefore choose guardians, give evidence, and consent or disagree to a marriage. A female has the last privilege from the 12th year, but the marriage cannot be celebrated until the majority of the parties without the consent of parents or guardians. At 21 both males and females obtain their full legal rights and become liable to all legal obligations. Thus both sexes may enter parliament and be called to the bar, upon attaining majority. In the Church of England, however, a candidate for deacon's orders must be 23 (in the Roman Catholic Church, 22), and for priest's orders 24 years of age; and no clergyman is eligible for a bishopric under 30. In Scotland infancy is not a legal term. The time previous to majority, which, as in England, is reached by both sexes at 21, is divided into two stages: *pupilage* lasts until the attainment of puberty, which the law fixes at 14 in males and 12 in females; *minority* lasts from these ages respectively until 21. *Minority* obviously corresponds in some degree to the English *years of discretion*, but a Scottish minor has more personal rights than an English infant in the last stage of his infancy, e.g., he may dispose by will of movable property, make contracts, including that of marriage, carry on trade and become liable to be declared a bankrupt. Throughout the British Empire the age of majority is usually 21, but the



LONGITUDINAL SECTION FROM BAILLON.
HISTOIRE DES PLANTES.
CENTURY PLANT (A. AMERICANA).
SO NAMED BECAUSE IT WAS SUPPOSED TO BLOSSOM ONLY WHEN 100 YEARS OLD AND THEN DIE
Showing long flower stem and rosette of spiny leaves; vertical section and single flower enlarged

nubile age is 20 in the Channel Islands; 18 in New Brunswick and Ontario; 18 for females in the North-West Territories and 15 for native females in Fiji. In Belgium and France the age of majority is 21, and the nubile age 18 for males and 15 for females, but marriage cannot be contracted without the consent of the parents or guardians if the parties are under 25. The age of majority is in Argentina 22; in Chile, Spain and Austria 24; in China 20; in Brazil, Denmark, Holland, Germany, Greece, Italy, Mexico, Norway, Peru, the Philippines, Poland, Portugal, Rumania, Sweden, Switzerland and Tunis, 21. In Denmark the nubile age is 18 for males and 16 for females; in Germany 20 for males and 16 for females, subject to the consent of the parents or guardians, and without such consent the males must be 25 and the females 24. But a person of 18 may be declared of full age by a competent court. In Spain majority is reached at 23; the nubile age is 18 for males and 16 for females. In Greece the nubile age is 16 for males and 14 for females; in Holland 18 for males and 16 for females; in Italy 18 for males and 15 for females; in Switzerland 21 for males and 19 for females, but the canton authorities may in extraordinary cases reduce these figures to 19 and 18 respectively. Marriage by minors is subject to the consent of their parents or guardians.

By the constitution of the United States the President must be not less than 35; a senator not less than 30, and a representative not less than 25 years of age. The age of majority, as a rule, is 21 for both males and females, but in Arkansas, California, Colorado, Dakota, Idaho, Illinois, Iowa, Kansas, Maryland, Minnesota, Missouri, Nebraska, Nevada, Ohio, Oregon, Vermont and Washington females attain majority at 18. In Maryland, Oregon, and Texas a female attains majority upon marriage. In Iowa, Texas and Louisiana both males and females attain majority upon marriage, and in Washington a female minor married to a male of age is regarded as herself of full age. (H. H. L. B.)

AGE GRADES means a system of compulsory association or classification by age and sex, whereby groups of coevals are admitted by a series of initiatory rites of varying complexity, including generally the payment of a due, into a tribal association with definite functions both within the age group itself and in relation to the tribe as a whole, promotion to higher degrees, where such exist, being at regular intervals jointly compulsory on all the individuals comprising a group.

Though superficially resembling secret societies (*q.v.*), and though the ritual of initiation and subsequent ceremonies and esoteric beliefs are secret where a knowledge of them is confined to those who have been initiated and is moreover commensurate with the degree of their initiation, age grades are differentiated from other forms of association, including secret societies, by the following distinctive features: (1) Admission depends primarily on age and is associated with puberty rites. (2) Every member of the tribe must be affiliated to the system at the proper age. (3) There is no individual admission, but groups of coevals are jointly initiated. (4) Promotion to higher degrees of initiation is similarly compulsory and automatic with the passage of years, even when fees have to be paid or further rites have to be undergone. (5) The system is strictly unilateral, confined to males, though a corresponding institution for females may exist but, where it exists, functions independently. (6) The system is democratic.

Primitive societies are conspicuously divided vertically into families and clans and are horizontally stratified by a variety of associations: religious, occupational, political, social, and so on. Distinction by age and sex cuts across the bonds of consanguinity and creates a new orientation of social activity. Mere classification by age or sex, however, does not of itself indicate an age grade, for a variety of other factors is involved. A physiological classification of a tribe into boys, youths, adults and old men, with their feminine counterparts, stereotyped by custom into a conventional nomenclature, often lacks the distinctive sociological features of an age grade: just as we find puberty rites in almost all primitive societies, whereas age grades, though associated with puberty ceremonies and retaining them as an essential element in the complex, are comparatively rare.

Many of the institutions which are reported from different

parts of the world, though analogous to age grades, differ in one or more essential factors and are therefore to be excluded from this survey. Such institutions are found in Australia, New Guinea, in the Banks Islands, among some of the Naga tribes of Assam, and in certain American Indian societies. The *aluzhi* of the Sema Naga, for instance, are working gangs, with few sociological obligations on the members. They are bisexual, coevality is not essential, and members can be ejected from the group. When clan feeling runs high in a community the *aluzhi* groups break up, indicating that the lateral stratification of society has not the same validity as the vertical. In short, all the essentials of an age grade are lacking. The Kimta of Bartle Bay, though it has a superficial resemblance to an age grade, admits of individual members being degraded or promoted to lower or higher degrees, thus invalidating the paramount theory of group-solidarity. Again, though age is the theoretical basis of Banks Islands' societies it is in fact an unimportant factor, and at every stage of initiation except perhaps the lowest, increasingly prohibitive admission fees have resulted in "a commensality of varying years and vastly different social prospects." This is no less true of America and even in the military societies of the Hidatsa, which approach nearest to the definition, the bases of membership are purchase and age, and group-promotion is not automatic but depends on purchase.

Only in Africa, and within a limited area, is the true age grade system found functioning as a sociological element in tribal life and of the utmost importance. Nowhere do we find age grades and secret societies concurrently, for secret societies are associated with the evolution of monarchies and powerful aristocracies, which they both limit and reinforce, whereas age grades are democratic and are incompatible with any system of centralized and individual authority. This accounts for the absence of age grades in Bantu societies generally, with the exception of a few Bantu tribes of the eastern group, such as the Akiyuyu, Akamba, Giriama and Chaga, who have been considerably influenced by neighbouring Hamites and have a culture which is no longer characteristically Bantu. Similarly, on the west coast of Africa we find a system analogous to age grades among the Kru, where secret societies are almost negligible and are subordinate to the Sedibo class of age grades, which comprises the tribal legislature and executive.

The age grade is the distinctive feature of Hamitic culture and is found in all the tribes of East Africa which belong to the Hamitic or Nilo-Hamitic groups, including the Nilotic Lango. The Galla, with their very complex system, are the centre and source of this culture, and from them it has permeated all the Nilo-Hamitic tribes which cluster round them, the Masai and the Nandi, the Topotha, the Turkana and the Didinga.

There are naturally modifications and variations in the system adapted to the cultural requirements of each tribe, but the essentials are basically the same. At the puberty rites (which recur at regular intervals) a group of boys is initiated and they are thus aggregated into tribal, as opposed to family and clan, life. Henceforth they are no longer classed with the women but find themselves in a group of coevals, with a variety of lifelong privileges and obligations towards each other. Hospitality within the age group is compulsory, and at a later stage, when the members are permitted to marry, this often includes access to the wives of age-mates. The group on the formal side is distinguished by a variety of emblems, such as shield designs, bodily markings and ornaments, and a special name assumed jointly and individually at initiation by every member of the group and retained throughout life. Promotion to higher degrees of the system is automatic after a given number of years, and each degree has its own special functions, appropriate ceremonials and emblems, and often a particular diet and distinctive tabus; the warrior degree, for instance, being generally prohibited smoking, beer and marriage. The final degree usually enables the group-members to retire from the active life of the tribe to the more passive rôle of an elder.

The essence of the system is the corporate unity of the group, which moves from degree to degree as a single entity. This unity

makes the group so significant an element in tribal culture. At the puberty schools and at subsequent initiations on promotion to higher degrees the age groups receive a systematic education which, as among the Galla, may extend over 32 years. Candidates are instructed in the duties of citizenship, in tribal history and tradition, ethics, the law, hunting, war, religion, husbandry, medicine, sex, in short, in every aspect of individual and communal life. They are disciplined by hardships and privations and trained to endure all manner of physical discomforts and dangers, in order to be the better able to perform the rôle traditionally allotted to the group at each degree in its initiation. Among the Galla the system provides for the government of the country by each group in turn during its last eight years of active existence. The Masai and the majority of kindred tribes use the system for military and governmental purposes, and the Lango, thanks to a changed environment, have endowed their age grade system with functions which are almost exclusively religious. Finally, the system as a whole makes for greater tribal unity by cutting across the narrow limits of the family and the clan, by giving every individual an interest in tribal, rather than parochial, concerns, and by making every individual feel that with his group he is for the time the repository of tradition and the custodian of his tribe, both heir to the past and the pledge of posterity.

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AGELADAS or (as the name is spelled in an inscription) **HAGELAIIDAS**, a great Argive sculptor who flourished in the latter part of the 6th and the early part of the 5th century B.C. Ageladas was said to have been the teacher of Myron, Pheidias, and Polycleitus; this tradition is a testimony to his wide fame, though historically doubtful.

AGEMA, the name of the bodyguard of Alexander of Macedon. It was drawn from the distinguished corps of "shield bearers" or esquires (*ὑπασπισται*). While in Bactria, Alexander reorganized the agema and included some Persians.

AGEN, south-west France, capital of the department of Lot-et-Garonne, 84 mi. S.E. of Bordeaux by the Southern railway.



THE CATHEDRAL OF ST. CAPRAIS, AGEN, DATING FROM THE 12TH CENTURY, IS MODERN COMPARED WITH THE TOWN ITSELF WHICH WAS A CELTIC STRONGHOLD AND CONSIDERED OLD IN ROMAN TIMES

Pop. (1946) 33,397. It is skirted on the west by the Garonne, here crossed by a stone bridge and by a canal-bridge.

Agen (*Aginnum*) was the capital of the Nitiobroges, and extensive Roman ruins have been discovered. Later it was the capital of the Agenais. Its bishopric was founded in the 4th century. Agen frequently changed hands during the Albigenian wars, and at their close a tribunal of inquisition was established here. In the religious wars of the 16th century Agen took the Catholic side and joined the League in 1589. The cathedral of St. Caprais

has an apse of the 12th century and three apse-chapels: the rest dates from the 12th–16th centuries, the tower flanking the south façade is modern. The church of the Jacobins is a 13th century brick building. The prefecture (18th century) was once the bishop's palace. The *hôtel de ville* occupies the former *Hôtel du Presidial*, an obsolete tribunal, and contains the municipal library. Two houses of the 16th century, the *Hôtel d'Estrades* and the *Hôtel de Vours*, are used as the museum. Through its excellent water communication, Agen affords an outlet for the agricultural produce of a rich district, and forms an *entrepôt* between Bordeaux and Toulouse, dealing in poultry, prunes (*pruneaux d'Agen*), and other fruit, wine, vegetables and cattle. Flour, dried plums, *pâté de foie gras* and other delicacies, manures, drugs, woven goods and tiles are made. Agen is the seat of a bishop. It has a court of appeal and a court of assizes, tribunals of first instance and of commerce and a chamber of commerce.

AGENAIS or **AGENOIS**, a former province of France, of which Agen was the centre and to which the modern department of Lot-et-Garonne nearly corresponds. In ancient Gaul it was the country of the Nitiobriges, then a Gallo-Roman *civitas* (the 4th-century *Civitas Agennensium*) whose limits became those of the diocese of Agen. Having in general shared the fortunes of Aquitaine during the Merovingian and Carolingian periods, Agenais next became an hereditary countship; but from the middle of the 10th century it was part of the demesne of the counts of Bordeaux, dukes of Gascony; consequently in 1032 it fell to the counts of Poitiers when they inherited Gascony. The marriage of Eleanor of Aquitaine with Henry Plantagenet in 1152 brought it under England; but when Richard I married his sister Joan to Raymond VI, count of Toulouse, in 1196 Agenais formed part of her dowry, although remaining in the vassalage of Gascony. In 1249, with the other estates of Raymond VII, it lapsed to Alphonse of Poitiers, his son-in-law and the brother of Louis IX; but in 1259, by the treaty of Paris, Louis IX promised that if Alphonse and his wife Jeanne died childless their demesnes in Agenais would return to the king of England. When Jeanne did die childless in 1271, Philip III had the country occupied; but Edward I protested and it was restored to England by the treaty of Amiens in 1279. Yet the king of France claimed direct overlordship on a number of places, and the dispute over one of them (Saint-Sardos) brought a renewal of the war between France and England under Charles IV. During the Hundred Years' War Agenais was several times taken and retaken, until the final retreat of the English in 1441 left it under the French. It was for a time an appanage of Louis XI's brother Charles of Berry (1469–1472) and of Margaret of Valois (first wife of Henry IV), on whose death in 1615 it was reunited to the crown. Thenceforth Agenais was no more than an administration term. At the end of the *ancien régime* Agenais was a *sénéchaussée*, incorporated in the *gouvernement* of Guienne and the *intendance* of Bordeaux. Since the late middle ages at least, Agenais has been a rich agricultural country, subject however to alternating phases of depopulation and immigration.

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AGENT: see PRINCIPAL AND AGENT.

AGENT-GENERAL, the term given to the representatives in England of certain of the self-governing British colonies. They are appointed, and their expenses and salaries provided, by the governments of the colonies they represent. Their duties are to look after the political and economic interests of their colonies in London, to assist in all financial and commercial matters in which their colonies may be concerned, and to make known the products of their colonies. Those colonies which are not under responsible government are represented in London by crown agents.

AGENTS IN BUSINESS. An agent in the most general sense is any person who transacts business for another without being a direct employee, and in the majority of cases his function is to assist a principal in the purchase, sale or distribution of goods for a remuneration which usually takes the form of

a commission on the price obtained. It is a term very loosely applied. Assistance may be rendered to principals irrespective of the commercial undertakings in which they are engaged. Consignment agents and credit inquiry agents are examples of this category as compared with factors or brokers who operate continuously for principals in particular industries and with manufacturers' agents who are more particularly associated with special lines of goods. There is an intermediate class of agents not directly concerned with the sale of goods and therefore not remunerated on a commission basis but who are of vital importance to the producer and manufacturer, the two most important being (a) advertising agents, whose function is to promote the commercial activity which is the beginning and the end of every undertaking, and (b) patent agents whose services are needed in most cases before manufacture can be commenced and who are also in a position to introduce their clients to the agents best qualified to market the product.

Manufacturers' Agents.—In the early stages of a manufacturing business when problems of production absorb the energies of the proprietor he is frequently glad to be relieved of all marketing problems by handing over the entire output to be disposed of by one or more manufacturers' agents on the commission basis which maintains this important section of the trading community. The method usually adopted is to sell by sample, the principal making arrangements for delivery and collecting accounts. But some manufacturers' agents operate on a much larger scale, especially in the textile industry, maintaining warehouses, stock rooms and administrative departments. The intimate knowledge possessed by the manufacturers' agent of the various requirements of the public is of great value to the principal; so much is this the case that the advisory services of the agent may be vital to the success of the undertaking and his influence on the policy of the business as powerful as if he were a partner. An agent of this standing is invariably consulted before new lines are introduced and he periodically brings forward suggestions calculated to increase trade which will bring him increased commission and the principal increased turnover.

Factors.—The tendency of modern business is to shorten the chain between producer and consumer, the chief forces operating being the extension of advertising in all directions, the growth of consumer co-operation and the increase in competition which leads to producer co-operation and the formation of trusts or buying groups. The effect on the manufacturers' agent is for him to accept greater personal responsibilities and virtually to take over the functions of a factor who, while his remuneration is also on a commission basis, is much more independent of his principal than is the manufacturers' agent. Invariably the factor has possession of the goods of the principal; he is generally able to get a better price and sells the goods as though they were his own, leaving the buyer no clue to identity. He also frequently acts as banker for his principal, owing to the necessity of his carrying a large stock for disposal in anticipation of increased demand. It is in his interests to induce the manufacturer to produce on a larger scale at a lower cost than if the production were small, and this is done by his relieving the manufacturer of the necessity of recouping the expenditure of production with a quick sale. The factor is a large-scale operator in a number of industries, produce, textile, grain, hide, etc., and like the manufacturers' agent is continually exposed to the pressure of the forces making for a shorter chain between producer and consumer. The tendency is for him to discharge other marketing functions, to buy manufacturing businesses and do the work of a wholesale merchant.

Brokers.—A broker is an intermediary whose function is simply to buy or sell on behalf of a client, and who does not have possession of the goods dealt with. He is present at all exchanges where produce is disposed of and business arranged. He has a specialized knowledge of particular classes of goods, their sources of supply and the avenues of marketing. His duties are of a personal character, only a small establishment being required as his business is carried on by negotiation at the exchange and in the offices of clients. In the produce market brokers are indispensable—they study the crop reports, watch cargoes, take samples, collect

statistics and furnish market reports. Pressure of competition and the shortening of the producer-consumer chain impels the broker to buy and sell on his own account.

(See ADVERTISING AGENT; BROKER.)

(A. B. C.)

AGENTS OF PRODUCTION, in economics, a term used to describe the factors which combine in the production of wealth, as land, labour (*qq.v.*), capital and organization. (See AGRICULTURAL ECONOMICS; CAPITAL AND INTEREST; ECONOMICS; ENTREPRENEUR.)

AGESANDER, a Rhodian sculptor who is mentioned by Pliny (*Nat. Hist.*, xxxvi, 37) as author (with Polydorus and Athenodorus) of the group of the Laocoön. Inscriptions found at Lindus in Rhodes date Agesander and Athenodorus to the period 42–21 B.C.

AGESILAUS II, king of Sparta, of the Eurypontid family, was the son of Archidamus II and Eupolia, and the younger stepbrother of Agis, whom he succeeded about 401 B.C. Agis had, indeed, a son Leotychides, but he was set aside as illegitimate, current rumour representing him as the son of Alcibiades. Agesilaus' success was largely caused by Lysander, who hoped to find in him a willing tool for the furtherance of his political designs. In this hope, however, he was disappointed, and the increasing power of Agesilaus soon led to Lysander's downfall. In 396 Agesilaus was sent to Asia with a force of 2,000 neodamodes (enfranchised helots) and 6,000 allies to secure the Greek cities against a Persian attack. On the eve of sailing from Aulis he attempted to offer a sacrifice, as Agamemnon had done before the Trojan expedition, but the Thebans intervened to prevent it, an insult for which he never forgave them. On his arrival at Ephesus a three-months' truce was concluded with Tissaphernes, the satrap of Lydia and Caria, but negotiations conducted during that time proved fruitless, and on its termination Agesilaus raided Phrygia, where he easily won immense booty since Tissaphernes had concentrated his troops in Caria. After spending the winter in organizing a cavalry force, he made a successful incursion into Lydia in the spring of 395. Tithraustes was thereupon sent to replace Tissaphernes, who paid with his life for his continued failure.

An armistice was concluded between Tithraustes and Agesilaus, who left the southern satrapy and again invaded Phrygia, which he ravaged until the following spring.

He then came to an agreement with the satrap Pharnabazus and once more turned southward. It was said that he was planning a campaign in the interior, or even an attack on Artaxerxes himself, when he was recalled to Greece because of the war between Sparta and the combined forces of Athens, Thebes, Corinth, Argos and several minor states. A rapid march through Thrace and Macedonia brought him to Thessaly, where he repulsed the Thessalian cavalry which tried to impede him. Reinforced by Phocian and Orchomenian troops and a Spartan army, he met the confederate forces at Coronea in Boeotia, and in a hotly contested battle was technically victorious, but the success was a barren one and he had to retire by way of Delphi to the Peloponnese. Shortly before this battle the Spartan navy, of which he had received the supreme command, was totally defeated off Cnidus by a powerful Persian fleet under Conon and Pharnabazus.

Agesilaus took a leading part in the Corinthian War, making successful expeditions into Corinthian territory, and capturing Lechaum. But the destruction of a *mora* by Iphicrates neutralized these successes, and Agesilaus returned to Sparta. In 387 the Peace of Antalcidas (*qq.v.*), which was warmly supported by Agesilaus, put an end to hostilities. When war broke out afresh with Thebes the king twice invaded Boeotia (378, 377) and it was on his advice that Cleombrotus marched against Thebes in 371. Cleombrotus was defeated at Leuctra and the Spartan supremacy overthrown. In 370 Agesilaus tried to restore Spartan prestige by invading Mantinea territory and his heroism saved Sparta when Epaminondas penetrated Laconia that same year, and again in 362 when he all but succeeded in seizing the city. Sparta stood aloof from the general peace of 362 hoping to recover its supremacy. In order to gain money for the war Agesilaus had supported the revolted satraps; in 361 he went to Egypt at the head of a mercenary force to aid Tachos against

Persia, and died, at the age of 84, on his way home.

Agesilaus was a small man, somewhat lame from birth. He was a successful leader in guerilla warfare, alert and quick, yet cautious, and his bravery was unquestioned. He lived in the most frugal style and enriched the state and his friends with the spoils of his campaigns, returning himself as poor as he had set forth. He was sincerely patriotic; but the worst trait in his character was his implacable hatred of Thebes, which led to the battle of Leuctra and Sparta's fall from supremacy.

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AGGLOMERATE, the term applied to coarse fragmental rocks produced by explosive volcanic eruptions, and consisting mainly of rounded or subangular bombs, at least partly plastic when erupted, that lie in a matrix of tuff and are found within or near volcanic pipes. Volcanic breccias differ from agglomerates in the angularity of the fragments, which are erupted in a solid condition. (H. Ws.)

AGGLUTINATION, a term used technically in philology for the method of word formation by which two significant words or roots are joined together in a single word to express a combination of the two meanings each of which retains its force (Lat. *ad* and *glutinare*, lit. to fasten together with glue). This juxtaposition or conjoining of roots is characteristic of languages such as the Turkish and Japanese, which are therefore known as agglutinative, as opposed to others, known generically as inflexional, in which differences of termination or combinations in which all separate identity disappears are predominant.

The term was also formerly used by associationist philosophers for those mental associations which were regarded as peculiarly close. W. Wundt applies this term to those simplest cases of apperceptive synthesis in which the simpler ideas composing the complex idea retain their independence—as, for instance, in the idea expressed by "church-steeple." (X.)

In medicine, the holding together of wound edges as a part of the process of early healing is called agglutination, as is the clumping of bacteria, organisms or cells in some fluid medium either natural or artificial. It is believed to be caused by more or less specific substances called agglutinins. The reaction may be seen under a microscope or with the naked eye in some cases. This phenomenon is utilized to determine the existence of a disease such as typhoid fever and also to decide whether or not a specific blood is a safe one for transfusion. (F. L. A.)

AGGRAVATION (Lat. *ad*, "increasing," *gravis*, "heavy"), the making anything graver or more serious; also used as synonymous with "irritation." In the canon law "aggravation" was a form of ecclesiastical censure, threatening excommunication after three disregarded admonitions.

AGGREGATE, a term used in building and construction to designate the material with which cement, lime, gypsum or other adhesive material, such as bitumen, is mixed to form a concrete or mortar (*q.v.*). The most common aggregates are sand, crushed or broken stone, gravel or pebbles, broken blast-furnace slag, boiler ashes or clinker, burned shale and burned clay. The purpose of the aggregate is to provide volume, freedom from change in volume, and resistance to wear or erosion and other desired physical properties, in the finished product.

Aggregates are divided into two general classes commonly known as fine aggregate and coarse aggregate. The fine aggregate is generally sand, crushed stone or crushed slag screenings; the coarse aggregate is gravel (pebbles), fragments of broken stone, slag and the other substances above mentioned. The dividing line between fine and coarse aggregate is usually a $\frac{1}{4}$ -in. screen opening, sometimes a $\frac{1}{2}$ -in. opening. Aggregates are mixed with the cement or binding material in proportions varying from one part of cementing material to one part of fine aggregate for a "rich" mortar to one part of cement to nine or ten parts of mixed

fine and coarse aggregates for a "lean" concrete. The theory upon which such mixtures are proportioned is that there shall be sufficient cementing material to coat all of the particles in the fine aggregate, and that there shall be sufficient mortar so produced to fill all the voids in the coarse aggregate. The ideal concrete would consist of closely packed fragments of crushed stone, slag or pebbles in which all the fragments are coated with mortar, and all the voids between the coarser fragments filled with mortar. Under actual conditions in construction work there is practically always an excess of mortar. Nearly all natural sands require washing or rinsing to remove loam, clay, organic material, etc. A gradual variation in size from about 50 mesh (50 openings per linear inch) to $\frac{1}{4}$ -in. mesh is desirable for the strongest mortar or concrete. The preparation of commercial fine aggregate therefore often requires artificial grading or mixing of the various sizes. This is usually accomplished by hydraulic separation of the undesirable fine sizes, which usually are in excess. For coarse aggregate any hard, tough, durable rock may be crushed, screened and graded. The common commercial sizes vary from $\frac{1}{4}$ in. to $3\frac{1}{2}$ in. in largest dimension. The most desirable rocks for general construction purposes are basalt, commonly called trap, and fairly pure limestone. Such rocks are not only durable but fire-resisting. Specification requirements include cleanliness (maximum limits of extraneous impurities), limiting percentages of various sizes, soundness (freezing and thawing tests, for example), sometimes mineralogical composition (designed to ensure soundness).

In this age of concrete construction and road building the business of supplying aggregates for construction work has grown to large proportions. In the U.S. alone production amounts to approximately 300,000,000 tons per annum, valued roughly at \$300,000,000, requiring an investment of about \$500,000,000 in washing, screening and crushing equipment and accessory machinery for mining and conveying the raw and finished materials.

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AGGREGATES, THEORY OF. An aggregate may be defined as a collection of objects of some kind or other. In mathematics the objects making up an aggregate are usually mental objects; *i.e.*, concepts or ideas. However, material objects may also be used to constitute an aggregate. Other synonyms for aggregate are: class, set, domain, totality. In this article these words will be used interchangeably. Writers on mathematics sometimes make special distinctions between them for special purposes.

The theory of aggregates was developed enthusiastically by Georg Cantor and other mathematicians in the latter part of the 19th century, but the uncritical use of its concepts and methods soon led to logical contradictions. Workers in mathematical logic made a variety of attempts to set up rules which would prevent these contradictions, but no general agreement as to a desirable method was reached. However, contradictions are not met in the uses to which the theory of classes is actually put in mathematics.

Determination of an Aggregate.—The fundamental relation in the theory of classes is that of class membership. This may be taken as an undefined relation, whose meaning is understood from the way in which it is used. The symbol $x \in A$ is frequently used to state that an object x is a member of a class A . A class is well-defined when a workable criterion is given for telling what objects are members of it. Thus, a class may be determined by a suitably stated property or a suitably worded "propositional form," or in some cases by simply pointing out its members. The class of all people who have blue eyes is not well-defined for mathematical purposes, first, because it may sometimes be difficult to determine whether a person's eyes are blue or gray, and second, because people are continually being born and dying. On the other hand, the class of all integers greater than 10 and less than 100 is a mathematically well-determined class.

Operations on Aggregates.—A class A is said to be a subset of a class B in case every member of A is also a member of B . This relation of class inclusion is indicated by the notation $A \subset B$, which is read " A is a subset of B ," " A is included in B ," or " A is contained in B ." Let U denote a fixed class, and denote sub-

classes of U by the letters, $A, B, C, \dots$. The fundamental operations on classes are: logical addition, logical multiplication and logical subtraction. The sum $A+B$ of two classes (also called the union of A and B) is the class consisting of all the members of A or B or both. The product AB of two classes (also called the intersection of A and B) is the class consisting of all the objects which are simultaneously members of both A and B . The difference $A-B$ consists of all the objects which are members of A but not members of B . The special difference $U-B$ is called the complement of B , and denoted by cB . The operations of logical addition and logical multiplication may clearly be applied to any number of classes and even to an infinite collection of classes. In order that the operations of logical multiplication and logical subtraction may always be carried out, a special class, called the null class, and having no members, is introduced by agreement. If $A \subset B$, then $A-B$ is the null class. The null class behaves with respect to logical addition and multiplication much as 0 does in ordinary algebra. Logical addition and multiplication obey the associative, commutative and distributive laws of ordinary algebra, and also the new distributive law: $A+BC = (A+B)(A+C)$. But logical subtraction does not behave like ordinary subtraction, since $(A+B)-C$ is not always equal to $A+(B-C)$. Also $(A-B)(A-C) = A-(B+C)$. Another important operation on two classes A and B is the Cartesian product $A \times B$, which is defined as the aggregate of all pairs (x, y) of which the first element x is a member of A , and the second element y is a member of B . This kind of product is named after the French mathematician René Descartes. In his analytic geometry the points of a plane are represented by pairs of numbers (x, y) , where the numbers x and y represent distances measured respectively along two intersecting lines in the plane. The Cartesian product is not commutative, but it is distributive with respect to logical addition, and also with respect to logical multiplication, that is, $(A+B) \times C = (A \times C) + (B \times C)$, $(AB) \times C = (A \times C)(B \times C)$.

Finite and Infinite Aggregates.—An important distinction is that between finite and infinite aggregates. This distinction is defined logically by means of the notion of one-to-one correspondence. An aggregate A is said to be in one-to-one correspondence with an aggregate B when each element a of A is paired with one and only one element b of B , and vice versa. If for every possible one-to-one correspondence between A and a subset B of A it is true that B is the whole of A , then A is said to be finite. But if there is a one-to-one correspondence between A and a proper part B of A , then A is said to be infinite. The size of aggregates is compared by means of this notion of one-to-one correspondence, and this leads to the notion of number (*q.v.*). The numbers associated with infinite classes by means of this notion of one-to-one correspondence are called transfinite cardinal numbers. (See also INFINITY AND THE INFINITE.) The numbers associated with finite classes are called natural numbers. If an aggregate A can be put into one-to-one correspondence with the set of all the natural numbers, it is said to be countably infinite. The cardinal number of countably infinite aggregates is usually denoted by $\aleph_0$. It is the smallest infinite cardinal.

Theory of Aggregates in Mathematics.—The theory of aggregates is fundamental for all of mathematics. Many of the branches of mathematics are characterized to some extent by the special structure or properties assumed for the aggregates considered in them. For example, part of algebra is concerned with aggregates whose elements are numbers, and with the operations of addition, multiplication, etc., performed on those elements. Geometry is concerned with aggregates whose elements may be called points, and with operations of motion, projection, deformation, etc., and relations of congruence, distance, etc. Aggregates in geometry are frequently called point sets. (See TOPOLOGY; POINT SETS.)

One of the basic notions in mathematics is that of ordered aggregates. A class A is said to be ordered if a relation of precedence is set up between pairs of elements of A , with the following properties: (1) if x and y are distinct elements of A , then $x < y$ (read " x precedes y ") or $y < x$; (2) if $x < y$ and $y < z$ then $x < z$; (3) no two of $x=y$, $x < y$, $y < x$ can hold simultaneously. In case the

ordering in A is such that every subclass B of A has a first element x_0 , that is, x_0 precedes every other element of B , then A is said to be well-ordered. Every ordering of a finite class is a well-ordering, but this is no longer true for infinite classes. For example, the natural numbers in their usual order form a well-ordered class, but if the order is reversed it is no longer a well-ordering of the class.

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AGGREGATION, in physics, a collective term for the forms or states in which matter exists. Three primary "states of aggregation" are recognized—gaseous, liquid and solid. Generally, if a solid is heated to a certain temperature, it melts or fuses, assuming the liquid condition (see FUSION); if the heating is continued the liquid boils and becomes a vapour (see VAPORIZATION). On the other hand, if a gas is sufficiently cooled and compressed, it liquefies; this transition is treated theoretically in the article LIQUEFACTION OF GASES.

AGGTELEK, a village in northern Hungary in that portion of the county of Gömör that remained in 1918 within Hungarian rule. Although small (pop. 648), it is world-renowned for its remarkable limestone grotto, the Aggtelek or Baradla cavern, one of the largest of its kind in Europe. It is composed of a labyrinth of passages and halls of various sizes, the total length, including its ramifications, exceeding 5 mi. A stream traverses the caves, which are rich in fantastic stalactite forms.

AGINCOURT (AZINCOURT), a village of northern France in the department of Pas de Calais, 14 mi. N.W. of St. Pol by road, famous on account of the victory, on Oct. 25, 1415, of Henry V of England over the French. The battle was fought in the defile formed by the wood of Agincourt and that of Tramecourt, at the northern exit of which the army under Charles d'Albret, constable of France, had placed itself so as to bar the way against the English forces which, after the capture of Harfleur, had set out to march through Picardy to Calais. Torrential rains hindered the English in crossing the Somme, and the delay allowed the French to concentrate in overwhelming numbers—d'Albret, indeed, refused to avail himself of the offer of 6,000 crossbowmen of the Paris citizen militia. Worse still, the English became so short of supplies that had the French but been content to block the path without risking an attack, hunger would have brought them the victory. The night of Oct. 24 was spent by the two armies on the ground, and the English had but little shelter from the heavy rain. Early on the 25th, St. Crispin's day, Henry arrayed his little army (about 1,000 men-at-arms, 6,000 archers, and a few thousands of other foot). It is probable that the usual three "battles" were drawn up in line, each with its archers on the flanks and the dismounted men-at-arms in the centre; the archers being thrown forward in wedge-shaped salients, almost exactly as at Crécy (*q.v.*). The French, on the other hand, were drawn up in three lines, each line formed in deep masses. They were at least four times more numerous than the English, but restricted by the nature of the ground to the same narrow front 1,100 yd., they were unable to use their full weight (*cf.* Bannockburn); further, the deep mud prevented their artillery from taking part, and the crossbowmen were as usual relegated to the rear of the knights and men-at-arms. All were dismounted save a few knights and men-at-arms on the flanks, who were intended to charge the archers of the enemy. For three hours after sunrise there was no fighting; then Henry, finding that the French would not advance, moved his army farther into the defile. The archers fixed the pointed stakes, which they carried to ward off cavalry charges, and opened the engagement with flights of arrows. The chivalry of France, undisciplined and too obtuse to have assimilated the lesson of Crécy and Poitiers, was quickly stung into action, and the French mounted men charged, but their slow-moving horses made easy targets, soon shot down or driven back in confusion. The constable himself headed the leading line of dismounted men-at-arms; weighted with their armour, and sinking deep into the mud with every step, they yet reached and

engaged the English men-at-arms; for a time the fighting was severe. The thin line of the defenders was borne back and King Henry was almost beaten to the ground. But at this moment the archers, taking their hatchets, swords or other weapons, penetrated the gaps in the now disordered French, who could not move to cope with their unarmoured assailants, and were slaughtered or taken prisoners to a man. The second line of the French came on, only to be engulfed in the *mêlée*; its leaders, like those of the first line, were killed or taken, and the commanders of the third sought and found their death in the battle, while their men rode off to safety. The closing scene of the battle was a half-hearted attack made by a body of fugitives, which led merely to the slaughter of the French prisoners, which was ordered by Henry because he had not enough men both to guard them and to meet the attack. The slaughter ceased when the assailants drew off. The total loss of the English is stated at 13 men-at-arms (including the duke of York, grandson of Edward III.) and about 100 of the foot. The French lost 5,000 of noble birth killed, including the constable, three dukes, five counts and 90 barons; 1,000 more were taken prisoners, amongst them the duke of Orleans (the Charles d'Orléans of literature). The moral lesson of the battle was the incapacity of a military caste to learn from experience, and to adapt their traditions intelligently to new needs. The material lesson was that armour stultified its own purpose when it fettered mobility. The 15th-century soldier pinned his faith as obstinately on an increasing weight of armour as the 19th-century soldier on an increasing weight of numbers.

See Sir Harris Nicolas, *Battle of Agincourt*; Fortescue, *History of the British Army*, vol. i.; and H. B. George, *Battles of English History*; Oman, *History of the Art of War in the Middle Ages*, vol. ii. 379-386.

AGIO, a term used in commerce in three connections.

(a) The variations from fixed pars or rates of exchange in the currencies of different countries. For example, in most of the gold-standard countries, the standard coin is kept up to a uniform point of fineness, and so bears a constant relation to coins of other countries in a similar condition. This is what is known as the mint par of exchange. The balance of trade between the various countries is the factor determining the rate of exchange. Should the balance of trade be against England, money must be remitted to France as payment for the indebtedness. But owing to the cost for the transmission of specie there will be a demand for bills as a cheaper and more expeditious method of sending money, and it therefore will be necessary to pay a premium for it, called the agio.

(b) The term is also used to denote the difference in exchange between two currencies in the same country; where silver coinage is the legal tender, agio is sometimes allowed for payment in the more convenient form of gold, or where the paper currency of a country is reduced below the bullion which it professes to represent, an agio is payable on the appreciated currency.

(c) Lastly, in some states the coinage is so debased, owing to the wear of circulation, that the real is greatly reduced below the nominal value. Supposing that this reduction amounts to 5%, then if 100 sovereigns were offered as payment of a debt in England while such sovereigns were current there at their nominal value, they would be received as just payment; but if they were offered as payment of the same amount of debt in a foreign state, they would be received only at their intrinsic value of £95, the additional £5 constituting the agio. Where the state keeps its coinage up to a standard value no agio is required. (See BALANCE OF TRADE.)

AGIRA (formerly San Filippo d'Argirò), town in the province of Enna, Sicily, with a railway station $4\frac{1}{2}$ mi. to the south; 35 mi. W. of Catania. Pop. (1901) 17,738; (1936) 14,411 (town), 15,350 (commune). *Agyrion*, an ancient Sicel city, was ruled by tyrants, one of whom, Agyris, was contemporary of Dionysius I., and with him successfully resisted the Carthaginians in 392 B.C. Agyrion was not colonized by the Greeks until Timoleon drove out the last tyrant in 339 B.C.

AGIS, the name of four Spartan kings:

(1) Son of Eurysthenes, founder of the royal house of the Agiadae (Pausanias iii. 2. 1). His genealogy was traced back to Heracles (Herodotus vii. 204), and he belongs rather to

mythology than to history. Tradition ascribed to him the capture of Helos, and the institution of the class of serfs called Helots. (q.v.). See Ephorus ap. Strabo, viii. p. 365.

(2) AGIS I., son of Archidamus II., Eurypontid, succeeded his father, probably in 427 B.C., and from his first invasion of Attica in 425 down to the close of the Peloponnesian War was the chief leader of the Spartan operations on land. After the conclusion of the peace of Nicias (421 B.C.) he marched against the Argives in defence of Epidaurus, and after skilful manoeuvring surrounded the Argive army, and seemed to have victory within his grasp when he unaccountably concluded a four months' truce and withdrew his forces. The Spartans were indignant, and when the Argives and their allies broke the truce Agis escaped having his house razed and a fine of 100,000 drachmae imposed only by promising to atone for his error by a signal victory. This promise he fulfilled by routing the forces of the Argive confederacy at the battle of Mantinea (418). In the winter 417-416 a further expedition to Argos resulted in the destruction of the half-finished Long Walls and the capture of Hysiae. In 413, on the suggestion of Alcibiades, he fortified Decelae in Attica, where he remained directing operations until, after the battle of Aegospotami (405), he took the leading part in the blockade of Athens, which was ended in the spring of 404 by the surrender of the city. Subsequently he invaded and ravaged Elis. He fell ill on his return from Delphi, where he had gone to dedicate a tithe of the spoils, and died at Sparta, probably in 401.

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(3) AGIS II., son of Archidamus III., of the Eurypontid line, succeeded his father in 338 B.C., on the very day of the battle of Chaeronea. During Alexander's Asiatic campaign he revolted against Macedonia (333 B.C.) and, with the aid of Persian money and ships and a force of 8,000 Greek mercenaries, gained considerable successes in Crete. In the Peloponnese he routed a force under Corragus and, although Athens held aloof, he was joined by Elis, Achaea (except Pellene) and Arcadia, with the exception of Megalopolis, which the allies besieged. Antipater marched rapidly to its relief at the head of a large army, and the allied force was defeated after a desperate struggle (331) and Agis was slain.

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(4) AGIS III., son of Eudamidas II., of the Eurypontid family, succeeded his father, probably in 245 B.C., in his 20th year, at a time when the unequal distribution of land and wealth and the diminution in the number of full citizens threatened to ruin Sparta. He determined to restore the traditional institutions of Lycurgus. Lysander as ephor proposed on behalf of Agis that all debts should be cancelled and that Laconia should be divided into 19,500 lots, of which 4,500 should be given to Spartiates, whose number was to be recruited from the best of the perioeci and foreigners, and the remaining 15,000 to perioeci who could bear arms. The abolition of debts was carried into effect, but the land distribution was put off on various pretexts by Agesilaus, the king's uncle, who wished to preserve his estates. At this point Aratus appealed to Sparta to help the Achaeans in repelling an expected Aetolian attack, and Agis was sent to the Isthmus at the head of an army. During his absence his enemies gained the upper hand, and on his return Agis, after a mock trial, was strangled in prison, his mother and grandmother sharing the same fate (241).

See Plutarch's biography. Pausanias' accounts (ii. 8. 5, vii. 7. 3, viii. 10. 5-8, 27. 13) of his attack on Megalopolis, his seizure of Pellene and his death at Mantinea fighting against the Arcadians, Achaeans and Sicyonians are without foundation (J. C. F. Manso, *Sparta*, iii. 2. 123-127, 1800-05). See also Manso, *op. cit.* iii. I. 276-302; B. Niese, *Geschichte der griechischen und makedonischen Staaten*, ii. 299-303 (1884).

AGISTMENT. To "agist" is, in law, to take cattle to graze, for a remuneration. The word is derived through O. Fr. from Lat. *iacere*, to lie. "Agistment," in the first instance, referred

more particularly to the proceeds of pasturage in the king's forests, but now means either (a) the contract for taking in and feeding horses or other cattle on pasture-land, for the consideration of a weekly payment of money, or (b) the profit derived from such pasturing. Agistment is a contract of bailment, and the bailee is bound to take reasonable care of the animals entrusted to him; he is responsible for damages and injury which result from ordinary casualties, if it be proved that such might have been prevented by the exercise of reasonable care.

There is no lien on the cattle for the price of the agistment, unless by express agreement. Under the Agricultural Holdings Act, 1883, agisted cattle cannot be distrained on for rent if there be other sufficient distress to be found, and if such other distress be not found, and the cattle be distrained, the owner may redeem them on paying the price of their agistment.

AGITATION, THERMAL, the motion of the molecules, within a body, which they possess by virtue of their absolute temperature. (See KINETIC THEORY OF MATTER; THERMODYNAMICS.)

AGITATO (Ital.), a musical term implying that the composition or passage so marked is to be played in a restless, agitated manner; a rapid tempo being usually indicated at the same time by the accompanying time-direction, e.g., *presto agitato*.

AGITATORS or **ADJUTATORS**, the name given to representatives elected in 1647 by the different regiments of the English parliamentary army. Early in 1647 the Long Parliament wished either to disband many of the regiments or to send them to Ireland. The soldiers, whose pay was largely in arrear, refused to accept either alternative, and eight of the cavalry regiments elected agitators, called at first commissioners, who laid their grievances before the three generals, and whose letter was read in the House of Commons on April 30, 1647. The other regiments followed the example of the cavalry, and after a temporary conciliation Parliament decided to disband the army on June 1. The agitators determined to resist; a mutiny occurred in one regiment and the attempt at disbandment collapsed. There followed the seizure of the king by Cornet Joyce, Cromwell's definite adherence to the policy of the army, the signing of the manifestos, a *Humble Representation* and a *Solemn Engagement*, and the establishment of the army council composed of officers and agitators. The agitators finally demanded a march towards London and the "purging" of the House of Commons. Subsequent events are part of the general history of England. Gradually the agitators ceased to exist, but many of their ideas were adopted by the Levellers (*q.v.*), who may perhaps be regarded as their successors.

See S. R. Gardiner, *History of the Great Civil War*, vols. iii. and iv. (1905).

AGNANO, LAGO DI, a crater lake, 5 m. W. of Naples, Italy; 4 m. in circumference, not mentioned in antiquity, probably formed in the Middle Ages, drained in 1866. It has a large modern thermal establishment with springs, natural sulphurous vapour baths and a grotto with constant exudation of warm carbonic-acid gas from the floor. There are extensive Roman remains (V. Macchioro, *Monumenti dei Lincei*, xxi. p. 225. sqq., 1911). On the north side of the crater is a racecourse.

AGNATES, in Roman law, persons related through males only, as opposed to cognates. Agnation was founded on the idea of the family held together by the *patria potestas*; *cognatio* involves simply the modern idea of kindred.

AGNES, SAINT, a virgin martyr of the Catholic Church. The legend of St. Agnes is that she was a Roman maid, by birth a Christian, who suffered martyrdom at the age of 13, during the reign of the emperor Diocletian, on Jan. 21, 304. The prefect Sempronius wished her to marry his son, and on her refusal condemned her to be outraged before her execution, but her honour was miraculously preserved. When led out to die she was tied to a stake, but the faggots would not burn, whereupon the officer in charge of the troops drew his sword and struck off her head. St. Agnes is the patron saint of young girls, who, in rural districts, formerly indulged in all sorts of quaint country magic on St. Agnes' Eve (Jan. 20–21) with a view to discovering their future husbands. This superstition has been immortalized in

Keats's poem, "The Eve of St. Agnes." St. Agnes's bones are supposed to rest in the church of her name at Rome, originally built by Constantine and repaired by Pope Honorius in the 7th century. Here on her festival (Jan. 21) two lambs are specially blessed after pontifical high mass, and their wool is later woven into pallia.

AGNESI, MARIA GAETANA (1718–1799), Italian mathematician, linguist and philosopher, was born at Milan on May 16, 1718. She was an extremely precocious child. Her father was a professor of mathematics. Maria was only fourteen when she began to read a series of theses on philosophical questions to the learned men of Bologna who met regularly in her father's house (see Brosse, *Lettres sur l'Italie*). Her family resisted her early desire to enter a convent, but from her 20th year onward she lived in complete seclusion at home, devoting herself to the study of mathematics. When her father fell ill in 1752 Pope Benedict XIV. appointed her to his chair in the university. But on his death in 1754 she became directress of the Hospice Trivulzio of the Blue Nuns at Milan, and eventually joined the sisterhood. She died on Jan. 9, 1799. Her principal work is *Istituzioni analitiche ad uso della gioventù italiana* (2 vols., Milan 1748; French trans. of vol. i., Paris 1775; complete Eng. trans. by John Colson, 1801).

Her sister, MARIA TERESA AGNESI (1724–80), composed several cantatas, two pianoforte concertos and five operas.

BIBLIOGRAPHY.—See Antonio Francesco Frisi, *Éloge historique de Mademoiselle Agnesi*, translated by Boulard (Paris, 1807); Milesi-Mojon, *Vita di M. G. Agnesi* (Milan, 1836); J. Boyer, "La Mathématicienne Agnesi," in the *Revue Catholique des revues françaises et étrangères* (Paris, 1897).

AGNES OF MERAN (d. 1201), queen of France, was the daughter of Bertold IV, duke of Meran in Tirol. In June 1196 she married Philip II, king of France, who had repudiated Ingeborg of Denmark in 1193. The pope espoused the cause of Ingeborg and eventually put the kingdom under an interdict, whereupon Philip pretended to agree to a separation from Agnes. In fact, he did not turn her away, and Ingeborg was imprisoned. Agnes died in Aug. 1201. The pope legitimized her children by Philip.

BIBLIOGRAPHY.—H. F. Delaborde et al. (eds.), *Recueil des actes de Philippe-Auguste*, vol. 2 (Paris, 1943); Duc de Lévis-Mirepoix, *Les Trois Femmes de Philippe-Auguste* (Paris, 1947); E. Rossier, *Sur les degrés du trône* (Lausanne, 1940).

AGNEW, DAVID HAYES (1818–1892), U.S. surgeon, was born in Lancaster county, Pa., on Nov. 24, 1818. He graduated from the University of Pennsylvania in 1838, and became a lecturer at the Philadelphia School of Anatomy. He was appointed surgeon at the Philadelphia hospital in 1854 and was the founder of its pathological museum. For 26 years (1863–89) he was connected with the medical faculty of the University of Pennsylvania.

From 1865 to 1884—except for a brief interval—Agnew was a surgeon at the Pennsylvania hospital. During the American Civil War he was consulting surgeon in the Mower Army hospital, near Philadelphia, and acquired considerable reputation for his operations in cases of gun-shot wounds. He attended as operating surgeon when Pres. James Garfield was fatally wounded by the bullet of an assassin in 1881.

Agnew was the author of several works, the most important being *The Principles and Practice of Surgery* (1878–83). He died in Philadelphia on March 22, 1892.

See *Surgery, Gynecology and Obstetrics*, pp. 295–299 (Feb. 1928).

AGNI, the fire god of the Hindus, second only to Indra in the Vedic mythology of India. He is invoked as "priest of sacrifice" in the first verse of the *Rig-Veda*, and, as messenger, between gods and men, sacrifices to him are upborne to the deities. On earth his parents are the two sticks of the fire drill, and every day he is reborn an immortal, living among men and supreme director of religious rites and duties. His form is however three-fold, fire on earth, lightning and the sun, and in art he is depicted as ruddy, with two faces, beneficent and malignant, three-legged (as in the fylfot, with seven arms). Later he was identified with Rūdra (*q.v.*). In modern India he has no professed sect, but is invoked in many ceremonies, and specially

affected by Agnihotri Brahmins who perform the "fire sacrifice" (*agnihotra*).

See A. A. Macdonell, *Vedic Mythology*, and F. Washburn Hopkins, *Epic Mythology* (1897 and 1915); J. N. Farquhar, *Outlines of the Religious Literature of India* and Mrs. Sinclair Stevenson, *Rites of the Twice-born* (1920).

AGNI, inhabitants of the Gold Coast and the French Ivory Coast between the Fanti territory and the Comoé river, south of the Abon (*q.v.*) people. They are of the same origin and have the same physical, social and linguistic characteristics as the Baule.

AGNOETAE, a minority of adherents to the Monophysite movement who (contrary to the general tendency of that form of Christology) maintained that Christ as man was ignorant of many things (Mark xiii. 32; Luke ii. 25) (Gr. *ἀγνοῶ*, "be ignorant of"). The doctrine was condemned by Gregory the Great. (See **MONOPHYSITES**.)

AGNOIOLOGY (the theory of ignorance). The term was used by J. F. Ferrier (*Institutes of Metaphysics*, 1854) as a set-off to *Epistemology* (theory of knowledge). The theory was intended to counter the sceptical contention that Absolute Being may be beyond human knowledge, that the human mind may be condemned to remain ignorant of it. Ferrier's contention is that man cannot be said to be ignorant of what cannot be known; he can only be said to be ignorant when he does not know what can be known. On such lines Ferrier concludes that, since Absolute Being must either be something that we know or something that we are ignorant of, it cannot be subject only or object only but a synthesis of both.

AGNOSTICISM. Whereas scepticism, as a technical term in philosophy, denotes varying degrees of doubt as to whether some or all of the psychological processes, purporting to yield knowledge, really do so, agnosticism rather asserts that, of certain kinds of objects or facts, we possess assured knowledge, while as to certain other kinds of alleged existents we have, and can have, none. The kinds of alleged objects, knowledge as to which the agnostic believes to be impossible, are such as are the primary concern of metaphysics and theology: God, the soul and its immortality, and—more generally speaking—the ultimate realities of which phenomenal things, such as the sciences study, are appearances. Of these phenomenal things, we have ever-increasing and irrefragable knowledge; as to the things *per se*, the ontal or noumenal existents, of which the "things" of common sense and science are the knowable shadows or appearances, we can never have knowledge pure and subjectively undefiled. If we know that they are, we cannot know *what* they are; if we can assert their existence, we are ignorant as to their essence.

The name "agnosticism" was coined by Huxley about 1870 to distinguish this philosophical attitude from others, but the attitude had been professed before. It is, in fact, one of the issues of Kant's imposing theory of knowledge, and it had become, through the investigations of Sir W. Hamilton, Dean Mansel and Herbert Spencer, more sharply defined and more elaborately developed. Huxley, who was perhaps its most widely-known champion in the latter half of the 19th century, gave definiteness to its exposition by forcibly contrasting metaphysical and theological belief with scientific knowledge. We can now see that the controversial issue was confused, through failure at that time to realize that the word "knowledge" denotes not one sole psychological process and product, but several that are distinguishable; and also that what is called scientific knowledge is not quite so simple in its psychological structure, nor so logically "positive" in its nature, as the philosophically-inclined representatives of science in Huxley's day were wont to assume. The positivists who were led by the progress and prestige of physical science to regard science as constituted entirely by sense-data, linked together solely by relations such as could be read-off with the inevitableness and self-evidence of similarity, temporal sequence, etc., overlooked the fact, which had been clearly discerned by Hume, that we have no *logical* right to pass from our sporadic and evanescent sense-data, which yield evidence only as to here and now, to belief in a stable system of permanent things governed by law. The right is not a matter of logical neces-

sitation but of psychological inevitableness; not of logical certification but of pragmatic verification; not of logical certainty but of personal certitude or sanguine confidence. Thus science is not knowledge, in the strict sense of reading-off, supplemented by logical inference. Such knowledge, and indeed the phenomenal objects about which it claims to know, are constituted such by suppositions that, in the first instance, are read *into* the data. Thus "knowing" means, in science of the actual, something different both from the immediate "acquaintance" of sense-perception and from the "truth" that is yielded by pure sciences, such as mathematics, whose "objects" are ideas—such as the line without breadth—and not actual things. This is also the doctrine of Kant. But Kant held that the reading-in that is involved in scientific knowledge is *a priori* necessary, so that such knowledge is knowledge in the strictest sense; whereas the reading-in that is involved in metaphysics and theology is but tentative and humanly expedient. This hard line between what Kant called understanding and reason—we might say between knowledge and mere belief—is now seen to be psychologically arbitrary, not so hard as he thought, and indeed to be drawn at the wrong place. Hence the rigid separation, once wont to be alleged between science and philosophy, and, on the strength of which, metaphysics and theology were disparaged, is no longer possible. The agnostic can no longer have that certainty as to the foundations of his science, in virtue of which he asserted nescience as to the non-phenomenal. The difference between the knowledge which he asserted and the knowledge which he disclaimed is one of degree of verifiability, not of kind or of intrinsic constitution.

But agnosticism, which issues out of Kant's phenomenalism, is imbued with consequences of what may be said to be another oversight of Kant, perhaps still more significant in import. Kant tried to work with the supposition that, though facts compel us to assert the existence of things *per se*, we can know no more about them. His doctrine implies that we can only know the phenomenal. This is the teaching that was developed by Hamilton into the dogmas that we can have no knowledge of the absolute or of ultimate reality, and no absolute or pure knowledge of anything: all knowledge is but relative. As to its Kantian foundation, it seems obvious that if we must posit things *per se*, in order to account for our sense-data being forthcoming, so must relations between things *per se* be posited to account for the stable connections between sense-data, which science elaborates into laws of nature. Indeed, unless we create most of our data out of nothing or out of our subjective states, etc., there must be structure and detail in the ontal corresponding to that which we observe in the phenomenal. Appearance cannot be appearance of nothing. Hence, instead of the Kantian formula, that we only know phenomena, it is more correct to say that we know the noumenal through the phenomenal. Thus there is not absolute nescience as to the noumenal, as agnosticism would assert. The most that can be urged is that we do not see the noumenal, so to say, through plate glass, but through the irremovable spectacles of the mind, which make a difference to the noumenal object or phenomenalize it. It is at this point that Hamilton's doctrine of the relativity of knowledge applies. He would regard phenomenal knowledge of the noumenal as not knowledge at all, because, in having it, we are not identical with the objects known nor become acquainted with them as they are in themselves. Our knowledge falls short of the ideal standard, in that it is impure—which is what he chiefly means by "relative." But it may be doubted whether knowledge suffers in value on that account. There is no reason to assume that, in imaging the real, the phenomenon veils it or caricatures and misrepresents it; it may reveal it, and reveal its significance just as effectually as would seeing face to face. What matters is that phenomenal knowledge should be *relevant* to reality, not that it should mirror its naked structure. An Ordnance map serves all purposes of the tourist, though it may not mirror the coloured landscape or the geological formations of the district; it is relevant, if but appearance and not a copy. There is point-to-point correspondence between the lines and contours on the map and the streams, roads, gradients, etc., of the country which

it represents. Our phenomenal knowledge may bear—nay, must bear—much the same sort of relation as this to the realities which manifest themselves in and through the sensible and phenomenal. It enables us to “find our way about” our world, to be on terms of understanding with it and it may minister as much to spiritual wisdom as to practical prudence; for all that it is but phenomenal.

That “we see through a glass, darkly” may be our lot here; but it does not follow that we are wholly blind as to all that concerns our souls’ health. Thus it would appear that agnosticism is superfluously modest. Its demurrer to the philosopher’s claim that knowledge as to ultimate reality in general is inaccessible is not sustained.

If it would refuse the name of knowledge to such cognition it would seem to be cherishing a conception of knowledge to which no actually forthcoming “knowing” corresponds. For science itself, wont to be taken as the paradigm of knowledge, is at bottom interpretative, constructive, ejective and partly symbolical.

Its inductive method involves faith, for which there is reasonable, but not logical, justification. And knowledge as to the objects with which metaphysics and theology are concerned, is but a further extension of the same method and the same sustaining faith as science uses, applied to such facts as evince meaning or purpose and value or significance, as well as to those which yield laws as to physical structure and connections.

BIBLIOGRAPHY.—J. Ward, *Naturalism and Agnosticism*; R. Flint, *Agnosticism* (1903). (F. R. T.)

AGNUS DEI, the figure of a lamb bearing a cross, symbolizing the Saviour as the “Lamb of God.” The name is especially given in the Roman Church to waxen discs impressed with this figure and blessed by the pope. When first mentioned (c. 820) they were made of the remnants of the preceding year’s paschal candle.

In modern times they are blessed on Easter Wednesday and distributed on the following Saturday, only in the first year of each pontificate and every seventh year after.

Agnus Dei is also the name for the invocation (based on John i, 29) *Agnus Dei, qui tollis peccata mundi, miserere nobis*, which appears to have been introduced into the Mass by Pope Sergius I (687–701).

It is there repeated thrice (the third time with *dona nobis pacem* for *miserere nobis*) between the Lord’s Prayer and the communion; it is also appended to many of the litanies. The legality of its use in English, under certain conditions, in the Anglican communion service was upheld by the judgment in the Lincoln case (1890).

For the various ceremonies in the blessing of the *Agnus Dei*, see A. Vacant, *Dict. de Théologie* (cols. 605–613).

AGOBARD (c. 779–840), Carolingian prelate and reformer, became coadjutor to Leidrad, archbishop of Lyons, in 813, and on the death of the latter succeeded him in the see (816). Deposed in 835 by the council of Thionville, he made his peace with the emperor and was reinstated in 837. Agobard occupies an important place in the Carolingian renaissance. He wrote extensively not only theological works but also political pamphlets and dissertations directed against popular superstitions. He denounced the trial by ordeal of fire and water, the belief in witchcraft, and the ascription of tempests to magic, maintained the Carolingian opposition to image-worship, but carried his logic farther and opposed the adoration of the saints.

In his purely theological works Agobard was strictly orthodox, except that he denied the verbal inspiration of the Scriptures. Agobard was revered as a saint in Lyons, and although his canonization is disputed his life is given by the Bollandists, *Acta Sanctorum*, Jun. ii, 748.

BIBLIOGRAPHY.—Agobard’s works were lost until 1605, when a manuscript was discovered in Lyons and published by Papirius Masson, again by Baluze in 1666. For later editions see Potthast, *Bibliotheca Historica Medii Aevi*. The life of Agobard in Ebert’s *Geschichte der Litteratur des Mittelalters* (1880), is still one of the best to consult. For further indications see A. Molinier, *Sources de l’histoire de France*.

AGONOTHETES, in ancient Greece, the president or superintendent of the sacred games. At first the person who instituted the games and defrayed the expenses was the Agonothetes. But in the public games, such as the Olympic and Pythian, these superintendents represented different States, or were chosen from the people in whose country the games were celebrated; thus at the Panathenaea at Athens ten *athlothetai* were elected for four years to superintend the various contests. They were variously called “regulators,” “arbitrators,” “judges of contests,” “stewards of the games” (at Athens), “rod-bearers” (from the rod or sceptre emblematic of their authority), but their functions were generally the same.

AGONY COLUMN, a term often applied to the column in newspapers devoted to personal advertisements, such as announcements of losses or bequests. At as early a date as 1800 the “agony column” was a medium also for matrimonial advertisements. It is sometimes known as the personal column.

See Alice Clay, *The Agony Column of the “Times” 1800–1870* (1881).

AGORA, originally an assembly of the people of one of the Greek city States, called by the king or other authority to receive a decree or to discuss a policy. At an early period the word was used to describe the places where these meetings were held and in historic times any open space for general meetings, either official or commercial, was termed an agora. The agora of the historic Greek city was thus similar to the Roman forum or the mediaeval English market place. As the agora was the centre of the city life, it was surrounded by, or adjacent to the most important civic buildings, the prytaneum or official residence of the general, the basilica where the court sat, the *bouleuterion* or council hall, the thesaurus or treasury and the prison. As the market place, it had ranges of sheds or colonnades for shops; frequently the colonnades were divided into parts, each named after the particular merchandise sold therein.

After the Persian war the architectural treatment of the agora became much more monumental and lavish colonnades were frequently added to the older agorae, such as the Stoa of Attalus in the agora at Athens (between 159 and 138 B.C.). Of these later agorae many fine examples exist in various states of preservation. That at Ephesus was a square court over 500 ft. on the side, connected with additional courts containing a gorgeous nymphaeum and the lavish Roman library. At Priene the agora was traversed by streets but arranged so that through traffic was carried below on a detour. The substructures of the hillside agorae at Aegaea and Alinda still remain almost complete. In these cases the agora on a high terrace had large storage warehouses below. The great terrace wall at Alinda, with its striking rusticated masonry and large Roman arched openings, is especially impressive. Most important of all, however, is the agora at Assus, of which extensive remains still exist in a good state of preservation, with enough fragments to enable a complete and definitive restoration. This, like the two foregoing, is a hillside agora, supported on massive terrace walls. Its main architectural feature is the great two-storey portico.

The forum at Pompeii, in plan, dates probably from the time of the Greek colony. It therefore forms a connecting link between the Greek agora and the Roman forum. With its surrounding colonnade, its basilica, the city temple at one end and the civic offices at the other, it gives a perfect picture of what the typical Greek agora was like. (For the agora at Athens see ATHENS.)

For a general discussion, see Cornish, *Dictionary of Greek and Roman Antiquities* (1898). The topical plan given is, however, absurd through its obvious misinterpretation of a passage in Pausanias in which he refers to colonnades separated by streets. Pausanias plainly refers to streets traversing the agora and thus dividing the enclosing colonnade into separate sections. See also S. H. Bacon and Robert Koldewey, *Expedition of the Archaeological Institute of America* (investigations at Assus in 1881–83, 1902–21); Anderson and Spiers, *Architecture of Ancient Greece*, new ed. by W. B. Dinsmoor (1927).

AGORACRITUS, a Parian and Athenian sculptor of the age of Pheidias, and said to have been his favourite pupil. His most noted work was the statue at Rhamnus of Nemesis, by some

attributed to Pheidias himself. Of this statue part of the head is in the British Museum; some fragments of the reliefs which adorned the pedestal are in the museum at Athens.

AGORANOMI. Magistrates in Greece, whose duties were similar to those of the aediles of Rome. In Athens there were ten, five of whom took charge of the city and five of the Peiræus. They maintained order in the markets, tested weights and measures, collected the harbour dues, and enforced the shipping regulations.

AGORDAT, a town of Eritrea, North-east Africa, on the route between Massawa and Kassala. It is connected by a railway, 194 miles long, with Massawa, via Asmara. At Agordat (Dec. 21, 1893) Italians under Colonel Arimondi defeated the followers of the khalifa. It was captured by British forces in March 1941.

AGOSTINO and **AGNOLO** (or **ANGELO**) **DA SIENA**, Italian architects and sculptors in the first half of the 14th century. Della Valle and other commentators deny that they were brothers. They certainly studied together under Giovanni Pisano, and in 1317 were jointly appointed architects of their native town, for which they designed the Porta Romana, the church and convent of St. Francis, and other buildings. On the recommendation of Giotto (q.v.), they executed in 1330 the tomb of Bishop Guido Tarlati in the cathedral of Arezzo, which Giotto had designed. This monument was destroyed by the French under the duke of Anjou.

AGOSTINO or **AGOSTINI** (**AUGUSTINUS**), **PAOLO** (1593–1629), Italian musician, was born at Valerano, and studied under G. B. Nanini. He succeeded Ugolini as conductor of the pope's orchestra in St. Peter's. Among his compositions is an *Agnus Dei* for eight voices, once greatly admired.

AGOULT, MARIE CATHERINE SOPHIE DE FLAVIGNY, COMTESSE D' (1805–1876), French author, whose *nom de plume* was "Daniel Stern," was born at Frankfurt-on-Main on Dec. 31, 1805. Her father was a French officer who had served in the army of the emigrant princes, and her mother was the daughter of a Frankfurt banker. She was married in 1827 to the comte Charles d'Agoult. In Paris she gathered round her a brilliant society which included Alfred de Vigny, Sainte-Beuve, Ingres, Chopin, Meyerbeer, Heine and others. She was separated from her husband, and became the mistress of Franz Liszt. During her frequent travels in Switzerland, France and Italy she made the acquaintance of George Sand, and figures in the *Lettres d'un voyageur* as "Arabella." By Liszt she had three children—a son who died young; Blandine, who married Émile Ollivier; and Cosima, who married first Hans von Bülow and later Richard Wagner. The story of her breach with Liszt is told under a very slight disguise in her novel *Nélida* (1845). On her return to Paris in 1841 she began to write for the *Presse*, and later for the *Revue des deux Mondes* and the *Revue indépendante*. Mme. d'Agoult was an ardent apostle of the ideas of '48, and from this date her *salon*, which had been literary and artistic, took on a more political tone; revolutionists of various nationalities were welcomed by her, and she had an especial friendship and sympathy for Daniele Manin. In 1857 she produced a national drama, *Jeanne D'Arc*, which was translated into Italian and presented with success at Turin. The most important section of Daniel Stern's work is her political and historical essays: *Lettres républicaines* (1848), *Esquisses morales et politiques* (1849), *Histoire de la Révolution de 1848* (1850–1853), *Histoire des commencements de la République aux Pays-Bas* (1872). Mme. d'Agoult died in Paris March 5, 1876.

See Mme. d'Agoult, *Mes Souvenirs* (1806–33), 1877; J. Mazzini, *Lettres de Joseph Mazzini à Daniel Stern* (1872); A. Pommier, *Madame la comtesse d'Agoult* (Daniel Stern), 1876; A. Cuvillier Fleury, *Portraits révolutionnaires*, vol. 1. (1889); A. Ungherini, "Daniel Stern" in the *Revista repubblicana* (1880, No. 9); S. Rocheblave, *Une Amitié romanesque, George Sand et Madame d'Agoult* (1895); R. Bory, *Une Retraite romantique en Suisse; Liszt et la comtesse d'Agoult* (1923), with an appendix containing letters; Daniel Oliver, *Mémoires de la comtesse d'Agoult: 1833–54* (1926).

AGOUTI or **AGUTI** (a-gōō-tē), rodent (*Dasyprocta aguti*), of the size of a rabbit, common to Trinidad and Guiana, and related to the guinea pigs. Agoutis are slender-limbed animals,

with five front and three hind toes (the first front toe very minute), and short tails. The hair is coarse and rough; the colour being rufous brown. In habits agoutis are nocturnal, dwelling in forests, where they conceal themselves during the day in hollow tree-trunks, or in burrows among roots. They take readily to water and swim well. Their food comprises leaves, roots, nuts and other fruits. They do much harm to sugar-cane. (See **RODENTIA**.)



BY COURTESY OF N.Y. ZOOLOGICAL SOCIETY
THE AGOUTI, COMMON IN EASTERN SOUTH AMERICA, AND DESTRUCTIVE TO SUGAR CANE AND BANANA PLANTS

AGRA, the headquarters of a district, division and province of the same name in the United Provinces of Agra and Oudh (q.v.), was for long periods the capital city of India. Pop. (1941) 284,149. It stands on the Jumna which, though now at this point a mere trickle in the dry season, was formerly one of the chief arteries of commerce with the rest of India and at the same time a powerful frontier defence. Of the original Agra, which apparently lay on the left bank of the river, practically no traces remain. The present city on the right bank was the creation of the Mohammedan conquerors. The earlier dynasties fluctuated between Delhi and Agra as their centre of power; but it was at Agra that Sikander Lodi (A.D. 1500) set up his court, deeming it the strategic point for holding in check his turbulent vassals to the south. In 1526 the city was captured by Baber, the Koh-i-nor diamond being part of his booty. It was here that he decided to occupy India in permanence; here also that he died. It was his grandson Akbar who began to build the present fort (still by the people called Akbarabad), ruled India from within the walls, died in it, and was buried at Sikandra a few miles beyond the city gates. Agra fell from its pride of place when Aurangzeb moved to Delhi, and was never again the seat of monarchy. In the latter half of the 18th century, it was captured successively by the Jats, the Mahrattas, the Mohammedans and Scindhia; but it was finally taken by Lord Lake in 1803. After British rule was extended to upper India, it became the capital of the North-West provinces until at the close of the Mutiny the seat of that Government was transferred to Allahabad. The city is now a busy railway and commercial centre with cotton mills, gins and presses, flour mills and an important carpet industry.

There are two large colleges and several other educational institutions, including a medical school for men and women.

Although to travellers Agra is essentially the city of the Taj, it enshrines several other magnificent specimens of Mogul architecture, each perfect of its kind. The fort, with its lofty walls of red sandstone 1½ m. in circumference, contains at least two such gems. Separated from each other by the main block of the buildings of the imperial court, stand on the north the Pearl Mosque, built by Shah Jahan, and on the south the Jahangiri Mahal or palace built by Akbar; the former unequalled for the beauty and purity of its proportions, material and constructive design in simple white marble; the latter a perfect adaptation of stately solidity and commanding symmetry of the Hindu style. If we leave the fort and cross the river, we find another gem of its kind in the tomb of Itmad-ud-Daulah, father of Jahangir's empress. Its architecture is transitional between the virile conceptions of Akbar and the poetic richness of Shah Jahan; elegant, elaborate and scholarly, it was the first triumph of marble inlaid work in direct imitation of Persian pottery decoration. Five miles from Agra is Sikandra, where Akbar was buried, though his remains were desecrated and scattered by Jat freebooters in later years. His tomb is a noble building in a noble setting, and the marble sarcophagus on its roof is strikingly impressive in its simple dignity. Far exceeding all the others in glory is the Taj, the most beautiful mausoleum in the world. It was built by Shah Jahan for his empress, who died in A.D. 1631; and from one of her titles, Taj Mahal or Crown of the Palace, it takes the name by which it is most generally known outside India. Built of pure white marble, it stands on a vast marble terrace, crowned by a great dome in the centre and smaller domes at each of its corners. From the angles of the terrace rise

four slender minarets. Subservient and supplementary to the glory of the outline is the beauty of the ornamentation. "All the spandrels of the Taj," writes Fergusson, "all the angles and more important architectural details are heightened by being inlaid with precious stones such as agates, bloodstones, jaspers and the like. These are combined in wreaths, scrolls and frets as exquisite in design as they are beautiful in colour, and relieved by the pure white marble in which they are inlaid, they form the most beautiful and precious style of ornament ever adopted in architecture."

The architect of the Taj was Ustad Isa, variously described as a Byzantine Turk, and as a Persian from Shiraz. The artificers engaged during the 17 years of its construction came from all

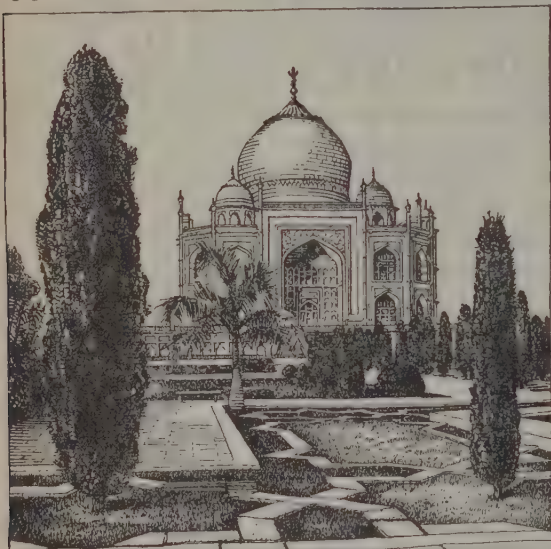
public land were laws (*leges*) in the strictest sense of that word. It is, however, convenient to consider in this article all the regulations that were made for the administration of the public land by the executive authorities, as well as by the people during the republic, and by the commands of the emperor, which had the force of law during the principate.

Public land was the prize of conquest and was one of the means of defraying the expenses of state administration. For this purpose land was often leased on the condition of the payment of dues. But it was made to fulfil another purpose, the satisfaction of the individual needs of poorer citizens. To this end land was assigned, and on assignment ceased to be the property of the state. But it often happened that the state was not disinterested in such acts of assignment. It gained security and territorial control by planting garrisons in conquered country, and it relieved itself of the necessity of providing for its poorer classes by state-aid. The connection between agrarian legislation and colonization can be seen at once, and also the two aspects of colonization—the military and the social. These two objects were connected throughout the whole of the earlier period of Roman agrarian assignation. After the time of the Gracchi social motives continued to be operative when military precautions had ceased to be necessary. One of the motives which prompted infant Rome to war with her neighbours was the land-hunger of her citizens. This hunger she satisfied after conquest by annexing a portion of the enemy's territory. The amount thus confiscated varied. It was usually a third, but sometimes a half or even two-thirds, and after the fall of Capua in the Second Punic War the whole territory of the state was annexed. By the close of the 2nd century B.C. one-half of the land of Italy belonged to Rome whether in private ownership or as the property of the state. Annexation was carried on in the provinces on a smaller scale; but Rome retained as domain-land much of the territory of communities which had been destroyed (e.g., Carthage and Corinth), and the estates of former kings. This peculiar property of the Roman state in the provinces must be carefully distinguished from the general overlordship which Rome was supposed to hold over all provincial soil, expressed in the statement that provincials had only possession or usufruct of land.

Methods of Handling Public Land.—Such portions of the territories of conquered cities as were not claimed by Rome were left in the possession of these cities. If the city was a federate state (*civitas foederata*) this possession was guaranteed by a treaty; if it was a free city, the guarantee was made by charter; where Rome had marked out territory for assignment to her own citizens, but where, in or near the limits of the assignment, some of the land had been left in the hands of its former proprietors, such land was noted in the state registers as *redditus veteri possessori*.

The State dealt in two ways with such land as it retained. It alienated it, in exchange for a price or gratuitously; or it kept it as a source of revenue, whether on lease or on some system of remunerative occupation. The land might be sold for the benefit of the treasury. Typical instances of this treatment are furnished by the sale of some Campanian land during the Second Punic War. The censors may have directed the sale, but it was executed by the quaestors as the regular officials of the treasury. Hence such land was described as *ager quaestorius*. The land was sold in definitely marked out plots, and when this sale had been effected the lots fell under the absolute ownership of their purchasers.

The second mode of alienation was that by assignation. Lands thus assigned were known as *agri dati adsignati*. The gift on the part of the State was gratuitous, and ownership passed wholly to the assignee. The land so given was definitely surveyed, marked out, and registered. Such an assignment might take one of two possible forms. It might be the means of establishing a new "plantation" (*colonia*), with some independent organization of its own, or it might be the means of providing allotments for individuals who remained domiciled at Rome or in some already existing municipality. The amount granted to individuals in assignments of both types varied from time to time. It was reckoned in terms of the *iugerum*, which was approximately five-eighths of an English acre. The earliest and smallest assignment was two *iugera*:



BY COURTESY OF CANADIAN PACIFIC STEAMSHIPS

THE TAJ MAHAL AT AGRA, ERECTED BY THE EMPEROR SHAH JAHAN AS A MAUSOLEUM FOR HIS EMPRESS WHO DIED IN A.D. 1631. THE ARCHITECT WAS USTAD ISA

parts of Asia and probably included a French goldsmith, Austin de Bordeaux.

The district of Agra has an area of 1,861 sq.mi. Its general appearance is that common to the Doab, a level plain intersected by watercourses with fringes of ravines. Its general elevation is estimated at from 650 to 700 ft. above the level of the sea. The district is intersected by the Jumna, and is also watered by the Agra canal. The principal crops are millets, pulses, barley, wheat, cotton and a little indigo. The population in 1941 was 1,289,774.

The division of Agra has an area of 8,646 sq.mi. In 1941 the population was 5,326,768. It comprises the five districts of Ali-garh, Muttra, Agra, Mainpuri and Etah.

AGRA CANAL, primarily an irrigation project opened in 1874, but widely used for navigation. It is supplied with water from the Jumna river and beginning at Okla, 10 m. below Delhi it passes through the districts of Delhi, Gurgaon, Muttra and Agra as well as the Bharatpur state. It finally joins the Banganga river about 20 m. below Agra.

AGRAM: see ZAGREB.

AGRAPHIA, the name given to certain utterances ascribed, with some degree of certainty, to Jesus, which have been preserved in documents other than the Gospels, e.g., Acts xx. 35; 1 Tim. v. 18; 1 Cor. vii. 10-12, and the Logia (*q.v.*) discovered in 1897 and 1903 at Oxyrhynchus.

BIBLIOGRAPHY.—See A. Resch, *Agapha* (Leipzig, 1889); J. H. Ropes, *Die Sprüche Jesu* (Leipzig, 1896); and the article "Sayings" in J. Hastings's *Dictionary of Christ and the Gospels*.

AGRARIAN LAWS, law dealing with the disposal of the public land (*ager publicus*) of ancient Rome. No gratuitous disposition of state property could be made without the consent of the people. Hence many of the ordinances affecting the

14 *iugera* was the maximum amount granted before the time of Ti. Gracchus (133 B.C.), and it was held by representatives of the old school that seven *iugera* were as much as any frugal Roman should want. The division was carried out by commissions appointed by the people. The land which the State retained as *ager publicus* was always placed in the hands of individuals, who occupied it in some manner remunerative to the State. These individuals (*possessores*) were never regarded as owners of the land thus occupied. It remained the property of the State, was held without a contract (*precario*), and could be resumed by the State at will. But though the tenants had no claim against the State, their ownership could be defended against all other claimants; from an early date the praetor's possessory interdict was used to protect all occupiers, provided their tenure had not been acquired by force (*vi*), by seizure of land in its occupiers' absence (*clam*), or by mere permission of the previous holder to occupy (*precario alter ab altero*). Tenants of this type could transfer their land by inheritance, and the land was accepted as security by creditors. This kind of occupation, therefore, though clearly distinguished from ownership (*dominium*), was yet regarded as a perfectly secure form of tenure. All occupiers of public land paid dues to the State through a state contractor (*publicanus*). These dues varied in amount and in the method of their collection. We learn from Appian that the ordinary dues paid by occupiers of arable land in Italy were one-tenth of seed crops and one-fifth of plant produce. Owners who turned cattle or sheep on pasture land belonging to the state also paid fixed dues to the treasury. The occupiers of the Roman public land in Campania paid a large rent. The conditions of the tenure of the Roman public land in Africa are known to us from the *Lex Agraria* of 111 B.C. The *publicanus* is the middleman between the State and the *possessor* and purchases from the censor the right of collecting dues. The law places no restriction on bargaining between the censor and the *publicanus*, but enacts that no *possessor* or *pastor* shall ever be required by the *publicanus* to pay more than the amount prescribed by the censors of 115 B.C. These conditions may be regarded as typical for the occupation of public lands. When Cicero speaks of public land as let on lease (*locatus*) by the censor, he refers to the leasing of the taxes to a *publicanus* for a fixed period, and not to the letting of the land. This seems clear from a passage (*In Verr.* iii. 6. 12) where he speaks of land in Sicily which had been restored by Rome to former owners as being leased. The land itself could not be leased by Rome if it belonged not to Rome but to the Sicilian inhabitants; but the collection of the revenues due to Rome could be so leased to *publicani* (*q.v.*). The same explanation would apply to Cicero's statements that the Campanian land was let on lease by the censors. Cicero's repeated statement that the Campanian land was expressly exempted from the legislation of the Gracchi shows that there was not sufficient distinction between the Campanian tenure and that of other public land in Italy to make this definite exception by name superfluous. The Sempronian law could obviously not touch land which the State had leased to occupiers on the basis of a definite contract. It seems certain that in every case the *possessor* occupied *precario*, and that only in the bargain between the censor and the middleman was there room for contract. Thus the State was justified in the claim to resume public land which it made in many of the agrarian laws.

Survey of Agrarian Legislation.—The earliest agrarian measures of which we have any record are the distributions to poor citizens of land conquered in war, which later authorities attribute to Numa and Servius Tullius. Such assignments were a voluntary surrender on the king's part of his own portion of the spoils. The agrarian law of Spurius Cassius (486 B.C.) distributed *ager publicus* among the plebeians. Another agrarian law proposed by the tribune Lucius Icilius in 456 B.C. regulated the tenure of public land on the Aventine. In 376 B.C. the tribunes Licinius and Sextius introduced into their laws, for the promotion of the privileges of the *plebs*, a clause enacting that no more than 500 *iugera* of land should be occupied by a single cultivator; the law also enacted that only 100 cattle and 500 sheep might be turned by one owner on the public pastures. But it failed of its object because it did not provide any adequate machinery for the resumption by

the state of land held in excess of the prescribed amount, and was therefore easily evaded. The next agrarian law was a measure dealing with lands conquered from the Senones (*q.v.*) and Pictinenses. In 232 B.C. C. Flaminius, tribune of the *plebs*, proposed to resume these lands for the state, although they were already occupied by large landholders, and to distribute them in allotments to poor citizens. The measure met with much opposition from the richer classes, and did not gain the sanction of the senate; but C. Flaminius ignored constitutional usage and brought it direct before the council of the *plebs*, by which it was made law. In 133 B.C. the tribune Tiberius Gracchus (*q.v.*) re-enacted the earlier measure of Licinius and Sextius, with the additional provisions that each owner might occupy 250 *iugera* for each son, in addition to the original 500, and that a commission of three (*III. viri agris dandis adsignandis*) should be appointed to carry out the terms of the law. He also enacted that the land occupied in excess of the prescribed amount, and on that account resumed for the State by the land commission, should be distributed in inalienable lots to poor citizens. Subsequent modifications of those provisions which dealt with the powers of the land commission led to a re-enactment of the whole by G. Gracchus (*q.v.*), the brother of Tiberius, tribune in 123 B.C. But within 15 years from the tribunate of G. Gracchus the whole of his law had been rendered null by three further enactments. The first of these permitted the sale of land allotted under the law, which thus tended to return into the hands of its former occupiers as private property, which the State had no longer any right to resume. The second abolished the commission appointed to carry out the terms of the law, thus putting a stop to further resumption and distribution, and also transformed existing occupiers into owners of the land they occupied, paying only a small due to the treasury. The third abolished the payment. That law belonged to the year 111 B.C.

From that time forward a change came over land legislation. The ordinary public land in Italy, in the hands of occupiers, which had given rise to all the agrarian legislation between 376 and 111 B.C. had practically ceased to exist. The Campanian land still remained, but the same reasons which led to its exemption from the Gracchan legislation seem to have continued to protect its holders until 63 B.C. In the meantime several agrarian laws were passed which provided for the distribution of land placed in some other way at the disposal of the State. In 100 B.C. Appuleius Saturninus (*q.v.*) tribune, proposed the allotment of lands recently taken from the Cimbri in Gaul. This law was passed but eventually declared null by the senate, with the rest of Saturninus's laws. A more dangerous precedent was set by Sulla in his dictatorship (82–81 B.C.). He was the first to confiscate the lands of his political opponents and of communities which had resisted him and, treating them as *ager publicus*, assign them to his veterans as a prize. This example was followed by Octavian (Augustus) and Antony (M. Antonius) after their proscriptions in 43 B.C. A third method of providing land for distribution was that adopted by Servilius Rullus (*q.v.*) in 63 B.C. His bill enacted that land should be purchased in Italy with money gained by the sale of Roman territories abroad, and allotted to citizens. A commission of ten (*X. viri agris dandis adsignandis*), annually elected by nine out of the 35 tribes, was to carry out the terms of the law. Rullus also ventured to propose the distribution of the Campanian land which had hitherto been respected by all agrarian reformers. It was chiefly on this ground that Cicero in his three speeches on the Agrarian law succeeded in exciting such a general feeling against it that it was eventually withdrawn. In 60 B.C. the tribune L. Flavius brought forward a bill for the distribution of lands to Pompey's veterans. The Campanian land was certainly to be included in the distribution, and it is clear from Cicero that the bill in some way dealt violently with the rights of private owners. It also, however, enacted that land should be purchased by the State with the wealth which Pompey's conquests had brought into the treasury. The last proposal was supported by Cicero, but the bill seems to have been dropped, only to reappear in more moderate form in the following year. A consular bill, the *lex Iulia Campana*, was passed by Julius Caesar in 59 B.C., which provided for the settlement of Pompey's veterans on the Campanian land, and other lands pur-

chased by the state from private owners in Italy with the full consent of the latter. In its original form, the bill omitted all reference to the Campanian land, which seems to have been included by Caesar in the distribution only when the continued and unreasoning opposition of the senate had goaded him to extreme measures. A commission of twenty was to be appointed to carry out the law, from which Caesar himself was expressly excluded. This measure finally settled the question of the Campanian land, which now passed out of the category of *ager publicus*. The last agrarian law of the republic was that passed in 44 B.C. on the proposal of the consul M. Antonius. We have no detailed account of the measure, but it seems to have provided grants of land for veterans, and was to be administered by seven commissioners. The law was afterwards cancelled by decree of the senate.

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AGRARIAN MOVEMENT: see **LAND TENURE: ECONOMIC AND AGRARIAN ASPECTS.**

AGREDA, MARIA FERNANDEZ CORONEL, ABBESS OR, known in religion as Sor (Sister) Maria de Jesus (1602–1665), was born at Agreda, on the borders of Navarre and Aragon, on April 2, 1602. All her family were powerfully influenced by the ecstatic piety of Spain in that age. From childhood she experienced ecstasies and visions. When she was fifteen the whole family entered religion. Maria, her mother and sister established a Franciscan nunnery in the family house at Agreda, which, when Maria's reputation had extended, was replaced by the existing building. She began it with one hundred reals (one pound sterling) lent her by a devotee, and it was completed in fourteen years by voluntary gifts. Much against her own wish, we are told, she was appointed abbess at the age of 25. Though the rule required the abbess to be changed every three years, Maria remained the effective ruler of Agreda till her death. In the earlier part of her life, while the Franciscan, Francisco Andres de la Torre, was her confessor, she wrote an *Introduction to the History of the Most Blessed Virgin*. It was destroyed by the direction of another confessor. Later on, under the guidance of her Franciscan confessor, Andres de Fuen Mayor, she wrote *The Mystic City of God*. It is an extraordinary book, full of apocryphal history, visions, and scholasticism. In 1642 she sent to Philip IV. an account of a vision of a council of the infernal powers for the destruction of Catholicism and Spain. The king visited her when on his way to Aragon to suppress the rebellion of Catalonia. A long correspondence, which lasted till her death on March 29, 1665, was begun. The king folded a sheet of paper down the middle and wrote on the one side of the division. The answers were to be written on the other and the sheet returned. How far Maria was only the mouthpiece of the Franciscans must of course be a matter of doubt. Her correspondence was apparently suspended whenever her confessor was absent. The letters are in excellent Spanish, are curious reading, and are invaluable as illustrations for the second part of the reign of Philip IV.

The correspondence of Sor Maria with the king has been published in full by Don F. Silueta, *Cartas de la Venerable Madre Sor Maria de Agreda y del Señor Rey Don Felipe IV.* (1885). *The Mystic City of God* continued to be much in favour with supporters of the dogma of the Immaculate Conception. It appeared in Madrid in 1668, with a biographical introduction by Samaniego, has been often reprinted, and was translated into French and Italian. It was for a time reserved by the Index, both Spanish and Papal, but was taken off by the influence of the Franciscans and of Spain, the chief supporters of the Immaculate Conception. An account of Maria de Agreda will be found in the *Tracts* of Michael Geddes (1706), vol. iii., written by a competent critic and Anglican divine of the 18th century who detested "enthusiasm."

AGRÉMENTS (Ital. *abbellimenti*; Ger. *Manieren*; Eng. *ornaments*), in music, are supplementary notes, or embellishments, introduced for the purpose of enriching, elaborating or otherwise altering the effect of the phrase or melody to which they are applied. As employed in connection with the older types of music, alike vocal and instrumental, they assumed a large variety of forms (*acciaccatura*, *appoggiatura*, *arpeggio*, *mordent*, *shake*, *turn*,

and so on) which in course of time became definitely standardized and so formed an essential part of the music, although nominally left to the discretion of the performer and indicated, if at all, only by conventional signs.

AGRIANES, a warlike tribe anciently inhabiting Upper Macedonia, and part of what is now south-western Bulgaria. They provided some of the most active and dangerous of the troops of Alexander's army, distinguishing themselves at the Granicus, Issus and on the banks of the Jhelum.

AGRICOLA, GEORGIUS (GEORGE BAUER) (1494–1555), German scholar and man of science, known as "the father of mineralogy," was born at Glauchau in Saxony on March 24, 1494. After studying philology at the universities of Leipzig, Bologna and Padua, he earned a degree in medicine at the University of Ferrara. From 1527 to 1533 he was city physician in the flourishing mining town of Joachimsthal in Bohemia and from 1534 to the end of his life practised medicine in Chemnitz. He adopted the Latinized form of his name and wrote in Latin. Although he made contributions to medicine, mathematics, theology and history, his most important writings were on mineralogy and mining. Living in what was then the greatest mining region in Europe, and in close touch with all phases of the industry, his intimate and practical knowledge enabled him to become the first writer on these subjects to rely on direct observation rather than on speculation. He exerted a direct influence on his contemporaries and successors and through them on the development of geological science. Best known of his six books on geological subjects is *De re metallica*, published posthumously in 1556. It deals chiefly with the arts of mining and smelting and contains many informative and attractive woodcuts.

In his *De natura fossilium* (1546), translated into German by Ernst Lehmann (Freiberg, 1809–10), and considered the first mineralogy textbook, he presented a new classification of minerals based on their physical properties, and described many new minerals, chiefly metallic ores, their occurrence and mutual relationships. His first mineralogical work, *Bermannus, sive de re metallica dialogus* (1530), a treatise on the Erzgebirge mining district, was translated into English by Herbert Hoover and his wife. In *De ortu et causis subterraneorum* (1546) he recognized clastic rocks and mineral-bearing solutions. His other geological works are *De natura eorum quae effluunt ex terra* (1546) and *De veteribus et novis metallis* (1546). He died Nov. 21, 1556.

See Reinhold Hofmann, *Dr. Georg Agricola* (Gotha, 1905); Ernst Darmstadter, *Georg Agricola, Leben und Werk* (Munich, 1926); Frank D. Adams, *The Birth and Development of the Geological Sciences*, pp. 93–94, 183–95 (1938). (L. Ws.)

AGRICOLA, GNAEUS IULIUS (A.D. 37–93), Roman general, father-in-law of the historian Tacitus, was born on June 13, A.D. 37 (according to others, 39) at Forum Iulii (Fréjus) in Gallia Narbonensis. His grandfathers were of equestrian rank; his father became a senator, but was put to death by Caligula. Agricola was brought up by his mother at Massilia. He entered the army and served (59) under Suetonius Paulinus in Britain. In 61 he returned to Rome, where he married Domitia Decidiana, a Roman lady of distinction. In 63 he was quaestor in Asia, in 65 tribune, in 68 praetor, and when Vespasian was proclaimed emperor, he immediately declared himself his supporter. In 70 he was appointed to the command of the 20th Legion in Britain, then stationed at Deva (Chester). On his return to Rome, at the end of three years, he was made censor, raised to the rank of patrician, and appointed governor of Aquitania (74–78). Appointed *consul suffectus* in the following year, he was admitted into the college of pontiffs and made governor of Britain. In the same year he betrothed his daughter to Tacitus.

Agricola spent at least seven years in Britain. After conquering the Ordovices in North Wales and the island of Mona (Anglesey), during the next two years he advanced to the Tais (Tay; others read Tanaus, perhaps the north Tyne), and in his fourth campaign fortified the country between Clota and Bodotria (the firths of Clyde and Forth) as a protection against the attacks of the Caledonians. Having explored the coasts of Fife and Forfar, he gained a decisive victory over the Caledonians under Galgacus at the

Graupian hill. (See BRITAIN: Roman.) Between campaigns he busied himself in helping forward the Romanization of his province. But his successes had aroused the suspicion of Domitian. He was recalled to Rome, where he lived in retirement, refusing the proconsulship of Asia. He died in 93, poisoned, it was rumoured, by the emperor's orders.

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AGRICOLA, JOHANNES (originally Schneider, then Schmitter) (1494–1566), German Protestant reformer, was born April 20, 1494, at Eisleben, whence he is sometimes called *Magister Islebius*. He studied at Wittenberg, where he met Luther. In 1519 he accompanied Luther to the great assembly of German divines at Leipzig, and acted as recording secretary. He taught and preached the Lutheran doctrine in Frankfurt, Eisleben and Wittenberg, but in 1536 an old controversy broke out more violently than ever. Agricola was the pioneer of the Antinomian heresy, which maintained that while the unregenerate were still under the Mosaic law, Christians were entirely free from it, being under the gospel alone. During the bitter controversy with Luther that followed, Agricola in 1540 left Wittenberg secretly for Berlin, where he addressed a letter to the elector of Saxony, which was generally interpreted as a recantation of his views. Luther, however, was not satisfied, and Agricola remained at Berlin, where Joachim II of Brandenburg appointed him court preacher and general superintendent. With Julius von Pflug and Michael Holding, he prepared the Augsburg Interim of 1548. He endeavoured in vain to appease the Adiaphoristic controversy (see ADIAPHORISTS). He died during an epidemic of plague on Sept. 22, 1566.

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AGRICOLA, RODOLPHUS (properly ROELOF HUYSMANN) (1443–1485), Dutch scholar, was born at Baflo near Groningen, Aug. 23, 1443. He was educated at Louvain, Paris, and at Ferrara, where he attended the lectures of the celebrated Theodorus Gaza (1400–78) on the Greek language. In 1482, on the invitation of Johann von Dalberg, bishop of Worms (1445–1503), he accepted a professorship at Heidelberg, and for three years delivered lectures there and at Worms on the literature of Greece and Rome. By his personal influence more than by his writings he did much for the renaissance of learning in Germany; and Erasmus and other critics of the generation immediately succeeding his are full of his praises. He died at Heidelberg on Oct. 28, 1485. His principal work is *De inventione dialectica, libri iii*, in which he attacks the scholastic philosophy of the day. His collected works were edited by Alard (Cologne, 1539).

See T. F. Tresling, *Vita et Merita Rudolphi Agricolae* (Groningen, 1830); v. Bezold, *R. Agricola* (München, 1884); and Ihm, *Der Humanist R. Agricola, sein Leben und seine Schriften* (Paderb., 1893).

AGRICULTURAL ARTICLES. Agriculture is treated in these pages under various headings, an enumeration of which will help the reader to consult any part of the subject.

For a general account of agriculture, reference should be made in the first place to the articles AGRICULTURE: A GENERAL SURVEY; AGRICULTURE, PRIMITIVE; FARM; GARDEN; HORTICULTURE; and to the sections on agriculture appended to the articles on the different countries.

As to the operations on agriculture, see the articles AGRICULTURAL ENGINEERING; AGRICULTURAL POWER AND MACHINERY; ARABLE; BAULK OR BALK; CROP-DRYING; CULTIVATION; ELECTRICAL POWER IN AGRICULTURE; FALLOW; FARM BUILDINGS; FERTILIZERS; FLAIL; FORK; GUANO; HARVEST; HARVESTING MACHINERY; LAND RECLAMATION; LIMING; LOAM; OPEN-FIELD SYSTEM; PLANT BREEDING; PLANTING MACHINERY; PROCESSING MACHINERY; REAPING; ROTATION OF CROPS; SOIL; SOWING; SPRAYING AND DUSTING MACHINERY; THRASHING OR THRESHING; TILLAGE;

TILLAGE MACHINERY; TRACTORS.

The business and organization of agriculture will be found treated under AGRICULTURAL CO-OPERATION; AGRICULTURAL CREDIT; AGRICULTURAL ECONOMICS; AGRICULTURAL EDUCATION; AGRICULTURAL INSURANCE; AGRICULTURAL ORGANIZATION; AGRICULTURAL RESEARCH; FARM MANAGEMENT (including farm organization and equipment); and FARM VALUATIONS.

LAND TENURE: ECONOMIC AND AGRARIAN ASPECTS is treated under that heading, and there are articles on ALLOTMENTS; FARM RENTS; and SMALL HOLDINGS. The various institutions connected with agriculture are treated under the headings AGRICULTURAL SOCIETIES AND SHOWS; AGRICULTURE, CHAMBERS OF; AMERICAN FARM BUREAU FEDERATION; FARM COLONY; FARMERS' CLUBS; FARMERS' ORGANIZATIONS; FARMERS' UNION; GRANGE, THE; INTERNATIONAL CONFERENCE OF AGRICULTURAL ECONOMISTS; and INTERNATIONAL INSTITUTE OF AGRICULTURE. For a discussion of farm relief legislation after 1928 in the United States see FEDERAL FARM BOARD. For statistics see AGRICULTURAL PRICES; AGRICULTURAL STATISTICS; and AGRICULTURE, CENSUS OF.

As to agricultural employment, the articles AGRICULTURAL GANGS; AGRICULTURAL LABOURER; and AGRICULTURAL WAGES should be consulted. Coming to agricultural production, in addition to general articles entitled AGRONOMY; ARVICULTURE; CEREALS; COTTON AND THE COTTON INDUSTRY; CROPS; GRAIN PRODUCTION AND TRADE; SUGAR; and WHEAT, there is an article on GRASS AND GRASSLAND which includes the discussion of hay crops and pastures.

As to animals, articles may be consulted on ANIMAL BREEDING; BRANDING; BREEDS AND BREEDING; CATTLE; HORSE; MERINO; OX; PIG; SHEEP; and STOCKYARDS.

There are articles on ENSILAGE; FEEDING STUFFS AND LIVESTOCK FEEDING; and FORAGE. Articles will be found on ARBOR DAY; ARBORICULTURE; BEE; COPPICE OR COPSE; CREAMERIES; DAIRY FARMING; EGG; ESPALIER; FORESTS AND FORESTRY; FRUIT FARMING; HONEY; POULTRY AND POULTRY FARMING; TOBACCO; TREE; and TURKEY.

There is a special article on TROPICAL AGRICULTURE.

AGRICULTURAL CO-OPERATION. The development of agricultural co-operation has taken widely different courses in various countries according to their specific needs. The main difference to be observed is between countries which are primarily producers of agricultural commodities for export, and those which produce mainly for home consumption. In the former, the co-operative movement has chiefly concentrated upon the organization of marketing; in the latter—apart from the development of rural credit and insurance—mainly upon the purchase of farm requisites, or the formation of co-operative dairy, bacon or other producing societies. Although this broad distinction holds good, it is nevertheless true that practically all types of co-operation are to be found to a greater or lesser extent in the principal agricultural countries.

Co-operation in Great Britain.—Agricultural co-operation in Great Britain may be said to have begun with isolated experiments during the 19th century, but very little resulted from these early attempts. The Agricultural Organization society in 1901 was the centre of the movement from its formation until it was wound up in 1924. During this period a great many societies were established.

The period following the war of 1914–18 brought forth a considerable intensification of the efforts to promote co-operation amongst British farmers, and the Agricultural Organization Society was assisted by grants from the state. A number of new societies were formed between 1918 and 1924. Unfortunately these efforts met with only limited success, and the creation of new societies was largely offset by a considerable number of failures. This was due to several factors—to the rapid fall in agricultural prices which took place after the spring of 1920, to the fact that a large number of the new societies were small and financially weak and were therefore unable to secure competent management, to the failure of many societies to adopt certain principles in co-operation which in other countries had proved to be essential, and

to the lack of interest shown by farmers themselves.

Among agricultural co-operative societies in Great Britain the most successful have been the relatively large-scale societies concerned with the supply of farm requisites, a few dairy societies, and a certain number of others engaged in the sale of eggs, wool, fruit and vegetables, etc. Mention should be made of the formation of the Agricultural Wholesale Society in 1918, which was an attempt to provide a central wholesale organization from which the local requisite societies could obtain their supplies; its relation to the latter was similar to that between the co-operative wholesale societies and the retail consumers' co-operative societies. Such central wholesale societies had for some years been an integral part of the agricultural co-operative organization in several European countries.

Co-operation in Europe.—In western Europe, where the majority of countries were importers of food or were approximately self-supporting, the growth of co-operation was mainly in the direction of developing rural credit societies (*see* AGRICULTURAL CREDIT) or of societies for the purchase of agricultural requisites, though often combining these functions with that of the sale of produce. But even here, Denmark, conducting a considerable export trade, developed its marketing organizations on co-operative lines in addition to its highly organized system of supply societies; indeed it has been the model upon which many of the marketing organizations in the newer countries have been based. Leadership in agricultural co-operation has belonged to Germany and Denmark.

A general characteristic of the European co-operative movement is that both in its origin and subsequent development there has been a certain idealism which has given it a special vitality. Thus, in Denmark, the movement was associated with a moral educational revival accompanied with the development of the people's high schools; in Belgium the co-operative organization had a basis of religious and social culture; in Germany the birth of the co-operative credit movement was largely a question of the social regeneration of the rural population. In most of these cases it started with the clubbing together of a small number of villagers to carry out a common object, whether it was the purchase or sale of produce, or the provision of credit. But, although built up upon this small foundation, the movement gradually assumed a different character through the consolidation of the small units into large federated organizations, the gradual centralization of control, and the development of many of the features of big-scale enterprise. Indeed, federation describes in a word the modern development of the co-operative movement in most agricultural countries.

The main divisions of the co-operative movement in Europe have been supply, production, marketing, credit and insurance. Other minor, but important, branches are the co-operative use of farm machinery, cattle breeding, the supply of electric light and power, the manufacture of potato meal and potato alcohol, forestry and fishing.

Supply Societies.—These have aimed at purchasing agricultural requisites in bulk at wholesale prices and delivering them to members at cost. They have been widely developed upon "Rochdale" principles, the goods being delivered to members at certain fixed prices and the profits of the societies being distributed amongst its members as a "dividend" in proportion to the gross amount of their purchases. This principle applies in many European countries, though an exception is to be found in France, where the profits of the "syndicats" go to the formation of a reserve fund which belongs to the members equally, irrespective of the amount of their purchases. The tendency in the development of these societies is to federate the local distributive societies to central wholesale societies on the general plan of the British distributive movement.

In Germany, the pioneer society in the movement towards wholesale federation was the Haas Society at Insterburg, founded in 1871. This example was subsequently followed by the rest of Germany, membership of the provincial wholesales being usually confined to the local distributive societies. The first permanently successful federation amongst consumers' stores in Denmark

started in 1884 with the formation of the Co-operative Wholesale Society of Denmark amongst the societies on Zealand (Sjælland), for the supply of farm requisites as well as ordinary household requisites. Four years later a similar wholesale society was started in the Jutland Peninsula, and in 1896 these two were amalgamated into one organization—the Co-operative Wholesale Society of Denmark. Since then it has made remarkable growth.

In Switzerland similar progress has been made. The Verband-Ost-Schweizerischer landwirtschaftlicher Genossenschaften was formed as a central society. The business was divided into two departments—the agricultural, dealing with seeds, manures, cattle food, etc., and the store department, dealing with household requisites. The organization also undertook the sale of members' produce, though its supply side remains its more important function. In France, the local, and more particularly the communal, "syndicats agricoles," united in departmental unions, and these unions formed the starting point of larger organizations—the "unions regionales."

Production Societies.—Probably the most successful branch of productive co-operation is to be found in the dairy societies existing in large numbers in all countries in which agricultural co-operation is firmly established. Leadership belonged to Germany and Denmark. Switzerland, France, Holland, Belgium and some of the countries of south-eastern Europe have also made considerable progress. Ireland, too, was one of the most successful countries in developing co-operative creameries. (*See* CREAMERIES.)

Mention should be made of the bacon factories and egg and poultry societies, the former of which have been brought to a high degree of efficiency in Denmark. These are factories requiring a considerable amount of capital and provided with subsidiary plants for the disposal of by-products. They are usually financed by loans jointly and severally guaranteed by the members, and receive the pigs from members under contracts binding them to supply their whole output for a period of years. The individual bacon factories are federated in the National Federation of Danish Co-operative Bacon Factories, with head offices in Copenhagen. One of the most remarkable achievements of this co-operative organization is the improvement of breed which it has enabled producers to bring about. A close study of the requirements of the British market (the principal export market) combined with scientific pig breeding under the supervision of the Government and the National Federation of Co-operative Bacon Factories, has led during the last 40 years to an improvement in quality, without parallel in other countries.

Marketing.—To Denmark also belongs the credit of beginning co-operative marketing. The tendency was to establish strong central selling or export agencies of which local productive societies were members. The need for co-operation among the local co-operative societies gave the impulse towards the centralization of marketing, and the formation of provincial and ultimately national associations, but many difficulties were experienced before the structural development of the marketing organizations was complete. The turning point was reached when the principle of binding contracts for the supply of produce was adopted. Under this system the members of a local co-operative marketing association undertook to supply the whole of their produce to their society for a term of years. The term ranged from one to as many as 20 years. On this firm foundation it has been found possible to build up the modern organization which markets the greater part of Danish agricultural produce. The local units, having a democratic membership control, are usually federated to the central society on "commodity" lines, that is to say, the federation of local societies is usually concerned with one agricultural commodity or commodities of closely allied character. Members are paid for produce by an advance at the time of delivery followed by a distribution of the profits at certain intervals. The produce thus delivered is classified and graded at the headquarters of the association, and the initial payment is made on the basis of this classification. For the purpose of marketing, the produce is "pooled." These principles—contracts, commodity organization and pooling—form the basis upon which a great part of Danish

co-operative marketing is conducted, and have been widely copied in America, Canada, Australia and elsewhere.

The benefits which agriculture has derived from the European co-operative system are many. By the centralization of purchase and of sale, considerable economies have been effected, not merely in consequence of the elimination of the middleman and of bulk handling of the produce, but by the removal of the powers of exploitation which buyers and sellers of agricultural commodities not infrequently exercised over unorganized farmers. In organized marketing, large-scale handling has enabled scientific grading and standardization to be carried out, which in turn has led to the production of standard grades of produce and standard breeds of live stock on the farms. This again, as in the case of bacon, has led to a general improvement in the quality of farm produce, and has greatly added to the competitive strength of the central export associations in foreign markets. Their products have earned a reputation for uniformity and sustained high quality against which unorganized farmers have found it increasingly difficult to compete.

Canadian Wheat Pools.—Canada affords some remarkable examples of the development of large scale co-operative marketing enterprise, of which the wheat organization is the most significant. The Saskatchewan Co-operative Elevator Company originated in the widespread discontent which was felt by farmers at the growing powers of the elevator companies.

Alberta followed the lead of Saskatchewan by setting up the Alberta Farmers' Co-operative Elevator Company in 1913, and four years later this company was taken over by the United Grain Growers, Limited. The movement towards centralized marketing has undergone further important developments. For the purpose of selling, an organization known as the Saskatchewan Co-operative Wheat Producers, Limited, was formed, with headquarters at Regina. Members of the company, who already form a substantial proportion of the wheat growers in the province, enter into a five years' contract to sell the wheat through the company. Very similar arrangements have been made in Manitoba and Alberta, the respective organizations being the Manitoba Co-operative Wheat Producers, Ltd., with headquarters at Winnipeg, and the Alberta Co-operative Wheat Producers, Ltd., with headquarters at Calgary. To complete the system of centralization only one step remained, namely, to unite the three provincial pools into one organization. This step was taken. The Canadian Co-operative Wheat Producers, Ltd., with headquarters at Winnipeg, was formed as the central selling agency for the above three producers' pools, and operated for the first time in respect of the 1924-25 crop. The handling of milk, butter and cheese, the marketing of wool, live stock, poultry and eggs, fruit and other produce by co-operative enterprise has also made considerable advance in Canada since the World War of 1914-18.

Australian Wheat Pools.—The co-operative wheat pools of Australia are an example of a somewhat different character, since they came into being as the result of direct State action in order to meet the abnormal conditions during the War. They have brought about a fundamental change in the system of marketing wheat in that country. The original scheme was compulsory. It was entered into by the Governments of the Commonwealth, the States of New South Wales, Victoria, South Australia and Western Australia for the purpose of realizing to the best advantage the wheat harvests of the respective States, and for making advances to farmers pending the realization. The scheme was first applied to the 1915-16 crop, and it was subsequently decided to deal with the succeeding crops on the same principle. The duty of realizing the crop was placed in the hands of the Australian Wheat Board, consisting of ministerial representatives of the Governments of the Commonwealth and the respective States, and one representative of the growers from each State.

In each State a local board or commission controlled the operations of the scheme within its area, and the local board effected all local sales, including sales to millers. Under arrangements with the Australian banks made by the Commonwealth and State Governments, advances were made to farmers upon delivery of their wheat at railway stations to the appointed representatives. The proceeds of the wheat sales were applied, as realized, in re-

duction of the bank over-drafts which had been used for the payment of advances and expenses. In 1922 the compulsory pooling of wheat was abandoned, but the principle of pooling the exportable surplus was continued on a voluntary basis under the respective State Governments. Under this scheme, as in the case of the compulsory scheme, each State ultimately received, in respect of the grain actually shipped, the average net profit from the overseas realizations, which, after paying expenses, was distributed *pro rata* amongst the growers.

Mention must also be made of the rapid growth of agricultural co-operation in India, which has mainly taken place during the present century. Indian co-operation bears a much closer resemblance to European than to the American or Australian systems. As in Germany, it has been developed largely to provide credit (and insurance) facilities, and to a limited extent for the purchase of requisites and the sale of produce. (X.)

THE UNITED STATES

For more than half a century farmers of the United States have been actively interested in the co-operative way of doing business. As early as 1870 and in isolated cases even before that, farmers in this country were banding themselves together into local groups and were marketing farm products, purchasing farm supplies, and providing themselves with farm business services on a co-operative basis.

The first broad expansion in the development of co-operative organization in this country occurred under the stimulus of the Granger movement, which reached the peak of its activity during the early '70s. Later, further stimulus was given to the movement by other farm organizations such as the Farmers' Educational and Co-operative Union, the Farmers' Alliance, the American Society of Equity, and more recently, of course, by the American Farm Bureau. But, generally speaking, agricultural co-operation as it has developed in this country represents a movement separate and distinct from the general farm organizations. It is wholly an economic movement concerning itself primarily with the marketing of farm products, the purchasing of farm supplies, and the providing of farm business services on a co-operative basis.

During its early years the movement was beset by many failures of the local associations, chiefly because of the unsound business practices. Much has been done to correct these weaknesses. Sounder business practices have been adopted and operating policies have been changed from time to time to meet changing economic conditions. The co-operative principles, however, remain much the same today as they were 50 years ago. Democratic control, limited returns on capital, and distribution of savings on a patronage basis still remain the dominant features of co-operative activity in this country. Agricultural co-operation in the United States has made its greatest gain since 1915. No other period of similar length in the history of the movement has given rise to as many associations as were formed during the years 1915 to 1921. In 1921 more than 12,000 associations, scattered throughout the United States, were in operation. Since that time, the number of active associations has declined slightly, but with a definite trend toward the formation of large-scale associations operating on a State-wide or regional basis, membership and volume of business has continued to expand. In 1939, almost 11,000 associations reported an aggregate membership of 3,300,000 and a grand total business of \$2,100,000,000.

In the United States, co-operatives have developed largely along commodity lines and the status of the movement can best be described by treating it in this manner.

Dairy Products.—In volume of business and in number of members, dairy co-operatives lead all other commodity groups. Scattered throughout 45 States are more than 2,400 dairy co-operative organizations selling milk, cream, butter, cheese and other dairy products for almost 750,000 farmers. Approximately 48% of all the fluid milk, 39% of all the butter, 25% of all the cheese and lesser amounts of other dairy products pass through the control of co-operative marketing organizations at one stage or another as these products move from farm to consumer.

Livestock.—The co-operative livestock marketing associations may be divided roughly into two groups: (1) those operating primarily at terminal markets, and (2) those operating primarily at country points. The first group is composed of 43 large terminal sales associations with 12 branches operating on 42 of the larger markets in the United States. This group of associations handles about one-fifth of all the livestock sold at public stockyards. The latter group is composed chiefly of local associations engaged primarily in assembling and shipping. In 1940 there were about 850 associations of this type in operation. A few of the local associations do their own selling, but the large majority of them consign the livestock to commission associations on the terminal markets.

Grain.—Co-operative grain handling facilities, which vary from inexpensive portable elevators to million-bushel terminals, are to be found in nearly every section of the nation where grain is produced on a commercial scale. These facilities are the property of more than

2,600 grain co-operatives which in turn are owned by 360,000 farmers. The typical local elevator has a membership of 100 to 200 persons, each of whom owns one or more shares of stock in the organization. Grain is received from both members and non-members and generally the prevailing price is paid at the time of delivery. Likewise, farm supplies such as feed, fertilizer, coal and machinery are sold at "going" prices. Any earnings or savings made by the association are later distributed as patronage dividends on the basis of the volume of business transacted. Many of the local elevators hold membership in large regional sales agencies through which much of the grain is marketed.

Fruits and Vegetables.—In all of the important commercial growing areas, producers of fruits and vegetables have developed co-operative marketing associations. More than 1,100 associations located in 45 states are now (1940) in operation. The greatest development has occurred in producing areas farthest from the large eastern markets. California, Florida, Colorado, Oregon and Washington are the leading states. Approximately 60% of all the citrus produced in this country is marketed by co-operative organizations. More than 180 associations, scattered over 33 states, are marketing potatoes. Apples coming mainly from the Pacific northwest, the Shenandoah valley, and the commercial areas of Michigan and New York, are handled by 78 associations. Strawberries from Louisiana, Missouri, Arkansas, Kentucky, Virginia and other commercial areas are placed on the market by 125 co-operative associations. Many other fruits and vegetables are handled in substantial volume by co-operative organizations. Some of the more important of these are grapes, prunes, peaches, pears, beans, celery, tomatoes, lettuce and asparagus.

Cotton.—Co-operation among cotton farmers in this country has developed along three distinct lines: (1) cotton marketing associations, (2) cotton gins and (3) cottonseed oil mills. Fifteen large-scale centralized marketing associations, most of which are operating on a state-wide or regional basis, report an aggregate membership of 280,000 cotton farmers, and during recent years have handled from 1,500,000 to 2,000,000 bales of cotton annually. The cotton gin movement has reached its greatest development in Texas and Oklahoma where 20% to 25% of the crop is ginned through farmer-owned and farmer-operated plants. The movement is gradually spreading to other cotton states and at least a few co-operative gins will be found in Mississippi, New Mexico, Arizona, California, Louisiana and Alabama. Northwest of the cotton co-operative enterprises are the cotton-seed oil mills. By 1940 there were six in operation. The first of these was organized in 1922 and has operated continuously since that time. Of the other five, two were organized in 1934, two in 1937, and one in 1939.

Wool.—Approximately 50,000 farmers and ranchmen, scattered throughout the United States, are marketing wool co-operatively. The greater part of the wool marketed co-operatively is handled by 25 to 30 large-scale centralized associations which operate on a state-wide or regional basis. These co-operatives assemble, grade, warehouse and sell the wool for their members. Much of the wool handled by this group of associations is marketed through the office of the National Wool Marketing Corporation of Boston. The remainder of the associations are mostly local wool pools. Generally these organizations are small and often serve but a single county. In most cases they are informally organized and frequently are inactive except for a month or two at shearing time. The wool is assembled and sometimes is offered for sale to the highest bidder, sometimes consigned to another co-operative, and sometimes sold direct to the mills.

Poultry Products.—The principal business of some 200 associations is that of marketing eggs and poultry for 100,000 farmers. In addition to these 200 associations, approximately some 700 other co-operatives are handling poultry products as sideline enterprises. Chief among these are a number of local co-operative creameries located, for the most part, in the middle western states. In the far western states of California, Oregon, Washington, Idaho and Utah where intensive commercial poultry production has developed on a large scale, poultrymen now own and operate some of the world's largest egg, poultry and turkey marketing associations. At least eight associations located in this area transact an annual volume of business in excess of \$1,000,000 each. In the eastern states, where producing areas lie within easy reach of large consuming centres, the auction method of selling eggs and poultry has become very popular. In this area 26 egg and poultry auctions are now in operation. All of these have been organized since 1930.

Other Farm Products.—More than 15,000 farmers located mainly in California, Oregon, Georgia and Virginia are marketing nuts co-operatively. Eleven associations with a combined membership of 70,000 are marketing tobacco. Marketing hay is the principal enterprise of eight associations and a secondary enterprise for at least 40 others. There are 25 to 30 sugar beet bargaining associations. In the southern states there are eight or ten co-operatives manufacturing cane sugar. And one or more associations are handling each of the following products: maple sugar and maple syrup, honey, nursery stock, pulpwood, tung oil, broomcorn and fox fur.

Farm Supplies.—One of the outstanding developments in the field of agricultural co-operation since 1920 has been the rapid growth of purchasing associations. From less than 1,000 associations in 1920, the number had increased to 2,600 in 1939. Volume of business increased from \$50,000,000 to \$335,000,000 during the same period.

Membership has grown to almost 1,000,000. Many of the marketing associations handle farm supplies as a sideline activity. Some of the fruit and vegetable associations supply their members with fertilizer, spray materials and packing supplies. Some of the dairy associations handle separators, milk pails, strainers and milk cooling equipment. Grain elevators quite generally handle feed, coal, salt, twine, hardware and other supplies for the convenience of their member-patrons.

Mutual Insurance.—Farmers' mutual insurance companies, the first of which was organized more than 100 years ago, represent one of the oldest forms of co-operative activity in this country. The primary purpose of this type of rural co-operative is to provide insurance on a cost basis. The 1,900 companies now active report an aggregate membership of 3,263,224 and a total of more than \$11,000,000,000 of insurance in force.

Mutual Irrigation.—Located mainly in the western states are approximately 2,500 mutual irrigation companies. These are voluntary associations of persons engaged in producing farm products under irrigation. These mutual companies differ from the commercial companies in that they are operating on a non-profit basis; they differ from the irrigation districts in that membership and financial support are generally voluntary.

Mutual Telephone Companies.—Farmers' mutual telephone companies are now operating in every state in the union. Some 2,000 of these represent fairly large formally organized companies operating complete telephone systems including a switchboard. More than 30,000 others represent small informally organized groups of farm people who have pooled their efforts and constructed neighbourhood lines. In many instances, these co-operatively operated lines provide the only telephone service available in the community and if it were not for them these communities would be entirely without telephone communication.

Rural Electric Co-operatives.—Among the newer undertakings by co-operatives is that of bringing electric power to rural communities. Since the Rural Electrification administration was created in 1935, the number of farms in the United States provided with electricity has more than doubled. Much of this has been accomplished through the co-operative form of organization.

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(W. W. FE.)

AGRICULTURAL CREDIT. The credit needed in agriculture is of two kinds. The first is long term credit, required to facilitate land purchase or the execution of improvements; the second is short term or personal credit, required to finance the growing, harvesting or marketing of crops, etc. Systems of agricultural credit as they exist today in various parts of the world may be roughly distinguished according to whether they are based on a co-operative principle or not. Co-operative credit has been successfully developed in Europe (with the marked exception of Great Britain) and in India. In most of the newer countries co-operative systems have been relatively unsuccessful, and other means of financing agriculture have had to be found.

Great Britain.—There are very few British institutions specifically engaged in providing credit for agriculture, the bulk of farm credit being furnished by the joint stock banks and tradespeople, insurance companies and private mortgages. In regard to long term credit, two institutions (the Farmers' Land Purchase company and the Lands Improvement company) have, however, sought to specialize in this business. The former has aimed at lending money on mortgage for land purchase, but its operations have been on a very restricted scale. The latter, founded in 1858 and operating under special acts of parliament, has lent upward of £13,000,000 for the purpose of carrying out certain types of land improvement. Apart from these, farmers and landowners have mainly had to rely for long term loans on bank overdrafts secured by the deposit of title deeds and private mortgages. In regard to short term credit, for several years prior to World

War I attempts were made to establish co-operative credit societies in Great Britain on the Raiffeisen model (which had had such widespread success in Germany and other continental countries). In 1910 there were 31 co-operative credit societies in Great Britain with 663 members; during and after this war there was a substantial decline in their number and membership.

In 1922 the subject of credit was considered by a committee appointed by the minister of agriculture, and its report was published early in 1923. Its recommendations were adopted by the government, and the Agricultural Credits act 1923 was passed in July of that year. The objects of this measure were: (1) to enable persons who bought their holdings during the currency of the Corn Production acts (April 5, 1917 to June 27, 1921) when prices were exceptionally high, to obtain mortgage loans from the state repayable within a maximum period of 60 years; (2) to establish co-operative credit societies with powers to borrow from the state. The latter were based on limited liability, each member being entitled to hold any number of £1 shares upon which 5s. had been paid up, and to borrow in proportion to his share holding. The credit societies could borrow from the state £1 for each share so held.

Under the first of the above provisions, mortgage loans were granted to the gross value of £5,000,000. Very little interest was, however, taken by farmers in the formation of co-operative credit societies, only nine societies being actually registered under the act, of which four never commenced operations. In view of the small response to this measure, state advances to credit societies were discontinued in March 1927. Subsequently, the government stated its intention of introducing a bill dealing with this subject.

Germany.—Germany may be regarded as the birthplace of co-operative credit in Europe. The typical organizations have been the *Landschaften* or credit unions (for long term credit) and the *Raiffeisen* banks (for short term credit). The former originated as far back as 1770, and gradually extended not only in Germany, but to Denmark, Hungary, Russia, Poland, Norway and elsewhere. The basic principle was the issue by the *Landschaft* of bonds based on estates mortgaged in its favour—the bonds being secured upon the collective guarantee of the members of the *Landschaft*. The borrower was paid not in cash but in bonds which he could realize on the market. He had the right to repay by annuity or by special instalments, or to cancel the loan by purchasing and tendering bonds. *Landschaften* bonds were regarded as first-class securities, and during the period 1910–14 were quoted on nearly equal terms with the loan bonds of the empire. The principle of the *Raiffeisen* banks, which were empowered both to make loans and to take deposits, was originally that loans were secured by the collective unlimited liability of all the members. Limited liability was, at a later date, adopted by a small number of these societies. In some cases they added to their credit business that of purchasing supplies for the members, such as seeds, fertilizers, coal, etc. Under *Raiffeisen*'s personal guidance the local credit societies were affiliated to central loan banks, which subsequently received assistance from the state. The wonderful growth of these societies into a vast banking organization, without incurring any serious losses, is perhaps without parallel in the history of finance. In 1924, out of 38,000 registered agricultural co-operative societies in Germany over 19,500 were rural banks.

The postwar inflation in Germany, involved the whole credit organization in acute difficulties, and with the collapse of the paper mark, confidence was destroyed and depositors ceased to lend their money. For these reasons German agriculture found itself faced with an extreme shortage of capital, interest rates rose to a very high figure and farm mortgages became, for a period, unobtainable. After the stabilization of the currency and the introduction of the rentenmark, drastic reorganization of the credit machinery became necessary. A central institution of agricultural credit, the *Rentenbank-Kreditanstalt*, an offshoot of the *Rentenbank*, was established, which operated through the previously existing credit institutions. Ultimately, with the aid of loans raised in the United States, the situation was considerably relieved and rates of interest substantially reduced.

France.—The conspicuous feature of agricultural credit in France is the state subsidy which it carries with it. Under the Méline act of 1894 all or part of the members of one or more agricultural *syndicat* could constitute a credit society, whose capital was obtained by subscription of members. The credit society became a *filiale* of the *syndicat*. A considerable growth of these societies took place with the assistance of a voluntary organization which prepared model rules. In 1897 it was made a condition of the renewal of the charter of the Bank of France that it would place at the disposal of the state without interest 40,000,000 francs, together with an annual share in the profits of the bank, for the assistance of agricultural credit. In 1899 regional banks were created, the members of which were the local credit societies, and the above subsidy enabled the regional banks to reduce their rate of interest to the credit societies, and consequently to provide cheap credit to farmers. The number of regional banks in 1921 was 69, with nearly 5,000 credit societies affiliated to them. The extension of the system to the provision of long term credit was made under acts of 1910 and 1920, which permit a maximum loan of 40,000 francs to individuals to facilitate the acquisition and management of rural properties.

Canada.—In Canada credit unions have been more successful, and over 150 with a membership of more than 66,000 have been organized since 1906, mainly in Quebec and neighbouring provinces. By a number of acts the provinces of Canada have also sought to extend the facilities for short term credit to farmers. These include the Livestock Encouragement act, 1917, of Alberta, under which persons may form an association and jointly apply to the Livestock Commissioners for a loan; the Livestock Purchase and Sale act, 1913, of Saskatchewan; the Rural Credits act, 1917, of Manitoba, and a similar act in Alberta, both designed to promote co-operative credit. Mention should also be made of the Ontario Farm Loan act and the Agricultural Development act passed by the Ontario Legislature in 1921—designed both to assist land settlement and to provide short term loans. As regards long term credit, legislation has been enacted by the separate provinces. Manitoba passed Manitoba Farm Loan act, which became effective in 1917, and was subsequently amended in 1919 and 1921. The act established the Manitoba Farm Loans association, which serves as the lending agency between the provincial government and the farmers, and is governed by a board of five members including a Commissioner of Farm Loans. Loans are secured upon first mortgages on farm lands and are repayable by annual instalments in 30 years. Saskatchewan has passed legislation on similar lines (the Saskatchewan Farm Loan act, 1917), and Alberta has followed the general lines of the Farm Loan act in the United States.

Australasia.—The development of agricultural credit has received and is still receiving a considerable amount of attention in Australia and New Zealand. In most states of Australia state credit institutions, such as state savings banks, make a specialty of providing agricultural credit. A number of acts have been passed in recent years dealing with the subject of rural credit, among which mention should be made of the Commonwealth Bank (Rural Credits) act 1925 making provision for financing producers' organizations in marketing their produce. An account of these measures is to be found in the Australian Year Book 1925. In New Zealand a Royal Commission on rural credit published a report in 1926 which was followed by two acts of parliament, the Rural Advances act 1926 and the Bank of New Zealand act 1926, both designed to assist the development of long term agricultural credit.

India.—The development of agricultural credit in India has mainly followed the European model, and has made consistently steady progress. The first act legalizing co-operative credit societies was passed in 1904. This act was replaced by an act in 1912 which closely followed the English Friendly Societies act and permitted other forms of co-operation. The number of rural credit societies under this act exceeds 40,000 and these are mainly modelled on the Raiffeisen plan.

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THE UNITED STATES

The past hundred years have seen a continuously increasing need in the United States for credit to finance farm operations, including the purchase and improvement of farm land and the production and marketing of crops and livestock. The increased cost of farm land, the use of commercial fertilizer, power machinery, and many other factors have contributed to increased credit needs. As a result a large percentage of farmers use credit. Farmers frequently have to go in debt to get in the farming business, either to buy equipment or land. To become landowners, most farmers have to supplement their savings with borrowed capital. The majority of farmers do not have sufficient working capital to supply their needs at all seasons of the year.

Rural credit, during the years in which farmers' credit needs were expanding, did not keep pace with the demand. Interest rates in some sections were abnormally high. At the turn of the century farm organizations and others interested themselves in the problem. Commissions were sent to Europe to study the farm mortgage systems in operation there. Finally, the congress of the U.S. passed the Federal Farm Loan Act of 1916, which provided for the establishment of a farm mortgage credit system. In 1923 provision was made for a system of federal intermediate credit banks which are wholesale credit agencies discounting agricultural paper. Ten years later, the Farm Credit administration was organized bringing together these and other federally sponsored credit services under one supervising federal agency. The Farm Credit Act of 1933 provided for a system of production credit, supervised by the Farm Credit administration, with local associations making loans directly to farmers and obtaining loan funds through the federal intermediate credit banks. This act also authorized the establishment of 13 banks for co-operatives under the Farm Credit administration to make loans to farmers' marketing, purchasing and business service associations. The Farm Security administration, the Rural Electrification administration and the Commodity Credit corporation also are sources of credit for farmers and farmers' co-operatives. Three states have operated rural credit systems but these were (1940) in liquidation. A number of states invest school and other funds in farm mortgages. The rural credit system thus includes commercial and private agencies, such as commercial and savings banks, insurance companies and individuals, supplemented with government-owned institutions and government-supervised co-operative institutions.

Long-term Credit.—Farm mortgage credit for purchasing farm land and making permanent improvements is used in much larger amounts but by a smaller number of farmers than credit for short-term production needs. The mortgage indebtedness of farmers in the U.S. was \$3,200,000,000 in 1910. It increased during and following World War I to a peak of \$10,800,000,000 in 1923. After 1923 it declined year by year to \$6,400,000,000 in Jan. 1943. In 1940, 52% of the total was on farms in the 12 north-central states.

The relative importance of different sources varies among the various regions. In 1943 important sources were the 12 federal land banks, \$1,603,000,000; life insurance companies, \$891,000,000; the land bank commissioner, \$512,000,000; insured commercial banks, \$471,000,000; Farm Security administration, \$164,000,000. A large part of the balance was held by individuals.

An outstanding change in farm mortgage credit in the 10-year period, 1928-38, was the shift in sources of credit. The refinancing activities of the federal land banks and land bank commissioner resulted in large increases in outstanding loans of these agencies. On June 30, 1939, these two sources accounted for 37.4% of the farm mortgage debt of the country. Investment of life insurance

companies in farm mortgages dropped from 22.9% of the total farm mortgage debt to 12.4% over the 10-year period, 1928-38. Joint stock land banks in 1928 holding 7% of the farm mortgage debt had liquidated their holdings to 1.1% on June 30, 1939.

The Federal Land Bank System.—Funds for farm mortgage loans were formerly brought into farming areas largely through banks. Selling farm mortgage notes in their original form became the usual practice. It was generally necessary to find a borrower who wanted a mortgage of a given amount, covering a certain period, and with definite terms. A system was needed which could standardize farm mortgages and hold them as collateral against which bonds could be marketed. The federal land bank system was established by the Federal Farm Loan Act of 1916 to meet these needs. The joint stock land banks, also established by this act and in 1928 holding a peak of \$667,000,000 in farm mortgage loans, were placed in liquidation by the Emergency Farm Mortgage Act of 1933. The 12 federal land banks operated under the supervision of the Federal Farm Loan board until 1933, when the board was abolished and the banks placed under the supervision of the newly organized Farm Credit administration. The 12 federal land banks make long-term farm mortgage loans largely through national farm loan associations, local co-operatives, organized in the first instance by 10 or more farmers desiring loans totalling at least \$20,000. In 1928 there were 4,500 to 5,000 national farm loan associations in the U.S. Consolidation of associations has resulted in a decrease in number to 3,484 active on Dec. 31, 1942. Each borrower subscribes to stock in the national farm loan association equal to 5% of his loan. The association subscribes to federal land bank stock. The 12 banks had a paid-in capital of \$217,506,258 on Dec. 31, 1942. Of this amount, national farm loan associations owned \$97,365,018, or 45%, and the U.S. government, \$117,176,065, or 54%. About \$3,000,000 was owned by direct borrowers.

Federal land bank loans can be made only to farmers or prospective farmers. No land bank loan may exceed 50% of the appraised normal value of the land plus 20% of the appraised value of the permanent insured improvements on the land. The maximum amount loanable is \$50,000. The term may extend up to thirty-odd years. All loans are made on an amortized basis. Prepayment privileges are allowed after five years. Borrowers may deposit money in good years to meet instalments in bad years. Funds for making loans are obtained by the sale of long-term bonds. The 12 banks are jointly and severally liable for the payment of principal and interest on all bonds issued. The bonds are not guaranteed by the U.S. government. The interest rate on new loans may not exceed by more than 1% the rate borne by the last bonds issued. The contract rate on loans through national farm loan associations on Mar. 1, 1944 was 4%. This rate has been in effect from 1935. From 1917 through Dec. 31, 1943, the federal land banks made loans totalling \$3,376,000,000. Federal land bank loans outstanding on Dec. 31, 1943, totalled \$1,358,000,000.

Land Bank Commissioner Loans.—As a result of the collapse in farm prices, farm income and land values, thousands of farmers from 1932-35 were faced with foreclosure. Emergency measures were necessary. The Emergency Farm Mortgage Act of May 12, 1933, authorized the land bank commissioner of the Farm Credit administration to make farm mortgage loans of a more or less emergency character. These loans may be made up to 75% of the value of the mortgaged property but cannot exceed \$7,500 to one individual. Funds for making loans are obtained through a government-capitalized institution, the Federal Farm Mortgage corporation, which issued government-guaranteed bonds aggregating \$1,651,559,000 from its establishment in 1934 to June 30, 1939. Part of these funds were used to purchase federal land bank bonds. As the law stood (May 1946) the authority of the commissioner to make loans expired on July 1, 1946. From Aug. 23, 1933, the federal land banks have acted as agents in making and handling these loans. Some 613,000 commissioner loans, totalling \$1,127,662,036, had been made to Dec. 31, 1943. Although a large percentage of loans were used for refinancing purposes, many young farmers have used these funds to supplement federal land bank loans for the purchase of farms.

The Farm Security administration makes first mortgage loans to enable a limited number of competent tenants, sharecroppers and farm labourers, unable to obtain credit elsewhere, to purchase family-size farms of their own and to make needed improvements on those farms. Loans may cover 100% of the appraised value of properties acquired but may not exceed \$12,000. The rate of interest is 3%. Annual payments of interest and principal are 4.3%. To July 1, 1943, loans made aggregated \$188,000,000. The Federal Housing administration is authorized to insure loans made to buy and improve farms or to modernize farmhouses and other buildings. Fifteen per cent of the amount of a loan must be used for materials and labour for new construction or repairs.

Terms and Conditions of Farm Mortgage Loans.—Marked changes have occurred in the terms and conditions of farm mortgages from 1917 when the 12 federal land banks first introduced the amortization principle into farm mortgage lending in the U.S. Prior to this, loans were made ordinarily for periods from five to ten years. As farmers were often unable to accumulate enough money to pay off a mortgage in that length of time the loan was usually renewed, entailing considerable expense. Following the lead of the federal land banks, most insurance companies and some commercial banks are making loans covering longer periods and often repayable on an amortized basis.

The trend in interest rates on farm mortgage loans was upward from 1917 to 1921, and then gradually downward from the early 1920s, except for a short period around 1930. Farmers in most sections were (1944) obtaining farm mortgage credit at the lowest rates ever available in the U.S. Federal land banks were making loans at a contract interest rate of 4%. The interest on instalments coming due prior to July 1, 1944, was payable at 3½%. Land bank commissioner loans were made at 5%, with all interest instalments maturing before July 1, 1944, payable at 3½%. The U.S. government reimburses the banks and the Federal Farm Mortgage corporation for the difference between the contract rate and the temporarily reduced rate. Interest rates of some commercial banks and insurance companies compare favourably with these rates in territories where they make most of their loans.

Short-term Credit.—It is estimated that from 60% to 80% of the farmers in the U.S. use some form of short-term credit each year. The largest source of production credit is commercial banks, which on June 30, 1943, had short-term agricultural loans outstanding totalling \$1,316,385,000. Most country banks are either directly or indirectly affiliated with the Federal Reserve banks, which makes it possible for them to obtain short-term loans or rediscount eligible notes. Their loan rates vary from 5% to 10%. Credit advanced by merchants and dealers in farm products is usually much more expensive. Many farmers' co-operative buying and selling associations grant some credit to their members. Production credit associations with loans outstanding on June 30, 1943, totalling \$256,991,000 are an increasingly important source of production credit. Since 1933, some 530 production credit associations have made production loans to farmers and livestock men. Twelve production credit corporations, one in each farm credit district, helped to organize, capitalized in part, and now supervise the local associations. Funds for making loans are obtained by discounting farmers' notes with the federal intermediate credit banks.

Each farmer-borrower owns class "B" stock in the production credit association equal to 5% of his loan. The capital stock of the production credit associations on Dec. 30, 1942, was \$104,246,194, of which \$21,989,942, or 21.1%, represented class "B," voting stock owned by 265,749 farmer-members of the associations and \$82,256,252, or 78.9%, was class "A," non-voting stock held by the corporations, farmers and other private investors.

From Feb. 24, 1939 to March 1944, the rate of interest charged on production credit association loans had been 4½%. Prior to that date it was 5% but a reduction in the Federal Interstate Credit bank discount rate on the date specified enabled the associations to lower their rate.

Most loans are made on a budget basis. That is, a farmer arranges for his credit for a season and the money is advanced as he needs it. He repays the loan when the crops and livestock

financed are sold. Interest is charged only for the time a farmer has the money.

In making production credit association loans careful consideration is given to farming plans and the ability of a farmer to repay a loan from the sale of farm products, rather than basing the loan entirely on the value of the collateral.

Another source of agricultural credit in a few localities is credit unions.

At times many farmers are unable to qualify for loans from banks and production credit associations. To meet the needs of this group, the United States government has provided emergency loans from appropriated funds or those advanced by government corporations. Under this heading may be grouped emergency crop and feed loans; loans made by the Regional Agricultural Credit corporations, and rehabilitation loans of the Farm Security administration. There were outstanding on Dec. 31, 1943, \$107,600,000 of "emergency crop loans"; \$40,000,000 of "drought relief loans" made in 1934-35, and \$12,100,000 of "orchard rehabilitation loans." The Regional Agricultural Credit corporation was very active in 1932-33 and was revived to make emergency loans in 1943. Outstanding loans, amounting to \$144,600,000 at the end of 1934, were down to \$4,000,000 in 1942, but increased to \$32,000,000 at the end of 1943. The Farm Security administration, developed from various relief activities among farmers in the middle 1930s, carries on a program with low-income farmers. On July 1, 1943, outstanding rehabilitation loans amounted to \$380,300,000.

Federal Intermediate Credit System.—The 12 federal intermediate credit banks were established in 1923 under the Agricultural Credits act as wholesale credit institutions for agriculture, to provide production and marketing credit for periods longer than those ordinarily supplied by commercial banks. In 1933 these banks were placed under the Farm Credit administration and form one of the permanent units in each of 12 Farm Credit districts. The government had paid-in capital (Dec. 1942) in the 12 banks totalling \$60,000,000, and they had accumulated earned surpluses of \$20,400,000. Funds to lend are obtained largely from the sale of collateral trust debentures. These are not guaranteed as to either interest or principal by the U.S. government, but have been readily salable at low rates of interest.

These banks under the law are authorized to discount paper of any production credit association, bank for co-operatives, national bank, state bank, trust company, agricultural credit corporation, incorporated livestock loan company, savings institution, co-operative bank, credit union, or farmers' co-operative. Production credit associations accounted for about 75% of the loans and discounts of the intermediate credit banks in 1939. Loans to farmers' co-operatives through the Farm Credit system are handled largely by the 12 banks for co-operatives which use the facilities of the federal intermediate credit banks in obtaining part of their loan funds.

Farmers' Co-operatives.—The farmers' co-operative movement in the United States has shown large growth in the past 50 years. In 1937 a national survey gave the business of some 10,500 farmers' marketing and purchasing associations as exceeding \$2,000,000,000 in a year. The capital of these associations is provided by farmer-member subscriptions and retains from the net proceeds of the products handled. Additional capital is often needed to supplement the association's funds in peak operating periods or to construct plants and to buy equipment.

To supply additional capital, farmers' co-operatives have a number of sources of credit. Commercial banks furnish a considerable portion of their credit needs. Beginning in 1923 the federal intermediate credit banks made loans to farmers' marketing and purchasing co-operatives on the security of commodities in storage. Since 1933 loans to co-operatives through the Farm Credit system have been handled largely by the banks for co-operatives which obtain part of their loan funds from the federal intermediate credit banks. The Agricultural Marketing Act Revolving fund, administered by the Federal Farm board from 1929 to 1933, provided funds for effective merchandising, facility, and commodity loans to farmers' marketing associations. Loans

from this fund were curtailed when the banks for co-operatives were established in 1933.

The 13 banks for co-operatives, one in each of the 12 Farm Credit districts and a central bank in Washington, D.C., make facility, operating capital and commodity loans to farmers' marketing and purchasing associations and to mutual companies. About 30% of the borrowings of marketing and purchasing associations outstanding at the peak period in 1936, according to the national survey, came from the banks for co-operatives.

The Commodity Credit corporation, organized Oct. 17, 1933, by executive order, provides funds for producers and farmers' co-operatives to finance the carrying and orderly marketing of certain agricultural commodities recommended by the secretary of agriculture and approved by the president. Loans authorized at a fixed rate per unit on basic commodities, such as cotton, corn, wheat or wool, may be obtained by producers through banks or other lending agencies on forms provided by the Commodity Credit corporation. The corporation also makes direct loans. Loans of the corporation outstanding on July 1, 1943, excluding loans held by banks and other financing institutions, totalled \$218,535,000. The Rural Electrification administration provides funds to co-operative associations of users for financing the construction and operation of rural electric systems. On July 1, 1943, such loans amounted to \$327,588,000.

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AGRICULTURAL ECONOMICS. Agricultural economics is the science which treats of the conditions, laws and institutions that affect the wealth-getting and wealth-using activities of farmers as individuals and of agriculture as an industry. Thus, it is concerned not only with the economic problems of the individual farmer in producing and marketing his products, and in financing his operations, but also with the economic aspects of the political, legal and other social relationships of farm people among themselves and with the rest of society, including the community, state and nation.

The scope of agricultural economics ranges, for example, from the acquisition, organization and use of the means of production on the individual farm to the broad programs and policies which affect the balance of all interests in the production, consumption and conservation aspects of agriculture. It includes, in addition, the study of the characteristics, behaviour and control of agricultural prices, the elements of cost in agricultural production, the problems of agricultural marketing, the methods of financing all phases of agriculture, the social and economic problems inherent in the ownership and use of agricultural land, the geography of agricultural production, and finally, the welfare of farm people as conditioned and determined by the foregoing aspects and by the size and distribution of farm population as related to agricultural opportunities.

Two methods of study have been used by workers in this field. The primary method has been to collect basic data regarding farmers, farms and institutions that serve rural people as well as more general economic data concerning agricultural subjects. As a part of this method, various research techniques have been applied to the data to ascertain those general principles which underlie the economy of rural people and institutions. A second method of approach has been to select from currently accepted principles of economics those considered helpful in the analysis of the problems under study. The two approaches, of course, have never been entirely separated and as the work has developed they have come to be more and more combined. Some studies have been confined to problems such as the economic organization of farms and of markets, while others have dealt broadly with issues involved in community, state, national and international policies which affect farmers, consumers or even entire

populations.

The emphasis upon agricultural economics as a special phase of economics is based on man's dependence upon the products of the soil to meet his primary needs, especially for food, clothing and shelter, as well as upon the large number of people who are engaged in the occupation of farming. In fact, the basis of the most pressing problem among people throughout the world is man's relationship to the availability of food and other agricultural materials. Agricultural economic problems have become more acute with the development of commercial agriculture and the growth of the world's population from the beginning of the 18th century. The abundance of food produced in relation to population in some of the newer countries, including those of North and South America, Australia, New Zealand and parts of Africa, gave rise to problems of maintaining a profitable, well-balanced agriculture based upon domestic and foreign demand. On the other hand, the pressure of population upon the food supply in densely populated countries, such as India and China, has been responsible for many social conditions peculiar to such countries. Primitive methods in such countries are largely the result of the scarcity of raw materials, land and capital goods, in relation to population. Under either set of conditions, the attainment of a balance between agriculture and the rest of the industry of a country and the development of international trade relationships which will enhance the well-being of the people are complex problems of major importance. Economic problems which have arisen from either a commercial or a subsistence agriculture have resulted in specialized research in agricultural economics.

Agricultural economics as a systematically organized body of knowledge is largely a product of the 20th century. In the United States, for example, following 1850, the invention of labour-saving machinery, improved transportation and communication facilities, and the bringing into cultivation of extensive fertile land areas rapidly expanded production to the point of burdensome surpluses. The amount of wheat production in excess of domestic needs in the U.S. at the end of the 19th century, for example, compared favourably with the total production of any European country. These surpluses, offered upon world markets, helped to disorganize the agriculture in European countries, and led to greater dependence upon the importation of food. With expanded grain production in some countries, improved transportation facilities and deficit food production in other countries, the comparative advantage among different countries led to increased specialization in production and to expanded world trade in agricultural products. The importance of these problems in both surplus and deficit countries naturally drew the attention of trained economists and technically trained agricultural workers interested in economics. It was in this setting that modern agricultural economics came to be recognized as an important agricultural science.

EARLY CONTRIBUTIONS TO AGRICULTURAL ECONOMIC THINKING

Many references, both secular and religious, point to the importance of agriculture in the economic life of early people. In ancient Greece, knowledge pertaining to religion, ethics, law, economics and philosophy attained a degree of systematic treatment. Aristotle recognized the importance of the so-called art of money-making, and observed that husbandry and stock raising constituted the true and proper art of money-making, with the exchange of goods given a secondary place. Aristotle's recognition of man's dependence upon production, exchange and consumption, stands as one of the early recorded contributions to economic thinking. From the time the division of labour and exchange began to characterize organized society, agriculture has generally been accorded an important place in economic thought.

Some early Roman writers considered the revival and reform of agriculture to be fundamental in preventing the moral corruption of the nation. The economic importance accorded agriculture by the Romans is expressed by Cicero in the statement that "of all means of acquiring gains, nothing is better than agriculture, nothing more productive, nothing more pleasant, nothing

more worthy of a man of a liberal mind." Roman writers, Cato, Columella, Varro and Virgil, paid special attention to technical agriculture and rural economy; they opposed large estates, absenteeism and the spread of slavery, but praised small-scale farming. Pliny lamented that the large estates—latifundia—had brought ruin to Italy.

During the middle ages, 400 to 1300 A.D., much of the land of Europe was cleared and brought into agricultural use. The feudal system tended to provide for local self-sufficiency although goods and services were limited. Some new patterns of land settlement were undertaken, but there was a tendency for the agriculture to develop in similar ways. However systematic the thought of that period may have been, it has not contributed much lasting influence on present-day agriculture. Monks and other members of religious orders which were large landholders studied the Roman writers. In the 13th century, Walter of Henley, in England, wrote a number of manuscripts on agriculture, which dominated the field until the 16th century when they were superseded by works on husbandry and surveying, in 1534, credited to John Fitzherbert. The gradual decay of feudalism from the early modern period opened the way for more systematic thinking regarding economic life and well-being.

The place accorded agriculture in the economic life of a nation received major consideration at the hands of the French physiocrats under the leadership of Dr. François Quesnay in the 18th century. The physiocrats praised agriculture for bringing into existence a net product (*produit net*) and stated that if the order or laws of nature were followed nature would be found providential in meeting human needs. In fact, they regarded all other industry to be sterile and agriculture as the only new source of wealth, because agriculture was the only industry that produced more than was put into it in the form of labour and capital.

AGRICULTURAL ECONOMICS IN THE 19TH CENTURY

Great Britain.—In the agricultural history of Great Britain, throughout the 19th century, there appeared much of the foundation upon which modern agricultural economics has been developed. In the classical school of economics, David Ricardo and Thomas R. Malthus deserve mention for their contributions of principles related to the economics of agriculture. Malthus took the point of view that nature instead of being munificent was niggardly, in the sense that population tended to outrun the food supply. Instead of looking upon agriculture as producing a net product, his theory was that as the supply of land became limited, man was forced to move to poorer and poorer grades of land. As this expansion in production became necessary, the best land produced a product above the cost in labour and capital required to produce the same amount of product on the poorer grades of land. Thus, he pointed out, in his essay on the *Principle of Population*, published in 1803, that, since population tended to increase by a geometric ratio while agriculture increased only by an arithmetic ratio, eventually population would tend to outrun the food supply. This would force man to operate successively lower grades of land except insofar as checks on population, such as famines and wars, retarded or reversed the trend. It was this theory in particular that gave Malthus and some of his associates the name of the "pessimists." His theory was developed when England was experiencing a shortage of food supplies at home.

Undoubtedly this theory was used by Ricardo in his development of a more complete explanation of rent. Ricardo's theory of rent, in brief, was that, with the growth of population, it became necessary to cultivate land of an inferior quality and that, as labour and capital were added to land in use, a reduced return was received for the added effort, or a diminishing return. Rent of land he regarded to be that share of the product of the soil which the landowner could charge for the use of the "original and indestructible powers of the soil." Land rent to Ricardo, therefore, represented the return from the better grades of land above that obtained from the labour and other costs expended on an equal area of low-grade land which produced just enough to attract labour and to justify the other costs incident to production. The extent of cultivation on the lower grades of land

would be determined by the needs for food. He further recognized that the best grade of land would profitably absorb more labour and other costs than an equal area of low-grade land. Thus, Ricardo recognized both the intensive and extensive margins of cultivation. While many criticisms and refinements have been made, the contributions of Malthus and Ricardo, in pointing out the differential return from land of different grades, are fundamental in the economic theory of land rent, although the incorporation of capital in land makes it difficult to determine true economic rent. Among the criticisms should be included those made in the 19th century in the United States by H. C. Carey, F. List and F. A. Walker, and in Germany by J. H. von Thunen.

The industrial revolution of the 18th century required marked adjustments in agriculture to meet the new conditions. As agriculture took on more of a commercial aspect, Jethro Tull, Charles Townsend, and Robert Bakewell introduced farming innovations which helped to meet the changing agricultural conditions. William Marshall, in his surveys of British agriculture, published in 1785, and Arthur Young, mainly in the next decade, as author and as secretary of the board of agriculture, deserve credit for careful study of agricultural practices and the development of a popular interest in agricultural economic problems. Marshall gave his book the title of *Rural Economy* and covered both agricultural practice and rural life. The writings of James Caird, *English Farming in 1850 and 1851*, and R. E. Prothero, *The Pioneers and Progress of English Farming*, in 1888, analyzed the problems of the individual farmer and the relationship of farm profits to the well-being of the landlord and of the nation.

Great Britain, in common with the United States, Germany and other countries, felt the effect of the decline in prices of farm products following the end of the Napoleonic wars in the 19th century. As a result, in 1833, a parliamentary commission was appointed to study agricultural problems. This report found no magic solution for farm problems, but recommended changes in farm practice with special reference to farm leases to permit farmers to depart from specified crop rotations. This focused attention upon the need for adjustments in rent because of the uncertainty of prices, and upon compensation to tenants for unexhausted improvements which they had placed on farms and from which they had not received full benefit before they were required to quit the property. This was intended to induce tenants to improve the properties. Writings dating from 1650 had advocated legislative action respecting landlord-tenant relationships, but the bill introduced in parliament in 1850 entitled, "A Bill for the Improvement of the Relation between Landlord and Tenant in England and Wales," put the issue into clear perspective. An Agricultural Holdings act dealing with the relationships of landlords and tenants was passed in 1883 and was modified at intervals by later acts. This legislative action based upon practical local experience provided arrangements which tended to standardize and develop improved landlord-tenant relationships.

Germany.—In Germany, Albrecht Thaer occupied much the same place with respect to agriculture as did Tull, Townsend, Bakewell, Marshall and Young in England. He introduced new practices on his own farm; he published in 1798, a three-volume work on English agriculture, which was followed by further publications dealing with the fundamentals of agriculture. As a result of his work, the king of Prussia induced him to establish an agricultural school and experimental farm near Berlin. His interest was in the economic phases of farming as well as in the physical and biological problems. One of his students, Johann Heinrich von Thunen, gained recognition for his presentation of economic considerations in determining the crops which farmers should grow under varying conditions of soil, transportation and markets. In *Der Isolierte Staat*, published in 1826, he criticized and refined Ricardo's theory of rent, pointing out that rent resulted because of location and relative transportation costs as well as from gradations in the productivity of land.

By the close of the 19th century, the more important German universities were offering courses in the field of agricultural economics. From the standpoint of emphasis, one could divide the professors of agricultural economics in Germany into two groups:

those who approached the field from a background of political and social economy, and those who were trained primarily in the technical phases of agriculture. An exception was Freiherr von der Goltz at the Agricultural College of Bonn, who included in his instructional work the history of agriculture, farm accounting, the economics of farm management and the political economy of agriculture. Von der Goltz deserves attention for his attempt to round out the field of agricultural economics, treating the economic problems which the farmer meets in his farming operations, as well as those which affect him but are beyond his immediate control.

German thought continued to distinguish between what might be termed farm management (*Betriebslehre*) and agricultural policy (*Agarpolitik*). The former refers to those economic principles of farm management which lead to maximum net profits from the operation of a farm; while the latter is concerned with providing an opportunity, under the assumed legal and social order, to all persons in agriculture in accordance with their skill and activity, and helping to remove barriers to or to establish procedures for the development of the agricultural industry as a whole. In addition to Von der Goltz and Von Thunen, credit must be given Wilhelm Roscher, who published a book entitled, *Nationalökonomik des Ackerbaues*, 1854, and in later years to Max Sering for contributing to the basic principles which aided in the development of agricultural economics in the United States.

United States.—Economic problems of agriculture received increasing attention in the United States in the period 1880 to 1900. In general, this was a period of falling prices and of a rapidly expanding agriculture. The low purchasing power of farm products had been accentuated by the rapid development of railroads and improvements in farm machinery which led to a rapid increase particularly in the production of wheat, corn, hogs and cattle. This expanded production and resulting low prices coincided with a deflation in the currency. Because of inability to pay debts, and the large number of mortgage foreclosures, farmers sought relief through governmental action.

Attention was attracted to the economic difficulties of agriculture by the Grange and the Farmer's Alliance following 1870, and the efforts of the Populist party in 1892. Of this group, the Grange was most successful in securing legislative and administrative help for agriculture as evidenced by their early sponsorship of the Interstate Commerce commission, free rural postal service, food and dairy product laws and tax reforms which found their way into state and federal legislation.

Interest in agricultural economic problems was shown by the American Economic association in 1892 when it devoted part of its program to the farmer movements in northern states. In 1896, this group discussed questions pertaining to the rapid growth of tenancy, mortgage indebtedness, soil exhaustion through one-crop farming, migration of young people from farms to cities, rural free delivery of mail, extension of electric railroads in the rural districts and better educational facilities for farm people. The general conclusion of the economists at that time was that the solution of the farm problem depended upon suitable adjustments in farm economy by the farmers themselves rather than through government action. The gradual rise in prices during the early part of the 20th century, however, probably did more to improve the prosperity of agriculture than changes in the organization of farms.

In the early part of this period Henry George's book, *Progress and Poverty*, written in 1880, received marked attention although it probably had more effect upon governmental policies in Europe than in the United States.

George developed a theory that landowners held a monopoly because of the growth in population, and were able to demand increased rents which made workers poorer. There is evidence that he accepted the Malthusian theory of population and the Ricardian theory of rent rather literally, and concluded that the way to secure more equitable distribution of income was through the "equal right to the use of land." This he would obtain through taxing the value out of land and using the income from the tax to support all public activities. United States economists in general

attacked the single tax on many grounds but George must be credited with sensing the impact upon farmers of the problem of paying for their farms each generation.

Prior to 1900, the major emphasis of the agricultural colleges and experiment stations in the United States was upon the physical and biological problems of agriculture. Some attention, however, was given to the questions of farm tenancy, costs of producing farm products and farmer co-operation in particular. (See AGRICULTURAL CO-OPERATION.) Thomas F. Hunt, who, in 1892, first offered a course in rural economics at Ohio State university, deserves special mention as a pioneer in the field of agricultural economics. This course, dealing with the historical as well as comparative agriculture, included lectures on Egyptian, Grecian, Roman, British and U.S. agriculture. Part of his course was devoted to practical farm management. His teaching influence was felt directly in the universities of Illinois, Ohio, New York and California. He was also an influential member of the American Association of Agricultural Colleges and Experiment Stations, and had wide influence in the introduction of the teaching of rural economics in the United States. In 1896 the course in rural economics was recommended by the association to be offered in all agricultural colleges while the outline for the course, adopted in 1900, was similar to that of Hunt's book, printed in 1899, entitled *Lectures in the History of Agriculture and Rural Economics*. In pioneering agricultural economic teaching, Hunt saw a place for economists and statisticians in agricultural colleges. While Hunt had much influence upon agricultural economics, because of his personal leadership, I. F. Roberts and F. W. Card came into prominence about the same time because of their contributions to farm management subject matter.

DEVELOPMENT OF AGRICULTURAL ECONOMICS

United States, 1900-1919.—The beginning of the 20th century marks a convenient point from which to describe the development, scope and techniques employed in agricultural economics in the United States.

Teaching of agricultural economics in the state agricultural colleges, indicated by the names of the courses, began prior to 1900 in only eight states. Within the next 20 years practically every state college offered several courses in this field. The organization at these institutions of separate departments or divisions of agricultural economics, called by such names as rural economics, farm economics and farm management, as well as agricultural economics, began in 1904 at Ohio State university and now includes all of the agricultural colleges in all states. In many institutions, rural sociology is included as a division of agricultural economics, while, in some, rural sociology is a separate division of work.

Outside of these colleges, prior to 1920, the work of T. N. Carver, at Harvard, merits special mention. Carver was a trained economist with strong agricultural and sociological interests. Perhaps more than others of that period, he emphasized that all agricultural economic work should have as its goal better living for rural people in proper balance with the rest of society.

Early agricultural economics research in the state agricultural colleges was focused largely upon farm management. In 1902, W. M. Hays and Andrew Boss initiated cost accounting research in Minnesota. With gradual refinement, the work was continued there until temporarily interrupted by World War I. Shortly after 1910, detailed cost accounting studies of the entire farm business were developed especially in Illinois, New York, Ohio and Wisconsin, and later both complete farm cost accounting and enterprise cost studies were conducted in many states (see FARM MANAGEMENT).

At Cornell university in 1908, G. F. Warren developed the farm management survey type of study, a survey of the entire farm business. The first study was made of farms in Tompkins county, New York. This method of study was a major contribution to farm management research and became the basis of the method employed in much of the farm management research by the United States department of agriculture.

At Wisconsin some work was being done in cost accounting and farm survey records, but a much broader program was initiated

under the leadership of H. C. Taylor. Publications prior to 1919 reported studies at Wisconsin in farm credit, co-operative marketing, agricultural history, farm tenancy, land economics, prices of farm products and rural life, as well as farm management. In other institutions similar expansion was taking place.

Research in the farm management aspect of agricultural economics under the auspices of the United States department of agriculture virtually dates from 1902, when W. J. Spillman became a member of the staff. Under his direction, studies were initiated to determine the way in which the best-paying farms were being managed, the relationships to surrounding conditions such as proximity of markets, the way of leasing or controlling the use of land, and the method of farming followed. A separate appropriation for the office of farm management within the bureau of plant industry of the department of agriculture was made effective in 1905. Farmers' bulletins and other publications, prepared under the direction of Spillman, indicate that the work was quite closely restricted to the study of individual farms and farm practices until 1908.

Spillman and his associates contributed to an enlarged interest in studies in agricultural economics although major emphasis was given to farm records and bookkeeping. The work of the office of farm management was closely associated with the early agricultural extension work, which was established in 1914, under the Smith-Lever Extension act. C. B. Smith, who had been associated with Spillman in the office of farm management, became the director of the extension work in the northern and western states. Under him and his associates, the farm management demonstrations, based upon farm management survey records, was spread throughout these states in co-operation with the state extension services working through the county agricultural extension agents. Interest in a practical system of farm financial and production records to be kept by farmers was developed in a number of states following 1914, particularly in Illinois, Minnesota, Nebraska and Ohio. Farm records practically displaced farm management surveys in extension work in 1917.

Federal work in agricultural marketing followed a development somewhat parallel to that of farm management and was initiated at about the same time. This led to the establishment of the office of markets in 1913. Especially to be noted among conditions which contributed to marketing problems in the United States were the long distances between centres of production and consumption, and the development of large-scale firms in various branches of the food industry. There was widespread feeling on the part of producers that something was wrong with the system of distribution. Reflected in political demands, it stimulated inquiry, first, by governmental agencies, then, by agricultural experiment station workers. The development of co-operative marketing and processing by farm groups made them more conscious of problems involved in market operations and gave stimulus to research.

In the U.S. department of agriculture, interest in marketing originated from two sources: statisticians and technical production men. The latter initiated commodity studies which laid the foundation for grade standards for various farm commodities. The office of markets, later becoming the bureau of marketing, emphasized systems of grading, standardization and inspection. World War I created interest in market information and a market news system was initiated. The rise in the cost of living developed interest in economic studies in this field and economists were brought into the federal work in marketing.

One of the early contributions to the field of agricultural economics was the work done in agricultural statistics, dating back to 1867, when data were first collected on the production and yield of important crops. The names of N. C. Murray and L. M. Estabrook following 1900 are associated with the refinement of the crop and livestock-reporting service and extended the use of questionnaires mailed to farmers for collecting important statistics pertaining to agriculture. These data, collected over a long period of time, have provided a basis for useful economic studies of agriculture.

Rapid development in the teaching, research, extension and

regulatory phases of agricultural economics followed the organization of the American Farm Management association in 1910. At that time, a paper by K. L. Butterfield, entitled "Analysis of Rural Problems," set forth the place of agricultural economics among other agricultural subjects. Butterfield, in keeping with much of the thinking of that time, divided agricultural subject matter under five headings, as follows: (1) the technical aspect: "farm practices," or "agriculture"; (2) the business aspect: "farm administration," or "farm management"; (3) the scientific aspect: "agricultural science"; (4) the industrial aspect: "agricultural economics"; and (5) the community aspect: "rural sociology."

It is probable that the distinction between farm management and agricultural economics emphasized at that time was responsible for the delay in including the subject matter of farm management with that of agricultural economics. While the work of the American Farm Management association went forward steadily, a second group, which early took the name "agricultural economists," was likewise developing. In April 1913 a group of men interested in the broad field of agricultural economics called a conference known as the National Conference on Marketing and Farm Credits, and in 1916 the Association of Agricultural Economists was organized to promote the study and research of the various phases of agricultural economics, including agrarian legislation. In the organization and objectives of both this association and the American Farm Management association, one finds the problems in the field of agricultural economics set forth more clearly than previously. The formation of the American Farm Economic association, in Jan. 1919, marked the unification in the United States of the workers interested in the economics of agriculture.

Appropriations under the Smith-Lever act in 1914 provided federal aid, specifically for extension work in farm management, and paved the way for expanded work covering various economic problems as they became more evident following World War I. Extension workers in contact with farmers rapidly became conscious of the varied economic interest of farmers.

In addition to those who have been mentioned in connection with early agricultural economic work, at least another group deserves recognition: C. J. Brand, B. H. Hibbard, E. G. Nourse, L. D. H. Weld, and others, who initiated marketing studies of an economic character and wrote extensively. At the same time, some technically trained agricultural workers initiated commodity studies, emphasizing the development of classes and grades of products together with their physical handling. An example of this is the work of H. W. Mumford and his associates which later became the basis for the federal standards for market classes and grades of livestock and meat.

Much research in marketing was done by private and co-operative business firms, particularly with respect to the demands for their products. One of the early notable books on co-operative marketing was published in 1914 by G. H. Powell, manager of the California Fruit Growers exchange. As a plant pathologist, he began studies of losses of citrus fruit in shipment and reached the conclusion that they could be prevented by improved methods of harvesting and packing. The formation of local co-operatives to perform these operations was an important link in the establishment of the California Fruit Growers exchange as an outstandingly successful co-operative marketing organization (see AGRICULTURAL CO-OPERATION).

Work in agricultural geography and history has been based largely upon the federal census of agriculture which first included farm production figures in 1840; acreage and values of farm property in 1850; land tenure data in 1880; farm mortgage data in 1890; and more complete information relative to land tenure, land use and other aspects of farm life from 1900 to date. Population data, from 1790, and occupational classification, since 1820, have been invaluable. The graphic presentation of data in the census volumes, developed first in 1880, has been of value in helping students to obtain fundamental information regarding the geography of and trends in agriculture. F. A. Walker was prominently associated with much of this development. Since 1900, census data

has been used extensively in presenting agricultural information historically and geographically.

Prior to 1920, land economics studies have been conducted at several institutions including the Universities of Wisconsin and Illinois. R. T. Ely, together with his associates at the University of Wisconsin, pioneered in the development of land economics. L. C. Gray for many years was the head of the early work in land economics in the bureau of agricultural economics.

While separate treatment is often given to rural sociology, it is included with agricultural economics in so many institutions and is so closely associated with it that it merits mention here. C. J. Galpin, while at the University of Wisconsin, pioneered in the study of the construction of the rural community in relation to trade centres, schools, churches and other centres of the community activities. The research projects in this field have emphasized the relationship of the individual and rural groups to institutional influences in their effect upon family and community lives.

A brief appraisal of agricultural economics in the United States, from 1900 to 1919, should emphasize the improved techniques of study and the systematic presentation of subject matter. Marked advance was made from abstract discussion and reasoning regarding agricultural problems to the adoption of the research method of analysis. Sound statistical methods and systematic economic interpretation of results led to widespread recognition of agricultural economics as a separate field of work.

It was the broadened interest in the economic problems of agriculture that led to the reorganization of the office of farm management of the United States department of agriculture in 1919. H. C. Taylor then became head of the office of farm management. The reorganization included seven divisions of work, as follows: cost of production, farm organization, farm finance, farm labour, agricultural history and geography, land economics and farm life studies.

United States, 1919-1943.—The 15 years after World War I were characterized by a growing demand for governmental action designed to bring relief from the low prices being received for farm products (see AGRICULTURE). The adjustment in the use of crop land to obtain food supplies needed during the war, and several years of large crop yields, left the U.S. with surplus grain for peacetime conditions. The postwar tendency was for Europe to develop a self-sufficing agriculture, while the accumulated surpluses in Argentina, Australia and other distant regions added to the available food supply as shipping became available. Farmers found, on the other hand, that new machinery, building materials, household goods, taxes, interest rates and other costs remained at a high level. Inflated land values, through 1920, led to the assumption of heavy mortgage indebtedness. Canada likewise met conditions similar to those in the U.S.

Until 1925, agricultural production continued to expand with the perfecting of the gasoline tractor and large-scale machinery. Approximately 50,000,000 ac. of grass land were put into cultivation west of the Mississippi river in the United States, and extensive areas were added in Canada. Attempts to sell the increased production upon depressed world markets met both low prices and trade restrictions in European markets. In general, agricultural prices followed a downward trend until 1933.

The rapid development of improved highways and motor transportation started a revolution in marketing farm products following 1920. Trucking livestock to market stimulated the growth of smaller widely-scattered packing plants. Likewise, the truck made possible the expansion of whole-milk producing areas about cities and contributed to the establishment of larger creameries at central points.

Early legislative attempts to bring relief for low agricultural prices included the Federal Cooperative (Capper-Volstead) Act of 1922, the Federal Intermediate Credit Act of 1923, the Federal Agricultural Marketing Act of 1929, and the Smoot-Hawley Tariff Act of 1929.

The combination of low agricultural prices and revolutionary changes in marketing processes stimulated research in agricultural economics. In 1922 the federal work in farm management, mar-

kets, and crop and livestock estimates was further consolidated as the bureau of agricultural economics.

Research in this bureau followed lines which had been outlined in the reorganization plan of the office of farm management in 1919, and with increased emphasis on crop and livestock statistics and marketing. The research studies in marketing may be grouped under the four heads of (1) co-operative marketing; (2) commodity market operations; (3) special marketing facilities; and (4) research pertaining to regulatory problems. The first group of studies described and analyzed the development and problems of many types of co-operatives. The second dealt with inspection, grading and market services. The third included the reorganization of terminal produce markets, interstate trade barriers and the disposal of surplus farm produce. The fourth group of studies was conducted by various agencies, including the Federal Trade commission, the Tariff commission, the department of commerce, and some other divisions of the department of agriculture. Prominent among such studies were those of the grain trade and cotton trade.

Regulatory work pertaining to the marketing of farm products experienced a broad development in this period in the administration of the Grain Futures act, the Cotton Futures act, the Packer and Stockyards act, and various warehouse developments—all of which were indicative of the forward steps being taken in the marketing and credit field.

During the same period, extensive discussion was given to measures designed to raise the level of farm prices. Prominent among the proposals were the equalization fee, the export debenture and the domestic allotment plans. Throughout this period the concept of parity prices for farm products was gaining in emphasis, although it did not find its way into legislative action until 1933. The results of research came prominently into the consideration of these legislative efforts. The expanding interest in and knowledge of the economic aspects of agriculture were reflected in the colleges and universities, especially the land-grant institutions in the direction given to research work, the heavy registration of students in agricultural economic courses and the broad program in agricultural economic extension.

The study of farm prices in relation to other commodities and the introduction of statistical and historical techniques of study were widely applied to agricultural economic problems in the period immediately following the close of World War I. In addition to the work initiated by Taylor in the Federal Bureau of Agricultural Economics should be mentioned that of G. F. Warren at Cornell university, although this work was rapidly expanded in many institutions.

The Purnell Act of 1925 made funds available for research in agricultural economics, home economics and rural sociology in the state agricultural experiment stations. These funds reached a level of \$60,000 a year to each state in 1929, and gave rise to numerous research projects in the various phases of agricultural economics. Many state experiment station bulletins dealt with marketing and other economic problems of local importance, and furnished valuable material for teaching and extension. In addition, books, journal articles and federal publications have appeared pertaining to agricultural economics. The extent of the literature, from 1900, was exceedingly great.

Extension work in agricultural economics was sponsored jointly by the federal government and the state agricultural colleges following 1919. With the reorganization of the office of farm management, Taylor stimulated farm financial and production records for farmer use. The development of the account books adjusted to conditions in the respective states rapidly spread throughout the country. The University of Illinois was responsible for the development of the co-operative farm management associations sponsored by the University, but financed primarily by co-operating farmers. Similar co-operating groups have been formed in a number of states, particularly Minnesota, Iowa and Kansas. Economic outlook information for farmers, first sponsored in 1922 by the bureau of agricultural economics, is now an important extension project in practically every state. Likewise, marketing specialists within the states have given much time to

assisting co-operating farmers and organizations in the marketing of particular products.

In addition to the agricultural experiment stations and state colleges of agriculture, much valuable work was done at Chicago, Harvard, Leland Stanford, Northwestern, Pennsylvania and other universities. Endowed research institutions, established following 1920, added impetus to agricultural economic studies. The Brookings institution at Washington, D.C., while interested in broad economic studies, directed considerable study to agricultural problems. The Food Research institute located at Stanford university, the Giannini foundation at the University of California, and the Farm foundation located in Chicago were primarily concerned with agricultural economic problems.

The deteriorating national economic situation following 1929 added to the misfortunes of agriculture, which continued to maintain a high level of production. There was unemployment and low purchasing power for farm products. It was this situation that led, with the change of administration in 1933, to the agricultural phases of the New Deal. The tariff revisions in 1929 had brought little relief to agriculture. The disparity in the prices of the farm products and the goods and services purchased by farmers, together with the heavy mortgage indebtedness, resulted in the ruin of many farmers.

It was the impact of these conditions that brought a number of important federal laws into effect. Among the more important of these are: the Agricultural Adjustment Act of 1933 with subsequent amendments; the Farm Credit Act of 1933; the Soil Conservation Act of 1935; the Agricultural Marketing Agreement Act of 1937; the Farm Tenant Act of 1937; and the new Agricultural Adjustment Act of 1938.

This legislative emphasis upon the economic problems of agriculture was paralleled by many studies pertaining to credit, market disposal, land tenure, land use, conservation of soil and the control of production. The controls over agriculture designed to rid the country of burdensome surpluses and to bring production into adjustment with demand continued until the outbreak of World War II.

The coming of the war found agriculture with abundant supplies of crops and livestock on hand, which enabled the farmers of the United States to greatly expand their production to meet the wartime demand. The war period brought an unlimited demand for agricultural products, leading to more attention to adjustments in the production and distribution of agricultural products to better meet national needs. After the outbreak of the war, emphasis was placed upon the production of maximum amounts of needed food per acre, per animal and per unit of labour or power. This period has led to many wartime organizations, including the Office of Price Administration, the War Food administration, Foreign Economic administration, Combined Food board and the United Nations Relief and Rehabilitation administration. These organizations, many of whose functions are economic in character, will not be treated here until their place, functions and accomplishments can be better appraised.

The period 1900-1919 marked a notable expansion in agricultural economics teaching, research, extension and regulatory work; the developments after that date were toward greater integration and toward work of a more vital character. Within the agricultural colleges, teaching, research and extension in agricultural economics have become progressively more closely knit. Instructional and research subjects included farm management, co-operation, marketing, agricultural prices and statistics, finance, agricultural economic history, agricultural economic geography, land economics, rural sociology and agricultural policies. Agricultural labour, agricultural law, the appraisal of farm real estate and buildings, and rural government have received attention. Agricultural economics thus has drawn upon the various social sciences to make its contributions more practical.

Great Britain.—Following 1900 to the close of World War I in 1918, the general economists in the British Isles helped to refine the analysis of economic problems pertaining to agriculture. During this period little was developed of a statistical nature in the study of agricultural problems, but economic reasoning was

applied to questions pertaining to policy, especially in the field of land tenure, marketing, land management and international trade.

In Great Britain, agricultural economics has had a somewhat different emphasis than in the United States. In agricultural economics research writings and teaching greater emphasis was put upon agricultural policies, although the problems of the individual farmer were continually stressed from a practical point of view.

The subject of agricultural economics was taken up by the ministry of agriculture and fisheries, but resources were limited prior to World War I. Assistance, however, was made available from the Development fund and from the University of Oxford. An Institute of Agricultural Economics was established at Oxford. Its activities were, at first, directed to the improvement of farm accounts, especially by the use of the cost accounts. As further resources became available, its scope was broadened and important investigations were undertaken in other phases of the field. In addition to Oxford, Cambridge university and the University College of Wales took initiative in conducting agricultural economic studies. Also, agricultural economics was placed in most of the agricultural colleges of the British Isles by 1930, and the provincial agricultural agents were serving as economic advisers in their respective areas.

Following 1920 research was expanded to include marketing, especially with the formation of the Empire Marketing board. To quite an extent the agricultural economic problems in Great Britain, like those of the United States, were accentuated by World War II. As a deficit food country, the United Kingdom was in a better position to regulate trade in agricultural products than many other countries. Canada, Australia and Argentina, as well as the United States, continued to supply cheap wheat to Europe. The cheap feed supply encouraged the expanded production of dairy products in Denmark, Holland, Switzerland, Finland and New Zealand, and, in turn, contributed to low world prices for these products. Barriers to free trade in Europe tended to force uneconomic agricultural production adjustments within countries. The problems were accentuated by maladjustment in trade and delayed agreements concerning war reparation settlements.

In the United Kingdom various schemes for promoting production of agricultural products were undertaken. These included subsidizing the production of sugar, wheat and hogs, and the development of marketing schemes designed especially to stabilize the production of dairy products and hogs. The United Kingdom, dependent upon the importation of much of its food supply, sought to stabilize its domestic agriculture on a basis which would encourage production by providing definite quotas of agricultural imports. The Ottawa agreements, for example, provided for preferential trade in wheat and some other products.

The growth of interest in agricultural economic matters in the British Isles is reflected in the formation of the English Agricultural Economics society and in its published proceedings, as well as in the publications of the ministry of agriculture and fisheries, the Empire Marketing board, and in university publications.

Selected Continental European Countries.—Agricultural economics has attained more prominence in western European countries where the peasant populations supply farm products to industrial markets. To the east of these countries, that is, in the area between the Baltic, the Adriatic and the Black seas, there have been more pressing farming problems. After 1900 the increase in wheat production outside of Europe and, during the inter-war period, the fall in prices of farm products, the prolonged depression and, finally, the closing of markets for imported food products in western Europe, brought hardships to many countries, especially to those in eastern and southeastern Europe. These and other agricultural problems stimulated work in agricultural economics, especially in the more industrialized European countries.

Several of the larger countries on the continent of Europe have aimed at being self-sufficing in food. The service of agricultural economics in these countries has been directed to these social ends as well as to the development of better organization of farms.

France.—The land survey (cadastre), dating its modern phase from about 1790, has had continued development. Appraisal technique for farm properties, nurtured by a professional organization founded in 1838, has likewise had continued development. E. Jouzier gave impetus to economic studies through his *Economie Rurale* (1903). Agricultural policies have been the object of considerable research by French economists. French peasants, generally, have been indisposed to make available facts as to the results of their farm and investment activities. The virtual absence of farm accounting work has retarded economic research in France.

Germany.—Agricultural prosperity has been a goal of German statesmen since about 1870. The Bismarckian philosophy extended practically to the establishment of the Weimar constitution, 1919. A third main phase of German economic policy making began in 1933. In tariff and other protectionist policies, and other phases of study, agricultural economists were active prior to the Weimar constitution, reached a high development under it, and suffered considerable eclipse after 1933.

Influential in economic thought on German farm problems at the turn of the 20th century were T. von der Goltz, F. Aereboe, M. Sering and others. Contributions to farm accounting, management and appraisal were numerous. Agricultural geography, history and policy were subjects of many treatises. The welfare of agricultural labourers as well as of tenants and landlords was examined statistically. Prior to 1933 there were many points of similarity in the breadth, depth and volume of scientific work in agricultural economics in Germany and in the United States.

Economic developments continued in German agriculture from 1933, but with considerable change in the personnel in governmental and university posts. The emphasis on self-sufficiency in foodstuffs increased under the Nazi regime. The Food Estate (*Nährstand*) was given control of farm and food problems. Upward trends in yields were a prime object in government policy. The land valuation services of the treasury were reactivated to provide a basis for adjusted tax rates promised the farmers for their support of the Nazi program. Peasant holdings were made the object of hereditary farm legislation, affording some of the effects of the principle of entailing which had long been enjoyed by the estate farms in eastern Germany. Both under the Weimar constitution and subsequently, the political and economic influence of these large landholders continued with little disturbance. Rising land prices and other symptoms of effective protection to producers of farm products and holders of property continued into the World War II period.

Marketing as well as production and its land tenure basis came in for readjustment under the Nazi regime. For example, boundaries were specified beyond which whole milk for table use might not be drawn into a city. Taxes applied to producers within the favoured area were used in part to reimburse those outside who must find other, usually less profitable, outlets. Perhaps, with the exception of Russia, the agricultural economy of Germany has undergone control more than that of any major country.

Recent contributions of German agricultural economists have been directed toward carrying out the administrative policies set by the national pattern. In general, new names appear as authors. These publications, however, show fewer comparisons of economic experiences within the country with those outside.

Italy.—By 1900, Italy had a background of scientific work on the land survey (cadastre) and in farm real estate appraisal methods extending back many decades. Creditable publications on land valuation were produced early in the 19th century, and other developed lines of agricultural economic work appeared toward its close. Prominent among economic theorists who made applications to agriculture was S. Iacini, about 1870. Also to be noted are G. Valenti, in agricultural statistics, and V. Niccoli (Milan and Pisa) and O. Bordiga (Portici), both of them university professors, who emphasized farm management, from 1900 to 1915.

Italian rural economy was in a disorganized condition at the end of World War I. It was then that A. Serpieri and other agricultural economists promoted the organization of the National

Institute of Agricultural Economics and Statistics. In 1927, the work in statistics was taken over by the Central Institute of Statistics. Research centres of agricultural economics were established at Bologna, Florence, Perugia and Portici.

Agricultural economists in Italy have brought the points of view of history and sociology into their studies. They have given much attention to agricultural labourers, to land reclamation and to mountain populations.

International Aspects of Agricultural Economics.—International conferences have dealt with many economic problems in agriculture from 1864. A single product, sugar, received major attention for about 25 years. From about 1890 to 1942 international meetings, largely prompted by import and export problems, included more and more countries and more farm products. Notable were the Chadbourne Sugar Plan of 1931 and the International Sugar Agreement of 1937. Rubber, in 1922, was subjected to the first operation of the Stevenson plan. In 1934 the International Rubber Regulation scheme was effected. No less than 16 international conferences were held in 1930 and 1931, primarily with regard to wheat. Under an agreement in 1933, a Wheat Advisory committee was formed which led, in June 1942, to the establishment of the International Wheat council, with provisions for semiannual sessions. In addition to efforts to bring about international regulation of production, exports and, to some extent, prices, international meetings have established world standards and grades, especially for cotton and wheat.

Apart from these farm commodity conferences, several types of agencies have promoted agricultural economic discussions at the international level. The International Commission of Agriculture called international congresses of agriculture. Beginning with the first session at Paris in 1889, 18 major sessions were held in 40 years. Relations between landlord and tenant claimed major attention at the Paris session. The second session, held at the Hague, 1891, is typical of the earlier meetings; it included seven sections, three of which were devoted to rural economy, credit institutions and legislative questions. In addition, some attention was turned to discussion of land nationalization, transportation of farm products and tariffs affecting agriculture. At Dresden, in 1939, there were nine sections which included (1) agrarian policy and farm management, (2) agricultural co-operative societies, (3) agricultural industries and (4) rural life and the work of the countrywoman. Both private and social economic emphasis has persisted in these farm congresses.

At the Budapest congress in 1896, David Lubin projected the idea of an international chamber of agriculture. The International Institute of Agriculture, founded at Rome, in 1905, realized a part of the goals included in the original project. Emphasis on agricultural economics gained impetus in 1933-35, when H. C. Taylor was the representative of the U.S. on the permanent committee of the institute. The institute has made outstanding contribution in its statistics and records of legislative enactments. The institute's efforts for a world agricultural census in the late 1920s, and again in the late 1930s, have had more than pioneering value. Numerous publications dealing with principal farm products on the world market and with broader problems of agriculture, as treated in *Agricultural Problems in Their International Aspect* (in co-operation with the League of Nations) (1923), and *World Trade in Agricultural Products* (1940), are of lasting economic value. The same applies to numerous articles in the *International Review of Agriculture*, one of the organs of the institute. In its library and other collections of data, the institute is unique.

The International Commission of Agriculture maintained several units. One of these was the International Confederation of Agriculture, and developed, about 1920, plans for separate biennial meetings in years in which the congresses were not convened. The confederation meetings for the most part have dealt with economic problems with which national farm organization leaders, primarily in Europe, have been confronted. The May 1938 report listed 14 international meetings in which economic aspects of agriculture were involved.

The International Federation of Surveyors has placed emphasis on valuation of farm real estate since about 1920.

The International Conference of Agricultural Economists was instituted in 1929 at Dartington hall, Devonshire, England. Subsequent sessions were held at Ithaca, New York, in 1930, Bad Eilsen, Germany, in 1934, Saint Andrews, Scotland, in 1936, and Macdonald college, Canada, in 1938. Published proceedings of these conferences show participation well divided between European and North American agricultural economists. Special publications on agricultural conditions in different countries of Europe appeared following the Bad Eilsen conference, and an *International Journal of Agrarian Affairs* was launched in 1939.

The United Nations Conference on Food and Agriculture, Hot Springs, Virginia, 1943, was followed by an Interim Commission on Food and Agriculture and provided for a permanent United Nations Food and Agricultural organization. The appraisal of the work of these agencies as of other agencies of the period of war and its aftermath is not to be made now (1944).

BIBLIOGRAPHIC NOTE:—In the United States, in particular, some of the more important current contributions are not included in books and are to be found through the use of bibliographic lists.

The United States department of agriculture has published in its *Bibliography of Agriculture* (monthly) current reference lists on agricultural economic subjects since July 1942. Similar current bibliographies were included, 1927–1942, in *Agricultural Economic Literature*; periodical articles and bulletins on economic aspects of agriculture have occupied a growing place in periodical indexes as *Agricultural Index*, 1915–date, *Bulletin of the Public Affairs Information Service*, 1914–date, and the *International Index to Periodicals*, 1913–date.

In its new series, also, the *United States Department of Agriculture Library Lists and Bibliographical Bulletins* include economic references.

Lists prepared in the division of bibliography, Library of Congress, 1900–1946, contain economic references especially for the period prior to the development of bibliographic services in the department of agriculture.

Agricultural economic bibliographies have been issued by various state and other institutions of research. To be noted is the *Wheat Studies*, Food Research institute, Stanford university.

The International Institute of Agriculture, Rome, published in English after 1938 an *International Bibliography of Agricultural Economics* (quarterly). This appeared, 1934–38, in *Berichte ueber Landwirtschaft*, Berlin, and was issued separately.

Lists of agricultural economic bulletins, periodicals and other publications of the national, state and provincial departments of agriculture, the experiment stations and colleges and other institutions of research are available from the respective institutions.

Among the many books that might be cited, the following have been prominent and are representative.

United States: P. W. Bidwell and J. I. Falconer, *History of Agriculture in the Northern United States, 1620–1860* (1925); J. D. Black, *Agricultural Reform in the United States* (1929); T. N. Carver, *Principles of Rural Economics* (1911); A. A. Dowell and O. B. Jesness, *The American Farmer and the Export Market* (1934); R. T. Ely and G. S. Wehrwein, *Land Economics* (1940); G. W. Forster, *Farm Organization and Management* (1938); L. C. Gray, *History of Agriculture in Southern United States to 1860* (1933); B. H. Hibbard, *The History of Public Land Policies* (1924); E. G. Nourse, *Agricultural Economics* (1916) and *American Agriculture and the European Market* (1924); T. W. Schultz, *Redirecting Farm Policy* (1943); W. J. Spillman, *Farm Management* (1923); H. C. Taylor, *Outlines of Agricultural Economics* (1925, 1st ed., 1905); G. F. Warren, *Farm Management* (1913).

British Isles: A. W. Ashby, *Allotments and Small Holdings in Oxfordshire* (1919); R. E. Ernle, *Prothero, English Farming, Past and Present* (5th ed., 1936); C. S. Orwin, *The Determination of Farming Costs* (2nd ed., 1921); R. H. Rew, *A Primer of Agricultural Economics* (1927); J. A. Venn, *The Foundations of Agricultural Economics* (1938, 1st ed., 1923).

Selected Continental Countries: Friedrich Aereboe, *Allgemeine Landwirtschaftliche Betriebslehre* (6th ed., 1923); F. Aereboe, J. Hansen and T. Roemer, *Handbuch der Landwirtschaft* (5 vol., 12th to 15th ed., 1928–1930); T. A. L. G. von der Goltz, *Geschichte der deutschen Landwirtschaft* (2 vols., 1902–1903) and *Leitfaden der Landwirtschaftlichen Betriebslehre* (vol. II, 7th ed., 1922); Etienne Jouzier, *Economie Rurale* (1903); Ernst Laur, *Einfuehrung in die Wirtschaftslehre des Landbaues* (2nd ed., 1930) and *Grundlagen und Methoden der Bewertung, Buchhaltung, und Kalkulation in der Landwirtschaft* (3rd ed., 1928); Kurt Ritter, *Der Getreideverkehr der Welt vor und nach dem Kriege* (1926); Walther Rothkegel, *Handbuch der Schatzungslehre fuer Grundbesitzungen* (vol. 1, 1930; vol. 2, 1932); Max Sering, *Die deutsche Landwirtschaft unter Volks- und Weltwirtschaftliche Gesichtspunkten* (*Berichte ueber Landwirtschaft*, new series, Sonderheft 50, 1932); Albrecht Thaer, *Grundsätze der rationellen Landwirtschaft* (new ed., 1880); J. H. von Thünen, *Der Isolierte Markt* (3rd ed., 1930).

Nongovernmental periodicals giving prominence to agricultural eco-

nomics materials include the following: *Jour. of Farm Economics*; *Jour. of Land and Public Utility Economics*; *Jour. of the American Society of Farm Managers and Rural Appraisers*; *Economic Geography*; *Proceedings of the British Agricultural Economics Society*; *Kuehn-Archiv* (since 1911); *Deutsche Landwirtschaftliche Presse* (since 1874); *Journal fuer Landwirtschaft* (since 1853); and *Landwirtschaftliche Jahrbuecher* (since 1872).

(C. L. St.; H. C. M. C.)

AGRICULTURAL EDUCATION. Though agriculture is the oldest and greatest of industries, agricultural education in any organized form is among the recent activities of modern states. In Great Britain, or at least in England and Wales, it may be said to go back only to 1890. It would be untrue, however, to say that before then nothing was done. Chairs of agriculture and rural economy were founded at Edinburgh in 1790 and at Oxford in 1796; the Royal Agricultural college at Cirencester was established in 1840. But agricultural education provided in universities or colleges was beyond the reach of the bulk of the agricultural population. Little or nothing was offered to the children of farmers, smallholders and labourers until nearly the end of the 19th century. In 1890, the Local Taxation (Customs and Excise) act placed at the disposal of county councils a sum of money (popularly known as the "Whiskey Money," because it was derived from an increase of the taxation on spirits which was originally destined for another purpose), amounting roughly to £750,000 a year, and authorized them to apply it to purposes of technical instruction, including instruction in agriculture. From 1890 onward there was a considerable, if slow, increase both of the higher education provided by university departments of agriculture and agricultural colleges, and of instruction provided by county councils. By 1912 the state was granting £19,000 a year for higher education, and the English and Welsh county councils were spending £70,000 a year on the more elementary instruction. World War I stopped the development of plans already prepared for further expansion on a relatively large scale.

Postwar Development.—The present system, though it follows prewar lines in its organization, is largely the creation of the years since 1918. It falls into two main parts; the university departments of agriculture and agricultural colleges, whose distinctive mark is that they provide a long course, two years at least, usually three, leading to a diploma or degree; and the education provided by county councils, which is essentially an education of short courses intended for the boy or girl who is already working on the land and proposes to return to it.

Higher agricultural education in England and Wales (excluding veterinary education) is provided at 14 centres, of which seven are departments or schools of universities, and the other seven are agricultural colleges, each possessing its own governing body, and not forming an integral part of a university. Eleven of these institutions (all except the Royal Agricultural college at Cirencester and the two women's colleges at Swanley, in Kent, and Studley, in Warwickshire), discharge an important function outside the actual teaching of students. Each is an "Advisory centre" for a group of counties forming its "Province"; it is provided with specialists in the more important branches of science bearing on agriculture, such as chemistry and entomology, who supplement the more general advice provided for farmers by the technical staffs of county councils, and it acts as a unifying and co-ordinating influence for the experimental and advisory work of county councils. All the 14 institutions are recognized and aided by the state. The cost to the student varies considerably between the two Welsh colleges (Aberystwyth and Bangor) at one end of the scale and Oxford or Cambridge at the other end.

Education of a less elaborate character is provided by county councils; in some counties by means of a farm institute (a simpler and smaller agricultural college, usually possessing residential accommodation and a farm attached), in practically all counties through organized classes, held at no special institution, or through discussion clubs, evening lectures and similar less systematic methods. In 1927 there were 16 farm institutes, four in Wales (including Monmouthshire) and the remainder in England, all but one supported and governed by county councils. On the average they can accommodate 40 students each; the fees for board,

lodging and tuition vary between 17s. 6d. a week for students coming from the county which supports a particular institute to £2, 10s. od. a week for other students. The main course at a farm institute is normally a six months' winter course in practical agriculture, extending from October to March, and designed for young people, from the age of 16 upward, who have been working on the land and are going straight back to it. During the summer months the institute is used for courses in dairying, poultry keeping and other special subjects. The great majority of county councils, however, do not possess farm institutes, but attempt to take agricultural education to the landworker by such means as the organized day course (a continuous course of instruction held at regular times, usually one day a week, in any town or village where there is a demand for it, and extending over several weeks or perhaps months), evening classes, travelling dairy schools, courses for instruction in manual processes (ploughing, hedging, ditching, milking, and the like), and lectures or demonstrations.

In 1937-38 the cost of the education provided by county councils in England and Wales was £420,000, of which the government provided a fraction over two-thirds and county rates the remainder. One other activity deserves mention. In 1922 the government started a scheme of scholarships in agriculture for the sons and daughters of agricultural workmen and of other rural workers in a similar economic position. Under this scheme approximately 100 scholarships are awarded every year, of which the great majority are short-term scholarships to farm institutes. The cost is £20,000 a year.

In Scotland, agricultural education has followed a rather different course, though it started on the same lines. The organization is not divided between universities and colleges on the one side and county councils on the other; the colleges control and direct the whole system. Apart from the small sums received as fees, the whole cost is met by grants from the state, which in 1925-26 amounted to £75,000. But in the education given, as distinct from the organization for giving it, the Scottish system resembles the English. The three colleges in alliance with their respective universities provide long courses (three winter sessions) for the university degree or college diploma; they take the place of the English farm institutes by including in their curricula short courses for farming; and through the appointment of organizers resident in the counties they conduct extension work similar to that done in England and Wales by the staffs of county councils. Two special institutions should be mentioned: the Kilmarnock dairy school and the Craibstone School of Domestic Economy for Women, the former associated with the Glasgow college and the latter with Aberdeen.

Other Systems.—Broadly speaking, and with considerable variations due to differences of national character and environment, continental systems tend to fall into the main divisions already enumerated, of two or three years at universities or agricultural colleges; in the second place, there are short courses of a few weeks or months in the dead season, or of a year at most, at a residential institution—sometimes a college, more usually a farm institute or farm school; thirdly, miscellaneous courses, lectures, and demonstrations given by peripatetic instructors who endeavour to bring technical education to the farmer's door, or at least to his town or village. But there are one or two features of foreign systems which ought to be mentioned, if only by way of contrast to the British system.

Of these the most striking is, perhaps, the large part taken in Germany, Denmark, Sweden, and in fact nearly all over the continent of Europe, by voluntary societies and associations; in Denmark, for instance, agricultural societies own and manage many of the Folk high schools and support many agricultural counsellors—experts who combine teaching, lecturing and advisory functions. But the Folk high schools of Denmark are notable not merely as an example of voluntary effort; they are a great and successful attempt to add a finish to the education of the adult land-worker by giving him or her a six to nine months' course, not entirely agricultural and sometimes not agricultural at all, at a residential institution. In Belgium, a country of small-

holders, there is a highly developed system of instruction for women and girls in a combination of practical agriculture and rural domestic economy; the system centres in the national institution at Laeken. In Sweden also (besides the usual agricultural colleges, agricultural schools, and farmers' sons' schools, the last providing a three months' theoretical course for young men, usually about the age of 22) there are something like 40 schools of agricultural economy for women.

Changes in the British System.—From 1924 or thereabouts two movements affecting agricultural education have gained prominence. The first is the movement for imparting into the ordinary subjects of instruction taught at rural elementary and secondary schools what is known as a rural bias—e.g., arithmetic may be taught through simple farm accounts, or geography with at least some reference to the physical characteristics of the district in which the school is situated. Provided it does not degenerate into a premature attempt at vocational training, there is everything to be said in favour of such a change.

The second change is a change of emphasis in the subjects usually taught in agricultural institutions and courses. Hitherto syllabuses of instruction have tended to be dominated by science or rather sciences—chemistry, physics, botany. A school of thought has arisen which starts from the fact that the farmer is not only a grower of crops, a producer of eggs or milk, a breeder of stock, but also a manager of labour, a buyer of goods, and a seller of products—in the ordinary phrase, a businessman. There is consequently a steady pressure toward modifying courses of instruction, particularly the short winter courses, by giving a larger place to such subjects as accounts (the foundation of business), the management of labour, and the elements of marketing technique. There can be little doubt that this side of agricultural education has been relatively neglected; but the teaching of management is not easy.

Defects in the British System.—But though these changes may be beneficial, the British system still reveals several notable defects. First, it is far too small, not, perhaps, for the demands which are actually made on it, but for the demands which ought to be made. In the second place, the larger part of the English and Welsh system—the part organized and directed by county councils—is "patchy." There is no power to compel county councils to supply even the barest modicum of agricultural instruction, and accordingly the provision made for it in a county varies with the character and finances of the county council and its electorate. Thirdly, provision for the residential education of adults—one of the most marked and successful features of continental systems—is noticeably absent. Lastly, provision for instruction in manual processes and in the handling of machinery, though not absent, is not so common as it should be.

Progress Being Made.—Some of these defects are being slowly remedied. In spite of financial exigencies, college and county education does progress and grow; and, best of all signs, authorities are agreed that since 1900 there has been a remarkable change of attitude on the part of the agricultural community.

Farmers welcome the assistance of college and county staffs; and a first attempt has been made, through private enterprise, to provide at Avoncroft, near Evesham, an institution very similar to the Folk high school of Denmark for adult land-workers. If that experiment proves a success, it may be the beginning of a new era. Moreover, the education of women and girls has recently been investigated by a strong committee, which has surveyed the whole field; and the ministry of agriculture has put before county councils a detailed scheme for extending instruction in manual processes. In 1925-26 the number attending such instruction rose to 1,900—a number which, however small in itself, was at least an increase of 50% from the previous year.

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(H. E. D.; X.)

IN THE UNITED STATES

Agricultural education in the United States finds its beginnings in the striving of individual landowners toward higher levels of production. This created interest and discussion in agricultural communities, induced the making of tests, trials and observations, pointed to the advantages of concerted action, and slowly but steadily laid the foundation on which present-day educational machinery was built.

Agricultural Schools.—Among the early attempts to provide agricultural instruction in schools of less than college grade the following may be noted: In 1821 the state legislature of Maine granted to Robert Hallowell Gardiner an annual appropriation of \$1,000 for the maintenance of an institute for agricultural and mechanic arts. The Gardiner Lyceum was opened at Gardiner, Me., in 1823. It employed a professor of agriculture, maintained a farm and offered short winter courses in agriculture. An agricultural school was founded at Derby, Conn., in 1826. So-called manual labour schools were established in New York state in the period 1825-40. They laid stress, in their curricula, on vocational training in agriculture and the industries. In 1845-50 several agricultural schools were founded, through private initiative, in New York and Connecticut. After the middle of the 19th century conditions became more propitious for the teaching of agriculture in elementary and secondary schools. A period of agitation was followed by the establishment of an agricultural high school at the University of Minnesota (1888). District and county agricultural schools were created a few years later, among them the agricultural schools in the nine congressional districts of Alabama.

By 1898 there had been established ten agricultural high schools. In 1909, there were 60 separate agricultural high schools. Agricultural courses were then being offered in 346 other high schools. Several states, among them Massachusetts (1911), New York (1913), Pennsylvania (1913), New Jersey (1913) and Indiana (1913) had established definite systems of vocational agricultural education.

It is estimated that in 1912-13 there were about 2,300 state agricultural schools, district agricultural schools, agricultural departments of high schools and ordinary schools that maintained systematic instruction in agriculture.

The Smith-Hughes Vocational Education act (1917) provides federal aid for vocational training, including the teaching of agriculture and home economics in secondary schools. Since the passage of this act many vocational agricultural schools, as well as agricultural departments of general high schools, have been established in the several states. Of the 11,561 rural high schools, 3,339 or 29% maintained vocational agricultural departments in 1927. They had an enrolment of 129,032 students. In that year there was available for the support of vocational agricultural education nearly \$7,500,000, compared with about \$740,000 in 1918.

The George-Deen act (1936) greatly increased federal funds and by 1942 a total of about \$15,000,000 was being expended for 610,000 agricultural students. It may be noted, further, that many states have special laws which concern the teaching of agriculture in elementary rural schools.

Agricultural Colleges.—Simeon de Witt, surveyor-general of New York, published, in 1819, a pamphlet entitled *Considerations on the Necessity of Establishing an Agricultural College, and Having More of the Children of Wealthy Citizens Educated for the Profession of Farming*. A state agricultural college was established in New York in 1853. The oldest surviving state agricultural college is that of Michigan (1857). Similar colleges were established in Pennsylvania and Maryland (1859) and the incorporation of agricultural colleges authorized in Iowa and Minnesota (1858). The Federal Land Grant act (also called the first Morrill act) was passed in 1862. It created a group of state institutions of higher learning, known as the land-grant colleges and universities (*q.v.*). This legislation was far-reaching in its effects on the social and economic development of the country. The second Morrill act (1890), the Nelson amendment of the

Morrill act (1907) and the Bankhead-Jones act (1935) provided additional funds for the state colleges. In 1936-37 the 69 land-grant colleges enrolled 21,254 agricultural students.

The state colleges and universities are intimately associated with the U.S. department of agriculture. This had its inception in the collection and distribution of seeds and plants by the patent office in 1839. The service was expanded to furnish information on various agricultural topics. In 1862 the department of agriculture was organized as such and in 1889 its head became a member of the president's cabinet. When the Hatch act was passed (1887), funds were made available for the establishment of experiment stations as departments of the state colleges. Prior to that, state agricultural experiment stations had been established in Connecticut (1875), California (1877), North Carolina (1877), New York (1879 and 1882), New Jersey (1880), Ohio, Tennessee and Massachusetts (1882), Alabama and Wisconsin (1883), Nebraska (1884), and Michigan, Indiana, Kentucky, Maine and Minnesota (1885). A private sugar planter's experiment station was established in Louisiana in 1885, and state stations in Louisiana, Vermont and New Hampshire in 1886.

In keeping with the provisions of the Hatch act, an office of experiment stations was organized in the department of agriculture for the purpose of maintaining contracts with the stations. Subsequent legislation referred to as the Adams (1906), the Purnell (1925) and the Bankhead-Jones (1935) acts augmented the income of the stations, established better correlation of research on a regional and national basis and encouraged co-operation among the stations themselves and with the department of agriculture. The stations are primarily research institutions. As such they are maintaining many hundreds of research projects of direct significance to agriculture and the farm home, and creating a vast body of knowledge from which facts and generalizations are being drawn for the benefit of resident instruction and of extension teaching.

The Smith-Lever act was passed in 1914. It represents a national scheme of extension teaching in agriculture and home economics and is the culmination of a long series of local, state, regional and national efforts to stimulate agricultural progress by bringing technical and general information to the farm and farm home.

The antecedents of the Smith-Lever act include the almanacs, agricultural journals and newspapers, agricultural societies, boards of agriculture, farmers' institutes and demonstrations and lectures by public-spirited individuals. The act provides for county agents, home demonstration agents, club leaders and extension specialists. It makes the department of agriculture responsible for coordinating and supervising the extension activities in the several states. The work was further developed by the Capper-Ketcham act (1928) and the Bankhead-Jones act (1935).

• The agricultural teaching, research and extension of the land-grant colleges and universities are being generously supported by the local, state and federal governments. In 1936-37 the federal government appropriated \$17,256,207 for the support of agricultural extension, while the states, counties, farm organizations and individuals were expending for the same purpose \$12,507,455.

See A. C. True, *A History of Agricultural Education in the United States, 1785-1925* (1929); W. H. Shepardson, *Agricultural Education in the United States* (1929); Advisory Committee on Education, *Staff studies on Vocational Education and the Land-Grant College* (1938); E. D. Ross, *Democracy's College, The Land-Grant Movement in the Formative Stage* (1942). (J. G. L.; X.)

AGRICULTURAL ENGINEERING, broadly speaking, is the science of utilizing in combination the forces and materials of nature for the benefit of agriculture; specifically it implies an understanding of biology, soils science and agronomy, as a basis for the intelligent application of engineering principles to agriculture.

While agricultural engineering deals entirely with agriculture, it is related more or less to several other important branches of engineering, as, for instance, mechanical engineering, which has to do with the design and construction of steam and gasoline power units, railroad and factory equipment, and mechanical de-

vices generally. But agricultural engineering makes use of the principles here involved in the design of mechanical farm power units and machinery to perform the many and complex farm operations. It is related to electrical engineering, which has to do with the design and construction of electric power installations, transmissions and distribution lines, in that agricultural engineering puts the electricity to work on the farm in energizing electric motors to grind feed, milk cows, in providing current for electric fences and other equipment, and in performing some 200 other chores. It is related to civil engineering, which, among many broad problems, handles those incident to the extensive storage and arterial distribution of irrigation water and to the design and construction of large community drainage systems. On the other hand, agricultural engineering sees that the irrigation water is economically distributed and applied to crops and that in drainage the ditches and underdrains are scientifically planned to suit each field and the use to be made of the land. The civil engineer is also charged with the design and construction of large steel and concrete buildings whereas the agricultural engineer applies the principles of construction to the design of farmhouses, dairy barns and other animal shelters, storage facilities for farm crops, and miscellaneous farm structures and equipment.

It is generally recognized that the marked advance in agriculture since 1850, especially the great increase in convenience in doing work and the large reduction in labour per unit of production, has been due in no small measure to improved engineering practices and more and better machines. Thus the development of farm land from the wilderness by clearing, the control of erosion by terraces, the disposal of surplus water and the acquiring and regulating of the water needed for plant growth and for human and animal consumption are problems of the agricultural engineer. The erection of farm structures of all types, with their problems of light, heat, ventilation, etc., and the best use and design for the machinery and implements used in farm operations and transportation, as well as the sources of the power which operates them, also are in the field of the agricultural engineer. In the United States this has been a natural consequence of a rapid increase in engineering of all kinds that came with the sudden opening up of great natural resources. In Great Britain and continental Europe, however, the scope of agricultural engineering is less specialized, the tendency being rather to give practical recognition to two distinct divisions of the science, dealing respectively with the mechanical phases (implements, machinery and power) and those of the soil (irrigation, drainage, erosion control, etc.).

Agricultural engineering as a profession got its start at Iowa State college, Ames, Iowa, where the first four-year course leading to a B.S. degree in agricultural engineering was established in 1905. Two years later the American Society of Agricultural Engineers was founded with a charter membership of 17. This number had increased to 1,300 by Jan. 1, 1944, mostly in the United States, but the membership includes citizens of Argentina, South Africa, Australia, Brazil, Canada, Colombia, Cuba, Ecuador, England, India, Mexico, Peru and Scotland. Before the outbreak of World War II there were members in Germany, Greece, Hungary, Netherlands, Norway, Panama, Sweden and Switzerland.

In the United States in 1941, 22 state agricultural colleges maintained courses leading to a degree in agricultural engineering, while several others, though they did not grant degrees, offered courses that constituted a virtual recognition of the science. In the United States, too, more than 100 agricultural engineers in various states were engaged in 1944 in full time extension activities—carrying to the farmer the results of agricultural engineering research in farm power and machinery, rural electrification, farm structures, soil conservation, and mechanical processing. Outside the United States, in 1941, the only degree course being offered in agricultural engineering was in Canada. In 1942 the only agricultural engineering education department in southern Asia was established at the Allahabad Agricultural institute in the heart of India.

The importance of agricultural engineering is further emphasized by the appearance in 1930, and each year thereafter, up to

and including 1939, of the *International Directory of Agricultural Engineering Institutions* published by the International Institute of Agriculture at Rome, Italy. This lists the institutions of some 45 countries throughout the world which have studies under way dealing with agricultural engineering problems. For each institution information is given, regarding the exact address, scientific staff, research work in progress, equipment, publications which have been issued since 1932 and the languages which may be used in correspondence. (See also articles on AGRICULTURAL POWER AND MACHINERY; FARM BUILDINGS; RURAL ELECTRIFICATION; TILLAGE MACHINERY; HARVESTING MACHINERY; etc.)

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AGRICULTURAL GANGS, groups of women, girls and boys organized by an independent gangmaster, under whose supervision they execute agricultural piecework for farmers in certain parts of England. The evils of this system were so great as to lead to the passing of the Agricultural Gangs act (1867), forbidding the employment of any child under eight years of age, and of any female under a male gangmaster unless a female licensed to act as gangmistress were also present. Gangmasters must be licensed by two justices, and may not hold a liquor licence. Later legislation made more stringent the regulations under which children are employed in agricultural gangs. By the Elementary Education act (1876), repealing and re-enacting the principal provisions of the Agricultural (Children) act of 1873, employment of all children under 11 was forbidden and restricted under 13. By the Education act of 1921, it is forbidden under 12 and restricted under 14. In 1940, in order to meet the exigencies of war, the provisions of this act were temporarily relaxed; local education authorities were, however, required to supervise the employment of school children, and to satisfy themselves in regard to hours of work, meals and other conditions.

AGRICULTURAL INSURANCE. Farmers have need for several kinds of insurance on property and on persons. Insurance contracts are made with farmers by (1) capital stock companies, (2) mutual companies or associations, (3) reciprocals or interinsurance exchanges, and (4) state or government funds or departments. Insurance on farm animals and growing crops is of types found only in agriculture. Risks involved have a different degree or character when in an agricultural setting; for example, farm buildings are usually isolated from the buildings of neighbours and are often remote from community fire-fighting facilities.

Insurance of farm buildings, crops in process of growth, livestock, motor-driven vehicles, and various items of personal property will be treated first in this article. Then will follow reference to employer's liability insurance, and health, life and various social security provisions.

Fire and Lightning Insurance.—Insurance equal to 75% of values of buildings and associated property items has been carried by many farmers against fire and lightning hazards. The amount of fire and lightning insurance in force on farms served by 1,885 mutual companies in the United States in 1941 exceeded \$11,000,000,000. Farmers' mutual fire companies are numerous in the middle Atlantic and north central states, and in some cases are smaller in membership and in volume of insurance than is desirable. In southern states where the cost of commercial insurance is high and large percentages of farmers are uninsured,

there are few farmer-owned and farmer-controlled companies. Under some so-called perpetual policies, the amount of property insured may remain constant over long periods. Five-year terms are regarded as more desirable.

During the period 1914-35, the annual average cost of protection through mutual fire companies varied from about 23 to 32 cents per \$100. About two-thirds of this cost was for losses and one-third for expenses. In some north central states annual costs were less than 20 cents per \$100. Classification or rating of risks has been most common among the farm mutuals of the Pacific Coast states.

Rural fire and lightning insurance has long been established on a mutual basis in countries of continental Europe but to a less extent than in the United States. Commercial fire and lightning insurance has been a main dependence in Great Britain.

Windstorm Insurance.—Tornadoes and windstorms produced losses in the United States estimated at \$35,000,000 annually from 1916 to 1935. In 1934 more than \$3,700,000 of windstorm losses were covered by farmers' mutual windstorm companies. In the period 1900-35, operating expense varied from 3.5 to 8.9 cents per \$100 insurance, an average of about 5 cents, while losses varied from 1.6 to 17.0 cents, an average of nearly 8 cents. Insurable risks include farm dwellings, most other structures, household goods, farm implements, livestock and farm products. A few companies provide that when a building falls or is materially damaged as a result of a windstorm, and fire ensues, the insurance is extended to cover the fire loss. Three-fourths of the companies in 1944 wrote policies for a five-year term, a small number for 8 and 10 years, and one-fifth wrote perpetual policies. A common practice is to write insurance at from 66⅓% to 80% of the total value of property. Since windstorm losses have been high on buildings poorly built for wind resistance, some companies classify risks and provide periodic inspection. Reserve funds of nearly 20 cents per \$100 of insurance were reported in 1935, this being about half the desirable amount of reserve. About one-third of the farm windstorm companies carry reinsurance.

Crops All-Risk Insurance.—The first attempt at all-risk crop insurance was in Minnesota in 1899. Between 1917 and 1921 certain fire insurance companies introduced contracts for comprehensive crop-risk insurance. The first U.S. federal attempt toward crop insurance was under Title 5 of the Agricultural Adjustment act of Feb. 16, 1938. The Federal Crop Insurance corporation thus established provided all-risk yield insurance for wheat beginning in 1939 and for cotton beginning in 1942. During the 1943 crop season, about 13% of the wheat acreage and about 11% of the cotton acreage was insured, and the percentages of participating growers were about 30 and 10, respectively. The Agricultural Appropriation bill for 1943-44 provided that no additional insurance be written, but the power was restored in 1945.

The corporation failed in five successive years to collect premiums equal to indemnities paid. For the crop harvested in 1942, there was an excess of \$22,000,000 of indemnities paid over premiums received. For three varieties of wheat insured, the premiums exceeded the indemnities, namely, white, hard red winter and hard red spring, but for soft red winter wheat indemnities were more than three times the premiums.

Under the crop insurance programs farmers were standing the first 25% (or 50%) loss in yield below the basic yield. In 1942 and 1943 an applicant could give a "commodity note" for the premium, which was expressed in bushels. Under this procedure the price was established at the maturity of the note, which was about harvest time.

The soviet union, under the law of July 19, 1934, developed two types of compulsory crop insurance. In addition to a specific risk insurance extended to many crops, there was provided an essentially all-risk insurance for a limited number of crops, mainly industrial crops, including cotton, tobacco and soybeans. This insurance did not cover low yield resulting from poor germination of seed and exhaustion of soil. With a few exceptions, quantitative losses only and not impairment of quality, are insurable in the U.S.S.R. The hazard of drought damage has been

among the most difficult to cover.

Crops Hail, Frost and Flood Insurance.—Hail insurance was begun in the United States in the 1880s among Connecticut valley tobacco growers and among farmers of North Dakota. A state hail insurance department was instituted in the latter state in 1911 and the example was followed by South Dakota, Montana, Nebraska and Oklahoma. In 1919 hail risks estimated at \$560,000,000 were carried by four state insurance departments, 41 mutual companies and 43 joint stock insurance companies.

High risk territory for hail damage is found also in the prairie provinces of Canada. In Saskatchewan the Municipal Hail Insurance association, organized under an act of 1912, carried \$25,000,000 of risks in 1921 and 1922. The Hail Insurance district of Alberta was formed under the Municipal Hail Insurance act of 1918, and in 1919-22, \$72,000,000 of risks were borne by its Hail Insurance board. These were reduced in later years.

In Europe, likewise, hail insurance has had extended use. Scottish Friendly societies are credited with having first provided hail insurance in the 1770s. In 1791 the Hail Damage society of Braunschweig, Germany, became the first continental venture. In the early 1800s came French hail coverage by a society of mutual insurance. After the 1860s provisions for hail insurance were made in Russia, and later in Austria, Czechoslovakia, Denmark, Italy, Rumania, Sweden and Switzerland.

Frost insurance has been written for the protection of growers of sugar cane in Louisiana and citrus fruits in Florida and California. Insurance against fire damage to growing crops has considerable application both in North America and in Europe. The first known attempt to provide insurance against flood was in Austria in 1846. In general, flood insurance has not been successful. A limited indemnification for losses to crops and other property sustained from flood, earthquakes, windstorms, drought, etc., has been provided at public expense in Italy. The more comprehensive provisions of soviet Russia require contributions from the insured, with only specially favoured crops insured free of charge. Private associations in China have provided insurance against flood, drought and locusts.

Livestock Insurance.—There was a rapid growth of livestock insurance in the United States in 1919 and 1920 when meat prices were high. Thereafter such insurance fell to almost negligible amounts. Insurance of livestock in premises insured against fire and lightning is often included. Under the Farm Security administration after 1935, associations of clients were set up to insure life and property, and a veterinary group plan was adopted.

Mutual livestock insurance originated in Europe about the 13th century, primarily in Germany. France provides a leading modern example of European livestock insurance. Among 14,896 subsidized co-operative insurance and re-insurance societies in France in 1921, more than 10,000 were societies for livestock insurance. European experience has shown it to be more practical to insure large animals, such as cattle, than smaller animals such as hogs and poultry. Insurance of carcasses against condemnation by sanitary authorities has been adopted in some European countries. In Lithuania, under a law of 1938, a fund was set aside from government taxes whereby 70% of the value of livestock killed by lightning or by the collapse of buildings was payable to the farmers.

Insurance of livestock of exceptional value per head, as for racing, breeding, etc., has been widely applied in North America and Europe alike. Insurance of livestock while in transit to market is normally provided by the carrier.

Farm Motor-Vehicle Insurance.—Fire, theft, collision, public liability and property damage are important phases of insurance of automobiles and other motor vehicles used on farms. In 1936 a federal survey indicated that in the United States three-fourths of the farm families had automobiles and one-third of these carried automobile insurance. In New England, middle Atlantic, north central and Pacific regions, more than half were insured. There was little difference between farmers of high and of low income in the proportion of automobiles insured. The average automobile insurance premium paid by farm families was \$22. There has been a lower accident risk for farm automobiles.

Farmers were maintaining less ample public liability and collision coverage. Trends after World War I were toward a higher proportion of farmers owning automobiles, trucks, tractors and other automotive items and toward a higher proportion insured. Insurance activities of farmers' organizations expanded the coverage in these fields. Under some state laws truck insurance was made practically compulsory.

Farm automobile insurance has been largely confined to commercial companies in countries outside of the United States.

Employers' Liability Insurance.—Farm operators with hired labourers are liable for employee accidents during time at work and when in transit to and from work, if the accidents are due to negligence of the employer. Employers' liability insurance is provided by farm mutuals and stock companies in the United States. In 1943 the annual minimum premiums charged farmers for workmen's compensation insurance and for employers' liability insurance were reduced in almost all parts of the country. Wartime use of emergency labour called for quarterly and even monthly insurance. An employers' liability contract with a reimbursement limit of \$250 (or \$500), for medical expense was developed for short-term employees.

Personal Insurance.—Members of farm families and others working on farms have need for personal insurance against loss of income or against increased outlays incident to (1) death (life insurance, burial insurance), (2) survival (old-age insurance, juvenile insurance), (3) impairment of health (accident and sickness insurance), and (4) inability to sell labour time (unemployment insurance). In areas of the United States surveyed in 1936, life insurance was held by only 43% of farm families. Many small policies had lapsed in the depression years preceding the survey. The average premium then shown was \$72 a year. Among four life insurance companies showing lowest expense per \$100 insurance in the United States in 1943 one was farmer-owned and farmer-controlled. In the period, 1936-41, there was a trend toward more personal insurance. A 1941 survey indicated that 50% of the farm families were carrying life, endowment or annuity insurance, and 11% health and accident insurance.

Protection against unemployment and against destitution in old age has been provided under national social security schemes in the United States since 1935, and in other countries for a longer period, but generally with little application to agriculture.

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AGRICULTURAL LABOURER. An agricultural labourer is a person, male or female, employed for wages by an occupier of agricultural land. In the United States and some other countries the term "hired man" is generally used. In Scotland the term "farm-servant" is the equivalent to that of "agricultural labourer" in England where the alternative term "farm-worker" is also in common usage. Conditions of employment vary widely. The contract of service may be by the day, week, the month, the half-year or the year. Remuneration may be wholly in cash or partly in cash and partly in kind. Census definitions of agricultural labourers vary considerably from one country to another, and comparisons of the relative importance of the wage-earning force in the various countries are difficult. In a few it is less than 20% of the persons occupied in agriculture, but in the majority of developed countries, it is between 20% and 40%. In Great

Britain and the Netherlands it was as high as 60% before World War II. In Great Britain the status of the farm worker after World War II was almost identical with that of the wage earner in other industries, semifeudal relics having been discountenanced by trade union influence and by statutory wage regulation. (See AGRICULTURAL WAGES.)

In addition to agricultural labourers permanently employed there are large numbers of men and women who are employed as casual workers. They are employed for short periods, usually at piece rates, in seasonal operations, such as corn harvesting, fruit picking, hop picking, etc. One class of casual workers may be employed most of the year at various jobs in agriculture. Another class are townsfolk unskilled in farm work who go into the fields only at certain seasons, particularly during the harvesting of fruit, potatoes, etc. Machinery in some instances greatly reduced the demand for casual labour.

Enumeration.—Returns collected annually by the ministry of agriculture and the department of agriculture for Scotland from all occupiers of agricultural holdings in Great Britain show that in June 1939 there were 711,232 agricultural workers of whom 600,700 were "regular workers" (54,679 women and girls) and 110,462 "casual workers" (38,535 women and girls). World War II made heavy demands on farm workers as in other industries. In 1945, the farm labour force of Great Britain totalled 785,804 persons, of whom 611,092 were "regular workers" and 174,712 were "casual workers." But the "regular" male workers were 24,742 fewer than in 1939. To handle the increased output of the war years "regular" women workers were greater than in 1939 by 35,064 and "casual" workers were 64,250 more (32,291 women and 31,959 men). These figures for 1945 do not include the members of the women's land army, which numbered about 46,000, and prisoners of war, approximately 67,800 of whom were working on the land.

The "gang" system of seasonal labour which was notorious in the early part of the 19th century declined after the Gangs act was passed in 1867 to repress its abuses. During World War II groups of labour were employed and organized by the agricultural authorities of the counties to provide a mobile reserve for farmers who found themselves unable to overtake seasonal operations or for special jobs like draining and hedging.

There is a great variety of jobs to be done on farms, but specialization of labour has not been carried very far. The "skilled" farm worker is a man capable of undertaking not one but a variety of skilled jobs. Versatility and resourcefulness are distinguishing qualities in high-grade men. There are, however, certain main classes, most of them determined by the handling of particular kinds of livestock. The decennial census enumerates horsemen, shepherds, cattlemen, tractor drivers, general labourers, but on some farms there are other titles such as pigman, poultryman, thatcher and so on, which may in most cases indicate more of a special emphasis of their work rather than an exclusive occupation.

The housing of farm workers had become by late 1946 an increasingly difficult and controversial subject. Single men were housed variously in different parts of the country. With the great mobility of modern transport the old system of "living in" with the farmer was probably being displaced gradually by the men finding lodgings in the neighbourhood. There was said to be no substantial decrease in the "bothy" and "chaumer" system (common in Scotland and north of England), but where formerly the feeding of the single men was done by the farmers' kitchens, it is now increasingly done on a contract by wives of the married workers. A married worker may be provided with a cottage by his employer and the occupation of the cottage is conditional on the job. This is known as the "tied cottage." Otherwise, the worker may occupy a house in the neighbourhood which is not "tied" to any particular farm or employer. In the case of the "tied cottage" the farmer deducts the rent from the man's wage but under the statutory wage regulations the maximum deduction is fixed. Opposition to the tied house is that if a man changes his job for any reason at all his home is also upset; it puts him more at the mercy of his employer than in the

case of a man whose house is independent of his job. On the other side it is claimed that farmers need to have certain men housed close to their work and to be able to get possession of cottages for men whom they themselves employ. The situation was obviously made more acute by the general scarcity of houses in rural areas. An official report in 1937 estimated that roughly 500,000 houses in England and Wales were occupied by agricultural workers, of which 200,000 were tied cottages. In Scotland the housing of married workers in tied houses was estimated at practically 100%.

Social Insurance.—Agricultural workers came under the National Health Insurance Scheme from the outset in 1910 and its subsequent developments under the acts 1911-41; the Old-Age (Non-Contributory) Pensions from 1908; the Widows' and Orphans' and Age 65-70 (Contributory) Pensions under the acts 1924-43, and the Workman's Compensation acts 1925-43. They were, however, excluded entirely from the Unemployment Insurance act of 1920 which extended state unemployment insurance to industry in general. Following a report in 1935 by the Unemployment Insurance Statutory committee, a special scheme for agriculture was brought into operation in 1936.

Organization.—The combination of workers for the advancement of their economic interests and particularly for collective bargaining with employers was later and less effective among agricultural workers than in other trades. In England, apart from a few spasmodic local efforts, the first organized attempt to establish an agricultural trade union was made in 1872 under the leadership of Joseph Arch. A National Agricultural Labourers' union was formed which in a short time enrolled about 70,000 members. Success was not maintained and trade union activity was negligible until the following century. In 1911 the National Agricultural Labourers' and Rural Workers' union was started and by the end of 1913 had a membership of nearly 12,000. The Scottish Farm Servants' union was established about the same time. The Workers' union also included an agricultural section. A substantial growth took place during and after World War I in both England and Wales and in Scotland. The establishment of the Agricultural Wages board and its county committees in 1917 was said to give the main impetus though statutory wage regulation in agriculture was not established in Scotland until World War II. Because of the difficulties of defining a farm worker and to the number of scattered workers to whom unions can offer practically no union contact, the proportionate strength of trade union membership among agricultural workers is difficult to calculate. In 1919, it was claimed that about half the agricultural workers were enrolled in trade unions, while in 1926 the membership was said to be not more than 6%, but the former figure, if based on figures of all officially returned farm workers, was grossly exaggerated. During 1946, agricultural workers were enrolled in the National Union of Agricultural Workers, the Transport and General Workers union agricultural section (with which the former Workers' union was amalgamated) and the Scottish Farm Servants' union, which in late years had been affiliated with the Transport and General Workers' union. The estimated membership of these totalled in 1946 approximately 170,000.

(J. P. MN.; H. C. M. C.)

United States.—The typical farm in the United States is a family farm, with the farm operator and his family providing all or a large part of the labour. In the harvest months of heaviest farm employment there is, for the country as a whole, only one hired worker employed for each two farms. The census enumerated 6,000,000 farms in 1945; for the three years, 1944-46, the total number of hired workers employed in agriculture varied from about 1,500,000 in January to about 3,000,000 in the peak months of July to October. The January number approximates the number of year-round hired workers.

With farms increasing in size, largely as a result of mechanization, there had been a decline in the numbers of both hired workers and family workers, the latter including farm operators and members of their families working without wages. For the country as a whole the decline was relatively greater for hired workers than for family workers. Numbers of workers employed

in agriculture were reported as follows by the department of agriculture:

	1910-14	1935-39	1946
	1000's	1000's	1000's
Family workers	9,160	8,352	7,864
Hired workers	2,892	2,568	2,148
Total	12,052	10,920	10,012

Numbers of hired workers declined more in the corn belt than in any other area of the United States. In Iowa, Illinois, Indiana and Ohio the number in 1946 was only 47% of the 1910-14 average. In contrast, the number of hired workers in the northwestern states of Washington, Oregon and Idaho was 31% higher in 1946 than in 1910-14; in this area the number of family workers also increased, by 29% from 1910-14 to 1946.

During World War II and the immediate postwar period farmers requiring hired workers had great difficulty filling their needs, and at greatly increased wage rates. The composite wage rate per month, as calculated by the department of agriculture, was \$96.40 on Oct. 1, 1946, compared with an October average of \$30.20 in 1935-39, and \$24.76 in 1910-14.

To assist in the recruitment and placement of workers a farm labour program was set up in the agricultural extension service at the beginning of 1943. This program provided a valuable service to farmers in securing both year-round workers and the large numbers of workers needed for short periods during harvest. In the first ten months of 1945 a total of 5,724,445 placements were made in this program, the number declining to 3,752,176 in the first ten months of 1946. To supplement the workers available in the United States foreign workers were also recruited, principally in Mexico and in the West Indies. The extension farm labour program also placed World War II veterans as hired hands on farms, making 32,000 such placements in 1945 and 100,000 in the first ten months of 1946.

Farm labourers in the United States were in 1946 prevailingly unorganized. During the administration of Franklin D. Roosevelt there was some increase in their organization, particularly among migratory workers. The principal aims of organized farm workers were higher wages, better living conditions and amendment of the Social Security law to include agricultural labour.

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(H. C. M. C.; J. E. WS.)

AGRICULTURAL ORGANIZATION. In most countries a growing realization of the weakness of the isolated farmer as a marketing unit and, again, of the dominance of industrial and commercial interests in modern legislation prompted the formation of farmers' organizations, in order to secure more adequate consideration of the position and needs of agriculture. The conditions of food scarcity brought about by World War I stimulated this movement. (See AGRICULTURE: A GENERAL SURVEY.)

Governments were obliged to deal collectively with the primary food producers, who on their side were forced into combinations to secure that the necessary regulations neither impeded production nor imposed an impossible burden on the farmers. Combinations for marketing are dealt with elsewhere (see AGRICULTURAL CO-OPERATION); the organizations here to be considered aim at uniting the farming community in order to influence legislation.

Further, since it has become clear that the status of the food producer can with difficulty be determined within the nation itself, considerable effort has been given to the formation of international associations which might be able to secure common action in the interests of agriculture. It is recognized that as regards the great staple articles of food, wheat and the other cereals, meat and dairy products, a common world price tends to be set, determined by the incidence of the exportable surpluses from the countries producing more than they consume, upon the chief open markets, e.g., the United Kingdom. For example, the United States produces a certain excess of wheat beyond its requirements, which has to be exported chiefly to Europe. The price the American farmer will receive will be forced down by competition to the price obtainable in Europe less freight and

commission. This is, to take an analogy, the pressure generated by internal competition to sell, at which the safety valve blows off. The coincidence of other surpluses upon the European market or weakness in purchasing power there tends to lower the price; conversely the growth of a new demand, as from China and Japan, will enhance the price.

The tendency of commerce is generally to bring the run of prices of agricultural products, the output of which fluctuates from causes beyond control, continually down to the level caused by a surplus anywhere, a level which is on the average undesirably close to or even below the cost of production. Hence a general depression of the agricultural interest all over the world and an increasing tendency on the part of farmers to seek more remunerative occupation in industry or commerce. This is the justification for the attempts to create some international organization of farmers, however remote and impracticable common action may seem.

National Organization.—Examples of national organizations with legislative programs are the Union Suisse des Paysans, the National Farmers' union of England and Wales, the National Farmers' Union and Chamber of Agriculture of Scotland, and the Patrons of Husbandry (*see* GRANGE), the Farmers' Educational and Co-operative Union of America and the American Farm Bureau federation (*q.v.*) in the U.S. (*See* FARMERS' UNION.)

Perhaps the most notable agricultural organization in Europe from the point of view of influence is the Union Suisse des Paysans of which Ernst Laur was long the director. Organized in 1898, its membership includes nearly all the farmers of Switzerland.

The National Farmers' union was founded in 1908 and grew comparatively slowly until 1917, when it became necessary for agriculturists to have one organization to deal with the government in the campaign to increase food production. It is organized on a basis of county branches, each of which makes an allotted contribution to the central body. The union for Scotland was organized in 1938.

International Organization.—The International Institute of Agriculture (*q.v.*), as visualized by David Lubin, was created on the initiative of King Victor Emmanuel III of Italy in 1905. Its constitution was determined by treaty between the contributing states, and it was governed by a president and a permanent committee acting as the executive authority to carry out the instructions given by an assembly representative of the constituent states, sitting every two years in Rome, where the institute had its permanent home.

The representatives at the assembly and on the permanent committee were nominated by the respective governments; thus the institute was essentially a governmental organization, in which agricultural associations as such had no part. The work of the institute was of a technical character. It prepared an annual summary of the agricultural statistics of all countries and a digest of agricultural legislation; it also issued bulletins at regular intervals abstracting the papers appearing in the technical publications of the world on economic and scientific subjects connected with agriculture. The institute also convened from time to time international conferences on particular questions. In order to obtain an expression of international agricultural opinion that would be independent of governments the institute formed an association of representatives of agricultural associations of all countries, and the first meeting of this body was held in Nov. 1927. The associations invited to send representatives were, however, nominated by the governments of the respective countries.

Italy's entrance into World War II necessitated the withdrawal of the delegates representing the United Nations from the institute. With the founding of the Food and Agriculture organization of the United Nations in 1945 (*see* below), member nations of the U.N. who were also members of the International Institute of Agriculture agreed to dissolve the latter. All activities were assumed by the F.A.O., and the institute wound up its work on July 31, 1946.

The Commission Internationale d'Agriculture (later Confédération Internationale de l'Agriculture) a body founded in 1889, of which the chief task was the organization of the successive in-

ternational congresses of agriculture, was eventually reconstituted in 1928 to consist of representatives of agricultural associations, not exceeding six for each country, and of co-opted members of distinction in agriculture, which latter might take part in the discussions but not vote. While the commission met twice a year in Paris, the resolutions to be communicated to governments were reserved for discussion at a conference held every second year in connection with the international congresses of agriculture.

The Food and Agriculture organization of the United Nations was created by the U.N. at the Hot Springs, Va., convention of May 1943 and was established as a specialized agency of the U.N. on Oct. 16, 1945. The F.A.O., as mentioned above, took over the work of the International Institute of Agriculture, with headquarters in Rome.

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AGRICULTURAL POPULATION, U.S. As defined by the U.S. census bureau prior to the 1950 census, urban territory in the U.S. included all incorporated places of 2,500 or more. This definition was expanded for the 1950 census to include suburban areas around cities of 50,000 or more, and certain unincorporated places not previously included. Under this definition, 96,440,528 persons were classified as urban (60.4% of the total) and 54,256,833 as rural (39.6%). It was estimated that under the old definition of "urban," approximately 41% of the population would have been classified as rural in 1950. In 1940 about 43.5% and in 1930 about 43.8% had been counted rural.

AGRICULTURAL POWER AND MACHINERY. The ingenuity of man has provided the farm with power and machines to make possible the necessary crop production in spite of the demand for labour in carrying on the world's other various and complex work. When industrial developments or simple trades grew up in cities and attracted labour from the rural districts, inventors soon began to improve the means of preparing seedbeds, cultivating, harvesting and simple processing on the farm or at places near by. This development was slow at first when manufacturing was small-scale and crude. Those were the days when plows were changing from natural wood forms to shaped wood and then to metal-shod wood, to metal and finally, to polished steel; the days when reaping equipment was changing from the back-tiring sickle to the back-tiring scythe and cradle; the days when man was slowly learning to save himself or his wife by using animal power—cattle, camels, horses and mules. Man and his beasts of burden provide much of the farm power in wide areas of the world, but the period following 1830, for 100 years and more, saw a steady change toward laboursaving and efficiency in agriculture, particularly in the United States and the countries of western Europe. After 1900 the tempo of farm mechanization had been greatly accelerated not only in the countries mentioned, but in other countries, notably in the U.S.S.R. following World War I. This trend reached into Australia and New Zealand, parts of South America, and into South Africa. The tendency at first in the adoption of farm power was to use tractors for the heavy work of plowing and the crucial work of harvesting where time is of unusual importance.

In many wide parts of the world the use of power and other modern methods of farming has not gone far. This is true in much of Africa, nearly the whole of Asia, except in Siberia where Russia has developed the use of power on its collective farms, and in South and Central America except for considerable modernization of corn and small grain growing in Argentina and spotty developments in modern farming of cotton and sugar lands where large owners have introduced power and machines.

The speed with which power and machinery have changed the age-old methods of getting food and clothing from the soil and saved man from the bugbear of excessive man-hours is attested by carefully prepared statistics. Other factors than laboursaving

are, of course, recognized as resulting from the use of power and machinery—better quality of product as the result of having the work, particularly the harvest work, done at the right time; better yields resulting from precise planting and proper placing of fertilizers and more thorough harvesting; and less waste through weathering and rotting.

The tables prepared by the U.S. department of agriculture are presented as showing the hours of man labour required in growing an acre of wheat (20 bu. to the acre) at various times—by so-called hand methods in the period about 1830, by machines in 1896 and again in 1940. Not all the operations in 1830 were done by hand, of course. Horses (or probably oxen) did the plowing and harrowing and hauled the bundles of grain to the threshing floor.

Table I.—*Approximate Labour Requirements for Major Operations in the Production of One Acre of Wheat (20 bu.)*
Hand Methods, About 1830

Operation	Equipment used	Operators Number	Power		Man-labour Hours
			Horses Number	Tractors Number	
Plowing	Walking plow	1	2	..	6.7
Sowing	Sack	1	..	..	1.2
Harrowing and covering seed	Brush	1	2	..	2.5
Reaping, binding and shocking	Sickles	2	..	..	20.0
Hauling bundles to barn	Wagon	2	2	..	4.0
Threshing and stacking straw	Flail and forks	1	..	..	13.3
Winnowing	Shovel, sheet, and measure	3	..	..	10.0
Total					57.7

By 1896, according to the same source, an acre of wheat in the winter-wheat belt, where the growing of the crop was not so highly specialized as in the more strictly wheat area of the Great Plains, required only 8.8 man-hours. Table II shows the details and records an event of great significance to modern agriculture—the arrival of the farm tractors, which at this time did only threshing work.

Table II.—*Approximate Labour Requirements for Major Operations in the Production of One Acre of Wheat (20 bu.)*
Machine Methods in Central Winter-Wheat Belt, U.S.A., 1896

Operation	Equipment used	Operators Number	Power		Man-labour Hours
			Horses Number	Tractors Number	
Plowing	Two-bottom gang plow	1	4	..	2.0
Sowing	Broadcast seeder	2	2	..	.2
Harrowing and covering seed	Section harrow	1	4	..	.3
Harvesting	Binder	1	3	..	.7
Shocking		2	..	..	1.3
Hauling bundles to thrasher	Wagons	12	16	..	2.0
Threshing and stacking straw	Thrasher and forks	7	..	1	1.0
Hauling water and fuel	Wagon and barrels	1	2	..	.2
Hauling wheat to granary	Wagons	1	4	..	.9
Unloading at granary	Shovels	1	..	..	.2
Total					8.8

Table III.—*Machine Methods in Great Plains, U.S.A., 1940 (20 bu. per acre)*
(Figures for one acre)

Operation	Equipment used	Man-labour hours
Plowing	2-bottom gang (14")	1.5
Disking	7-in. tandem disk	0.4
Harrowing	12-ft. harrow	.2
Drilling	10-ft. drill	.4
Harvesting and threshing	5-ft. combine	.8
Hauling to granary by truck		.8
Total		4.1

At the time represented in Table III showing the rise of mechanization in wheat production in the United States, the farm tractor had long been an important factor not only in grain farming

in that country but in many other parts of the world—Great Britain, western Europe, Russia, South Africa, Australia, Argentina. It had become a factor in corn (maize) production and in growing even those crops that do not require such extensive acreages.

From the time agricultural engineers really began developing power machinery for field work, about 1900, the tractor and the machines drawn or pushed with it have been modified extensively—the tractor to be made more suitable for the machine and the soil, and the machines to adapt them to the tractor and the soil and to specific crops. Tractors have become progressively lighter, better suited to many field machines and to smaller farms and smaller fields—in other words, a handy source of power. In the modern agricultural communities of many countries the generation of farm boys running the farms in the 1940s knew about tractors and the tractor way of doing work from the beginning of their farming. But the tractor is not the entire change—it is the symbol of a long chain of modernization, including a procession of plows, planters, fertilizer distributors, cultivators, harvesters, loaders, storing machines (elevators), and equipment for preliminary processing, such as the cleaning and ginning of cotton and the preparation of flax fibre and other materials that are partly processed before leaving the ownership of the farmer.

Along with the rapid adoption of power for field work (draw-bar power), belt work and for hauling on the highways, there was a rapid increase from 1910 on in the use of electric power on farms as well as of electric current for lighting. This growth in rural electrification was most conspicuous in Germany, the Scandinavian countries and the British Isles. However, after 1930 there was a great increase in the number of farms in the United States using electric power, in part the result of government development work. Along with the rise in the number of farms electrified came new applications of electricity such as for chicken and pig brooders and as power for hay drying. In many places there has been a great increase in the use of milking machines and other dairy equipment.

The United States.—In the United States, where the number of farm tractors manufactured annually increased from 4,500 in 1910 to 358,550 in 1941, the use of horses and mules decreased accordingly, the total number falling from 24,000,000 to about 12,000,000. There were about 2,000,000 tractors in the United States in 1944. A conspicuous change was in the adaptation of all kinds of field equipment for various crops to the use of mechanical power. Furthermore, there was a noticeable spread in the use of power to include more operations and crops that require special equipment. Examples of the latter are machines for planting so-called sheared sugar-beet seed (cut down so as to get rid of multiple-germ seed balls and reduce the plant thinning job) and corn picker-huskers (adapted to fields of 50 acres or more). The use of power and machinery on farms in the United States was at one time thought to mark the beginning of the end of the family-sized farm, but the size of a family-sized farm is larger than it once was (size depending on the kind of farming), and engineers and manufacturers have built machines for use on smaller and smaller farms. The small so-called handy tractors are a good example of this trend. Many improved machines are of as much benefit to family-sized and small farms as to large farms. This may be said of many planting machines and fertilizer distributors. It can also be said of much labour-saving equipment for use about the farmstead—for example, milking machines, coolers, and shop equipment such as grinders, saws and drills.

The rise in the use of power and machinery on U.S. farms is in no way better emphasized than by the fact that in practically every one of the 48 states there is a state-paid agricultural engineer as a part of the educational organization known as the extension service, whose duty is to acquaint the county agricultural agents, and through them the farmers, with the most useful new mechanical equipment and practices.

For the United States the advances in this field might well be summarized as: (1) a rapid increase in the use of power, largely internal-combustion engines and electric motors; (2) application of power to more farm operations; (3) a greater variety

of better machines; (4) machines for small farms as well as large; (5) great expansion in rural electrification; (6) improved machinery and methods for harvesting hay to cut cost of labour and improve quality; (7) great increase in self-propelled farm machines such as combine harvester threshers, and tractor pulled and operated picker-huskers and balers; (8) better planting and fertilizer distributing equipment and practices; (9) electrical equipment for farm refrigeration and quick freezing; (10) new practices in weed control, including use of machines and even burning contrivances (experimental); (11) ways of reducing draught of farm machines; (12) safety devices; (13) more durable material in machinery.

Great Britain.—In Great Britain, where the system of cable plowing by means of stationary steam engines which pull plows back and forth with cables wound on drums had been extensively used, the gasoline tractor increased greatly in numbers, particularly following the outbreak of World War II. The scarcity of labour for farms made greater use of power a necessity and many more tractors were built and great numbers imported from the United States. As in the United States, the tendency in the 1930s and 1940s was toward the moderate-sized or handy tractor, the one-plow or two-plow kind being much in favour. From 1939 to 1944 the number of tractors in Great Britain increased from 55,000 to 160,000.

The British, as was to be expected, applied power and new machines to the problem of getting the best returns from grass. Because of frequent rains, putting up good quality hay is difficult and the storing of grass in silos became popular with the more progressive farmers. Machines which cut the grass into short lengths and elevate it into wagons or trucks are a satisfactory means of harvesting this large-acreage crop.

British farmers, especially after the outbreak of World War II, made increased use of the grain combine—the harvester-thresher—and the use of this machine, as grain was often damp because of lack of curing, led to an increase in the use of grain driers.

Some grain harvesting in the British Isles is done by a system in which the grain is cut with a reaper and not bound in bundles, the unbound grain being elevated to a wagon and hauled to the thresher. British threshing machines not only separate the grain from the straw, but chaff, short straw, long straw and dirt are all delivered in separate piles which makes it possible to utilize the various materials to the farmer's liking. The method fits in well where the coarse materials are needed both as feed and as bedding for livestock.

Because of the high humidity, pastures in some parts of the British Isles often become choked with a growth of moss, and this has led to the use of the moss harrow in spring and early summer.

The Institute for Research in Agricultural Engineering at Oxford university, England, conducts investigations on all sorts of farm engineering problems and has a tractor-testing plant similar to the one at Lincoln, Neb., in the United States. The institute's tests have had a considerable effect on increasing the use of pneumatic tires on farm machines. Other work has had an effect in reducing the draught of plows and other implements.

By and large, the increased use of power and machinery in Great Britain in the second quarter of the 20th century has not changed the farming systems, but has made for more economical application of them and for more convenience of the farmer. Output went up gradually as the number of workers on the land went down.

Russia.—Russia (the U.S.S.R.) was able to take over tractors and the other machines of mechanized agriculture rapidly because it overcame the disadvantages of small farms through the establishment of collective farms and systematic planning of measures and machines to be adopted over a definite period—for example, planning for a five-year period. In many important crop-producing regions of that country the topography, soils, presence of cheap fuel and the nature of the main crop were such as to invite the rapid development of tractor farming. Men were trained to the new farm form in one generation. By 1940 a large part of the farming of the U.S.S.R. was done on collective farms or

soukhos and machinery is the heart of these farms. These collectives consist of small peasant farms amalgamated for more efficient and economical operation. The medium-sized and small collectives get their machines as they need them from the state tractor stations. Large state farms have their own machines.

A decade before the outbreak of World War II large tractor and harvester-thresher plants in Russia had attained a considerable output. Among these was a large tractor plant at Stalingrad and the combine-harvester plant at Saratov in the lower Volga region. Although farm implements were made in Russia before 1914, no tractors or combines had been made there. These machines imported at first and then made at home were the outstanding development in the mechanization of Russian agriculture. They have to do mostly, of course, with the production of wheat and other small grains, but tractors, especially, are the foundation of economical seedbed preparation and harvesting of various other crops to a greater or lesser extent, depending upon the accessory machines available for the particular crop. Modern machinery has been adapted extensively for cotton production, including trials of mechanical pickers and the establishment of gins with pneumatic equipment and hydraulic presses. The growing of sugar beets has also been modernized through the use of special machinery as well as tractors and modern plows. There was a strong tendency after 1926 to try out all new developments in farm machinery and to develop new ones through experiment.

Germany.—Germany's variety of agricultural machinery at the beginning of World War II is shown by the machines listed as of considerable number in that country's census of May 1939. The list includes more than 1,800,000 electric motors, two-thirds of them 1 to 6 h.p., 11,755 steam engines, more than 200,000 gasoline and oil engines, nearly 70,000 tractors. There were large numbers of motor mowers, choppers, seeders, fertilizer distributors, cultivators, winnowers, harvesting machines, potato pickers, threshers, forage cutters and wagons with rubber tires.

The Germans found a strong appeal in tractors (mostly small ones) powered commonly by diesel or semi-diesel engines, not particularly because of the saving in labour, but because of the need to conserve as much of the crop land as possible for growing the kinds of crops needed for human food. Every horse replaced by mechanical power meant 3 to 5 acres of land available for growing crops. Tractors and trucks were much used for transportation from the farm to market.

As in some other European countries and in Great Britain, farm machinery in Germany was designed to bring the farmer that little additional yield that is so much appreciated where land is none too plentiful. The row cultivation of wheat in Germany is an example, also the extreme care given to accuracy in drills for planting grain.

In Germany before World War II almost 100% of its farms were reported to have electric power. One reason for this wide distribution is the fact that these farmers live in villages and can hook up to electric lines easily and at low expense. On the other hand, they are not said to be heavy users of current.

In Germany considerable study was given to conserving and spreading barnyard manure, the solid and liquid parts often being handled separately, a tank for the latter.

France.—France has long been a country of farms made up of small scattered patches so that power machinery has not made the headway it has in Great Britain, Germany and Russia. The French, however, have been noted for good draught horses and have loved and tended their soil, saving manure carefully and hauling it in carts and tanks for distribution on the land. Small tractors made some headway, but it is not to be compared with the progress in the countries mentioned above. However, much attention was given to spraying and dusting machinery, largely for protection of fruit and vegetable crops, and, to some extent, to machines for placement of commercial fertilizer.

As might be expected, the limitations on the application of heavy machinery and the use of tractor power tended to keep down any large development of farm machinery manufacturing in France. Agricultural engineers studying French farming in the period just before World War II reported the farmers much in-

terested in many new machines developed in the United States, particularly in the lighter equipment, but very little new machinery was bought. In that period France showed a growing use of electric power by farmers, but not to the extent noted in many other European countries and in England.

Before World War II France's ministry of agriculture maintained the Central Agricultural Machinery Testing station at Paris, principally for the study of physical-mechanical characteristics of the soil and to demonstrate the quality of tractors and other machines.

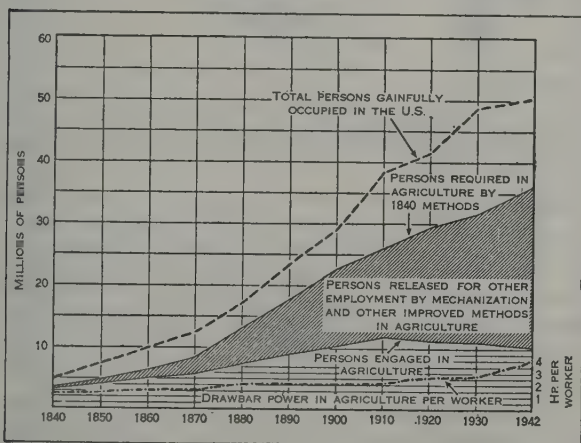
South Africa, Australia, New Zealand and Argentina.—

In South Africa, Australia, New Zealand and Argentina there have been trends toward wider use of farm machinery. Wherever petroleum fuels are expensive and upkeep of horses relatively low, as in Argentina, there is a strong tendency for farmers to keep to animal power. In all these countries what mechanical power there was on farms was used mostly for seedbed preparation and grain harvesting. In New Zealand the importance of the dairy industry stimulated the use of dairy machinery and equipment.

Africa.—In Africa (except South Africa), from the valley of the Nile through practically the entire continent, the raising of crops is a series of primitive operations with very simple tools and poorly developed work animals. For the most of Asia, the same can be said for all the crops—cotton, rice, etc. In some areas in the far east where U.S. or European influences have been at work there has been some tendency toward mechanization and organization for more efficient production, as in the production of sugar cane, abaca (Manila hemp) and rubber. But, by and large, hand labour is the dominant factor since it is cheap and has long been accustomed to the crops.

Machine Influence on Quality of Work and on Product.

—With machines and power available farmers soon found that not only could they do more work, and usually do it more economically, but that they could do a better quality of work. For example, plowing could be done deeper and even in the more difficult soils with a smooth steel mouldboard of proper design



COURTESY OF WAR PRODUCTION BOARD

FIG. 1.—EFFECT OF MECHANIZATION AND OTHER IMPROVED METHODS ON THE NUMBER OF PERSONS REQUIRED IN AGRICULTURE, 1840-1942

and a good margin of power. The importance of this power advantage is shown when it is necessary to plow under a heavy growth of rye or some legume crop for soil improvement. Farmers with relatively lightweight work animals find it difficult or even impossible to do such work in a way to leave the growth sufficiently covered with soil. On the other hand, with adequate mechanical or animal power, it is possible to do much better work and, what is more, the job may be finished in a favourable time. When it is possible to harrow the soil immediately after it has been turned by the plow by means of a harrow drawn behind, the use of that extra power produces a better seedbed more quickly and more easily. By using accurate planters and culti-

vators designed to fit the standard spaces properly, this work can be done with the minimum damage to the growing crop and the maximum of weed control, considering the time that can be spent on it. Modern harvesting machines have been adapted to all sorts of crops, and can be adjusted so as to do the minimum of damage to grain, potatoes and other products. Even the relatively simple factor of the cleaning of grain such as wheat—keeping out pieces of stalks, leaves, weed seeds and broken pieces of grain—is important in insuring a lower moisture content and in reducing insect infestation.

Planting machines insure more accurate placing as to depth in the soil, and as to space between rows and between seeds, all of these factors important in the development of plants and in proper cultivation and harvesting. In the period after 1930 great attention was given to the accurate placement of fertilizers for row crops, particularly in the United States. This was found a means of doing much better fertilization work, producing better yields, often at a saving in plant food, commonly producing a better quality crop. Modern spraying and dusting equipment not only saves fruits and vegetables and sometimes other crops from the ravages of insects and fungi, but similar methods and equipment are used for other purposes which also improve yield and quality. In the 1940s there was developed in the United States a method of spraying maturing apples and pears on the trees with certain highly diluted hormones which prevent preharvest dropping of the fruit. This reduces the percentage of damaged fruit and effects an economy in picking, as in treated orchards it is unnecessary to shift workers from one part of an orchard to another to pick from trees that have begun to lose fruit. In this same period devices for applying chemicals in vapour form in the soil to kill destructive nematodes were developed.

It may be well to mention also the development of a so-called aerosol "bomb" for use in combating insects by diffusing various insecticides widely and easily through use of a highly volatile chemical confined in a steel cartridge. These "bombs," equipped with handy valve releases, were widely used by the fighting forces on various fronts in World War II as a means of destroying flies, mosquitoes and other insects dangerous to health. The method is widely used to insure the eradication of insects in aeroplanes that might carry the pests into countries that had been free of them. By 1944 experimental work on this method in the United States was directed to the possibilities of effective use in garden and field.

Most machines that tend to make crops grow better and with less interference from various factors contribute an improvement in quality. Other machines—beyond the harvesting machines—permit a better utilization of various products. For instance, feed grinders, silage cutters and shredders increase the feeding value of roughages and other feeds. The manure spreader (and the even more modern manure loader) makes possible the better utilization of barnyard manure.

Such processing machinery as cotton gins and accessory equipment including driers and cleaners are necessary to retain whatever good qualities the fibre had when picked. Flax and hemp processing machines are of similar importance to growers of these crops.

Machines of great variety have been developed to make farm products attractive to animals, as feed, or to people who buy them on the markets. Hay is put up in such a way with driers and grinders as to keep the maximum of palatability. Citrus fruits are gassed in chambers to bring out a uniform characteristic orange or yellow colour that may have been masked by green because of conditions in the orchard. Nuts are sometimes coloured and polished to give them a uniform, pleasing appearance.

Machines have had an interesting and indirect effect on crops that is also of high economic importance. The strong demand from farmers for more and more machines and ever more efficient ones led the plant breeders and engineers to a kind of collaboration that is yielding good results in plants and machines better fitted to each other. A few examples will suffice: hybrid corn (maize) has been so bred that the height of the stalks is uniform and the ears are at uniform height, facilitating harvest with the

mechanical picker-husker. Another characteristic accentuated by the plant breeders is the tendency of the plant not to go down easily in the wind thus making it hard to harvest.

The strong stalks bred into many varieties of wheat and other small grains have become popular in many parts of the world because they do not "lodge" or crinkle down readily and thus cause heavy losses of grain the harvester fails to catch.

In the southwestern United States in the somewhat arid plains country plant breeders have adapted grain sorghums to mechanical harvesting machines by creating much shorter or dwarf varieties with upstanding seed heads to take the place of those that curved over.

Such changes make for economy in harvesting and better quality in most instances.

The effect of the machine on quality often goes far beyond the immediate effect. For example, a corn (maize) harvester, that is a picker-husker, may be kept in good adjustment or may get out of adjustment and put much trash such as husks, silks and loose kernels in the wagon with the ears. This accumulation interferes with ventilation in the crib and may cause a heavy spoilage loss, especially in seasons when the grain has not matured well.

The use of machines for the betterment of the quality of work has gone so far in some areas as to tax the credulity of persons in other areas where mechanization has received small attention. For example, in California a great part of the commercial rice crop is sown from aeroplanes. Formerly the fields were planted with ground machines and later flooded as a means of watering and controlling weeds, and the fields drained before harvest. A later technique is to flood the fields early to prevent weed growth, then sow the seed from the aeroplane into the water and then, as before, drain the field for harvesting.

The new method saves labour and practically eliminates the weed competition. Not only is the work better, but the crop harvested is better. Planes are often used for dusting cotton and trees with insecticides.

Economics of Farm Machinery.—At no stage in the development of farm machinery and mechanical methods has it been possible for all farmers to use the machines of their time economically. It is even less so (1944) as may be seen readily when reflection is given to such practices as the use of planes for planting or for fighting pests. However, more and more kinds and sizes of farm machines are made available to small farmers and in some places the use of machines or of machines and operators has been made available at a price. In parts of the United States cotton belt men do custom aeroplane dusting of cotton for planters of an area.

Horse-drawn planting machines, such as corn planters and bean planters, that were just pushing the hand planters out of use in commercial farming at the end of the 1890s are found everywhere in the western world and many of them have become multiple-row planters drawn by tractors. Farmers in the more progressive farming regions commonly have steel plows. These have spread over the world after about 1840. Because it slipped through the soil more easily—that is, "scoured" well—the draught of the steel plow was less and made farming easier for man and beast. For the farmer it was easier physically and economically. Mechanical improvements in farming have been frequent reductions in draught. Plow improvements of this nature continue. In the second quarter of the 20th century there were improvements in the plow that tended to reduce draught, changes in the curve of the steel plow was less and made farming easier for man and plow design to reduce clogging with trash; new coulters and jointers that could pass obstructions with less difficulty. Then rolling resistance on scores of farm implements, including the tractor itself, was reduced through the application to them of pneumatic tires; better lubrication and construction materials also have done their parts in reducing friction and, therefore, draught.

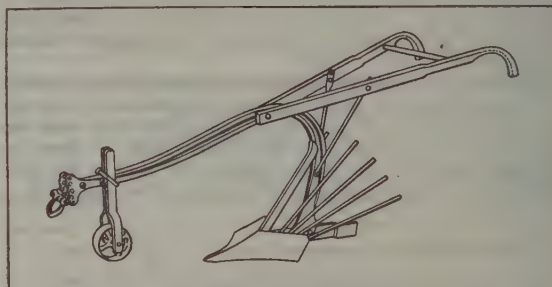
Practically everywhere, except possibly in primitive areas, there is evidence that the economy of the machine has pulled it out in front. In some instances it may be far from the latest development, but the farmer is feeling his way, balancing steel and brawn. The size of the individual farm and the type of farming

are important determining factors. A man who raises a small acreage of berries will not use much machinery, but he might have a small tractor and in some localities he would most certainly have a truck for marketing and for hauling supplies. A dairy farmer with a dozen or more cows would frequently be found to have a milking machine, maybe with more than one unit, possibly a cream separator, almost certainly, in some countries, a manure spreader, haying machinery, and if he is right out in front in a rainy country (in 1945) he would have a hay drier in his barn.

It has become generally recognized in Europe and the United States that electrically operated tools are an economy for electric current has become widely available at reasonable rates. Sharp tools save time and improve the quality of work. With an electric grinder a farmer keeps his tools in better condition with a smaller expenditure of time.

As they have become better acquainted with machines, farmers of various countries have been less prone to overinvest in such equipment. Machines must not lie idle too much. Therefore, they must be adaptable enough for various jobs or be used jointly in the community unless farms are large. So, before buying a machine a farmer must assure himself that he has at least the minimum amount of work that would justify the investment.

The potato crop may be used to illustrate how a farmer might proceed under different conditions: the cheapest way to dig a small patch of potatoes is with a fork; if the area in the crop is an acre or so the farmer would likely make a good return on money invested in a simple potato plow; while a larger area



COURTESY OF JOHN DEERE

FIG. 2.—HORSE-DRAWN WALKING POTATO DIGGER

This model is particularly suitable for harvesting sweet potatoes. The rod mouldboards free potatoes from dirt and drop them on the ground. Gauge wheel regulates depth

would justify purchase of a more complex machine. But the use of machinery involves consideration of factors other than relative cost of the operation in comparison with the cost by other methods. The speed with which the work can be done, especially when the state of the weather and the possibility of its continuance or change are considerations, is of primary importance even though the value is hard to measure. The study of farm cost accounting has been of help in a better understanding of these problems.

As machines have been designed to serve farmers better, their use has increased, and the size of farms and the improved land in them has become greater. In the United States, where the use of farm machinery has shown perhaps the greatest increase, the average acreage of improved land per agricultural worker went from 23.1 in 1880 to 38.4 in 1940; and the value of agricultural implements and machinery per agricultural worker went from \$45.74 in 1870 to \$365.81 in 1940.

Using the estimates of the department of labour (U.S.) for nine important crops (barley, corn, cotton, hay, oats, potatoes, rice, rye, wheat) and comparing the machine methods of about 1895 with the hand methods of earlier times, H. W. Quaintance (*The Influence of Farm Machinery on Production and Labour*) states: "Taking the percent of labour saved as indicating the average proportion of these crops due to the use of machinery, it appears that the quantity of products is almost five times as great, per unit of labour, as it formerly was." This suggests how ma-

chinery has enabled agriculture to supply labour to the industrial cities and for commercial activities and still increase the output, as was suggested in the introduction to this article. After an extensive study and presentation of data on 15 crops (barley, broom corn, corn, cotton, hay, oats, onions, peas, potatoes, rice, rye, sugar cane, sweet potatoes, tobacco, wheat) grown in the United States, the same author says: "Surely it will not be too much to say that during the last half of the 19th century the cost of production¹ of these crops was reduced by one half." There is ample evidence that the influence of machinery in effecting economies in production costs has gone on at least unabated after 1895. In 1940 figures available in the U.S. department of agriculture indicated man-hour requirements per acre as follows, under highly mechanized conditions except in cotton: corn 5.1; wheat 4.1; hay 3.5; cotton 73.0. Cotton felt mechanization less than the other major crops.

Other Effects of Machinery.—Beyond doubt the wide adoption of farm machinery has had much more than economic effects. Farmers, and particularly young people on farms, give great consideration to the convenience of machinery, to the fact that it does away with much drudgery and dignifies the work perhaps as much as scientific knowledge of the problems of the farm, and as much as skill in the performance of hand work. More often than not the use of machines leads to a better quality of work. A simple illustration will serve to explain one factor in this better quality. A man sharpening the knife of a mowing machine with a power grinder is much more likely to make all the sections sharp than if he were doing the work with a grindstone operated by himself with a treadle. Farmers can plant crops much better with an automatic planter both from the standpoint of the requirements of the crop itself and from the standpoint of the farmers' problems in caring for it and harvesting it. Modern machines and methods used on almost any of the important crops—wheat, maize, sugar beets, potatoes—could be used to illustrate the point. Here economics and the more elusive factors are on common ground.

The introduction of improved farm machinery frequently met with resistance from those who expected bad effects on employment, and at times active resistance developed. When early wheat harvesters (binders) were introduced in the developing wheat belt of the United States many of the machines were burned or damaged in other ways by worried farm hands. These machines, and the still more effective ones that have succeeded them and each other, resulted in wheat production greater than ever known before and were one of the important factors in creating a higher standard of living and in making food production more readily adjustable to meet emergencies.

At times men supposed that the introduction of farm machinery led to falling rural population, but there is evidence that in many instances the invention and introduction of labour-saving machinery for the farm followed the draining of labour away from the land. As an example, self-binding grain harvesters were invented and developed by more than one man at about the same time when the rapid increase in industrial activity lured an ever rising stream of labour from the fields. It was not railroads alone that were responsible for the rapid settlement of great agricultural areas in the United States, Canada and Australia during the 19th century; improved farm machines and implements had much to do with it. Without the machinery much of the land cropped in these areas would have been used for grazing or for timber.

The more machines are used for farming, the more skilled the workers become and the higher the wages that can be paid them. A demand for skill and a desire to acquire it tend to improve the quality of the rural population.

Although automatic equipment and higher quality tools are made in sizes and at costs that make them suited to many small and medium sized farms as well as large ones, there has been a decided tendency for the use of farm machinery, and more convenient power to increase the size of farms. In the northern part

of the Mississippi valley where more machinery is used than in any other region of general farming the improved land per farm has steadily increased after 1850. In regions where general farming is practised but where machinery has not been used so much, the cultivated acreage has not increased so rapidly, and in some areas farms have even become smaller. In some instances, of course, such a tendency might be explained on the basis of a change in type of farming, such as from general or livestock to truck, because of a new market, for example, in a rising industrial area.

If the total investment in all farm property in the United States is considered, the increase after 1850 has been much greater in the farming areas in which machinery is widely used. Land is the largest item in farm valuation, but its value depends to an extent upon the means at hand for making it productive. Many factors enter into increases in value, but the reduced costs made possible through machinery should always be kept in mind.

There is scarcely a farm operation in the more progressive regions that does not require less drudgery than it required, say, in 1880, or in 1900, or even in 1910, and in some instances, 1920. One farm operation that had drudgery or "stoop labour" taken away from it after 1920 was the thinning of sugar beets. To mention a few other operations that have gradually lost much of the strain and monotony over the years, where machinery has been used, there are milking, corn cutting, haying, plowing, harrowing, all the operations done with tractors and many of those done with engines and electric motors. Most farmers are, perhaps, as busy as their grandfathers, but they work more with their heads and their skills than with biceps and backs; and they work to the better advantage of themselves and society. In 1800 most nations had to have a large proportion of the people working on farms to provide themselves and the small industrial and business groups with food, clothing and a few other materials. In the second quarter of the 20th century an active industrial-agricultural country such as the United States had less than one-fourth of its population engaged in farming and nevertheless had farm products for export. It did, however, buy some farm products from other parts of the world—rubber, waxes, coarse fibres, etc.

There is primitive farming even in modern times, some of it here and there in the most progressive agricultural countries, but modern farming is a relatively complex business even though frequently highly specialized. The first-class farmer, with many machines and exacting requirements as to breeds, varieties and mechanical and biological processes, has exchanged drudgery for application and intensity of mental effort and still has much physical labour in his lot. But he and his wife and children have a higher standard of living—more conveniences, better schooling, greater opportunities for reading and for carrying on other cultural activities. In other words, they produce more and get more, at least in many ways.

Classification.—Types, kinds and sizes of agricultural machinery and implements form a complex subject. Agricultural conditions into which machinery must fit vary widely between the one-horse farms found in many countries (even the most progressive), and the great wheat ranches of Canada and the United States; the operation of a hill farm varies from that of a rich valley corn farm, and the latter, in turn, is vastly different from a citrus fruit ranch. Differences in size of farms, in size of fields, in kinds of crops grown, and in the kind and size of power units most economical or practical—all cause variation in type and size of machine or implement. For a small field, one can buy a one-horse or one-mule implement for a very few dollars, or for a great plantation one may buy a special harvester which costs several thousand dollars. Because of the wide variation in soil types some large manufacturers find it necessary to make more than 100 different shapes and kinds of mouldboards for plows in addition to the disk type of plow which is demanded in very hard, in very fluffy or in very sticky soils. Land values have some influence. Then, last but not least, the human equation enters; differences in peoples and in regional customs add complication. The farm labourer of low mental calibre and of little mechanical skill requires a smaller, simpler implement than the skilled oper-

¹Cost of production here is based on cost of labour and does not include differences in machine overhead between hand and machine methods. This discrepancy, if it seems such, is more than offset by the fact that labour by hand methods is figured at the rate of about 1850, while for machine methods it is computed on the basis of the higher wages current about 1895.

ator who commands a tractor hauling a combination of implements which performs two or three operations in one trip over the ground.

Space does not permit description of all kinds of agricultural machines and implements. Fortunately, however, the subject lends itself to classification according to the purpose of the machine. Most of the agricultural machines, implements and tools used by farmers may be classified according to purpose. The list includes only those items considered part of the business of raising or making agricultural products, up to the moment those products are sold out of the farmer's ownership. It does not include the strictly household conveniences, devices and utilities which are becoming so widely adapted to assist the housewife and to enable the farmer and his family to enjoy more the art of living.

Machines and Implements for the Reclamation, Maintenance or Improvement of Land: stump pullers, pilers; brush breakers, cutters, power brush and tree saws; burners; open ditch, tile ditch and mole ditch machines; land drain cleaners; land levellers; terracing scrapers, bulldozers, graders, moss harrows; irrigation pumps, land planes (for levelling fields for irrigation), sprinklers, water controls, ditchers; sub-soilers; limestone crushers; lime and fertilizer distributors (artificial manure distributors); manure loaders, lifters, muck grab spreaders; straw spreaders; stone pickers.

Machines and Implements for Seedbed Preparation: mould-board, disk and polydisk plows; lea, sod, stubble breaking plows; drags; spike-tooth, spring-tooth, chain, zigzag disk and special harrows; smoothers and pulverizers; plain, corrugated and bar rollers; surface and subsurface packers; clod crushers; rotary, gyro and special tillers; sweeps; listers; ridge busters; stalk cutters, shavers; cotton stalk choppers; stubble diggers, pulverizers; markers.

Machines and Implements for Seed Preparation: fanning mills; grain, pea, bean, cottonseed, peanut, flax, onion set, rice, potato and corn cleaners, graders and sorters; seed scarifiers; sugar-beet seed slicers; seed dusters (for applying fungicides); seed testers; seed stringers; seed driers; butters and tippers (for use in shelling seed corn); potato cutters.

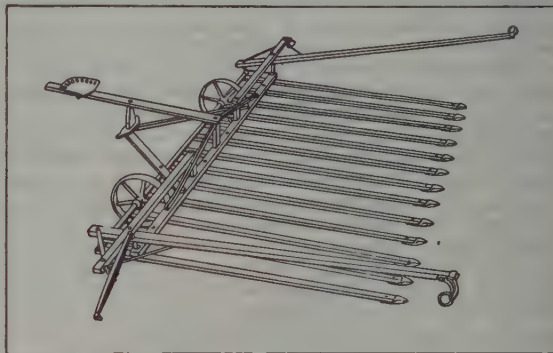
Machines and Implements for Seeding and Planting: broadcasters, broadcast sowing machinery; grain, beet, grass and garden seed, bean, pea, corn (small grain), onion and rice drills; corn, cotton, beet, potato, pea, bean, onion and peanut planters; transplanters; seeders, wheelbarrow seeders; markers; lister-planters; fertilizing attachments.

Machines and Implements for Cultivating: corn, beet, cotton, potato, sugar-cane, vineyard, orchard and garden cultivators; celery, potato and tobacco hillers; drags; spike-tooth, spring-tooth and disk harrows; weeders; rotary hoes; crust breakers; ridgers; renovators; sweeps; root blockers; cotton scrapers, choppers; thinners.

Machines and Implements for Harvesting: mowers; tedders; "flop-over," dump and side-delivery rakes; "bull" and sweep rakes; hay, shock, bundle and cane loaders; crop collectors; stacking elevators, stackers; bunchers; windrowers, straw and hay balers, pickup balers, roller balers; reapers; grain and corn binders; grain and corn headers; header-binders; combination harvester-threshers; corn, cotton, potato, peanut and fruit pickers; corn picker-huskers; flax pullers, cleaners, tow shakers; grass cutter-chopper-loaders (for ensilage); root and plant lifters; potato and peanut diggers; root

toppers; bean, pea, beet, celery, grass seed, spinach and onion harvesters; field ensilage harvesters; seed and cotton strippers; sugar-cane cutters, harvesters; corn and hemp cutters; shock compressors, movers, sweeps; huskers; milking machines; wool clippers; tree fellers.

Machines for Preparing Products for Market: grain, pea, bean, peanut and rice threshers and cleaners; alfalfa, clover, almond, bean, pea, grain and rice hullers; grain, pea, bean, cottonseed, peanut, onion set, rice, potato, corn, berry and fruit cleaners, graders and sorters; cotton gins and presses; balers; produce washers; produce waxers; grain polishers; corn, peanut, rice and popcorn shellers; vegetable bunchers; cream separators; milk emulsifiers, pasteurizers, sterilizers, irradiators; milk coolers, aerators; churns; butter workers; bottling machines; cheese and lard presses; sugar, fruit, sorghum and syrup evaporators; honey extractors; berry and fruit crushers; cider and juice mills, presses, extractors; bleachers; pitters; parers; sugar-cane and sorghum mills; hemp breakers and cleaners; saw mills; baggers; weighers.



COURTESY OF JOHN DEERE

FIG. 4.—HORSE-DRAWN TRUSS-FRAME RAKE

Machines for Feed Preparation and Feeding: cutting boxes; ensilage and fodder cutters; feed mills (including hammer mills), grinders, cake breakers, mealers; roughage mealers; feed mixers; shredders; root and vegetable cutters, pulpers; feed cookers; stock feeders; bone cutters; corn and cob crushers; silo packers.

Machines and Implements for Combatting Crop Enemies: row crop sprayers, tower sprayers, aerosol "bomb" (experimental in 1944) sprayers using liquified gases in steel cartridges as a means of propelling the insecticide or fumicide in extremely fine particles; dusters; field burners; flamers; stubble pulverizers; stalk crushers (for killing larvae that might otherwise survive in waste material); insect sweeps, poison bait spreaders, catchers, traps; tobacco bed burners; seed treaters; smut cleaners; fumigators; soil fumigators for nematode control.

Machines, Implements and Conveyances for Transportation: automobiles; motor trucks; wagons; carriages; horse and hand carts; sleighs; bobs; stone boats; wheelbarrows; farm, wagon, log, lumber, header and sugar-cane gears; racks and barge boxes; hay carriers, forks, slings; blowers; grain dumps, elevators; car loaders; feed and litter carriers.

Power, Light and Heat Generators: gas, gasoline, paraffin, distillate, kerosene, hot air and steam engines; steam and internal combustion tractors; boilers; windmills; turbines; water wheels; hydraulic rams; tread mills; power sweeps; electric motors, dynamos, generators; lighting plants; containers for compressed illuminating gas (bottled gas); tank heaters.

Miscellaneous Machines, Implements and Tools: incubators and brooders; disk and knife grinders; pumps and pump jacks; hay knives and hooks; hand hoes, mattocks, rakes, shovels, forks; corn, cane, tobacco and cabbage knives; pruning and grafting hooks, knives, shears and saws; fence stretchers; hog rubs; post-hole diggers, augers; lifting jacks; animal pokes and leads; de-horners; poultry debeakers to prevent birds injuring each other; horse and cattle clippers; grooming machines; milk and cream testers; utensil washers, sterilizers; scales; ladders; hand tools

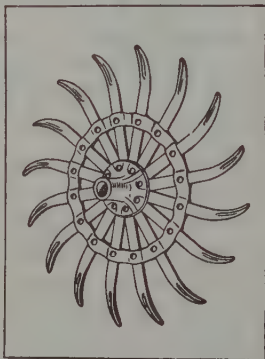
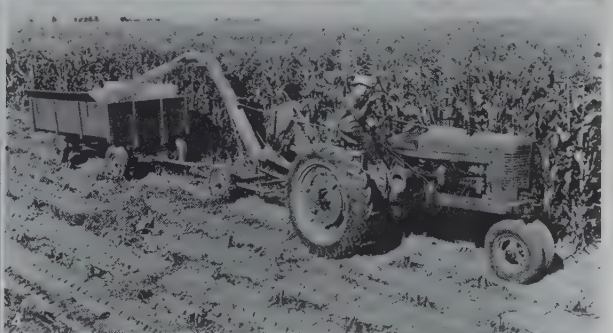


FIG. 3.—SINGLE WHEEL FROM A TRACTOR-DRAWN ROTARY HOE

The rotary hoe is used for early cultivation of all kinds of row crops, pulverizing the top soil and tearing out weeds. Each section of the hoe cultivates one row and is composed of fourteen 20½ in. wheels



BY COURTESY OF (1, 2) THE OLIVER CORPORATION, SUCCESSOR TO THE CLEVELAND TRACTOR COMPANY, (3, 6) CATERPILLAR TRACTOR COMPANY, (4) INTERNATIONAL HARVESTER COMPANY, (5) FORD MOTOR COMPANY, (7, 8) JOHN DEERE, (9) THE OLIVER CORPORATION, (10) ALLIS-CHALMERS MFG. CO.

IMPROVED FARM MACHINERY USED IN THE UNITED STATES

1. Spraying a potato field with a row crop sprayer
2. Dusting a potato field with a row crop duster
3. Land plane used for levelling fields in irrigated regions to make the distribution of water feasible
4. Cutting corn for the silo with a field ensilage harvester
5. Building terraces for soil erosion control with a tractor-drawn land scraper
6. Loading pea vines with a pickup vine loader
7. Gathering and pushing hay to the stack with a buck rake
8. Harvesting corn with a two-row corn picker husker
9. Harvesting sugar beets with a harvester that leaves beets in one windrow and tops in another
10. Gathering hay with a one-man pickup automatic baler. The machine picks up and bales, in a single operation, a double-swath windrow of hay, rolling it into cylindrical bales

AGRICULTURAL POWER AND MACHINERY



BY COURTESY OF (1) THE JAKUES POWER SAW COMPANY, (2, 6) FORD MOTOR COMPANY, (3, 8) CATERPILLAR TRACTOR COMPANY, (4, 5, 9) INTERNATIONAL HARVESTER COMPANY, (7) JOHN DEERE, (10) THE MASSEY-HARRIS CO.

IMPROVED FARM MACHINERY USED IN THE UNITED STATES

1. Cutting down a small tree with a portable power saw. The saw is attached to a tractor and used to cut down brush, saplings and trees
2. Mechanical post hole digger in operation
3. Spraying citrus groves with power sprayer and high tower
4. Digging potatoes with a two-row machine driven from a tractor through a power take-off
5. Picking cotton with a mechanical picker
6. Sawing wood with a circular saw mounted on a tractor
7. Loading manure on a two-wheel spreader with a power loader
8. Pickup hay chopper in operation. It gathers cured hay from the windrow and chops and loads it
9. Harvesting soybeans with a small-sized combine
10. Harvesting wheat with a self-propelling combine

and machines for wood and iron work. (See TILLAGE MACHINERY; DAIRY MACHINERY AND EQUIPMENT; HARVESTING MACHINERY; PROCESSING MACHINERY. Also such articles as SHEEP SHEARING MACHINES; TRACTORS; DRAINAGE OF LAND; etc.)

HISTORY

From pictorial and other ancient scraps of evidence it seems certain that in very early times man used devices for making the soil more productive and the struggle for food and clothing easier. It is reasonably safe to say that once started on this road of improvement through invention and planning, the chain of change was never broken up to 1945, with agriculture feeding, clothing and providing materials for various purposes for more than 2,000,000,000 persons.

Studies of ancient civilizations in many parts of the world, including some regions of Central and South America, indicate cultivation of the land was going on hundreds of years B.C., even 1,000 years or more B.C. in Egypt and China. Such dates could be put much farther back on the basis of what it is certain men must have observed when they began gathering grains, fruits and roots to provide some degree of food security beyond the day or the season.

The first soil working implements very probably were the crude pieces of wood that provided the idea for shaping such chance pieces into the first hoes; the first rake very likely was a leafless branch of a tree with stiff twigs. When man had a hoe he really had his first plow; and when he had a wisp of brush for a rake he had his first harrow. Brush harrows are still used, and not too badly either, when the branches are fitted into a rigid frame or holder. Harvesting at first was simple pulling and picking—and it is really surprising how much of many crops is still pulled and picked and forked by hand in countries where complicated farm machines are common. Since the earliest cultivated crops are supposed to have been cereals and pulse (that is beans and peas and things of that sort), a very early improvement was the sickle. Some sickles in ancient Egypt were made of flint blades in a wooden handle. Later, but still near 1,000 years B.C., the men of the Nile valley used bronze to make the counterpart of the hand sickle. In those days Egyptian grain was trodden out on the threshing floor by animals just as it is even today in near-by Ethiopia and in primitive places in other parts of the world. Wheat and other grains and seeds were winnowed by casting into the wind.

Engineers who have studied the development of agricultural machinery and power generally consider that the first great mechanical advance in farming was the evolution of the plow from the hoe. It became not only an implement for preparing the seedbed and controlling weeds, but a means of covering seed, cultivating the plants, providing drains, building terraces to control erosion and even grew into a harvesting machine for digging such crops as potatoes and sugar beets. Plows were used in ancient Egypt. They marked a great advance in the use of beasts of burden and must soon have stimulated man to begin the long and slow job of breeding up the draught ox and the draught horse, the really great power sources on the land until the advent of the tractor which even in the middle of the 20th century does only a small proportion of the world's field work except in some of the western nations.

By Roman times a primitive ridging plow had been evolved by use of a device similar to the modern double mouldboard. Pliny, the elder, in the first century wrote of a wheel plow, but such plows were not common until much later. He had heard of the use in Gaul of a harvesting machine pushed ahead of oxen for heading or stripping grain. Such machines and a combined plow and drill, invented still earlier in Mesopotamia, gave way before the barbarian invasions of these more civilized regions, and mechanical progress in agriculture during the middle ages and until after the Renaissance. But apparently there were small changes from time to time even in that period. In 1523 in England Sir Anthony Fitzherbert's *Book of Husbandry* mentioned plows of different types in different districts and indicated the need for different designs for the various soils in order to cut

down draught. By then hand tools had been nicely designed and many of them were much like those of modern times except as to material. By 1600 more elaborate farm implements were appearing in Europe and English books of the day discussed new ways of planting grain. In 1730 Jethro Tull, of England, renowned for his developments in horse-hoeing husbandry, made a seed drill which was really workable and marked the beginning of a new day in the planting of small grains and many other seeds.

In Tull's century plowing matches began in Britain and competitions in the use of drills and horse-hoes. These activities were typical of the lively thought on ways and means of improving farming and easing the load on human shoulders. The tempo of tool improvement has continued to rise ever since. Tull opened the floodgates of farm machinery invention. It was significant that this opening was at the time when the American colonies were beginning to realize what might be done in the new land with better machines and stronger work animals. They began improving oxen and horses as the British and Europeans already were doing, and Americans began working on the plow. Eli Whitney before the end of the 18th century had devised the nucleus of the modern cotton gin. The whole western world was in this same state of mind about agriculture. India had long had a hand cotton gin, the *chirka*, but the east had not been in the same state of mind about farming. This state of mind, which encompassed far more than agriculture, led to the steam engine, the internal-combustion engine, traction engines, tractors, electricity, milking machines, self-binders, combine harvester-threshers, manure spreaders, grass harvesters, aeroplanes (used for dusting crops with insecticides and even for planting), and whole sets of mechanically operated machines.

The Steam Engine.—Even by the opening of the 19th century developments had gone far enough to justify the term "agricultural machinery." Strangely enough to present-day farmers, there was a threshing machine before there was a steam engine. The first workable threshing machine came late in the 18th century and was driven by water or wind power, sometimes by horse labour and later by steam. But steam was not much used in agriculture until after 1830. Then in England a system was devised whereby one or two engines were used to draw multifurrow plows, by means of cables, backwards and forwards across the field. The system of double-engined steam plowing was well established by 1850. Then other heavy implements were added such as the cultivator and mole plow. Then steam threshing was popular and steam engines were used to some extent to run other barn machinery. But for the most part the development of machinery on the farm owes little directly to steam. However, in the early part of the 20th century lightweight steam tractors were used in England for the direct pulling of plows and to some extent also in other countries.

The mowing machine and the self-binder, the tedder and swath turner, the drill, the potato digger, chaffcutters and root cutters all were developed in the first instance for horse or manual labour, though doubtless receiving a fresh stimulus from the general mechanization of industry applied to the farm and the still greater stimulus arising from a shortage of farm labour.

The Internal-combustion Engine.—An important practical contribution to the mechanization of the farm came from the invention of the internal-combustion engine. Used first of all to drive stationary machinery, as chaffcutters, root cutters, and corn mills in the barn, in the second decade of the 20th century the internal-combustion engine also made headway as a source of power for field operations. Steam engines, though widely used for traction on the road, suffered the disadvantage of being heavy for use on the land for the direct haulage of machinery and implements; it was not until the internal-combustion engine had been perfected that agricultural tractors made their appearance in any number.

This type of tractor has (1945) an established position on the farm on both sides of the Atlantic; it supplies power for plowing, cultivating and harvesting; it can both drive and haul the threshing machine, and there can be no doubt it contains the promise of still further usefulness. The practice of mole draining,

for example, was greatly stimulated, not only in Great Britain but on the continent of Europe, by the invention of mole plows that can be hauled by a suitable agricultural tractor. The cost of the work is substantially less than when performed by steam tackle and is far more expeditious than when performed by horses. The tractor has also rendered it easier for the farmer to undertake deep plowing and subsoiling, which are very important for growing a crop such as sugar beets. Subsoiling had been looked on with disfavour because of the heavy strain imposed upon the teams and, when carried out at all, had been left in great measure to steam tackle. The application of the internal-combustion engine also enabled designers to produce machines of more moderate size and weight than formerly. Another direction in which the internal-combustion engine is likely to prove its usefulness is in rotary tillage.

The internal-combustion engine enables operations to be efficiently performed which were beyond the resources of the ordinary farmer, or which were little more than ideas in the days of steam and horse labour. But this is not its only or perhaps its chief usefulness. It enables operations to be performed far more speedily with an equal labour force and is therefore an ally to the farmer in his struggle against adverse weather conditions. Obviously, if five or six acres can be plowed in a day by a tractor where formerly a plow team accounted for less than one acre, another factor than the unit cost of the plowing, namely, that of speed or of the time conditions, has entered into the operations. Again, if 20 acres can be reaped in a day as against 10 or 12 acres by two teams of horses, the same factor enters.

Electricity.—But a still newer source of power on the farm is electricity. Because of the shortage of coal and oil fuel during World War I, a stimulus was given to the exploitation of water power and the generation of electricity. Although employed at first principally for lighting, electricity, when it is available at low cost relatively to other forms of power, is gradually coming into use for driving stationary machinery on the farm. Beginning after World War I, there was a rapid increase in rural electrification in many countries of Europe and in the United States. The increase was especially noteworthy in the United States, where in 1944 it was estimated more than 40% of the farms had electricity and agricultural engineers predicted an increase to as much as 75% in the first decade after World War II. The principal new uses developed were for heating chicken and pig brooders and for refrigeration.

Rise of Farm Mechanization in the United States.—Because of the rapid development of mechanized agriculture in the United States, special attention is devoted to some of the highlights of its history. During the colonial period (1607 to 1783), farming was on a self-sufficing basis; that is, the farmer made his own shelter, he and his family made much of what they wore, and, with the exception of some wheat, tobacco, rice and indigo, the farmer raised but little more than was required for his own family. The ground was spaded or hoed up, or it was plowed with a crude "bull" plow which carried a wooden mouldboard sometimes stripped with iron. If the seedbed was harrowed at all, a peg-tooth harrow was used; this was a wooden frame with wooden spikes for teeth. Small grain was sown broadcast by hand; sometimes it was harrowed in or was trodden in by animals. The new crop was cut with a hand sickle, scythe or cradle, threshed with hand flail or by driving animals over it on a treading floor; then the grain was winnowed by casting it against a light wind. Corn was dropped, covered, cultivated and harvested entirely by hand. Wooden wheeled carts were used. Thus, with the exception of a great number of hand tools, crude forms of the plow, harrow and wagon were the only agricultural implements of the colonial period.

With only one or two notable exceptions the same conditions held and the same old implements were used throughout the second period (1783-1830) of agricultural history. Early in the 1790s the Whitney cotton gin appeared; this made the removal of the seed from the cotton fibres mechanically possible and was a great boon to the young cotton industry. The influence of the cotton gin was so far-reaching economically, commercially and

socially that it is considered one of the high lights in the history of agricultural machinery.

About 1797 Charles Newbold demonstrated his cast-iron plow. It was similar to the cast-iron plows which had been demonstrated shortly before in England. Records indicate that farmers feared detrimental effects from so much iron in contact with the soil, and evidently this first American cast plow was never repaired after its mouldboard became broken. Hence wooden plows, some of which carried wrought-iron cutting edges, continued well throughout the period. Between 1814 and 1820, however, Jethro Wood, evidently continuing the mediations of Thomas Jefferson on the mathematics and mechanics of the mouldboard, began to give the plow bottom scientific shape for better turning, pulverizing and for lighter draught. To obtain these shapes Wood had to cast his plows, and he introduced the important feature of having various parts of the plow renewable.

At no time has American agriculture undergone such changes as during its third historical period (1830 to 1860). At the beginning of this period the farmer produced first for himself and family; at the close he was raising crops chiefly to sell.

The obstinate scouring qualities of the soils in the Mississippi valley led to the use of steel instead of iron strips to face the mouldboards of plows. In 1833 John Lane built the first steel mouldboard, using crosscut saw blades for the purpose. John Deere starting in 1837, and William Parlin beginning in 1842 were other pioneers in the steel plow business of the middle west. Much credit is due also to James Oliver who, beginning his experiments in 1853, greatly advanced the process of chilling cast plow parts, thus securing greater durability and improving the scouring qualities of this type of plow.

Early in the '30s the Manning, the Hussey and McCormick patents brought out the idea of cutting grass and grain by a reciprocating knife passing through fingers or guards. It is this principle upon which modern mowers, binders, headers and combination harvester-threshers still operate.

By 1850 several factories had been established for the manufacture and sale of what were then improved and successful plows, harrows, grain drills, reapers, mowers, threshers, strippers and power sweeps. Of course much work on the farm still had to be done by hand, and much improvement and many new devices were to appear after that date. But by that time the farming public was accepting mechanical devices so rapidly that 1850 is recorded by historians as the close of the period of "hand production" and the beginning of the machine era in American agriculture. The advent of machinery and implements placed farming on a commercial basis on which the farmer raised products to sell rather than simply to sustain himself and family. It is interesting to note that from 1850 to 1860 the number of establishments manufacturing agricultural machinery increased from 1,333 to 2,116.

From 1850 to 1860 patents appeared and there was development work on each of the following: force-feed devices in grain drills, stalk cutters, baling presses, two-row corn planters, disc harrows, feed grinders and "straddle row" cultivators. Improvements continued on all classes of implements, especially on mowers, threshers and reapers. One of the most interesting developments concerned mechanical binding attachments made for and used to some extent on reapers.

The fourth period in the history of American agriculture extends from 1860 to 1887. It was characterized by remarkable expansion, a chief cause of which was the passage of the homestead acts. The disbanding of the armies of the Civil War sent men and mules back to the land, and, machinery being available, many sought the agricultural opportunities of the far west which was about to be opened up by the completion of the transcontinental railroads. The perfection of the twine binder and the introduction of the roller process for flour manufacture also stimulated agricultural expansion.

The drain of the Civil War on farm labour forced farmers to the use of more and more machinery. During the war, mowers came into very general use, and early in the period much was done to perfect horse rakes, which, as an accompaniment to the

mower, could displace more labour in the haying process. This was to be followed soon, in 1872, by the development of hay forks, slings and carriers by which hay could be moved from the wagon to the mow or to the stack by horse power rather than by hand. Thus the production of hay became mechanical save for one step—that of loading. This gap began to be closed in 1874 when the mechanical hay loader appeared; the implement was considerably improved about 1880 and came into use about 1885. Although they had been patented years previously, two-wheeled sulky and gang plows did not appear in good quantities until about 1870.

The first automatic grain binder—that is, the first harvester of the Marsh type to carry an automatic bundle forming, compressing and tying attachment—appeared in 1870, and was known as the Locke machine. At last the tedious process of binding sheaves by hand was doomed, and the importance of this development in the history of agriculture can hardly be overestimated. Attachments using twine as the binding material, and some using wire, followed quickly. About 1878 the famous tying device known as the Appleby knoter appeared. It became the standard tying mechanism of nearly all modern grain, rice and corn binders. Thus the grain binder was the result of 40 years of struggle.

Although combination harvesters and threshers had been thought of as early as 1826, it was not until about 1875 that the combine came into use, and then it appeared in the vast wheat fields of the Pacific coast states. These were large machines, drawn by from 12 to 30 horses, cutting a swath of grain from 16 to 24 feet wide, and threshing, cleaning and sacking the grain in one trip over the field.

In 1875, largely through the activities of the Haworth brothers, automatic checkrowers for planting corn became practical. The dropping mechanism in these machines was operated by regularly spaced buttons or knots on a wire stretched across the field, instead of by an extra man on the planter. Thus one man, and the previous operation of marking off the field were eliminated from the planting process. In 1876 manure spreaders of the wagon type were developed to the practical stage. About the same time ensilage cutters, or silo fillers and disc plows appeared, the latter, however, did not become commercially practicable until about 1890. Although stationary steam engines, and steam engines on trucks which could be hauled from place to place had been used previously, the self-propelled steam traction engine did not appear in agriculture until about 1880. This was the forerunner of the modern tractor. In 1884 three-wheeled sulky and gang plows were developed. About 1885 a combination machine for husking corn and shredding the stalk made its appearance.

The fifth period in American agriculture, 1887 to about 1940, began with the practical exhaustion of those public lands in the United States which could be converted easily and cheaply into quick producing farms. After 1887 agriculture had been settling down to more intensive cultivation accompanied by improvement in farms and the subsequent rise in land values. (The same tendency is in evidence in Canada, though there the corresponding periods are from 10 to 20 years later.) Obviously attempts to intensify and diversify agriculture involved machinery and implements in no small way.

The period opened with many of the most fundamental types of agricultural machinery well established. Minor improvements continued in all classes of implements. Sled corn harvesters, corn binders and side delivery rakes to facilitate loaders came in early in the period. These were great labour savers. Inasmuch as one man with three horses on a two-row cultivator can cultivate 90% more acreage per day than one man with a single-row machine, it was only natural that attention should be given the two-row cultivators which began to appear early in the '90s. About 1890 the Babcock device and system was developed for determining the butterfat content of milk and cream. The Babcock test helps the farmer cull the unprofitable cows from his herd. Cream separators appeared about 1890, and a great labour saver, the milking machine, came into use about 1910.

Among the early attempts to adapt the internal-combustion engine to farm work no efforts stand out more prominently than

those of C. W. Hart and C. H. Parr, two young men who developed very satisfactory, stationary, gasoline (petrol) engines as early as 1896. A little later they conceived the idea of mounting a gasoline engine on a truck, and gearing the two together so that the combined unit would propel itself. In 1902 these men built such a machine and proved that the gasoline engine could be used for haulage purposes. A new industry, the great modern tractor industry, was born. Manufacture began almost immediately by several companies, and within nine years a large number of tractors were plowing, harrowing, seeding and threshing in those regions of the United States and Canada where the farms and fields were large. These early tractors were large, heavy and somewhat crude. Being able to develop 30, 40 and sometimes 50 horsepower at the drawbar, they pulled six-, eight-, ten- and twelve-bottom plows, or large combinations of soil preparation and seeding implements.

The tractor had demonstrated its ability to get work done quickly with a minimum of human labour, and, in farming, getting work done when weather, crop or soil is right is a decided advantage. The old heavy tractors, however, required considerable outlay in cash, and they were too unwieldy for practical use except in large fields. About 1910 the power farming idea had so thoroughly gripped agriculture that suddenly a demand for small tractors developed from farmers on smaller tracts, and many of the old manufacturers, together with a great number of new tractor concerns, began bringing out smaller tractors. This tendency to cut the size, power, weight and price continued until the light tractor of 8-16 and 10-20 horsepower came onto the market about 1916 and brought with it the light, two-wheeled tractor plow which was quite an innovation in plow design. The light tractor and light plow, selling at prices which made their use economical on small farms, introduced power farming onto thousands of farms in both the United States and Canada, farms which could not have enjoyed their advantages had not smaller, cheaper units been made available. Likewise, small sizes of grain threshers, of ensilage cutters and of feed grinders became popular because the presence of the small tractor on the farm enabled the farmer to perform these respective operations himself instead of having to depend upon the custom outfit which previously had passed from farm to farm doing belt work for hire. By 1944 the United States had 2,000,000 farm tractors, mostly of the handy size, and in Great Britain during World War II the number increased from 55,000 to 160,000 by 1943.

Another major development in the current period of agriculture is the mechanical corn picker. Such a machine was talked of in 1851; some were built and successfully operated about 1910, but not until about 1920 did it really start to take its place in the corn belt. Likewise, rotary hoes, for rapid corn cultivation, were in 1928 just beginning to become popular, although they had been on the market for 20 years.

Although the motor truck is not strictly a farm machine it has proved to be one of the most helpful to farmers. In the U.S. it was estimated in 1944 that 1,100,000 were used on American farms, mostly lightweight ones of the pickup sort.

Among the noteworthy developments in farm machines during the 1930s and '40s were improved planters of various kinds, some very special ones such as machines for planting "sheared" sugar-beet seed, specially cut down so as to produce more single plants and reduce the work of thinning; then there were also many new designs of planting plates, particularly those for planting seed and hybrid corn, including the irregular butt and tip kernels (worth saving when the price is high) and those for planting the very small seeds of some vegetables such as turnips, radishes, cabbage, etc. At the same time devices were developed to make feasible aeroplane planting of rice in California.

In this same period many new harvesters appeared such as the corn picker-sheller, the self-propelled combine harvester-thresher, very small combines for many crops and small farmers, and there were many crop varieties developed with the idea of fitting them better to machine harvesting, for instance, bush snap beans that would produce much of the crop at one time so the plants could be pulled and taken to a machine for picking off the beans, thus

saving hand labour.

The development of new planters and cross-blocking machines for sugar beets was noteworthy as a combination of efforts to produce a good yield while at the same time eliminating much heavy labour. There was considerable development of flame weeders, especially in sugar-cane fields. There was a decided tendency toward more surface cultivation in contrast to deep cultivation. This meant greater use of such tools as duckfoot cultivator shovels.

Significant changes came in ways of fighting insects and fungi. One of these was the aerosol method of spreading, which, at least insofar as field crops were concerned, was still experimental in 1944. The method is to use a highly volatile chemical liquefied under pressure in a steel cartridge and containing the insecticide or fungicide. Opening a valve causes automatic spreading. Such equipment was widely used by military forces during World War II for control of flies and mosquitoes. In addition new insecticides, fungicides and materials for control of nematodes appeared. Machines were made for applying picric acid and "DD," a petroleum by-product, to the soil to kill nematodes.

Manufacturing.—As the farmer found increasing need for more complicated machines and more different kinds of tools and machines with greater variety in agriculture, the manufacture of farm machinery became a great industry, especially in western Europe, Great Britain, the United States, and, after 1920, in Russia. In most other parts of the world the manufacture of farm machines is of only minor and local importance, except perhaps in Canada, South Africa, Australia and New Zealand where considerable numbers of machines are made. The United States is the largest user and the largest producer of farm machinery.

In all the progressive agricultural countries the value of farm implements on farms increased rapidly after 1850 and even more rapidly after 1900, with the widespread adoption of mechanical power for both field and stationary work. As a result of the demands of war, values of machinery on farms receded, but at the same time more thorough use has been made of the implements available. During World War II the practice of pooling farm machines became common in many countries and old machines were brought back into use through repair work and replacement of parts.

One factor of great significance is the rapid increase in durability of many machines, the result of improved materials such as alloy steel, better design and more effective lubrication. These factors no doubt accounted in great degree for the extra wear obtained from farm machinery in wartime.

Credit for the improvements in farm machines during the modern period is not only due to the scores of inventors such as Jethro Tull, Eli Whitney, Obed Hussey, Cyrus Hall McCormick and John Deere, but also to the improvers of steel, the manufacturers and their laboratories, and government and private agricultural research institutions. Through such organizations as, in the United States, the American Society of Agricultural Engineers there has been close co-operation that has speeded developments.

Improved steels really made it practicable to have farm machines move faster in the field, such as mowers, binders, combines and other harvesting machines. These new materials have made it possible for manufacturers to reduce the weight of many implements and to produce more durable parts such as mouldboards of plows and the shovels of cultivators.

Changes in design, of course, have been frequent. Some of the more outstanding have been: changes in plows which provide more space between the mouldboard and the beam, thus reducing the tendency to clog with trash; plow jointers that tend to avoid obstructions and return to the original line of travel, thus reducing draught; enclosed gears that require infrequent lubrication and wear long because they are kept clean; forced lubrication on some of the more complex machines; planting plates and other seed-spacing devices that greatly improve accuracy of plant placement and cut down later labour in tending the crop. These are but a few of many examples that may be cited.

In 1933 the American Society of Agricultural Engineers published a report of a survey made by a group of eminent agri-

cultural engineers on "changes in the quality values of farm machines over a 20-year period (1910-14 to 1932)." These changes in quality values, the result of various factors, were expressed simply in figures by letting 100 represent the quality value at the beginning of the period and then arriving at a figure for the increase in value resulting from various changes. Twenty-five machines were studied in this way.

The index of quality value of the grain binder (horse-drawn), for example, rose from 100 in 1910-14 to 170 in 1932. This estimate of increase in quality value in this one machine was based on 65 engineering developments which were listed in the report. A few of the developments mentioned were: binder driving shaft changed from 10 to 30-40 carbon steel, knottor frame strengthened, heavier teeth in main gear and pinion, and knottor hook made of steel rather than malleable iron.

Following is a list of the other 24 machines and the quality index figure for comparison with the base of 100 representing the quality value of 20 years before: cultivator (single-row riding, pivot wheel), 165; farm engine (gasoline), 200; disk harrow (horse-drawn), 190; peg-tooth harrow, 130; spring-tooth harrow, 140; hay loader, 155; mower (horse-drawn), 170; corn picker, 210; corn planter, 155; tractor plow, 190; gang plow (two-furrow, horse-drawn), 150; walking plow (one-horse), 140; walking plow (two-horse), 140; sulky rake, 135; side-delivery rake and tedder, 140; cream separator, 145; corn sheller (power), 190; corn sheller (two-hole hand or power), 190; sheller (one-hole hand), 170; manure spreader, 180; grain thresher (steel), 195; feed grinder, 175; ensilage cutter (or silo filler), 215; and spraying machine (two-nozzle), 175.

Many improvements have been brought about in farm machines after the making of the survey on quality values. Experience has shown that technical improvements in all sorts of mechanized equipment are sooner or later reflected in better farm implements. Because of the high pressure exerted for improvement of mechanical equipment of many kinds during war there is usually a period of varied and rapid change following hostilities.

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(C. E. GN.; R. B. G.)

AGRICULTURAL PRICES. Prices of agricultural products were of little importance when agriculture was virtually self-sufficing. They are of paramount importance to the typical commercial farmer of today, who sells most of what he produces and buys most of the things he needs for family living as well as many of the things he uses in production. The relation which prices of agricultural products bear to the farmer's living expenses and his expenses of production are of primary importance in determining not only the welfare of agriculture but also what farmers will produce and how much.

From the historical standpoint, special interest in agricultural prices centres on (1) the development of markets and methods of price determination, and (2) the periods of agricultural price depression and prosperity which have resulted from changes in agricultural and other prices.

Development of British Markets.—In the early stages of English agriculture the mass of producers were content to satisfy their own wants and were practically indifferent to outside trade. Later, however, the need arose for some machinery for bringing buyers and sellers into touch, and this was met by the institution of fairs and markets held at fixed places and periods. These in the first instance no doubt arose spontaneously, but it speedily became apparent that the holding of a fair or market in a town could be made a source of profit to the burgesses, or if there were no sufficiently powerful organized community, to the lord of the manor. Thus arose a system of tolls on goods exposed for sale in the market. The crown, exercising its authority as overlord, saw at once an opportunity of revenue and claimed and exercised the right to forbid the holding of a fair or market except under royal charter, which was granted on terms. Tolls and regulations of the market would tend to raise the price level, but the effect could only have been slight.

A more serious effect on agricultural prices was caused by legislation against the practices of badgering, forestalling, engrossing and regrating, which was passed in the early part of the 16th century and did not disappear from the statute book until late in the 18th century. The purpose of this legislation in restraint of trade was to protect the consumer from trade practices which were presumed to raise artificially the price of food. A "badger" was a dealer in food who bought in one place and sold in another. He was licensed for a year and was under recognizances against forestalling, engrossing and regrating. Forestalling was purchasing food on the way to market with intent to sell it at a higher price; engrossing was attempting to control—in modern phraseology to "corner"—the market by buying up all the food for the purpose of exacting higher prices; regrating was the resale of food previously bought in the same market.

The state for many centuries intervened directly in the regulation of the price of wheat and bread. From the Norman conquest to the reign of Henry VI the exportation of wheat was prohibited, although in earlier times it had been common. Importation was unchecked, although there is no record of it until the 14th century.

In 1436 an act was passed authorizing the exportation of wheat whenever the price did not exceed 6s. 8d. per quarter and in 1463 the exportation of corn was forbidden until the price exceeded that at which exportation ceased. Thereafter a succession of enactments were passed some giving a bounty on exports, others imposing a duty on imports, or adopting both methods under limitations of prices. In 1774 an act was passed permitting imports at a nominal duty of 6d. per quarter when the price reached 48s. and forbidding exports unless the price was below 44s. when a bounty of 5s. per quarter was given on exports in British ships.

Up to this time legislation had for its main object the interests of consumers while attempting also to have regard to the interests of producers, and also to encourage shipping. In 1791 the first of a series of acts was passed which, with increasing stringency, aimed mainly at protecting the interests of home wheatgrowers, which continued until the repeal of the Corn Laws in 1846.

In the 13th century the Assize of Bread was established, by which the duty was imposed on justices of the peace of adjusting the weight, quality and price of bread to the current prices of wheat. The system was modified in detail from time to time, but continued in force until 1822 in London and until 1836 in the provinces.

In later times the establishment of great markets in the large centres of population did much to determine prices on the basis of general and not of local supplies. Many of the markets developed from local to national importance by reason largely of their position in relation to means of communication. Covent Garden is a notable instance. It was originally a place where growers of fruit and vegetables in the vicinity of London could dispose of their produce direct to retailers and consumers. The convergence in the metropolis of the main lines of railway made it a national distributing centre, serving, through various channels, all parts of Great Britain, and "Covent Garden prices" became the standard of values throughout the country.

The organization of commercial price-making on a national basis had, however, scarcely been completed when a new factor was interposed which speedily changed the basis on which price levels of some of the principal foodstuffs rested. Imported wheat, meat, cheese, butter and other kinds of agricultural produce were sent to the British markets in ever-increasing quantities. As they increased in bulk and improved in quality their influence became so great that prices in the wholesale markets were determined on an international rather than on a national basis.

The most prominent instance of this modern development is to be found in the wheat trade, where imported grain, forming as it does about four-fifths of the whole supply, dominates British prices and determines the value, at any given time, of British wheat.

Price-making arrangements in the wheat trade are highly organized. World's prices are practically settled at four great markets, viz., Chicago, Winnipeg, Liverpool and London, and so well adjusted and sensitive is the mechanism that fluctuations in one are immediately reflected in the others.

Prices in America.—Prices have been important to American agriculture ever since early colonial days. Although the agriculture of the frontier regions was always largely self-sufficient, much of the total output was for sale either in the domestic or the export market. As the frontier was pushed westward into the fertile valley of the Mississippi, an ever-growing volume of agricultural products was shipped either down the rivers or eastward to the older settlements to be exchanged for all kinds of manufactured products. This rapid growth of agricultural production in America during the 18th century also had a profound effect upon prices throughout the commercial world. Cheap food and cotton from America was basic to both the growth of manufactures in Britain and to the decline in British agriculture.

Throughout most of the history of the United States, the determination of prices of agricultural products has been left to private competitive enterprise in the market places. Tariffs and other government regulations have had their influences, but the actual process of price determination has been left almost entirely to the bargaining of private enterprisers. The most notable exception was during World War II, when price ceilings were

established for most farm products as well as for other products. Nevertheless, prior to the war there had been a growing government participation in the process of agricultural price determination. The Federal Farm Board, through its loan and purchase operations from 1929 to 1933, had an important influence. The Commodity Credit corporation, operating on a larger scale, was a much more important market factor from 1933 on. These loan and purchase operations, together with the influence of the Agricultural Adjustment administration and the soil conservation service upon agricultural production, indicate that the United States has been moving toward a degree of control over agricultural prices comparable to that attained by some European countries a decade or more earlier.

The Course of Agricultural Prices.—Agricultural prices in the United States from the beginning of the 19th century have been influenced by four periods of inflation. The first was due to the War of 1812, the second to the Civil War, the third to World War I, and the fourth to World War II. After each inflationary peak there has been first a sharp decline and then a rather long period in which the general trend of prices has been more slowly downward. In a general way the prices of agricultural and non-agricultural products moved together. However, over the entire period agricultural prices have risen relative to the others—owing to the less rapid improvement in the arts of agricultural production.

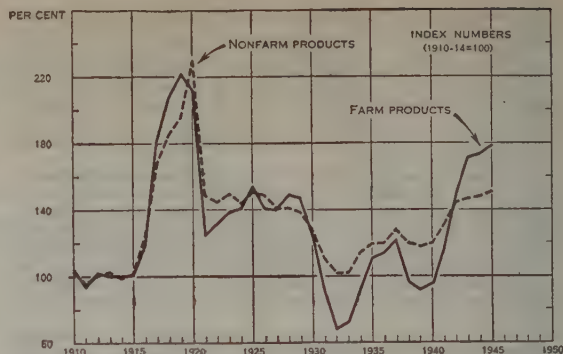
Price changes in England have been somewhat similar to those in the United States, but in England there was no price inflation corresponding to that during and immediately after the Civil War in the United States. Instead, there was a period of gradually rising prices and of agricultural prosperity from about 1850 to 1872. This was in contrast to the long period of falling prices and chronic agricultural depression which had prevailed for about thirty years following the Napoleonic Wars.

From about 1873 to 1895 agricultural prices declined gradually not only in the United States and in England, but also in other countries whose currencies were maintained at a constant level in relation to gold. In England rents fell and marginal land went out of cultivation. In the 1890s, a British Royal Commission stated, "We have no hesitation in expressing our entire concurrence in the opinion that the crisis in agriculture is due primarily to the fall in prices."

Conditions in the United States during the latter part of the 19th century differed greatly from those in England. The area under cultivation was constantly expanding. In the newly settled areas, rents and land values tended to rise at times because of improvements in transportation and in methods of agricultural production, especially the greater use of machinery. For the older settled regions of the United States, however, conditions bore much more resemblance to those in England. Even in the West, where many of the pioneers pushed on from one new frontier to another, exploiting the virgin soil resources as they went, agriculture was not very prosperous because of the declining price level.

The course of wholesale prices of farm products and nonagricultural products in the United States is shown by the accompanying chart from 1910 through 1945. There have been few times from 1920 when the prices of farm products have been as high relative to nonagricultural products as they were in the base period, 1910-14. If the comparison is made between prices received by farmers at their local markets and the prices paid for the goods they buy at those markets it is still more unfavourable to agriculture. Increases in freight rates and other marketing costs widened the spread between local market and central market prices and resulted in an increase of retail prices relative to wholesale prices. As a consequence, there was no time from 1921 to 1941 when the index of prices received by farmers was as high relative to the 1910-14 base as was the index of prices paid, interest and taxes.

Parity Prices.—The disparity between prices received and prices paid by farmers was generally viewed by agricultural leaders in the United States as the primary cause of agricultural distress from 1920. Parity, or the level at which prices of farm



COURTESY, U.S. DEPT. OF AGRICULTURE
WHOLESALE PRICES OF FARM PRODUCTS AND OF ALL COMMODITIES
OTHER THAN FARM, UNITED STATES, 1910-45

products would be as high relative to the prices of things farmers purchased as they were in 1910-14, was widely accepted as the proper goal of agricultural programs. At first the term parity was applied only to each individual farm product. The parity principle as applied to individual commodities became a part of the Agricultural Adjustment Act of 1933 and has since appeared regularly in laws relating to agricultural aid and prices of farm products. The desirability of maintaining prices of individual products at the legal parity has been questioned by economists because the formula does not make allowance for changes in costs of production, in size of crops, or in other things which affect the normal prices of commodities.

Differences Between Countries.—In most countries of the world prices of agricultural products rose during World War I. The extent of the rise and the timing of any subsequent decline depended upon the extent of the inflation and when that inflation reached its peak. The course of agricultural prices in England was fairly similar to that in the United States, but the rise was greater and the decline of the early 1920s was less precipitous and longer continued. In Germany, agricultural prices shot upward under the influence of a postwar hyper-inflation until the end of 1923, when a new currency was established having the same gold equivalent as the old mark. In France, after a temporary decline in 1921 and 1922, prices continued to rise until 1926 when the franc was stabilized at about one-fifth of its former gold value.

Differences in the movement of agricultural prices in the various countries during and after World War I were primarily dependent upon monetary—including credit and foreign exchange—conditions which affected the value of the particular country's currency. Most countries, however, experienced one or two periods of severe declines in agricultural prices at some time between 1919 and 1932. In many countries, however, agriculture did not suffer during the 1920s from prices which were low relative to those of industrial products.

As a result of World War II there were again rapid increases in the prices of agricultural products in most countries of the world. Government price controls were soon resorted to in almost all countries. The degree of effectiveness of the controls varied greatly, as did also the difficulty of the problem of holding inflation in check. The potential inflation as measured by the increase in bank credit and money supply was generally much greater than during World War I, yet through 1945 price increases were less than during the 6½ years following the outbreak of the previous war.

Factors Affecting Prices.—Since about 1920 a great deal of attention has been devoted by economists to statistical and other studies of the factors affecting prices of agricultural products. These include analysis of the prices of individual products, of the relation of agricultural prices as a group to prices of other commodities, and studies of the general price level. Studies of individual products, and even of agricultural products as a group, have been quite successful in arriving at quantitative measurements of the influence of various factors upon prices. Studies

of the general price level have been less successful, not because of inability to measure the numerical relationships involved, but because clear evidence is often lacking as to the causal connections.

It is apparent, nevertheless, that whatever are the monetary and other influences responsible for changes in the general level of prices, these same factors have been important causes of the variations in prices of all agricultural products since 1914. In addition, prices of agricultural products have been largely influenced by changes of industrial production and employment—that is, by changes in the general level of “real” demand. Finally, prices of the individual products have been greatly influenced by various factors which relate specifically to the commodity itself, such as supplies of the commodity and of competing commodities.

Much of both year-to-year and seasonal price fluctuations of agricultural products is occasioned by variations in the weather, but there are also important fluctuations which are the consequence of shifts in agricultural production in response to price changes themselves. Cyclical variations in hog prices are an important example of the latter. (E. J. Wg.; R. H. R.)

AGRICULTURAL RESEARCH, if broadly defined, may be said to have begun when primitive man commenced to observe his experiences with crops and livestock and to interpret his findings with resultant improvements. In modern times it is limited to the manipulation of things, concepts or symbols, with a view to formulating generalizations which verify, correct or extend mankind’s knowledge of all processes concerned with agriculture. Such knowledge may facilitate the construction of a scientific explanation or promote the practice of actual farming. Thus defined, agricultural research encompasses all work in the natural and social science fields that are concerned with or affect agriculture.

In Graeco-Roman times the art of agriculture reached a comparatively high state of efficiency, but this development was based upon centuries of observation and experience rather than research. Scarcely any progress was made in deriving true scientific explanations of the chemical, physical, and biological processes involved in agriculture. The Greek love of speculation gave rise to numerous physical theories, but the validity of these systems could only be established by experimentation. For this mankind had to wait for more than 1,000 years after the disintegration of the Roman empire until Theophrastus Paracelsus (1493-1541) attacked speculative philosophy as the source of knowledge and bid his followers put their faith in experience.

The progress of agricultural research from mediaeval times to the controlled laboratory and field experiments of the 19th century was tortuously slow. Its history is interlinked with that of the modern beginnings of the various sciences and is replete with famous names. Prior to the onslaught of modern industrialization and its accompanying urbanization there was no reason for the segregation of the agricultural part of these sciences or for specialization on distinctly agricultural problems except as determined by the personal interests and experiences of experimenters. For example, the chief contributions of Bernard Palissy (1510-1589), the French craftsman, were in the field of ceramics, and yet his investigation of the nature of soils and fertilizers justifies his being called the founder of agricultural chemistry.

By the beginning of the 19th century the sciences had reached stages of development where further progress seemed dependent on field experiments. Antoine Laurent Lavoisier (1743-1794), who established the foundation of the structure of modern chemistry, conducted numerous experiments on his farm at Blois, France, and prepared reports on his findings with a view to improving agriculture and relieving the poverty of his peasant neighbours. In 1784, Albrecht Thaer (1752-1828), began to turn his attention to agricultural research on an estate near Celle, Germany. In 1802 he converted this estate into an agricultural institute where he lectured on farming. Heinrich Einhof (d. 1808) assisted by teaching the relations of chemistry, physics and mineralogy to agriculture, and many future scientists received their initial training at this institute. In 1804, Thaer was called by King Friedrich Wilhelm III of Prussia to head a new state agricultural institute at Möglin. Another pioneer in the use of

field experiments was S. F. Hermbstädt (1760-1833), a professor at the University of Berlin, who, from 1815 until his death, investigated the chemical composition of cereals and the influence of fertilizers on the production of the proximate constituents of plants.

The modern aspect of agricultural research began with the field experiments of Jean Baptiste (Joseph Dieudonné) Bous-singault (1802-1887). Earlier scientists had developed much knowledge concerning the elementary composition of agricultural products, but no one had sought to follow the balance of chemical elements in the growing of crops or in the feeding of animals. It remained for Bous-singault to seek scientific facts in the fields and stables. Following an adventurous career as a mining engineer in South America, he settled on a farm at Bechelbronn in Alsace where he conducted a carefully planned series of field experiments from 1834 until his land became German territory in 1871. By quantitative methods he investigated the changes in the elementary composition of seeds during germination; the assimilation of atmospheric nitrogen by plants; the rotation of crops; the use of fertilizers; the care of barnyard manure; the nutritive value of forage crops; the feeding of livestock; the influence of feed on the yield and composition of milk; and many other practical agricultural problems. These experiments, co-ordinated with laboratory controls, pioneered in the problems of feeding crops and provided the basis of all modern field work. The facts gathered by this and other methods were reduced to order by Justus von Liebig (1803-1873) in 1840 and later in his brilliant generalizations on plant nutrition and crop production.

In Britain J. B. Lawes (1814-1900) began to experiment with artificial fertilizers at his Rothamsted estate in 1836. Formally organized by Lawes and Sir Joseph Henry Gilbert (1817-1901) in 1843, these experiments are still carried on, and thus Rothamsted ranks as the oldest agricultural station in continuous operation. The effects of their artificial fertilizers on the soils of Britain were so striking that similar experiments were soon made in most countries with mature agriculture. Although the results were not always as clear and definite as in Great Britain, the experiments opened the way to new knowledge of soils, crops and livestock. In the United States where water supply was often a limiting factor in crop production, these experiments led to important developments in soil physics; in France, to the important contributions of Georges Ville (1824-1897) on the use of fertilizers; and in Russia, to far-reaching studies of soil morphology. Animal nutrition was also studied by Lawes and Gilbert at Rothamsted, but considerably developed in Germany.

In due course agricultural colleges and experiment stations were founded as research centres in almost every civilized country. Eventually most countries also created departments of agriculture in their governments which conducted extensive research as well as supervisory and regulatory work. The needs of World War I compelled rapid integration of special studies and emphasized the desirability, if not necessity, of a higher degree of co-operation and co-ordination of research projects, not only within countries and empires, but also internationally. Although impoverished by the war, the European countries extended their organizations for agricultural research in the 1920s and 1930s, and eventually most countries had experiment stations owned and financed by the state; frequently others were financed by private grants, agricultural organizations, or trusts. World War II brought further and greater recognition of the contributions of agricultural research in its many fields to the welfare of mankind.

In Britain parliament provided the development fund in 1909 at the instance of David Lloyd George and assigned a capital sum of £2,000,000 for rural development, including agricultural research and education. It was decided to make grants to existing institutions, holding each responsible for certain fields of agricultural research, rather than to create new stations to cover all fields. The main subjects and the institutions to which they were assigned are: Soils, plant nutrition, and plant pathology at Rothamsted Experimental station; animal nutrition at the Rowett Research Institute, Aberdeen; plant physiology, at the Imperial College of Science and Technology, London; plant breeding at

Cambridge university, the University College in Aberystwyth and the Scottish Plant Breeding station in Edinburgh; fruit research at Long Ashton, Bristol and at East Malling, Kent; the glass-house industry at Cheshunt, Herts.; animal breeding at Edinburgh university; dairying at Reading university, the Royal Veterinary college in London, and the Scottish Animal Diseases Research association; animal parasitology at the London School of Hygiene and Tropical Medicine; and agricultural economics and engineering at Oxford university. The development fund was augmented in 1921, and additional aid was provided through the Empire Marketing board established in 1926. The agricultural societies continued also to make grants.

In Canada one single result of agricultural research, namely, Marquis wheat, has long since repaid all expenditures for experimentation in the commonwealth. A school of agriculture, eventually affiliated with Laval university, was established at Ste. Anne de la Pocatière, Que., in 1859; the Ontario Agricultural college, founded at Guelph, Ont., in 1873, carried on experimental work; and Prince Edward Island had a government stock farm at an early date. It remained, however, for the Dominion Experimental Farms system, established in 1886 after an extended investigation of agricultural conditions by a select committee of the Canadian house of commons, to provide most of the research needed by a vast country with widely varying agricultural conditions and problems. Under the first director, William Saunders (1836-1914), the Central Experimental farm was located at Ottawa and the original branch stations at Nappan, N.S., Brandon, Man., Indian Head, Sask. and Agassiz, B.C. Eventually 29 other stations and about 200 illustration stations were added to the system.

In Australia, the wheat-breeding work of William J. Farrer (1845-1906) at Lambreg, New South Wales, and of his continuators at other stations, contributed much to arable farming. Special attention has also been given to pastoral problems. The Waite Agricultural Research institute, established at Adelaide under A. E. V. Richardson in 1924, began a wide range of planned experimentation, and the Council for Scientific and Industrial Research, created by parliament in 1925, provided federal funds and co-ordination for all stations within the commonwealth. In New Zealand, the privately-endowed Cawthron institute was established in 1915, to supplement the work of the state experimental farms and the colleges. In India, the central station, started at Pusa in 1903 with a gift from Henry Phipps, an American, and removed to New Delhi after an earthquake in 1934, was supplemented by state and college stations.

After World War I notable progress was made in other tropical regions. The Imperial College of Tropical Agriculture was opened in 1922, at Trinidad, for training and research in tropical agriculture. The research institute originally founded by the Germans at Amani, in Tanganyika, was reopened and expanded. The veterinary research station at Onderstepoort, South Africa, early won world recognition as the leading centre in its field. The stations at Gezira and Medani in the Anglo-Egyptian Sudan concentrated on cotton and crops used in rotation with it. The growers also organized and financed experimental work; the Rubber Research Institute of Malaya and Tea Research Institute of Ceylon are examples.

The researches of the separate parts of the British empire were conducted independently of the rest until 1927, when an imperial agricultural research conference recommended that the governments of the commonwealths establish on a co-operative basis bureaux to collect, collate and disseminate information on research in selected branches of agricultural science and generally to assist research workers in the empire with data relevant to their subjects. These bureaux are financed from a common fund supplied by the governments in agreed proportions and governed by an executive council with equal members. The bureaux are located in Great Britain at research centres specializing in the respective sciences as follows: Soil science at Rothamsted, Cambridge; animal health at the Veterinary Laboratory, Weybridge; animal nutrition at the Rowett Research Institute, Aberdeen; plant breeding and genetics at the School of Agriculture, Cam-

bridge; pastures and forage crops at Aberystwyth; horticulture and plantation crops at East Malling, Kent; animal breeding and genetics at Edinburgh; and agricultural parasitology at St. Albans. In 1933, the council also assumed financial and administrative responsibility for the already established Imperial Institute of Entomology in London and the Imperial Mycological Institute at Kew. In 1936, a forestry bureau was located at Oxford and one for dairy science at Reading.

In Denmark, the intensive agricultural system which gained the admiration of the world owes much to agricultural research. After their military defeat by Germany in 1864, the Danes sought, as one of their distinguished statesmen said, "to gain within their borders what they had lost without." For many years the Royal Danish Agricultural society contributed to the advancement of agricultural science by appropriations and continued to serve as an important agency to this end after the organization of a department of agriculture in 1896. The dairy investigations, notably the feeding experiments of N. J. Fjord, at the Royal Agricultural college, Copenhagen, were started in 1872. Its laboratories also conducted feeding experiments with pigs, investigations of animal diseases and testing apparatus used in dairying. Although this institution remained the main centre of research, five other stations and a few substations were established for work on soils, plant pathology, horticultural crops and plant breeding. The Danish Heath Society has aided in the reclamation and forestation of new lands. Economic research on co-operatives and marketing also contributed to the advancement of the country's agriculture.

In France, a large number of research centres continued the practical example of Boussingault. The agricultural college at Grignon, founded in 1827, was long concerned with agronomical problems. The experiments of Ville, from 1848 to 1863, were made at Vincennes, near Paris. The Station Agronomique de l'Est, founded by Louis Grandeaue at Nancy in 1868, emphasized soil investigations. The station at Montpellier studied the vine and its diseases and pests. The Institut Pasteur, although not an agricultural agency, conducted research in plant physiology and microbiology of great importance to agriculture. Soil bacteriology (*q.v.*) began in France as the result of investigations by J. J. Schlössing (1824-1919) and Achille Müntz (1846-1917); other fields were opened up by M. P. E. Berthelot (1827-1907). The striking advances made by S. N. Vinogradsky (1856-1946), who introduced new concepts and more precise methods, made the subject a science. Although the agricultural stations and laboratories were long under the general direction of the ministry of agriculture, they were reorganized into a more comprehensive and centralized system under the institute of agricultural research in 1921 as an office of the ministry of agriculture.

In Germany, an agricultural college was founded at Hohenheim in 1817, but the country had no permanent experiment centre until 1851, when the Economic Society of Leipzig started the station at Möchern in Saxony under Emil Wolff. Similar stations were soon opened, but the most rapid expansion came after the federation of the German States in 1871. Most of the stations were attached to universities and under close government control; they also had certain responsibilities in the regulation of fertilizers, feeds and seeds. In 1888, an association of experiment stations was formed to secure uniformity in methods of investigation and inspection of articles. By the 20th century, the German stations had increased in number and size and had won world-wide recognition. Certain of them contributed to the enormous strides made in the output of synthetic nitrogenous compounds. Among the larger state institutions were those at Halle for animal nutrition, agricultural chemistry and microbiology; at Bonn-Poppelsdorf, Königsberg and Landsberg, for soils, plant nutrition, animal husbandry and plant physiology; at Bremen and Landsberg for moor culture; at Breslau, Hohenheim and Göttingen for agricultural chemistry and bacteriology; and at Berlin and Leipzig (Möchern) for many fields of agricultural science. In addition, the nitrogen and potash syndicates and the superphosphate manufacturers maintained private research laboratories.

The Netherlands has several experiment stations which have specialized on the country's particular problems. The station at Wageningen, begun in 1877, is the largest and is especially notable for the work of H. M. Quanjer in plant pathology and D. J. Hissink in soils. The Netherlands has also won commendation for the admirable research work carried out at Buitenzorg in Java and elsewhere in the Netherlands Indies where scientists pioneered in the field of hill culture.

Russia's best-known contributions to agricultural research are in the fields of soil science and plant breeding. The soils work was begun about 1870, under the leadership of V. V. Dokuchaiev (1846-1903), followed by N. M. Sibirtsev (1860-1900) and K. D. Glinka (1867-1927) and others. In contrast with the scientists of western Europe, who analyzed specimens of soils in laboratories, the Russians studied soils in the fields and then supplemented their findings with laboratory data. They concluded that the character of the soil is largely dependent upon its geographical position and climatic environment, and on this basis developed a system of soil classification. Although not widely known outside of Russia until well into the 20th century, the Russian ideas greatly stimulated research in this field. In the work on plant breeding directed by N. I. Vavilov, emphasis was given to thorough exploration of all parts of the world for varieties and breeding material of value and to extensive programs at numerous locations for studying introduced materials in detail and for large-scale hybridization and selection work. Agricultural research in Russia was completely reorganized after the revolution of 1917. The soviet union was reported in 1938 to have had over 14,000 scientists working at 90 agricultural research institutes, 367 experimental stations and 507 experimental farms with numerous branches.

The history of the British colonies that became the United States is replete with instances of agricultural experimentation. As in all new countries the colonists were obliged to determine by experimental plantings the crops that thrived in the respective localities, and the desirability of encouraging such experimentation through aid from the imperial and local governments was early recognized. A number of distinguished leaders, including John Winthrop, Jr. (1606-1676), William Penn (1644-1718) and Jared Eliot (1685-1763) conducted agricultural experiments. John (1699-1777) and William Bartram (1739-1823) and Humphry Marshall (1722-1801) maintained botanical gardens near Philadelphia, Pa., and a public experimental garden was established at Savannah, Ga., in 1733.

About 1760 George Washington began to study agricultural problems systematically and to make experiments to ascertain the best methods for his Mount Vernon estate and vicinity. Thomas Jefferson gave special attention to natural phenomena in relation to plant growth, introduced plants useful to American agriculture, and made Monticello a veritable experimental farm. For about 30 years, John Beale Bordley (1727-1804) conducted experiments on Wye Island near Maryland's eastern shore, and John A. Binns (1761-1813) devoted two decades to experiments with gypsum in Loudoun county, Va. Beginning in 1785, the efforts of these men and others were facilitated by agricultural societies (*q.v.*), formed for the promotion of agriculture. Among the individuals who made outstanding contributions was Edmund Ruffin (1794-1865), whose essay on calcareous manures has been described as the most thorough work on a special agricultural subject ever published in English. The numerous geological and agricultural surveys during 1820-1857 laid a considerable foundation for the more intensive work of the experiment stations with soils and fertilizers in their relations to plant growth.

Except for special projects, the first federal fund specifically authorized for agricultural purposes was the \$1,000 voted the patent office in 1839 for collecting agricultural statistics, conducting agricultural investigations and distributing seeds. With this and later appropriations, an agricultural division in the patent office served as a federal clearinghouse for information on agricultural improvements during the 1840s and 1850s. After long agitation the federal department of agriculture which ultimately became the most extensive agricultural research agency in

the world was created by congress and approved by President Lincoln on May 15, 1862. On July 2 of the same year, the bill providing for the establishment of a college of agriculture and mechanical arts in each of the states was signed. Beginning in the 1840s steps were taken to establish institutions of research under private and then state auspices, but it remained for the Hatch Act of 1887, augmented by the Adams Act of 1906 and the Purnell Act of 1925, to provide the federal aid that facilitated the development of the national system of experiment stations associated with the agricultural colleges in all the states and territories. To direct the relations between the federal department and the stations, the office of experiment stations was established in 1888. Its publication, the *Experiment Station Record*, has provided abstracts of the reports on scientific research in the U.S. and foreign countries from 1889.

By the end of the 19th century, discerning leaders throughout the world were becoming increasingly aware of economic and social problems relating to agriculture and farm living. The agricultural colleges and the federal department had begun work in this field, and the findings of the Country Life commission appointed by President Theodore Roosevelt served to focus attention on the need of both study and action. In 1913, the federal department was authorized to study the marketing and distribution of farm products. The needs of agriculture during World War I and economic repercussions afterward resulted ultimately in the department's bureau of agricultural economics becoming one of the greatest agencies of research in the social sciences.

Although the stations tended to specialize on the agricultural problems of the states where they were located, leaving to the federal department the investigation of general scientific principles and subjects beyond local means, there was a growing recognition of the need of co-operative action on problems common to several states after World War I. In 1935, the Bankhead-Jones act made special provision for the federal department to undertake scientific, technical and economic research into the laws and principles underlying basic problems of agriculture in its broadest aspects. In the 1920s more emphasis was given to discovery and perfection of new consuming outlets for farm products by the federal department and the stations. Improvements in the sugar industry, the production of casein and the revival of the naval stores industry in the south may be cited as examples. In 1933, a federal laboratory was established at Ames, Ia., to study the industrial uses of agricultural residues like straw, cornstalks, corncobs and hulls. Later a laboratory at Urbana, Ill., began to investigate the possible wider uses of soybeans. In 1938, congress authorized the federal department to extend this type of laboratory upon a comprehensive scale by providing for regional laboratories which were located at New Orleans, San Francisco, Peoria, Ill., and Upper Darby, Pa. In 1910, the federal government began to develop what became a national agricultural research centre near Beltsville, Md. By 1945, much of the laboratory and field work of the scientific bureaus of the department of agriculture had been transferred there, and the centre comprised 13,900 ac., 36 laboratory buildings, 31 greenhouses, 100 barns and storage buildings and 500 other buildings.

The interchange of scientific data between the countries of the western hemisphere began in the 1840s, and the need was long felt for inter-American action to carry out research projects which require methodical study and joint action by both the governments and scientists. The first Inter-American Agricultural conference, held in Washington in 1930, recommended the establishment of a Pan-American experiment station to serve this end, and after long negotiation and planning the Inter-American Institute of Agricultural Sciences was inaugurated at Turrialba, Costa Rica, in 1944. Its work was planned to fall in four broad departments: animal husbandry, plant industry and soils, agricultural engineering and economics and rural life.

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AGRICULTURAL REVOLUTION, THE, a term indicating that period in history which witnessed the transition of English methods of farming from mediaeval to modern conditions. During the 18th century increasing knowledge and new inventions revolutionized both agriculture and stockbreeding. At the same time the rapid growth of enclosures vastly improved the conditions under which farming was carried on. But it increased the resources of the great landowner to the extinction of the yeoman farmer, and thus an essentially progressive movement in agriculture brought much misery in its train. The expenses incurred by the enclosure movement, the subsequent rise in the value of land, reductions in agricultural establishments, the protective system of the corn laws, and the supplementing of wages from the rates (Speenhamland system [*q.v.*] 1795) raised prices, lowered wages and depressed a large section of the agricultural population to the level of paupers. (Cf. INDUSTRIAL REVOLUTION.) See also AGRICULTURE: A GENERAL SURVEY; COMMONS; CORN LAWS.

AGRICULTURAL SOCIETIES AND SHOWS. In agricultural history there is scarcely a parallel to the enthusiasm that spread through Great Britain during the last quarter of the 18th century. Even George III contributed to Arthur Young's *Annals of Agriculture* and became known as "Farmer George." The politicians, including Fox and Burke, the great landowners, such as the Duke of Bedford and Coke of Norfolk, shared in the zeal and were excited by farming topics and busy with farming experiments. One of the results was the organization of associations for the promotion of agriculture in many parts of the country. Among the earliest and most important were the Bath and West of England society (1777), the Highland society (1784) and the Smithfield club (1798). Another result was the founding of the board of agriculture by Pitt in 1793 with Sir John Sinclair as president and Young as secretary.

A chief activity of many of these societies was the holding of an annual agricultural show. As a rural institution combining exhibit and amusement features it is now found in practically all countries of the western world. In Europe and Australia it is known as an agricultural show, while in the United States and Canada it is usually called a fair. Possibly the earliest local agricultural show was that of the Lancashire society in 1761. The first national show was held by the board of agriculture in 1821.

The Royal Agricultural Society was founded in 1838 and received its charter in 1840. Its first show was held at Oxford in 1839 under the presidency of Lord Spencer. The classes for cattle, sheep, horses and pigs were limited, but the names of many famous breeders appeared in the award sheet. Nineteen manufacturers were represented in the implement exhibit. Many had only one entry, but the display by Messrs. Ransomes was extensive. Prizes were also given for essays on agricultural subjects, for skill in plowing and for white and red wheat. From that day the scope of this annual show, as that of most others, has increased, and its form has been closely imitated in the British empire and foreign countries. Although Britain has become overwhelmingly industrial, its agricultural shows are superior in magnitude and excellence to any in the world.

The royal show has always been peripatetic, except in 1903, 1904 and 1905, when it was taken to Park Royal, on the north of London, with disastrous financial results. The prevailing principle in the selection of sites is to alternate populous districts with rural centres. Except when the weather has been unfavourable, the receipts from the first usually enable the society to bear the losses sustained in the second.

Several of the local shows are comparable with the royal shows, though smaller and of shorter duration. A similar variety of exhibit is seen in the shows of the Highland society, the Bath and West of England society, the "Royal Counties" and the "Three Counties" in the Welsh national, and in many of the larger county shows. Many of these, as well as the royal, have attracted large numbers of foreign buyers, especially from South America.

Most of these shows and the societies that sponsored them progressed, with some oscillations, until the depression years following World War I when it became apparent that they were too numerous and elaborate. Although such shows as those of the Suffolk, Lincolnshire and Cornish societies continued prosperous in the 1920s, a movement for the merger of local and county shows began. Yet the breed associations, more in Britain than in other countries, are the backbone of the shows and give no sign of decline.

The great additions to the scope of the shows in the 20th century were made not only with the idea of promoting agricultural science but to draw larger attendance and so provide funds for the proper objects of the societies. The royal show, which continues for five days, may occupy as much space as 100 ac., and the machinery, much of it in operation, is alone a great feature. Besides almost all breeds of livestock and poultry, there are exhibits devoted to flowers and forestry, sections on education and science, and displays of rural crafts and the work of the women's institutes. A dairy is seen in action several times a day. Lectures and demonstrations of many sorts are given at intervals, and every afternoon, except on the opening day when most of the judging is done; horse jumping and harness competitions draw large crowds.

The fat-stock shows, held in November and December, and the dairy show, held in London in October, have flourished under urban conditions. As dairying took the lead over corn growing in British farming following World War I, the annual dairy show became a remarkable epitome of the science of dairying and of the quality of the dairy breeds. Of the winter fat-stock shows the three attracting the best entries are held at Norwich, Birmingham and the Agricultural hall at Islington in north London. From the first the Smithfield club has always emphasized the supply and breeding of meat in its London show.

The Countries of the European Continent also have vast agricultural shows. Among the more important are the Concours Général Agricole de Paris, the East Prussian Agricultural exhibition, the International Exhibition of the Cheese Industry and Trade of Italy and the General Association of Breeders National show in Spain.

Agricultural Societies in the United States were long an important means by which farmers effected mutual help and gained knowledge needed in solving technical problems. There is evidence of several ephemeral organizations of this sort during the late colonial period, but the two oldest of those still functioning (1946), namely the Philadelphia and the South Carolina societies for promoting agriculture, were founded in 1785. The Columbian Agricultural society, which aspired to national leadership, was begun at Georgetown, D.C., in 1809. These societies, together with other local and state groups modelled on them, were pioneers in agricultural education. They provided the public with accounts of the best agricultural practices abroad and the results of experiments conducted by their own members. Several of them endowed professorships in natural history, chemistry and agriculture. For the most part their membership consisted of men primarily concerned with public affairs rather than dirt farmers.

The incorporation of the Berkshire (Mass.) Agricultural society in 1811 marked the beginning of a new trend. Its founder, Elkanah Watson, was convinced that the societies should be organized by counties and on a more democratic basis. His success in developing the fair as the main educational medium for agricultural societies led to an organizational movement that was practically nation-wide. The allotment of state funds to county societies was an important factor in their rapid expansion, begin-

ning with New Hampshire in 1817. With the discontinuance of state aid, the number of societies declined, but there was a revival of interest in them in the 1830s.

Following an abortive attempt to effect a national association in the early 1840s, the United States Agricultural society was organized in 1852 by representatives of 23 states and territories to co-ordinate the work of county as well as state groups. Its membership included farmers as well as men prominent in political life. It held annual sessions and sponsored exhibitions and field trials. It was influential in securing the establishment of the United States department of agriculture.

The nature of the problems confronting the farmers after the Civil War resulted in new types of societies. A series of farmer organizations turned to political action as a main means of improving the agricultural situation (see AGRICULTURAL ORGANIZATION). Simultaneously, with specialization in farming, societies began to be organized according to the crops or livestock raised. The oldest horticultural society was started in 1829, and several states authorized boards of horticulture relatively early. It was not, however, until after 1875 that the interest in pure-bred livestock resulted in the organization of numerous breed associations that maintained registries and otherwise promoted their respective breeds. Similar organizations appeared for the various field crops, vegetables, fruits and nuts. With the progress of agricultural education and the sciences pertaining to agriculture, the technical specialists formed the American Society of Agronomy, the American Farm Economic association and similar professional organizations.

With the 20th century, county societies as visualized by Watson disappeared or limited their activities to the annual fairs. Even the state societies lost most of their former influence. Their place in the field of education was taken by boys' and girls' clubs, the county farm bureaus and similar units of the Grange and the Farmers union, and by local clubs devoted to community development.

Agricultural Fairs and exhibitions were an integral part of U.S. rural life for more than a century and played an important part in the progress of agriculture. The first fair is usually credited to Washington, D.C., where a series of three was begun in 1804. Although combined with sales, premiums appear to have been offered. After a brief lapse, the Columbian Agricultural society held a series of five fairs in Georgetown, D.C., beginning in 1870. It remained, however, for Elkanah Watson, a wealthy business man who had retired to Pittsfield, Mass., for "rural felicity," to demonstrate and sell the values of fairs as a distinctive educational institution in the U.S. In 1807 he exhibited two Merino sheep on the village green, and three years later he induced his neighbours to form a society, pledged to hold an annual fair. Thus the Berkshire Agricultural society became the first permanent fair association in the United States.

The movement for county agricultural societies and fairs spread fairly rapidly, and Watson was active in assisting in their organization. In 1819 the New York legislature appropriated \$20,000 for two years for the county fairs of that state; and after a few years other states generally provided modest subsidies for their fairs.

The fairs prior to 1870 were primitive and crude. Those held by county societies usually lasted two days and those by states three days. Few of the fairgrounds were more than 10 ac. in extent and usually not more than 1 or 2 ac. State fairs were rotated from city to city. Inadequate transportation was a drawback. For instance, low water on a navigable river often dictated failure. The inadequacy of funds was also a dominating factor. The premiums were modest, and the highest awards were usually certificates of membership in the society. Agricultural books and subscriptions to agricultural periodicals were also given as awards. In many lines the exhibits were meager and poorly classified, and the judging was done by impromptu committees. Plowing matches were held, but amusement features were subordinate. The annual address had a leading place in all programs. Horace Greeley was probably the most widely known and celebrated lecturer. Abraham Lincoln's address before the Wisconsin State fair at

Milwaukee in 1859 may well have helped win him the presidency.

The Civil War had an unsettling effect on the fairs. The grounds were usually used as places for assembling and quartering troops, and the Indian uprisings and invasions were disturbing. The years following 1870, however, brought revival and change. The country was experiencing a vast expansion of agricultural production. Class-conscious farmer organizations sprang into being. The land-grant colleges became the established medium of agricultural education, and the work of the federal department of agriculture was extended.

In consequence, the main educational functions of the fairs came to be carried out in co-operation with the colleges and the farmers' institutes. The lectures and evening sessions were discontinued. The depressions and the competition of the world expositions cut the attendance. The amusement features came to the fore. Horse racing, velocipedism, balloon ascensions and eventually auto races became major attractions. Circus stunts and spectacles such as locomotive collisions were added. Night shows featuring pyrotechnics were popular. Many of the fairs were extended to cover a week or more. The problem of what to emphasize on Sundays was solved by including sermons and musical concerts.

After 1910 there was a revival of interest in the educational features of the fairs. Boys' and girls' club work and farm bureau activities contributed immeasurably to this end. Judging contests, home economics, visual instruction, health clinics, agricultural engineering demonstrations and pageants received considerable attention. Many of the larger associations systematized their organization and hired expert managers. Including regional, state, district, county, community, township, school and street fairs, the number is around 3,000, and the range in character of exhibits, time and location is large.

The first great show of more than local importance, known as the American Fat-Stock show, was established in 1878 by the Illinois state board of agriculture and was held annually in Chicago from that time until 1897. It was the outgrowth of the desire of a number of stock breeders and feeders, as well as men interested in horses and swine, to stage a show in keeping with the progress of the purebred livestock industry. The show was patterned after the famous Smithfield Club show in England and flourished for many years until political influence and inadequate support caused its failure in 1897. Three years later, the present International Live Stock exposition was organized. It held its first show in Dec. 1900, at the Union Stock Yards in Chicago. It was founded largely through the efforts of a group of admirers of purebred animals which included such famous leaders as Robert B. Ogilvie, Mortimer Levering, William E. Skinner, Alvin H. Sanders, John Clay and John A. Spoor. Profiting by the experience of the old Fat-Stock show, the new organization laid plans for a great educational institution free from political favoritism. Following closely the ideals of the founders, succeeding directors have made the International the leading exponent of a great movement for the improvement of livestock and crops in the U.S. The International has been held annually in Chicago ever since its organization, except in 1914 and 1915, when it was omitted because of the presence of foot-and-mouth disease in the United States. Staged usually during the last week in November and the first few days in December, a time when all other fairs and shows have been completed, the International draws the year's prize-winning draft horses, beef cattle, swine, sheep, grain and hay exhibits from the United States and Canada. The organization owns its own grounds, covering 500 paved acres. Joined to the many barns and other buildings housing the show stock is the amphitheatre, seating 12,000 visitors and enclosing a tanbark arena 238 ft. long. There the finest livestock in North and South America are paraded before the eyes of leading judges of North and South America and Great Britain. Carlots of fat stock and individual dressed carcasses are exhibited. Standards have been set by this show. Year by year this institution has expanded until all major phases of U.S. agriculture are embraced within its scope. While the display of breeding and fat livestock is still the cornerstone of the exposition, many educational and

entertainment features have been added from time to time. The evening horse shows, including ponies, hunters and jumpers, saddle and light harness horses, have won world fame for the quality of the entries. The various state colleges have long been exhibitors of some of the finest livestock in all classes and the annual livestock judging contest for agricultural college students is of far-reaching importance as an educational feature. Within the last decade 1,000 or more farm boys and girls have attended the International annually as a reward for achievement in club work in agriculture and homemaking. Classes for baby beeves and lambs raised and fitted for show by these young farmers have formed one of the new and important attractions, and the livestock judging contest, open to champion junior judging teams from every state, is another innovation. Interest in feeding, fitting and showing livestock is encouraged by a large class of awards for herdsmen, caretakers and other helpers.

While the International is the livestock classic of the year, there are other shows of great importance to the regions in which they are held. The exhibits at such shows are often on a par with those at the International, although they draw from a much more limited territory. Such shows as the American Royal Live Stock show held annually at Kansas City, Mo., the Pacific International Live Stock exposition at Portland, Ore., the Southwest Exposition and Fat Stock show at Ft. Worth, Tex. and the National Western Stock show at Denver, Colo., are important shows held prior to the International. From these it draws many of the winning animals. The great show of the east is the Eastern States exposition held annually at Springfield, Mass., from its organization in 1916. Dairy cattle are the big feature of this show, although there are always excellent classes of all breeds of beef cattle, sheep, swine, light horses, hunters, jumpers and ponies.

The National Dairy show is primarily a show for the advancement of the dairy industry, although some classes are held for horses. Its livestock exhibit consists of 1,000 or more of the finest dairy cattle of all breeds in the U.S. It is by no means limited to the livestock end of the industry. Machinery and equipment for the creamery, the distributing plant and every other phase of dairy manufacture, form a large part of the attraction and add to the educational value of the show. The show was first held in 1906 in the Chicago Coliseum. The success of this first venture resulted in the organization of the National Dairy association and the continued success of the show thereafter. It is a much travelled show, having been held in Chicago, Ill.; Columbus, O.; Springfield, Mass.; Milwaukee, Wis.; Detroit, Mich.; Indianapolis, Ind.; St. Paul, Minn.; and Memphis, Tenn. Another important dairy show is the Dairy Cattle congress held annually at Waterloo, Ia. The National Swine show is the leading show in the world of breeding swine and is devoted exclusively to this branch of the livestock industry. While in point of numbers it is often exceeded by some of the larger state fairs, no other swine show draws so many champions of the various breeds from all parts of the continent. It was organized by the National Swine Growers' association primarily as a breed-promotion institution, holding its first show in 1916 at Omaha, Neb. It has also travelled, having at different times been held in Cedar Rapids, Ia., and Des Moines, Ia. In 1921 it moved to Peoria, Ill., where the association now owns its buildings and grounds.

Poultry shows have been held in the United States for more than 50 years. Thousands of shows of varying sizes are held annually, small towns and communities having their local shows and many state fairs having poultry exhibits also. Large state shows are held later in the season and are followed by regional or international shows. The leading poultry show is the Madison Square Garden Poultry Show at New York city, where it has been a regular event from 1870. Thousands of birds are exhibited in individual cages designed to show them to advantage. Pigeons, bantams and every other variety and breed of feathered domestic fowl are included. The Boston show was the first large poultry show in the U.S., having been started in 1865. It is well balanced and in some respects is better than the Madison Square Garden show. Other poultry shows of nation-wide interest are held in various cities.

There is scarcely a branch of the agricultural industry that does not have some show of more or less national scope. Special shows are held by rabbit breeders and fanciers, by kennel clubs and by organizations interested in bees and in songbirds. There are shows exclusively for horses of certain breeds, for fruits and vegetables and for flowers. The Society of American Florists and Ornamental Horticulturists holds the National Flower show at a different place each year. The International Flower show is held annually in the Grand Central palace, New York city. The American Orchid society holds a large show, usually every other year, at Madison Square Garden. Countless other flower societies exhibit their new products in various local and regional shows. Obviously all these exhibits are of immense value to specialists as well as amateur breeders and growers in making progress in their profession.

Canada.—Approximately 500 fairs are held annually in Canada, most of them being provincial or local. Probably the first was at Niagara-on-the-Lake (then Newark, Ont.) in 1798. The most important is the Canadian National exhibition at Toronto. Held usually in September, it includes practically every branch of agriculture and allied industries and emphasizes educational features.

Another fair of note is the Royal Agricultural Winter fair, patterned after the Royal Agricultural society's show in England. It was first held in 1922 on the grounds of the Canadian National and grew rapidly. This annual show is usually in December and is limited to livestock, grain, hay and other farm products. Its entries are drawn from Canada, the United States and other countries.

Other agricultural fairs of note are the Central Canada exhibition at Ottawa, the Calgary Exhibition and Stampede, the Old Winter fair at Guelph, the Provincial exhibition at New Westminster, the Quebec Provincial exposition, the Provincial exhibition at Regina and the Great Eastern exhibition at Sherbrooke.

South America holds many local or regional fairs and expositions every autumn, but the principal one is the Argentinian *Exposición Nacional de Ganadería*, usually called the Palermo show. This exposition ranks with the leading livestock shows of the world. It was inaugurated in 1875, with but 18 head of horned cattle by the Argentine Rural society (founded in 1866). Its early progress was irregular and in some years no shows were held because of financial and other difficulties. With the growth of the livestock industry in Argentina and other South American countries it finally became established and is now held annually in the autumn at Buenos Aires, where the society owns grounds and buildings near the fashionable Palermo suburb. The Palermo show is principally a beef-cattle show. There are often from 1,000 to 1,800 head of Shorthorn bulls in the show rings. The Shorthorn classification is perhaps the most elaborate show-ring exhibit to be found in any livestock show in the world, there being as many as 29 classes, in which the animals range from junior yearlings to 3-year-olds. The great number of classes is due to the separation of the animals into groups differing in age by from 15 to 30 days, whereas in other countries most show classes are from 4 to 8 months apart in age. Another unique feature is the compulsory auction of practically all animals exhibited, the purchaser paying a selling commission of 6%. The commission rate is doubled if the owner buys back his own exhibit. The auctioning of the grand champion bull is the outstanding attraction and has become an event in the social season. A week or ten days is often required to complete the auction after the closing of the show. Besides Shorthorns, other breeds are shown in great numbers and in good quality, as are horses of both light and draft breeds, sheep, swine, poultry and other agricultural exhibits. Dairy cattle are also an important feature of interest. The exhibition grounds are beautiful and in perfect condition and the buildings are elaborately designed and well-arranged around the show rings to permit all judging to be done in the open.

Two other important livestock shows in South America, both of which are held in Uruguay, are the National Live Stock and Poultry exposition at Montevideo, and the Live Stock and Poultry exposition at Salto.

The exposition at Montevideo is under the management of the Rural Society of Uruguay and is largely a cattle show, but there are usually good classes of sheep, swine, dairy cattle and horses. The Salto show is principally a cattle show, the Hereford breed predominating.

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(E. E. Es.; L. S. R.; X.)

AGRICULTURAL STATISTICS. Agricultural statistics have a vital, basic significance in a nation's social and economic welfare. The practical use of statistics of production, supplies and movements of the products of agriculture has been highly developed by business and governments. The world-wide depression of the early 1930s, and the ensuing increased activity of governments in aiding or controlling agricultural production and marketing added impetus to the further development and use of agricultural statistics. War emphasizes still further the fundamental national importance of maintaining adequate sources of information on agricultural resources, potentialities and deficiencies.

The regular systematic collection of statistics relating to agriculture began early in the 19th century. Annual estimates of agricultural production were begun in France in 1815. In the United States, agricultural census taking began in 1840, and annual estimates of production in 1866.

In England it might be claimed that the first agricultural statistics were those collected in the 11th century in Domesday Book, which included a record of the use of all land then under cultivation. Gregory King estimated the use of land and the production of England at the end of the 17th century. But it was not until in the 19th century that the state undertook, as an ordinary function of administration, the annual collection of statistical information about agriculture. In the early part of the 19th century spasmodic attempts were made from time to time in different parts of the country to collect agricultural statistics. In 1855 a committee of the house of lords reported in favour of uniform and compulsory returns and in 1864 a resolution was passed by the house of commons demanding the immediate establishment of a national system of agricultural statistics. No legislation was passed but the board of trade gave effect to the wish of parliament and established a system of annual returns from every occupier of agricultural land of the acreage of crops and number of livestock on each holding. The returns were first obtained in 1866, and in 1884 they were supplemented by the collection of estimates of the year's yield of the principal crops. The responsibility for the collection of all agricultural statistics was transferred from the board of trade to the board of agriculture soon after its establishment in 1889.

The most systematic attempt to provide agricultural statistics by private enterprise was that made by Lawes and Gilbert in their calculations of the production and consumption of wheat in the British Isles. These were started in 1852 and continued annually until official estimates of the yield of wheat and other crops were begun 32 years later.

In many countries the field of agricultural statistics has been extended to include the collection of price data, estimating cost and income, and securing data relating to the occupiers of and the conditions of living on the land.

The International Statistical Institute and the International Institute of Agriculture have been influential in extending the systematic collection of statistics relating to agriculture in many countries in recent years. About 1930 an effort was made to encourage countries which had not developed systematic census taking, to take a census which could be co-ordinated with the censuses of other countries so as to obtain a more complete world-

wide coverage of agricultural production. The most significant development in agricultural statistics in recent years is the use of current and historical data relating to prices, supplies and economic conditions affecting the demand for agricultural products, to forecast or estimate probable prices in the market or the income from the products of the year. Such analyses are being used extensively in the U.S. and to some extent in other countries as a basis for formulating programs and policies relating to agriculture.

Systems of Collection.—Most of the larger nations, and many private business groups, maintain trained organizations and well developed methods for gathering agricultural statistics. In the U.S., the department of agriculture issues comprehensive regular, periodic and special reports that are accepted by business generally as authoritative. The department's monthly forecasts and reports on crops and markets are awaited by all major lines of business and are quite a material factor in determining business activities. These statistical reports are gathered and compiled by a trained staff. In addition the department maintains specialized services throughout the country, such as those of grain inspectors at 135 shipping points and meat inspectors at packing centres. The quinquennial census also provides comprehensive data and serves as a valuable test-check.

There are a number of private agencies that supply agricultural statistics which are accepted as authoritative. These usually relate each to a specific commodity such as cotton, wheat, sugar, etc. Outstanding among such statistical organizations is Broomhall's, Liverpool, whose forecasts and reports on grain are standard market information throughout the world. The New York Cotton Exchange, and other large commodity markets maintain permanent statistical organizations to supply information on production and distribution.

Statistics of World Agriculture.—Nearly all countries have been signatories to the International Institute of Agriculture, Rome, which supplies regular monthly and annual reports and special studies on the major crops, livestock and livestock products of the entire world, excepting chiefly U.S.S.R. and China, for which information is fragmentary. The Institute issues a monthly *International Review of Agriculture*, which contains official reports on conditions of agricultural production in nearly all countries, forecasts of crop yields and size of harvests. The Institute's *Yearbook of Agricultural Statistics* is an annual summary of world agricultural production and, like its monthly reports, is printed in English and French.

The average annual production (1935-39) of four principal cereal crops in major producing areas was as follows, the figures representing millions of bushels:—

	Wheat	Rye	Barley	Oats
Europe (Except U.S.S.R.)	1,626	898	719	1,745
North America	1,086	54	331	1,384
Africa	143	1*	121	22
Asia (Except U.S.S.R.)	1,442	..	768	..
South America	281	10†	28	61‡
Oceania	177	0.2	13	27

*University of South Africa only.

†Argentina only.

‡Argentina, Chile and Uruguay only.

Statistics of farm livestock are less complete than those of crops and are in many countries collected infrequently at irregular intervals. The following table shows approximately the world's totals of the principal meat animals in comparison with the human populations of the six great world areas, in thousands.

	Population*	Cattle†	Sheep†	Hogs†
Europe (Except U.S.S.R.)	398,287	110,200	120,300	81,200
Soviet Russia	170,467	48,500	79,680	23,000
North and Central America	182,409	96,600	59,700	61,300
South America	91,192	105,600	101,000	31,200
Asia (Except U.S.S.R.)	1,108,634	283,000	139,500	80,000
Africa	158,408	61,100	100,600	3,300
Oceania	10,610	18,000	143,900	2,100

*International Institute of Agriculture, 1938 figures.

†Reports of U. S. Department of Agriculture, Office of Foreign Agricultural Relations, averages for 1936-40.

Unfortunately no statistics of any reliability are available for China (pre-eminently an agricultural country). The annual value of pigs reared in China must be enormous and cattle and horses are everywhere in evidence; but the unsettled state of the country has made records difficult to obtain.

The distribution of the animals and their relative importance as indicated by their density are shown in the following table:—

Country	Number of livestock per 1,000 hectares*			
	Horses	Cattle	Sheep	Pigs
United States	14.0	85.8	68.4	57.4
United Kingdom	45.6	363.6	1,091.3	181.7
Canada	3.1	0.5	3.8	3.9
Germany†	73.0	435.6	90.7	506.6
France	48.9	286.8	181.4	129.2
Italy	25.5	247.3	395.3	94.8

*1 hectare = 2.47 acres. †Figures for Germany do not include Austria or the Sudeten; do include Saar. The figures for livestock are for 1938.

Statistics of British Agriculture.—For many years statistics of British agriculture were collected by the Board of Agriculture for Great Britain and the Department of Agriculture for Ireland. In 1912 the Board of Agriculture for Scotland was established and took over the collection of statistics in that country. When Ireland was divided, separate departments were set up for Northern Ireland and Eire so that there were then four departments responsible for the agricultural statistics of the British Isles.

During World War II food production was greatly expanded as indicated by the following figures of acreage and production:

Crop	Acres (thousands)		Production (million bu.)	
	1939	1944	1939	1944
Wheat	1,766	3,220	61.4	117.2
Barley	1,013	1,973	41.6	81.8
Oats	2,427	3,056	140.2	206.7
Potatoes	704	1,421	104.7	368.1

The numbers of farm livestock, including poultry, in the United Kingdom in 1944 were as follows: Horses and colts, 918,000; cattle and calves, 9,501,000; sheep and lambs, 20,108,000; pigs, 1,867,000; chickens, 50,301,000; ducks, 3,004,000; geese, 905,000; turkeys, 995,000.

Particulars of other crops, and statistics relating to agricultural output which are not included in the annual returns are obtained from time to time in connection with the census of production (see AGRICULTURE, CENSUS OF).

Statistics of Agriculture in the U.S.—The averages (1934-43) of the annual estimates of the area and production of some of the principal crops in the U.S. are presented as follows:

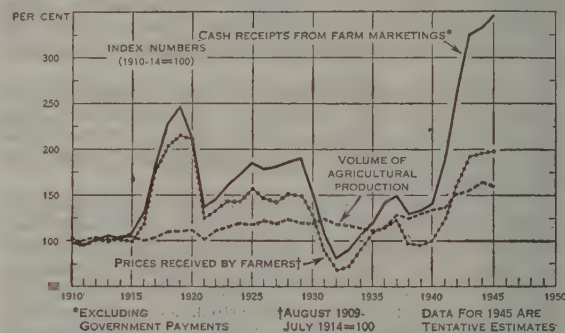
	Acres harvested (millions)	Production (million bu.)
Wheat	53.8	780.1 bu.
Corn	91.2	2,433.1 bu.
Barley	12.0	273.5 bu.
Oats	35.8	1,068.4 bu.
Cotton	25.6	12.3 bales
Tobacco	1.5	1,392.0 lbs.
Potatoes	3.0	375.1 bu.

The crop areas seeded and harvested in the United States vary considerably from year to year. The area of wheat harvested is in many years considerably less than the area seeded because of heavy winter freezes, droughts and diseases. The acreage losses from the seedings of the other crops are as a rule small. The estimates given above represent the areas harvested. The 10-year averages are presented as a better indication of areas and yields than the estimates of any one year which may be affected significantly by droughts or other conditions causing considerable changes in either the area harvested or the outturn of the crop.

In recent years the department of agriculture has extended its estimating service to include intentions to plant crops. The data are collected in advance of seeding so that each individual farmer may have some information as to what farmers generally are planning to do for the forthcoming season. These data are useful in determining the marketing policies of both private and co-operative distributors. They are used by the federal government also in determining production and marketing policies. Averages

of the annual estimates for the 10 years (1935-44) of the numbers of the most important species of livestock on farms in the U.S. are: horses and mules, 14,729,000; dairy cattle, 25,656,000; all other cattle, 45,381,000; sheep, 52,768,000; hogs, 55,300,000; chickens, 447,889,000.

The numbers of animals in the U.S. vary considerably from year to year and in cycles of years. The production of hogs in the U.S. is such an important factor in the agricultural economy of the country that an elaborate statistical service has been developed for this industry. In addition to estimating the number on farms as of January 1, the department of agriculture estimates in June and December of each year the number of pigs farrowed and the number of sows bred or to be bred. These estimates of breeding and farrowing are designed to provide a basis for estimating the number of hogs likely to be marketed and the pork production in the season ahead. Reports from slaughter establishments provide a basis for estimating the actual production of pork. The dairy and beef-producing industries of the U.S. are likewise important, but the changes in the numbers of cattle on farms are less variable from year to year and have longer production cycles which can be anticipated to a considerable extent from supplies of feedstuffs and the relation between prices of feedstuffs and of the animal products.



COURTESY, U.S. DEPT. OF AGRICULTURE

AGRICULTURAL PRODUCTION, PRICES AND RECEIPTS, UNITED STATES, 1910-45

Estimates of income have been developed as measures of the buying power of farmers, as indications of how economic conditions generally affect farmers. Also, the relative importance of the several agricultural enterprises of the country is best indicated by the estimates of income received from these enterprises.

The average income received from principal farm products in the five years (1940-44) follows, in millions of dollars:—dairy products, 2,305; cattle and calves, 2,116; cotton, 1,147; hogs, 2,013; chickens and eggs, 1,509; wheat, 765; tobacco, 459; sheep, lambs and wool, 414; corn (maize), 479; potatoes, 159.

The importance of corn (or maize) and other feedstuffs is, of course, not indicated by estimates of income received directly from those crops. The production of such crops comes to market mostly as livestock products. Consequently, the variations in prices of feedstuffs have little significance in the income of the country. They are an indication of the relation of supplies of feedstuffs to the demand for them and affect costs of production as between the farmer who raises the feedstuffs to sell and the farmer who buys them for feeding.

The effects of recovery and of World War II on the agricultural economy are reflected in the annual estimates of cash income from marketings of farm products. Annual estimates¹ for the years 1932-44 follow, in millions of dollars: 1932, 4,743; 1933, 5,314; 1934, 6,334; 1935, 7,086; 1936, 8,367; 1937, 8,850; 1938, 7,686; 1939, 7,877; 1940, 8,343; 1941, 11,157; 1942, 15,316; 1943, 19,340; 1944, 20,228.

The receipts from the sale of farm products are estimated currently for each month, on the basis of prices reported as received by farmers and estimates of marketings by states as well as for

¹These estimates do not include government payments, nor the value of products consumed on the farm where produced.

the country as a whole. The expenditures for production annually are also estimated to provide a basis for determining annual net returns.

(E. J. Wg.; O. C. S.; R. H. R.)

AGRICULTURAL WAGES. The payment of wages for agricultural labour in England began with the disappearance of serfdom. The coming of the Black Death or plague in the middle of the 14th century hastened the growth of the wage system and stimulated a rise in wages. The Statute of Labourers was enacted in part to check this rise. The change to the wage system came much later in eastern Europe. Even today most of the wages are paid in kind in some regions. The money wage system was carried into all of the English colonies, in many places in combination with a system of indentured servants and with slavery. When slavery was abolished in the United States, a wage system would seem logically to have followed. The Negroes, however, were not yet ready for this step and presently most of them were working under a cropper system in which they lived on plantations in cottages furnished by the owner, used equipment furnished by the owner, and received their compensation in the form of a share of the crop. Those familiar with this system still look upon it as more nearly a wage relationship than a landlord-tenant relationship.

A major complication in measuring wage-rate changes is that in all countries a good part of the actual compensation of the farm worker is in the form of board and lodging, in the case of single men, and of food and fuel for the use of the family and the use of a dwelling, in the case of married workers, plus perhaps the right to use a plot of land or to keep some livestock on the employer's land. In central Europe these allowances are known by the term *deputat*; in the United States as *perquisites*. Where wages are regulated, official valuations may be placed upon these extras; otherwise the wage-reporting agency must make a rough estimate of their value. The basis of valuation is invariably what these allowances are worth in the immediate neighbourhood. Commonly they would cost very much more if they were being purchased by an industrial worker in the city. The listing of wages is also involved by the fact that the period of hiring may be the whole year, the summer or winter half-year, a few months during the spring and early summer, or from day to day. The day labourers may be casuals hired for a few days now and then or workers hired regularly by the day for a considerable period. The most numerous in the first group are the piece-rate workers, who help especially with harvesting. The year-round rates reported are commonly for more experienced workers carrying more responsibility. Many of them are part-managers of the farm enterprise, perhaps in some such capacity as herdsman or shepherd. The farm servant in Great Britain and several other countries, and the *deputatist* of Germany and other countries on the continent, are typically year-round workers on a somewhat lower wage scale. From the point of view of income, only the data for the year-round workers are adequate. One has no means of knowing how much of the rest of the year the seasonal workers and day hands are without employment.

History of Wages.—Money wages need to be converted to real wages before they are significant. This can be done crudely for the United States since farm wages were first assembled in 1866 by adjusting them for the changes in the general price level. The money wages increased 20% from 1869 to 1897, and the real wages 135%. Then came the period of rising price levels ending in 1915, during which money wages rose 58% and real wages only 10%. The final effect of World War I was a rise of 85% in real wages by 1925–29. Real wages in industry rose 150% to 1897, held even until 1915, and then rose 63% to 1925–29. The lag in both agricultural wages and industrial wages in 1897–1915 was due mainly to the inability of wages to move as fast as prices. Wages in wartime Europe lagged in the same way. The wartime shortages of labour broke this lag. Farm wages did not rise as much as industrial wages in the recovery period after 1933.

For a longer series of wage changes, England can be taken as an example, but real wages for such series will have to be expressed still more crudely in terms of wheat. In terms of money, agricultural wages in England rose from 4s. per week in the 13th

century to 46s. by 1775, but in terms of wheat this represented an actual decline from 126*l* to 71*l*. This is the reason for Thorold Roger's statement in his *Six Centuries of Work and Wages* that the 15th century was "the golden age of the English labourer." By the end of the 19th century the purchasing power of wages for wheat had returned only to the 15th century level. All through the 16th to the early 19th century, weekly wages in wheat remained around 71*l* to 91*l*. The movement from then until World War I was roughly the same as in the United States. In 1914, a week's farm work in Great Britain bought 4.2 bu. of wheat. Money wages had advanced 24% from 1900 to 1914, but real wages 15%. Wages rose less than the cost of living during the war, and the Agricultural Wages' board in 1920 set wages at levels from 42s. to 56s. in the various counties. The passage of the Repeal Act of 1921, following the sharp break in prices, wiped out this board, and the wages and voluntary conciliation committees set up in its plan were not very effective. Wages fell to 28s. by 1924, compared with 18s. in 1914. This meant a decline of 12% in real wages. The new boards set up under the Agricultural Wages Act of 1924 had raised wages 3*l* 5s. by 1931 while the cost of living was declining. Real wages as a result rose one-fifth in this period.

For the years after 1928, much more adequate data were assembled by the International Labour office, and published first, for 27 countries, in the *International Labour Review* for Nov. and Dec. 1934. The latest release, in the *Yearbook of Labour Statistics, 1945–46*, extends this series through 1937 for 21 countries, through 1942 for 17, through 1945 for 12 and into 1946 for 7. Money wages declined in all these countries except Chile in the big depression of 1930–35, but by varying amounts. The lowest year was 1933 in the aggregate, but ranged from 1931 in Japan to 1937 in India. In five countries, including the United States and Canada, the break was around one-half; in Australia, New Zealand, Japan, India and Italy, around 30%; and in the western European countries, between 4% and 11%. All but three in this last group either had agricultural wage boards or were supporting farm prices with heavy import duties and the like.

In the period leading up to World War II, farm wages generally rose. The gains were smallest, around a fifth or less, in the exporting countries, like the United States, Canada and Australia, and most in the countries of western and central Europe, from 30% to 50%. The severity of the continuing unemployment to 1935 was no doubt also a factor, and presently in Europe, the amount of preparation for war. If depression losses and recovery gains are balanced against each other, farm wages in Canada and the United States in 1940 were around 30% below the 1929 levels; in Australia and Mexico, 10% below; in Great Britain, 6% higher; and in Norway, France, Ireland, Sweden and Denmark, from 10% to 40% higher respectively in the order named.

No doubt the extent of the general price deflation in the depression, and reflation afterward, was also an important factor in these wage movements. Clearly the general price level movements were the main reason for the difference between countries in the wage increases during World War II. In the International Labour office tables, the index numbers for 1945 range, with 1937=100, from 138 in New Zealand, 159 in Australia, 203 in Sweden and 210 in Great Britain, where prices and wages were kept fairly well under control, to around 250 for the United States and Canada, to around 300 for Denmark and Norway, and 500 for France and Finland.

Wage Differences.—Wage differences between countries are best indicated by taking the data on money wages of the International Labour office for some nearly normal year, like 1928, and reducing them to a common purchasing power basis, as in the table on page 391*l*.

The wage taken as representative in each case is the wage without board and lodging of an adult male ordinary day labourer. The conversion to shillings and pence is in terms of the average rate of exchange for the year 1928. The prices for wheat and other products are the internal wholesale prices at a principal market in the country.

Taken at their face value, the differences appearing are very

Country	Daily wages	Wages in British money	Wages in wheat (bu.)
China	0.10 silver dollars	4d	*
Japan†	0.86 yen	1/10	0.13
Rumania‡	36 lei	1/3	0.24
Czechoslovakia	13.2 koruny	1/7	0.23
Lithuania	6.1 litas	2/6	*
Spain	4 pesetas	2/6	*
Chile§	5.50 pesos	2/9	*
Poland	6.2 zlotys	2/10	0.43
Hungary§	4.37 pengos	3/1	0.51
Italy	15.0 lire	3/5	*
Finland	33.84 marks	8/6	*
Germany	4.10 marks	4/-	0.63
Sweden	4.24 kroner	4/8	0.88
Denmark	4.58 kroner	5/-	0.93
France	32.4 francs	5/3½	0.75
Great Britain	5/3½	5/3½	1.00
Norway	5.01 kroner	5/6	*
Switzerland**	8.2 Swiss francs	6/6½	0.73
United States	2.30 dollars	9/10	1.80
New Zealand	11/6	11/6	2.30
Canada	3.15 dollars	13/-	2.30
Australia	20/-	16/-	3.14

*No wheat prices available. †All figures are for 1931. ‡All figures are for 1932. §All figures are for 1929. ¶Figures for money wages are 1928; for wheat wages, 1932. **All figures are for 1930.

large: from 4 pence in China to 16 shillings in Australia. They are in order with what we know about relative density of population and other significant factors in the various countries; but the range is no doubt exaggerated in terms of real wages. The number of yen equal to a shilling in the foreign exchange market buys much more in the way of food, clothing and shelter in Japan than the number of kroner equivalent to a shilling in Sweden, and even more so than the number of cents equivalent to a shilling in the U.S. market. The comparison in terms of quantities of wheat bought by a day's wage is subject to the serious objection that the price of even as staple a commodity as wheat is subject to special influences in each country; for example, to very high tariffs in France, Italy and Switzerland. Wheat prices in Canada, Australia and the United States are on an export basis, which means that they are less than the world price by the amount of the cost of transportation.

The International Labour office reports male and female wages separately where available; also wages of "permanent," "seasonal," and "daily" workers. Female wages in 1928 averaged about 70% of male workers. Wages of seasonal and day workers are generally higher than annual rates. In the United States, for example, a day labourer would have needed to work only 240 days in 1928 to earn as much as a year-round labourer without board and lodging; in Japan, 200 days.

The wage differences between sections of any one country may be fully as large as those between whole countries. The range within France in 1928 was from 16 francs per day for regular day labourers in Dordogne to 27 francs per day in Loiret; in Italy, from 0.66 lire in Calabria to 1.59 lire in Emilia. The total wages of the deputatists (men) in 1928 were 1,619 zlotys in south Poland and 2,263 in west Poland. In the United States the range in the period 1925-29 was from around \$25 per month in the southern states (with board and lodging) to more than \$50 a month in some of the western states. These differences in the U.S. are closely correlated with such factors as natural resources and capital goods per worker, and in turn with the net farm income per worker. Associated with these circumstances are such factors as density of population, type of agriculture, alternative employment and the like. The high wage rates reported in some of the eastern states are much affected by competition with city employments. Almost everywhere the level of agricultural wages appears to be lower than that of industrial workers, particularly than that of skilled industrial workers. The explanation commonly offered is that the surplus population of the farms does not move to the cities rapidly enough to equalize returns.

Wage Regulation.—Wages were controlled in one way or another in England all the way from the Black Plague until 1835. The controls were largely locally administered and generally in behalf of the landed gentry, and had the effect of shifting to Poor Law relief part of the cost of maintaining farm labour. Similar controls commonly followed the abolition of serfdom on the continent. Individual bargaining replaced these controls with the passing of mercantilism in one country after another in the 19th

century. Controls in behalf of farm labour began in the early 20th century; for example, in England in 1917. In North America, the new Mexican constitution in 1917 provided that minimum wage rates should be fixed for all the workers. Estonia provided for fixing minimum wage rates in an act of 1921, and Hungary, Uruguay and Argentina in acts of 1923. The present form of public wage fixing in England was provided in the Agricultural Wages Act of 1924. It can be said of the wage-fixing legislation enacted in the war and postwar years that its general purpose was to raise agricultural wages and improve the condition of agricultural workers. But much of it was induced by pressure from agricultural unions. An immediate purpose was to remove the causes of disorder and conflict between the employer and worker groups. It is proper to state that in a number of the countries agricultural wages are now adjusted mainly by collective bargaining. A large proportion of the labour may be outside the union, but the union dominates the scene.

In the Netherlands, for example, collective agreements increased from 11 covering 742 farms in 1918, to 326 covering 20,700 farms in 1936. By 1937 the wage rates of 30,000 Swedish workers were covered by trade union agreements. Collective bargaining is the device used for general wage adjustments also in Denmark, France and Norway. This system was well developed in Germany in the postwar years under the republic and in Czechoslovakia and Poland before 1938.

In Scotland the Farm Servants union insisted upon this method of wage adjustment until July 1937. It then secured the adoption of a plan of public wage fixing similar to that prevailing in England and Wales. As a matter of fact, wage determination by collective bargaining and by public wage fixing are not as clearly distinct as the foregoing statements indicate. The two methods are frequently made to supplement each other. Thus in Italy the wages are negotiated by collective agreements, but the Charter of Labour requires that the wages so determined apply to all workers whether organized or not. In the Netherlands the employers are required to negotiate wages with the workers' organizations, and if necessary an arbitrator makes a compulsory award. In Australia and New Zealand the process of public wage fixing takes the form of calling the workers' organization and the employers' organization before an arbitration court, holding a hearing, and then establishing a rate. Even the procedure of England and Wales, which is clearly designed as minimum wage fixing, sets up local wage-fixing boards upon which the workers' organization and the employers' organization constitute all the board except for a small number of outside members appointed by the minister of agriculture.

The Central Agricultural Wages board has no power to influence the level of wages fixed by the local wage boards. The Irish Agricultural Wages Act of 1936, in contrast, gives to the Central Wages board the authority to fix the minimum wage rates, but only after consultation with the local wage committees upon which employers are represented. The Joint Labour committees set up in France on a regional, department and local basis under the order of July 7, 1946, were constituted about like those in England and function in a similar way. The wage boards which functioned in parts of the United States in World War II had little or no union or even employee representation on them, farm labour being very little organized in the United States.

The reason commonly advanced for having employer and employee organizations participate in the wage-making process is that the wages fixed are not likely to be accepted unless these groups help make them. The objection, of course, is that the unorganized employers and employees are required to abide by wage determinations made by organized groups that often are only a small minority. If, however, it is the policy of the country to encourage the unionization of agricultural labour, such an arrangement may well have the effect of bringing most of the employers and workers into it.

Hours and working conditions are commonly regulated along with wages. In England the hours set by the different county boards ranged in 1937 from 48 to 60 per week, with an average of 51 hours. Regulations also provide for extra pay for overtime

and Sunday labour, but these are not always enforced. The Holidays with Pay Act of 1938 provided for 7 days of holiday for farm labour, but not more than 3 days at a time. The New Zealand Agricultural Workers Act of 1936 incorporated in it the Accommodation Act of 1908 which stipulated certain standards of first aid, housing, laundry and food storage space for agricultural workers. Illustrating the form that wage regulation may take when modern forms of regulation are imposed upon relic social organizations are the decrees issued by the Bolivian government in May 1945 providing for setting up an Indigenous Labour Code limiting to 4 days the labour that can be required of the "colonos" on the landowner's estate as payment of rent, and giving the colonos full right to sell their own produce.

A development since 1930 in several countries is that minimum wage rates have been tied to arrangements for improving the prices of farm products. The sugar growers of the United States must pay certain rates to share in the benefits of the Agricultural Adjustment act. The New Zealand butter and cheese act of 1937 has a similar stipulation. Swedish sugar factories may conclude contracts only with farmers who agree to pay the wages named in the collective agreements in force.

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AGRICULTURE: A GENERAL SURVEY. Agriculture is so primitive and fundamental an art, the beginnings of which so far precede any documents, that any attempt to write its earliest history becomes a matter of surmise and unverifiable conclusions from general principles. It is reasonable to suppose that prehistoric hunter man began by learning to tame the young of certain species, which proved to be fertile in captivity and could be attached to his wanderings. At probably a later stage tribes that gathered certain grains of food value began to make provision for future years by scattering a portion of the seed and effecting some rough clearance of the soil. They took the desirable grains with them in their wanderings and by sowing them they learned to become independent of return to the original centres of growth. When any remains of the early settlements emerge, they reveal evidence of animals and cultivated plants. For example, predynastic tombs in Egypt, an early Sumerian house in Mesopotamia (3500 B.C.), and lake dwellings in Switzerland and Italy associated with neolithic man, have yielded grains of wheat of a comparatively advanced type, which must have

a starting point of our cereals, N. I. Vavilov argued that the existing distribution of varieties points to certain centres as the original fountain of the cultivated races, these being regions which are today characterized by a concentration of varieties in the cultivated fields, where a host of forms occur not yet segregated into distinct races and shade off into weed forms which equally inhabit the uncultivated land. Vavilov thus indicated the highlands of southwestern Asia, particularly Afghanistan, as the probable centre of the soft and club wheats; northern Africa as the home of durum wheats, while einkorn, a primitive wheat cultivated in prehistoric times, may have had its origin in Asia Minor. Still another race, emmer, perhaps the most ancient of cereals, is found in patches all over the old world and only among isolated and backward peoples. (See also AGRICULTURE, PRIMITIVE.)

Similar general conclusions cannot be drawn concerning the early history of the growth of husbandry. When agriculture appears in written history in the time of the Greeks and Romans (see GEOPONICI), it is already a highly developed art, which had behind it many centuries of empiric progress, the results of observation and of trial and error. Cato, Varro, Virgil, Columella and the elder Pliny described an elaborate system of farming, embodying many sound principles, such as the value of leguminous crops as a preparation for wheat, for which modern science only lately found an explanation. The methods of growing corn, vines and olives then prevailing were not substantially altered until the middle of the 19th century, and the sculptured representation of a sacrificial bull, lamb and boar on the *plutei* of Trajan in the Roman forum bears witness to an advanced state of stock breeding. Roman agriculture is indeed the foundation of modern farming, and though over a greater part of Europe it was disrupted by the barbarian invasions, its traditions probably never died out in favoured regions but were resumed in modern systems of farming.

Mediaeval Farming.—The course of farming in England that prevailed in early days is in many respects common to all the invading northern peoples who drifted across Europe; it finds its parallels in all countries north of the Alps, in Russia and in India. It is not uniform, since on the western side of Wales and Ireland, there is evidence of an earlier system, which is reflected in the grouping of the houses into scattered hamlets instead of into the larger villages characteristic of the more purely arable districts of the Midlands and eastern England. Whether the system was derived from an original communal ownership of the land and even of its produce is still a matter of dispute, but when records begin it had passed out of this stage and to some extent had been shaped by feudal theory (see ENGLISH HISTORY).

The Manor.—The unit of land holding and cultivation was the manor (*q.v.*), of which there might be one or more within the parish. The land was held at one or more removes from the king by the lord of the manor, from whom the tenants held in return for various services and with varying degrees of freedom. The cultivated land lay in three, or some multiple of three, open arable fields, divided into strips of one or one-half acre, separated by baulks of rough grass and terminating in still wider baulks, the headlands on which the cumbrous ox team and plow could turn. On heavy land the strips were steeply ridged to throw off the water and this ridge and furrow still persist in many parts of the Midlands which have long been laid down to grass. In some places the old strips still defy cultivation, because of the labour that would be required to throw down the ridges and the infertility of the subsoil that would be bared in their crowns.

The three fields were cropped on a fixed rotation of winter grain (wheat or rye), spring grain (barley, oats, peas or beans, or mixed corn) and bare fallow. In each field the tenants held a certain number of scattered strips, the original intention being probably to give to every man a share of the good land and the bad, and mingled with them were the strips held by the lord and constituting his demesne. Each tenant farmed his own strips but was required to give a stated number of days' service to cultivate the demesne strips, services which gradually became commuted into payments in money or in kind. At a certain date after harvest the arable land was thrown open to the cattle to



FIG. 1.—MEDIAEVAL METHODS OF AGRICULTURE

Scaring birds and harrowing. From the Louterell Psalter, an illuminated manuscript of the early part of the 14th century. ("Vetus Monumenta," vol. 6, Pl. XXII, fig. 7)

been preceded by long ages of culture. Flax and barley were also grown. It is significant, however, that no wild species can be assigned as the origin of any of our widely cultivated plants and the same complexity and uncertainty gathers round the sources of the domesticated horses, sheep, oxen and pigs. With the exception of maize and barley, the cultivated plants are polyploids, *i.e.*, the number of chromosomes in the cells is a multiple of the diploid number which characterizes the normal species. This points to a probable hybrid source; but whatever the origin, the polyploidy provides material susceptible of the variation on which selection can work, even when it is not attended by gigantism or an excess of vigour which would naturally draw the attention of the early cultivator. Though no wild species can be fixed upon as

wander over, and this of itself prevented any growth of fodder crops. On the lower land by the river would exist an area of meadow land to be laid up for hay and again divided in proportion with the arable land. The tenure of the particular strips for the year was often balloted for, a practice which still endures in places, as at Yarnton near Oxford. After hay harvest or Lammas the meadows were thrown open for common pasturage, hence the name "Lammas fields." Besides the arable and the meadows the manor embraced a certain amount of "waste," the origin of what today are known as "commons" (*q.v.*). On these the tenants had the right of pasturage and in suitable districts the right to cut turf or peat for fuel. They also provided fern for litter, reeds or heather for thatching, furze and brushwood for firing, rushes for the floors and other purposes, rough timber for fencing and building, stone, gravel and sand.

Production.—The farming that prevailed under these conditions was necessarily inefficient. Some manure appears to have been made by strewing roughage, marl or clay in the folds and in the "garsons," the little enclosures by the village into which the stock were driven at night; but the crops must have mainly depended upon the inherent fertility of the soil. The sheep were folded upon the fallow by night, though tenants were often obliged to put them upon the lord's land only. In the west where the area of unoccupied land was greater, there is evidence of a practice of moving the arable fields continually, whereby some fertility would be accumulated while the land lay in rough pasture. Of extraneous fertilizers there were none; in areas on the chalk the practice of sinking pits into the chalk and spreading it on the land may have endured, for it is mentioned by Pliny in his account of Britain, and the traces of the old pits that remain in certain districts indicate a long continuance of the process of chalking and marling. The level of production was exceedingly low. Walter of Henley, who wrote early in the 13th century the standard treatise on the management of an estate, advised the sowing of two bushels of wheat per acre, which ought to yield threefold. From the context this would be a minimum, and the same author said that barley might yield eightfold, wheat fivefold, rye sevenfold, peas and beans sixfold and oats fourfold. Other sources justify placing the level of production of open field land in mediaeval times at yield of about ten bushels of wheat to the acre.

If the conditions of cropping were bad, the livestock were in a worse state. The stock of all the tenants and of the lord herded together and were driven afield and tended by the village cowherd, shepherd and swineherd respectively. The class of stock that prevailed depended to some extent upon the nature of the land. The open downs and heaths had many sheep, and the woodlands with their mast supplied feed for swine.

Pannage (*q.v.*) for so many hogs is a common entry in Domesday as an appanage of a particular holding. But with this mixture of everybody's stock little in the nature of selective breeding could be practised. Walter of Henley insisted on the value of good boars, but in general the bull and the boar were common to the manor—the result was a "haphazard union of nobody's son with everybody's daughter." Whatever disease came along ran riot through the whole herd or flock. Oxen were chiefly kept for work, and Walter of Henley considered an ox at work should consume half a sheaf of oats a day. Though the greater speed of the horse was recognized, it required more care, cost more to feed and was "carrión" instead of meat when worn out. Cows were kept for milk and the milk was mainly converted into butter and cheese. In the early summer they grazed on the "waste" and marshes or were tethered on the grass baulks; later they had the aftermath of the meadows and the stubbles. With the advent of winter the worn-out oxen and the old cows were killed off and salted down. During winter the cattle subsisted in the yards on hay, pea and bean haulm and straw. Rarely were

cattle stall-fattened and the open field farmers sold most of their calves for slaughter. Sheep were from the earliest times an important element in English farming because of the value of their wool. The ewes were often milked, the toothless "crones" being killed for meat.

During the open weather they lived on the downs or the waste by day and were folded on the fallow by night; in the depth of winter they were housed or folded and fed upon whatever roughage was available. Swine afforded the chief meat of the community; they scavenged for a living in spring or summer and fattened upon the pannage of the woods. A few were specially fattened upon tail corn and the brewers' grains, for the barley that was grown was very largely turned into ale. The manor aimed at being self-supporting both for food and clothing. Rarely had even the lord any margin of corn for sale; the chief money revenue was derived from the livestock, wool, skins and dairy produce.

Enclosures.—The strict manorial system early began to break down. The lords often retained meadows and made enclosed fields which they either farmed themselves or let. Little holdings grew up by sufferance on the waste, occupied by "tradesmen" in the villages or other cottagers who also shared in the common grazing. The rising value of wool in the late mediaeval times tempted lords to aim at enclosures of the arable, and recurring dearths and epidemics, of which the Black Death is the most notable, deprived the land of its labourers and facilitated the putting together of larger units of cultivation. From the earliest times the substantial independent farmer, represented by Chaucer's Franklyn, was a feature of English country life. Not only were the old feudal services commuted into rents, but by new intakes from the wastes or by fencing off portions of the open fields the tenants began to enjoy land in severalty. In Tudor times the process of enclosure was in full swing, though the legislature was opposed to, and public opinion was loud in denunciation of, a movement which appeared to diminish corn growing and the rural population. But the driving force was the growing commerce of the nation. Not only did both landlords and tenants want something to sell and look upon the land as the basis of a business rather than a subsistence, but the small holders who had been barely able to exist upon their little parcels of cultivation found other and more attractive outlets in the growing commerce and industries.

The New Farming.—It was toward the close of the Tudor times and in the early 17th century that the new farming began. Increasing intercourse with the continent and particularly with Flanders, where some of the old Roman tradition had persisted, brought new crops and stock and new methods into England. Sir Richard Weston (1591–1652) who farmed in Surrey in Charles I's time, is credited with the introduction of turnips, clover and other sown grasses, and these crops providing winter keep were the foundation of the improved system of agriculture. With them cattle could be fattened and maintained during the winter; at the same time farmyard manure was made in quantity sufficient, with the help of the clover which enriches the soil in nitrogen, to raise enormously the whole level of production. The new farming could, however, only be practised on enclosed farms; on the open fields clover and turnips would be every man's property as soon as the common stock were turned on to them.

Turnips and clover were not the only introductions from the Low Countries; most of the common garden vegetables, as cabbages and cauliflowers, carrots and parsnips are owing to the same source. Fruit trees too were "fetched out of Flanders." Richard Harry, fruiterer to King Henry VIII, bought "105 good acres in Teynham which he divided into 10 parcels, and brought plants beyond the seas and furnished the ground with them," which land "hath been the chief mother of all other orchards for these kindes of fruites." Hop growing also had a similar origin.

Doubtless the same thing happened with livestock, but here the evidence is more meagre because the descriptions of the early writers are so imperfect. But it would seem probable that the large, long-woolled, white-faced sheep were originally of Roman origin and the Kents or Romney Marsh, the Lincolns and Leices-



FIG. 2.—MEDIAEVAL HUSBANDRY
Feeding chickens. From the Loutereil Psalter, an illuminated ms. of the early 14th century. ("Vetusta Monumenta")

ters, all on the eastern side of England, may well have been derived from a very similar sheep which is still found in Flanders. The importations may, indeed, have been earlier, for the English long wool was famous in mediaeval times and was among the first of the staple articles of export, its importance being still commemorated in the "woolsack" on which the Lord Chancellor sits. The earlier long wool chiefly came from the Cotswold country, the home of the other white-faced, long-woolled race of sheep, and this possibly may be a remainder from Roman occupation. The black and white cattle which have always been about the eastern counties were certainly of Low Country origin—the modern Holstein-Friesian or Dutch cattle. It may even be surmised that white cattle of Roman origin (either directly or from the Rhine provinces) were progenitors of the Shorthorns, whose hybrid origin is betrayed by the mixed white and red colour of the roans.

Enclosure Laws.—The progress of enclosures grew apace in the 18th century. Whereas in early days it was opposed by parliament, in the 17th century it became possible to obtain sanction for agreements from the court of chancery, and from the time of Anne a strictly legal procedure by private act was made available (see COMMONS). Commissioners were appointed to make the award and apportion the several holdings to the tenants of the open arable fields, but a private act remained necessary until the General Enclosure Act of 1845.

Under the acts the commissioners could proceed to an award although a minority of the parties interested, one-eighth or even one-third, refused to agree. In certain counties—Suffolk, Sussex, Kent, Essex, Somerset, Devon and Cornwall, the marches of Wales, Cheshire, Lancashire and the four northern counties—enclosures were early and were but rarely effected by act. Possibly from the nature of the land the rigorous common field arable had never been usual in them. It was in the great corn growing areas of the Midlands, Yorkshire, Lincolnshire and Norfolk that so much enclosure by act took place in the 18th and early 19th centuries. After 1760 the process was much accelerated by the growth of industry and population even before the Napoleonic Wars created so great a call for good production. Valuable, indeed necessary, as enclosures were to the nation from the point of view of production, so great a change in the economy of the countryside could not be effected without much serious, if temporary, dislocation of labour and some permanent change for the worse in the condition of the poorer classes. Often the lord and the larger tenants took the opportunity of enclosure to put the land down to grass, so that a single shepherd would take the place of a dozen men who had formerly worked on the village land. The enclosures themselves may have been fair enough in their apportionments, though it would always have been easy for the lord and the bigger farmers to overweigh their poorer neighbours, but many cottagers who had no arable and therefore no title in the award found their customary rights of grazing swept away with the commons. There were those who held that the commons encouraged an idle race of casual labourers and poachers, but the other side of the picture, the destruction of a thrifty peasantry, was the theme of many writers in the 17th and 18th centuries.

Arthur Young, himself an unceasing advocate of enclosure, deplored the evils that had resulted therefrom. "By nineteen Enclosure Acts out of twenty, the poor are injured, in some grossly injured. . . . The poor in these parishes may say, and with truth, *Parliament may be tender of property; all I know is that I had a cow, and an Act of Parliament has taken it from me.*"

The Agricultural Labourer.—With enclosure began the creation in rural Britain of a race of landless men, dependent for employment upon the larger holders of land; and though the darkest days of this class did not come until the close of the 18th and the first third of the 19th centuries, when the pauperization caused by the old Poor Law became universal, the lot of the agricultural labourer, still the worst paid and worst housed section of the community, was established. Thomas Mozley wrote of his parish in Northamptonshire in 1829: "There were many farmers, several yeomen, very many small freeholders, as many tradesmen

as the place could find work or customers for, and not one single labourer, in the sense of an independent workman offering his labour for wages, but a multitude of paupers."

The labourer class was also recruited from those yeomen proper who obtained small farms after enclosure but were unable to hold on to them. It required neither fraud nor force to displace the small proprietor; the mere pressure of economic change was sufficient. A run of bad seasons, the constant temptation to mortgage, the inheritance by a widow, and the neighbouring proprietor who wanted to add land to land found his opportunity, especially where, as in England, land had for so long possessed a non-economic social value. Special opportunities were also offered to active men in industries and commerce, and since many of the old yeomen farms could produce but the barest living for their occupiers, they were sold and merged in larger holdings because the owners were no longer content with the income derivable from them. In other countries peasant farming persisted largely because there were no alternative occupations with a higher standard of living within reach and because the layout of the land on the open



FIG. 3.—MEDIAEVAL METHODS OF AGRICULTURE

Reaping corn. From the Louterell Psalter, an illuminated manuscript of the early part of the 14th century. ("Vetusta Monumenta" vol. 6, pl. XLII, fig. 3)

field system did not permit putting together large units of farming. The open field system nevertheless persisted into the 19th century; and even on the eve of World War II a nonenclosed parish farmed on the old English plan could be seen at Laxton in Northamptonshire, and the parishes of Epworth and Haxey in the Isle of Axholme remained in strips, though the owners cropped them as they pleased.

The Norfolk System.—The improved methods of farming made possible by enclosure were soon manifest. Early in the 18th century what afterward came to be called the "Norfolk" or four-course rotation was being used. In consequence England became a grain exporting country during the first half of the 18th century; until the growth of population manifested itself with the development of industries. This epoch of British farming which became systematized in the early 18th century and endured until 1840, may be described as that of the conservation of the resources of the soil. The land was usually cultivated on a four-course system of two grain crops, alternating with turnips and a leguminous crop—clover or beans. The leguminous crop gathered nitrogen from the air and maintained the stock of this indispensable element of fertility at a comparatively constant level, despite the wastages that were going on. The turnips and the hay and straw provided for the making of farmyard manure, whereby there was returned to the soil the greater part of the valuable materials that the crops had taken out. Nothing left the farm except the nitrogen, phosphoric acid and potash sold away in the wheat and barley, the meat, milk and wool. Strict covenants prevented such wasting of the soil capital as would occur from the sale of hay or straw or roots, or the too frequent growth of salable grain crops. Under this system the average production became more than double that of the mediaeval farms. Arthur Young spoke of 24 bushels of wheat as the average yield per acre; John Bennet Lawes, writing of Hertfordshire as he knew it when he began his experiments at Rothamsted about 1835, set the yield at 20 bushels, and the lower estimate is probably nearer the mark for the whole country. This level of production, which may be compared with the six to ten bushels of mediaeval open field farming, could be maintained indefinitely. The limiting factor was generally the

supply of nitrogen, and this depended upon the recuperative actions of the leguminous crop in the rotation and of bacteria in the soil which made use of the organic matter supplied by the roots, the stubble and the straw, as against the removals in salable produce and the wastes that occur in the making of farmyard manure and in the soil itself under particular conditions, as leaching and waterlogging. The balance that was established was sufficient to maintain the yield at the level of 20 bushels of wheat per acre.

Livestock and Other Improvements.—Other improvements in agriculture were simultaneously in progress; great areas of waste land were being added to cultivation, especially on the heaths and light soils which before turnips and clover were introduced became immediately exhausted. Small's plow, the horse hoe, the drill, the threshing machine, were all inventions which took practical shape in the 18th century and did much to add to the effectiveness of the farming operations. Drainage and the systematic amelioration of the land which had been impracticable on the open field system were taken up vigorously, though the wide extension of field drainage had to wait until the invention of drain tiles in the next century.

Moreover, with the prevalence of enclosed fields, the improvement of livestock could be taken up with some prospect of rapid achievement. Robert Bakewell (*q.v.*) was the pioneer, and though he was unfortunate in selecting the Longhorn cattle to work upon, his creation of the Leicester breed of sheep persisted and led to rapid amelioration of all the long-woolled sheep. His methods were taken up by other men; Charles Colling made the Shorthorn breed, and John Ellman (1753–1832) the Southdown sheep which became the progenitor of all the other "down" breeds. England developed a race of breeders who combined the instincts of the fancier with certain definite principles. They began by selecting their breeding stock for conformity to an ideal type in which the meat was laid on in the most valuable places; by close line-breeding, even by inbreeding, the type was fixed and the "pedigree" sires became capable of stamping their own type in a few generations upon the common country-bred stock. Early maturity, the capacity to grow rapidly on good food, proved to be equally obtainable by selection, and the result was that in the 19th century Britain was possessed of a number of definite breeds of cattle, sheep and pigs that were doubly or trebly more efficient than were the old unimproved stocks. Their value may be gauged from the way the flocks and herds of the new countries of the world have been populated with stock of British origin. Shorthorns, Herefords and Devons are the great meat producers of the Americas, Australia and New Zealand; the only non-British breeds that achieved any world-wide extension were the Merino sheep because of their wool and adaptability to arid climates, and the Holstein-Friesian cattle because of their unrivalled milk yield.

Capitalist Farming and the Great Landlords.—The new agriculture which had grown up in response to the rapid increase of population under the beginnings of industrialism and had been overstimulated by the excessive prices that prevailed during the Napoleonic Wars, fell upon evil days with the break in prices and the restoration of a gold standard that followed the final peace in 1818. But it had accomplished its purpose of providing food for the nation from its own land, and it had completed the conversion of British agriculture from a system of peasant cultivation into one of capitalist business, small indeed in the main, but characterized by the employment of labour. In no other country did this development proceed so far. Prior to the disturbances arising



FIG. 4.—MÆDIEVAL HUSBANDRY
Going to the mill. From the Louterell Psalter, an illuminated ms. of the early 14th century. ("Vetusta Monumenta")

out of World War I, most countries in Europe other than France, Switzerland and Belgium, could show vast estates farmed as single units and owned by the territorial nobility, but there was little or nothing of a middle farming class between the domain owners and the peasants, carrying on farming as a business on land rented from the large proprietor. In Great Britain the political, social and sporting privileges attaching to the possession of land early led to the building up of great estates, but the owner found the best use of his property in letting it again to tenants, who on their side took advantage of the opportunity for employing their limited capital in the business, by which they could derive a bigger income from it than if the greater portion were locked up in ownership of the land.

Thus in England the great landowners were the leaders of agriculture along its path of progress in the 18th century, even though most of the actual improvements, especially in stock breeding, were the work of tenant farmers like Bakewell, Colling and Ellman. A few large proprietors led the way and rendered better farming possible by their expenditures on reclamations and buildings.

They introduced the improved livestock to their tenants and they enforced sound methods of cropping by the covenants inserted in the conditions of tenancy. Prominent among them was the 2nd Viscount Townshend (*see* TOWNSHEND, CHARLES TOWNSHEND), Pope's "Turnip Townshend," who devoted himself to the improvement of his estate in Norfolk on a basis of turnip growing, with the use of the drill and the horse hoe. He is generally credited with the Norfolk four-course rotation, but it had been evolved before his time and he only gave to it a wider extension. The ideas that Townshend put into practice were chiefly derived from Jethro Tull (*q.v.*) of Berkshire, the greatest original thinker about farming processes that England had then produced. His "*Horse-Hoeing Husbandry*," published in 1731, was the basis of all improvements in the operations of cultivation during the 18th and early 19th centuries. A little later Townshend's neighbour, "Coke of Norfolk," Earl of Leicester of Holkham (*see* LEICESTER OF HOLKHAM, THOMAS WILLIAM COKE) made a productive estate at Holkham of what had been little more than a rabbit warren, and became famous for his annual gatherings, the Holkham sheep shearings, where all the improving landlords and farmers of the day met and exchanged their experiences. There, too, the improved livestock of the time could be seen and judged. The duke of Bedford was equally active and held similar meetings at Woburn.

A little later the Earl of Egremont in Sussex, and in Scotland Hope of Rankellor and Sir John Sinclair of Caithness, first president of the Board of Agriculture (1793–1822), may be singled out.

Arthur Young.—But the most active promulgator of the new methods was Arthur Young (*q.v.*). The younger son of a parson with a small property, Young began by farming, but with constant ill success. He soon found his proper *métier* in writing, and from 1767 to 1795 he published those vivid accounts of the farming and the men and manners of England, Ireland and France, which became classics of observation and shrewd judgment. In 1784 he began the publication of the "*Annals of Agriculture*," which embodied contributions from all the men of the time interested in agriculture, even the king himself. When a board of agriculture was established in 1793 Young became its secretary and was responsible for a series of county surveys of the state of farming in England which, if unequal and in some respects inferior to William Marshall's *General Survey of the Rural Economy of England*, remained the most trustworthy source of information. Young was pre-eminently a diffuser of knowledge; he had a sound knowledge of the general trend of agriculture, witness his unceasing advocacy of enclosures, and a quick eye for improvements of method. If his zeal sometimes outran his judgment in his commendation of innovations, his lively style always exacted interest and made him for 40 years a most effective stimulus toward the reform of farming. Rarely can a farmer be instructed in the method he is to follow, but he can be excited to think out a novel adaptation to his own conditions.

Period of Scientific Progress.—The accession of Victoria in 1837 marked the beginning of a new era in British farming. The occupiers of land had slowly adjusted themselves to the new conditions, after the shock caused by the break in prices at the end of the Napoleonic Wars. Confidence in agriculture was returning and a new race of landlords was growing up imbued with the idea that the scientific developments then in rapid progress could be applied to farming operations. In 1838 some of the leaders, among whom perhaps the most active was Philip Pusey, founded the Royal Agricultural society (*see* AGRICULTURAL SOCIETIES AND SHOWS), which gave a powerful stimulus to the improvement of stock, to experiments in cultivation and manuring, and to the introduction of machinery. Another small landowner, John Bennet Lawes (*q.v.*) of Rothamsted, Herts., was beginning that fundamental series of field experiments which took formal shape in 1843 when he was joined by the young chemist, Joseph Henry Gilbert. At Rothamsted was laid the foundations of our knowledge of the use of fertilizers and the nutrition of animals. Previously there had been some empiric knowledge of the fertilizing value of such waste materials as woollen rags, soot and bones, but the supplies were limited and the employment only local. The first consignments of Peruvian guano and of nitrate of soda arrived in 1835; in 1843 Lawes began the manufacture of superphosphate, and his early experiments showed the value of the ammonia salts which could be made from the by-products of gas making, then becoming general. Other sources of phosphates than bones were rapidly discovered and about 1860 the great deposits of potash near Stassfurt, Germany, began to be exploited.

At the same time the science of agricultural chemistry was being explored and the theory of the nutrition of the plant—what it draws from the soil, the water and the air—a theory of which Justus von Liebig (*q.v.*) had given a brilliant preliminary sketch in his British Association address, provided a rational basis for manuring. By 1850 the manufacture of artificial fertilizers was in full swing and though all too many farmers lagged behind in their application, their use, together with the employment of foreign feeding stuffs like linseed and cotton cake, the fertilizing ingredients of which found their way to the land through the manure made by their consumption, had by 1870 raised the general level of British production from 20 to 30 bu. of wheat per acre.

Other improvements influenced perhaps more the extension of the cultivated area than its increased yield. Field drainage was applied to great areas of heavy land under the influence of James Smith (1789–1850), of Deanston in Scotland, and of Josiah Parkes (1793–1871) whose demonstrations of the value of drainage became easy of application with Thomas Scragg's invention in 1845 of a machine for moulding cylindrical tiles. Smith drained shallow, 30 inches; Parkes put his drains in at 4 ft., and much of his work was in consequence wasted. Only after a great controversy between the two schools did it become clear that Smith's was the way to deal with ordinary heavy land which suffers because it cannot get rid of the rainfall, whereas Parkes' was the best method to cut off underground water rising from below. The improvements in cultivating machinery continued and in 1853 Crosskill put an efficient reaper at the farmers' service. The steam plow was designed and acquired a valuable if limited field of action. Pedigree stock made rapid progress; one by one the existing breeds of cattle, sheep and pigs became differentiated; breed societies and flock and herdbooks grew up. Improvements in crops also followed; Patrick Shirreff, John Chevallier, John Le Couteur and Frederic F. Hallet introduced the idea of "pedigree" into cereals.

From 1850 to 1874 farming was a prosperous business and money was poured into the land. British farming reached its high-water mark of technical excellence. It was reported that some farmers offered a reward to anyone who could find a weed on their cultivated land; no other country could show such yields of corn and roots; men came from all over the world to buy British livestock with which to improve their native races.

Depression.—All this prosperity culminated in the high prices occasioned by the Franco-German War; in 1874 a turn in the tide

was manifest. A trade depression set in which limited the purchasing power of consumers; a run of bad seasons, culminating in the disastrous wet and cold year of 1879, brought ruin to many farmers. Other major causes beyond the control of farmers were at work to reduce prices. The growth of railways and the development of steamship traffic opened up the international trade in agricultural produce, and the wholesale settlement of new countries, particularly the western middle west of North America, gathered way. The area of the world devoted to wheat grew apace, faster even than the population; wheat prices fell year by year until 1894. The average *Gazette* price of English wheat was 54s. 3d. for the decade 1865–74, 46s. in the next decade, and continued to fall to 22s. 10d. in 1894. During 1875–94, 124,000,000 ac. of land were added to the cultivated area of the United States alone, and there were the corresponding increases in Canada, South America, Australia and New Zealand.

The other great factor was the appreciation of gold which began when Germany started to form a gold reserve after the war of 1870 and was accentuated by the falling yields from what had been the chief gold-producing centres of California and Australia. The situation was not rectified until the Transvaal became a big producer in the 1890s. The prices of all commodities fell, wheat more than the rest (according to Sauerbeck's index, all commodities fell 40%, wheat 51%), and some economists considered that to this cause alone was due the fall in agricultural prices and the resulting depression. But the vast increase of production must have also had its effect or the demand from the rapidly growing population would have counterbalanced it. During this period there was always a surplus of wheat and it was being grown at less than the cost of production, indeed it has been said that the only profit the pioneering American farmer made out of this situation was the eventual appreciation in value of the land he had settled.

Whatever the ultimate causes of the break in prices it had a disastrous effect upon British farming. Neither farmers nor landlords realized how continuous the fall was going to be, or how completely indifferent would the price remain to the occurrence of a short crop at home; farmers could not readjust their methods and in many cases landowners did not reduce their rents in time to avoid a crash. Much of the old perfection of British farming had to go because of its expensiveness in labour, for during the whole of the period wages were tending to rise rather than to fall. Farm after farm was thrown upon the owners' hands; in Essex great areas of clay land became for a time derelict or were let to Scotsmen who would undertake to pay tithes and rates. In some cases the landowners had to farm themselves on an extensive scale; in others farmers who had acquired an art of cheap management had farm after farm thrust upon them until they were operating areas of 4,000 to 10,000 ac. These big businesses which grew up toward the close of the century were not reflected in the statistics, for the separate farms were still returned in the rate books as units. Indeed they were farmed as units, each with a bailiff but on the common system which the farmers had found to work; the buying and selling only were centralized. Though prices did turn slightly after 1895 it was not until the close of the century that the conditions began to appear at all stabilized. By that time men had learned to cheapen their methods in the purely arable districts and in others the growing demand for milk had afforded an outlet. The Essex clay lands came back into use, if not under the plow, with a new race of Scotch and Devonshire milk producers. Prices of meat and wool had fallen though not to the same extent as with cereals, and the distress in the west and north of England had never been so great as in the purely arable counties. In some districts special crops solved the farmers' difficulties; a great potato industry developed in the Fen country, where energetic men with intensive methods built up large holdings out of the bankrupt small farms; but the price of potatoes, like that of milk, was made at home, foreign competition being negligible there, while the demand grew with a larger and more prosperous population. The growth of vegetables, fruit and flowers also provided an expanding industry, and the demand for such things increased with the rise in the standard of living.

Loss of Arable Land—But such commodities provided the exceptions; in the main the farming community had to meet the depression by reducing expenditure, despite the resulting fall in production. The acreage only under wheat in England, 3,337,000 in 1872, had shrunk to 1,745,000 in 1900; yet there was no accompanying increase in the yield per acre such as should have attended the abandonment of the poorer land, without taking into consideration the improvements in the varieties grown and in the supply of fertilizers. The chief resort of the English farmer in order to meet the situation was to lay his land away to grass. Thereby he shifted his production toward the more remunerative livestock and at the same time reduced the labour bill, because on grassland one man may suffice for 200 or 300 ac., whereas on the arable land about four men per 100 ac. were then employed. Only when dairying on grassland, was a staff required comparable with that employed on the plowland. Between 1872 and 1900 the area of land under the plow in England was reduced by more than 2,500,000 ac., or nearly 20% of the amount in 1872. There were some notorious examples of these changes; in one case on the Berkshire Downs some 4,000 ac. of plowland were converted into a sheep ranch tenanted only by a few shepherds, the old farmhouses and hamlets perishing away in desolation. In England and Wales the agricultural population diminished between 1871 and 1901 from 1,269,371 to 951,674, or nearly one-quarter. In Scotland the reduction in arable land was not appreciable, but a similar saving was effected by lengthening the duration of the leys in the rotation; the four-course shift became a five- or a six-course, with two or three years of temporary grass instead of one. (See ARABLE.)

For all the reduction of cultivation and the lower standard of farming the period was not entirely one of retrogression. Improvements in the quality of livestock, especially in the direction of early maturity, in the production of milk, and in the special branches of potato growing, market gardening and fruit growing continued. The self-acting reaper and binder began to be imported in 1873 and proved the great labour-saving implement of the period, though at the outset it only intensified the pressure of competition, since it was worth more to the wheat grower in new countries short of labour than it was to the British farmer. This distressed state of agriculture became the subject of more than one royal commission and parliamentary inquiry, none of which, with protection ruled out as contrary to national policy, could suggest any substantial alleviation. The one legislative action of importance was the creation of the Board of Agriculture in 1889. This action recognized the importance of agriculture in the national economy, since no other industry had a special department in the government. The new board took over certain existing services such as the collection of statistics, the control of scheduled animal diseases, and the administration of tithes, enclosures, and university and college estates and was charged with one new function, the allocation of £5,000 a year for the assistance of agricultural and dairy schools.

Agricultural Instruction.—The first systematic attempt at agricultural education began about 1890, and in its train followed some new beginnings in research. The great start made at Rothamsted had been left solitary and unaided, though other countries were copying its methods and extending them into all the sciences which bear on agriculture. The movement was too young to have any effect on the industry before the close of the century; it had to overcome the intellectual inertia of a class which had always been indifferently educated and had no opinion of book farming, while the new scientific teachers had to learn what was good in the practical man's outfit and to recover from their own mistakes. One new fertilizer had been added to the list available for the farmer, namely, basic slag, a phosphatic by-product of the steel industry which was to do much to improve the growing area of grassland. But owing to his poverty the British farmer was not using fertilizers as much as he might have done, and the greater part of the British production of sulphate of ammonia was being exported.

Steady recovery and quiet progress under the favouring wind of slowly rising prices characterized the opening years of the 20th century. Knowledge was growing, both from the example of suc-

cessful practitioners and from the technical instruction that was becoming more generally diffused. Statistically the industry continued to decline; the arable land of England diminished by a further 1,000,000 acres between 1900 and 1914; nor was there any compensating increase in the numbers of livestock, though the output was improving as better methods of feeding and breeding brought the animals earlier to market. All over the country examples could be found of progressive and prosperous farmers who were taking advantage of the resources science was increasingly putting at their disposal. But many were still set in old ways; mindful of the bad times that were not far off they sought the path of safety first and were distrustful of all enterprise that might cost money. In the use of lime, fertilizers and other ameliorations of the soil the farmers were falling behind their competitors in the Netherlands, Denmark and Germany, just as in the applications of machinery they could not rival the farmers of the U.S. and Australia. Labour was still too cheap in the agricultural counties of England; farmers still clung to the traditions that had answered when wages were 7s. a week and wheat over 6s. a bushel.

Marketing.—Above all the weakness of British agriculture as an economic unit was being exposed. The rapidly growing population was to an increasing extent being fed from overseas; in the five years preceding 1914 the United Kingdom only produced 42% of the food it consumed as measured in calories, including only 20% of the wheat it needed. Great Britain was the one open market for the agricultural surpluses of the whole world, for the one or two small countries that also persevered in a free trade policy were themselves exporters of agricultural produce. In consequence great commercial interests grew up to exploit this import trade, interests that could impose upon the aspirants for a place in the British market those conditions of uniformity of produce, standardization of output, and attractiveness of packing, which made for ready sale. Because of their dependence upon an export trade competitors were marshalled into co-operative societies, and through this discipline the peasant farmers of other countries secured all the advantages of marketing which might have been expected to belong only to the big businesses. The typical British farmer, who in his day had been a nonefficient unit for the sale of his staple produce and could look down upon the exploitation of the peasant, was loath to forgo his individuality and slow to recognize his weakness in the world's markets. The lack of leadership and organization was all a part of the want of public confidence in an industry which had become somewhat remote from modern life. The great landowners no longer regarded agriculture as a money-making business; they maintained home farms because of the traditional association of the English gentleman with the countryside and because the exhibition of pedigree stock was a recognized form of social competition; but the lawyers, the bankers and the capitalists remembered the past and had no belief in the earning capacity of the land. No joint stock enterprise to produce food at home could hope to obtain public support, however much money might be forthcoming to exploit wheat or wool, tea or rubber or copra abroad. The farmers who were making money said little about it and trusted to obtain whatever capital was needed for their businesses, many of them extensive, from their friends or trade connections. Politically the farming interest did not count; in parliament there could be no agrarian party, hardly even an agrarian member, because even in a purely rural constituency the more numerous labourers were not likely to vote with the farmers. Nor was there any policy upon which the agriculturists were united; although most farmers were still protectionists, such a measure was taboo to all parties so far as concerns food and even with the agricultural labourer the dread of higher prices outweighed the hope of better employment.

The one political measure of outstanding importance was the Small Holdings Act of 1908 which empowered county councils to acquire land and equip it for small holdings and allotments (see ALLOTMENTS and SMALL HOLDINGS). This act was a sign of growing public interest in agriculture and a feeling among thinking people that the urbanization of Great Britain was proceeding too fast and that some measures should be sought to check the drift of men away from the land. The triumphal march of industrial-

ism from factory to factory had lost some of its attractiveness; statesmen no longer regarded the simple theory of Great Britain wholly given up to manufacturing and exchanging its goods for food, as desirable or even safe. So the Small Holdings act was an attempt to recreate the peasantry that had long been dying out in Britain, and to provide access to the land for men whom circumstances had driven into the towns but who still felt a call to the soil. The growth of small holdings could do little toward reducing the volume of imports; the impulse was social rather than economic, but a small holding might give the energetic man a start toward a larger farm. The statutory small holders rarely failed to establish themselves, but their numbers barely sufficed to keep pace with the wastage that was elsewhere going on (see SMALL HOLDINGS).

The Development Fund.—Another measure of perhaps more far-reaching consequences was Lloyd George's Development Act of 1909, by which was set up a commission endowed with ample funds, the function of which was to promote research and education in agriculture and to carry out other experimental work in rural industries which might help to restore prosperity to the countryside. Thanks to this fund British agriculture began to be provided with an adequate establishment for research and investigation, such as the United States, Germany and other progressive countries already enjoyed. Some results from research were already accruing. The plant breeder's improvements were quickly recognized by farmers, and Rowland Biffen of the Cambridge School of Agriculture and E. S. Beaven of Warminster, working independently, had applied Mendelian principles to the breeding of new varieties of cereals. Some of Biffen's wheats and Beaven's barleys were already being widely grown by farmers in the progressive districts and their success did more than anything else to convert farmers to a belief in the value of research.

Toward the close of the period the tractor plow, driven by an internal combustion engine, began to appear. It could be operated on a farm of ordinary British size, whereas the steam plow was only economic on an extraordinary acreage and had become an emergency implement only hired for special work. Imperfect as the motor implement was, it offered potentialities of speeding up and economizing manual labour which have not as yet been fully realized.

World War I.—War halted these forces of quiet progress. Its first effect was to sweep the agricultural colleges and research institutes of their students and younger staff members for military service. For the first two years of the war the farmers were told to carry on their work as usual. Prices rose steadily but not abnormally, though here and there special shortages developed. It was not until the submarine campaign became ominous in 1916 and harvests at home and in the U.S. were deficient that the government deemed a special agricultural program vital.

Early in 1917 the Board of Agriculture under the presidency of Rowland E. Prothero (later Lord Ernle) set up a Food Production department directed by Sir Arthur Lee (later Lord Lee of Fareham), and county committees with power to direct the crops to be grown were constituted. Little could be done to enlarge the area under crop in 1917, but each county was assigned an area of land to be put under the plow for corn and potatoes. Attention was also given to land inadequately cultivated. Services were organized to provide and distribute steam and tractor plows, horses and implements. Labour was recruited from every possible source, including interned persons and prisoners of war. Many women helped, training centres being set up to make them and other unskilled labour serviceable. The supplies of seeds, fertilizers, feedstuffs and other necessities like binder twine were organized, and the necessary transport and credits for purchases overseas were arranged. Although late, the program was prosecuted with great vigour, and even in 1917 the area devoted to wheat, barley, oats and potatoes was considerably increased. The cultivation in allotments of all spare ground near cities and towns was promoted. This movement (see ALLOTMENTS) was of no small value in mitigating later food shortages.

To meet the emergency and also provide a permanent policy of encouraging agriculture for the national welfare, the Corn Pro-

duction act was passed in 1917. It guaranteed certain prices for cereals, but the rapid rise of prices rendered the provisions unnecessary during the war. It also provided for wage boards to determine minimum wages for agricultural labour from year to year in each district, but the price situation developed so rapidly that the boards fixed the actual rather than the minimum rates. Landowners were debarred from raising rents in so far as such increases could be ascribed to the guaranteed prices. The act sought to maintain and extend the area of cultivation, and regardless of its defects it was the first coherent scheme that recognized the needs of all classes interested in the land.

The course of prices was of more immediate interest to the farmers. Early in 1917 shortages attended by rapid rises of prices and speculation among dealers forced the newly formed ministry of food to fix prices and then ration all major articles of food. These steps involved a very complete control of all phases of distribution; prices had to be fixed for both the producer and the consumer, the middleman's allowances were determined, and the supplies had to be allocated to the needs of each district. The food controller had to compromise between the high prices necessary to stimulate production and the low prices required by the consumer. The consumption of bread was left uncontrolled, but its price was kept down by a subsidy. It was also necessary to fix the prices on much of what the farmers produced on a reasonable parity so that they would not be tempted to concentrate on the production of the most profitable. A shortage in cattle food developed since the rationed ships' tonnage for goods from overseas had to be reserved for essential human foodstuffs, soldiers and munitions. The normal home production of cattle food was likewise reduced because wheat was milled more deeply and this produced only 5% or 6% offals as compared with 30% before the war. Actually the milk herd of the country was not appreciably reduced, but the sheep population declined by 1,500,000 between 1916 and 1918, and the pig herd declined from nearly 2,500,000 in 1914 to 1,700,000 in 1918.

During the latter part of 1917 and early 1918 the program of the Food Production department and its county committees found a real response. In 1918 as compared with 1916 the total arable land of the United Kingdom was increased by 1,720,000 acres and the land under crops by nearly 3,000,000 acres, the increase in wheat being 750,000 acres, in oats over 1,500,000 acres, and in potatoes nearly 400,000 acres. But the withdrawal of more men for military service in the spring of 1918 and the disastrous harvest conditions so intensified the opposition to compulsory plowing that no further progress was made. In fact the acreage in grain in 1919 was nearly 500,000 less than in the preceding year. With the end of the fighting in Nov. 1918, the farmers turned very strongly against control, despite the persistence of the crisis of food supplies.

Effect of World War I on Farming.—The consequence of the war conditions which persisted until near the end of 1920, when the food controller's operations were relaxed, was a great temporary prosperity for the farmers. Although they had to sell their wheat at less than the world price and the cost of labour and supplies rose to a high level, rents did not vary and the balance was strongly in their favour. They also enjoyed the benefit which affects all farming operations, namely that on a rising market some of the costs, particularly labour, are incurred on a lower scale than that of the realization. While the largest sums of money were realized from potatoes and vegetables, probably the highest rate of profit was on the grazing farms which sold sheep and wool, young stock and milk, and employed little labour. But the only men who really kept their profits were those who gave up their farms and sold their stock before the end of 1920.

The most immediate effect of these farming profits was a sharp rise in land values. During 1918-21 there were immense sales of agricultural land amounting on a conservative estimate to 3,000,000 ac. in England and Wales. About one-eighth of the farming area of the country changed hands in these years at greatly enhanced values. Landowners were not able to raise rents though their disbursements for tithe, repairs and taxation had increased; farms being in demand, they could treble or even quadruple their

net incomes from land by selling it and investing the proceeds in government stocks. Tenants were anxious to retain their holdings but had to buy in order to do so.

Consequently these years saw the creation on a fairly large scale of an owner-occupier class of farmer. Some of these men had already made money enough to pay for their farms or were able to do so while prices were high; they were comparatively safe when the crash in values came in 1921. The men who then found themselves in difficulties were those who had bought their farms on borrowed money and still carried the mortgage; still more those who had entered and stocked their farms in the period of high prices.

Considering the production of the country the advance in the arable and particularly in the grain area attained in 1918 was not maintained even in the years of high prices that persisted until 1921. All powers of dictating cultivation were abandoned at the close of the war. As regards livestock the size of the milk herd was maintained, though the beef herd suffered a small decline. The sheep flock of Great Britain, of England in particular, was greatly diminished; in England and Wales it stood at about 17,500,000 at the beginning of the war, had fallen to 16,500,000 in 1918 and reached its lowest point, 13,383,000 head in 1921, while analysis of the returns shows that the loss had fallen almost entirely upon the sheep of the arable counties. Arable sheep farming had always been a special British feature characteristic of the open country upon the chalk and the sands. There half the arable land used to be farmed with fodder crops—rye, winter barley, tares, rape, kale, turnips and swedes, which were sown so as to afford a succession of green crops upon which the sheep were closely penned in folds that were moved day by day on to fresh ground.

In addition to their green food the sheep and lambs received a little hay and corn and cake to force them on for market at an early stage; the land received the benefit of the manure made from the food and the treading of the sheep. This system, the sheet anchor of the older light land farming, was unsuited to war and postwar conditions. The labour required, both for the fold and the growing of fodder crops, was too expensive at the new wage rates, the supplementary feeding stuffs were unobtainable, and prices tempted the farmer to sell all his flock and put the land into grain. Again fixed prices ignored quality; the arable sheep farmer could no longer realize the extra price he had been accustomed to obtain for his quickly-grown lambs. Consequently the great arable sheep areas in Hants, Wilts and similar counties lost up to 50% of their sheep and though their numbers revived later the restocking was with grass breeds like the Cheviot-Border, Leicester half-breeds, Exmoors, Kerry Hills, etc., to the permanent loss of the Down breeds, like Hampshires, Oxford Downs and Southdowns.

The stock of pigs suffered great reductions with the shortage of feeding stuffs in 1917, 1918 and 1919. The herd which in England and Wales had remained for many years at about 2,000,000 fell to 1,700,000 in 1918, but recovered rapidly to more than its previous level, reaching 3,250,000 in 1923. The numbers of poultry followed much the same course as that of pigs and from the same causes, but the postwar development was more marked with the rapid extension of the knowledge of skilled poultry management.

Depression of the 1920s.—War prices were maintained until the spring of 1921; then they dropped by about one-third by the close of the year. The prime cause was the deflation of money in Great Britain and the U.S. which was then effected; the secondary causes were the abundant harvests in the vastly expanded area of cereals in the Americas, particularly in Canada, and the lack of purchasing power among the war-ruined population of Europe. Prices in Britain continued to fall until 1923, then tended to recover a little until the long-continued coal strike of 1926 produced a new fall which specially hit the class of farmers who had so far suffered least, namely, the producers of milk and meat. The situation was aggravated by a succession of bad seasons after 1918, which of themselves would have hurt the position of farmers even in normal times. Bad growing seasons, wet harvests and foot and mouth disease, were serious contributory fac-

tors in the ruinous condition in which British farming found itself. Deflation alone wrote off nearly half the capital farmers estimated they possessed in 1921, and though this did not really alter the position of men who had been farming continuously from before the war, it fell heavily upon those who had entered farming during the years of high prices or had mortgages out from the purchase of their farms.

Postwar Legislation.—The state of agriculture was not without consideration and legislative action during the period after World War I. War experiences persuaded both parliament and the general public that the maintenance of a prosperous agriculture was of some moment in the national policy. Even during the war a reconstruction committee under Lord Selborne had examined the question and drawn up a series of recommendations on which the Corn Production Act of 1917 had to some extent been based. But that act, as already seen, had immediately become nugatory as far as guarantee of prices was concerned. As the outcome of a royal commission in 1919 an Agriculture act was passed in 1920, which accepted the main principles of the old act by charging the state with the payment of subsidies on the acreage of wheat and oats grown, whenever the prices fell below the assessed costs of production. The county agricultural committees became statutory bodies endowed with powers to determine tenancies in case of persistent bad cultivation or neglect, and even to enter upon the land and act themselves in cases of default. Wages boards were continued and tenants were given greater security of tenure by provisions which compelled the landlord to give compensation for disturbance equivalent to a year's or even up to four years' rent, unless the county agricultural committee would certify that the notice to quit was justified by the bad cultivation of the tenant. The Agriculture act had, however, but a brief existence. It antedated by only a few months the break in prices of 1921, and it soon became evident that under the guarantees the state would be called upon to pay a very large sum upon the acreage of wheat and oats grown. The basal figure had in fact been set much too high for oats, a crop which is mostly consumed upon the farm and which therefore does not greatly affect the income of the farmer. But no attempt was made to remedy this defect; the public cry for economy was so insistent that the act itself was repealed in 1921 within ten months of its passing, in spite of all the promises set out in the act that four years' notice would be given before the guarantees were withdrawn. The repeal coincided with the very situation the act was designed to obviate, a wholesale break in prices brought about by causes beyond the control of the farmer, and in this case by the deliberate deflation policy of the government. With the guarantees the wages boards disappeared and though conciliation committees were set up in most counties, the average weekly wage dropped from 42s. in Sept. 1921, to less than 28s. before the end of 1922. The repeal of the Agriculture act put an end to all ideas for a national constructive policy for agriculture and the industry was left to sink or swim by its own powers and be guided by its own lights. The action was part of the pessimism of the time, of the war weariness that shirks any sustained effort and doubts the value of any planning for the future. Bitterly as it was resented by the farmers, who thereby lost all confidence not only in governments but in agriculture itself, it was angrily acquiesced in, because they got rid of their two greatest bugbears—the shadow of control of farming and wages boards. The resentment generated by plowing-up orders given in 1918 and other interferences consequent upon the orders of the food controller, had been worked up to an intensity out of all proportion to the actual hardship that had been inflicted, and farmers generally were prepared to purchase freedom at any cost. A very large proportion of them indeed grew little wheat or oats and were anxious to grow less in the difficult state of arable farming. So the farmers' representatives, while protesting, accepted the situation; they saved those sections of the act that gave them compensation from disturbance (provisions which injured the landowners and were in many respects a hindrance to the improvement of farming) and they obtained as a slight recognition of the sacrifice imposed upon them the allocation of £1,000,000 to the extension of agri-

cultural research and education.

After the war the National Farmers' union, in which was concentrated the political opinion of the farming community, objected to any further interference of the state with agriculture. The distressed state of the industry gave rise to a further inquiry in 1923—the Agricultural tribunal, consisting of three economists not directly connected with agriculture, who produced an illuminating survey of the subject early in 1924. Its main recommendation, a subsidy upon arable land with further assistance to the growth of wheat, received little support from the farmers' organizations and was never adopted by the government of the day. It also recommended the re-establishment of the wages boards and this was effected in 1924. An act in 1922 disposed of a long-standing controversy by permitting the admission of Canadian store cattle into Great Britain, and the Agricultural Credit act of 1923 gave some relief in the shape of cheap mortgages to farmers who had purchased their holdings during the operation of the Corn Production and Agriculture acts. The British Sugar (Subsidy) act of 1925 provided a very ample scale of subsidies on sugar produced in Great Britain, for a period of ten years, in order to encourage the establishment of a sugar-beet industry in the country.

Wages and Prices.—The low agricultural prices of the 1920s and 1930s were not due to overproduction, since as far as can be estimated the gross output from the land of the world, actually lower in some items, did not keep pace with the growth of population after 1914 (see below, *World Agriculture*). That this shortage did not result in higher prices was due to the destruction of the purchasing power of so many of the countries of the world, through war and revolution and the depression in industries. The efforts that so many states made toward a deflation of their currency was regarded by many economists as the immediately operative factor, depressing prices for all producers and destroying the confidence upon which industrial activity depends.

The other element in the equation—the relatively high cost of labour—could not be met in England by a reduction in the wage rate, which in agriculture was already below that prevailing in other industries. Indeed, bad as was the state of trade, men left farming for other occupations; many farmers complained of the shortage of labour, and in certain cases where profits were assured, as in sugar-beet growing, labour from Ireland was imported. Any local call for men immediately drew agricultural labourers from their following and when any general revival of industry took place the land was likely to lose most of its active and able-bodied men. Thus if no other change supervened, farming, except for those special businesses that could command a sheltered or a luxury market, was reduced to a species of ranching with a minimum of labour. There was one alternative—a sustained effort to make labour more effective, on the one hand by better organization, by the use of machinery and the elimination of wasted effort, and on the other by careful training to increase the skill of the individual. Much of what was called "good" farming before World War I was still dealing with labour on a mid-19th century basis of wages, and though operations had been cheapened after the fall of prices of the '80s and the '90s, there had been no radical reconsideration of methods such as was called for by the modern relation of wages to the prices of agricultural produce. This was the big problem before British agriculture—the revision of all its traditions of husbandry, and it required the co-operation of the investigators, both scientific and economic, with the study by individual farmers of the conditions imposed by their own farm and particular business. The investigators might supply stimulus and guidance, but the main effort would have to be exerted by the farmers themselves, for the problem was one of management and practice, demanding a consideration of the technique of farming and the arts of leadership and management that had not been forthcoming for the last two generations. Some encouragement and renewal of confidence could come from increasing prices, for the withdrawal of men from the land because of the superior rewards in other occupations was not confined to Great Britain but was common to all countries. It affected the peasant as well as the wage-earning labourer; it was

manifest in the United States as in France.

Agricultural Co-operation.—The obviously attractive advantages which can be obtained by buying and selling on a wholesale scale and the great success attending co-operative effort among farmers abroad, particularly in Denmark, caused agricultural co-operation (*q.v.*) to be pressed upon the British farmer for many years. The work of propaganda and advice was undertaken by the Agricultural Organization society, which was modelled on the successful Irish society initiated by Sir Horace Plunkett. The A.O.S. was a voluntary organization supported by subscriptions from its affiliated societies, but it enjoyed a considerable amount of subvention from the Development fund from 1910 to its demise in 1924. The earlier efforts at co-operation chiefly aimed at the formation of purchase societies to supply the farmers' requirements for fertilizers, feeding stuffs and other materials. Though many of these ventures had but a brief existence some became strong trading corporations, such as the Eastern Counties Farmers' Co-operative society at Ipswich. A wholesale society, launched during World War I with the object of bulking the purchases of individual societies, came to disaster. Little progress was made with societies for the sale of farmers' produce, though a number of egg-collecting depots flourished. Dairy societies had a somewhat chequered existence; in some cases as soon as they attained local success they attracted the attention of one of the big dairy firms and after a period of fierce competition either succumbed or were brought out. Eventually the Agricultural Organization society, despite all the devoted work given to it and the subventions it had enjoyed, found it necessary to dissolve. It had never received any wide measure of support from farmers, and as the National Farmers' union had become the representative organization of the farmers of England and Wales and was prepared to take over the care of co-operative action among its members, the old society gave way to the National Farmers' union. At the same time the government under the Agricultural Credits act made provision for loans to Agricultural Co-operative societies on the basis of a loan of 20s. for each 20s. share taken up by members, of which no more than 5s. need be initially called up. The history of these latter ventures was not altogether encouraging. At the same time there was a movement for the setting up of co-operative bacon factories on Scandinavian models. Seven such societies were started. Two active wool-selling agencies were established, one in the southeast and one in the northern counties, both of which steadily progressed. In 1925 on the termination of the wartime hop control, a voluntary organization to continue the collective sale of hops succeeded in enlisting some 90% of the hop growers of the country. While other examples could also be named, speaking generally, agricultural co-operation made but little progress among the farmers of England.

The reasons are not far to seek. In the first place the larger English farmers make their purchases on a big enough scale to secure terms comparable with those offered by the co-operative society. When such men joined a purchasing society they were apt to use it merely to beat down the terms offered by their merchants. The smaller farmers followed the lead of the big men or were unable to forgo the credit they obtained from the merchants. Again the firms dealing in agricultural necessities were very firmly entrenched in Great Britain; many of them were bigger and more efficient than a newly-started co-operative society could be, and having capital behind them did not shrink from competition. They had the great advantage too of being able to offer credit, and their agents being generally drawn from the farmer class had friends and connections among the men with whom they wanted to do business.

Societies for the sale of farmers' produce had an even more difficult task. Trade rivalry was equally strong; the customary markets were close at hand and farmers were loath to forgo their individuality or renounce the chance of a temporary rise of prices. Co-operative selling involved working to contract and the production and regular delivery of a standardized article. The bacon factories failed largely because they could not ensure a regular supply, the farmers diverting their pigs to other channels when

prices rose. Firm contracts to deliver regularly were refused by the producers or could not be enforced. Milk societies were compelled by their members to give a price too high for successful working because a competing trader with a long view would offer prices above the economic parity. Certain ventures failed also from embarking upon a manufacturing process, like bacon curing, which requires a considerable degree of technical skill, and the inability of the society to pay a competent manager or else to find one before its resources went.

The existence of a near-by market is the great obstacle to agricultural co-operation for the sale of produce. Nearly all the examples that are so freely quoted of the success of farmers' organizations—the bacon factories of Denmark or the fruit-selling associations of California—rest upon the fact that only an export trade is available and that farmers cannot engage individually in such a trade. They are driven to organize because the alternative is the control of a wholesale trader who cuts the producers' returns to the minimum that will keep them in business. For these and other reasons the true co-operative spirit was lacking, and British farmers did not show that loyalty to the principle of combination which would induce members to stick to their society even at the cost of some loss to themselves. When there is an old-established market at hand it is almost impossible for a co-operative business to give the farmer better returns at once. Psychologically, too, defaulters and men who stand outside a combine have a powerful disintegrating influence upon it. They share in all the benefits if the combine succeeds in raising the general level of price; they take no risks and get paid at once, while members may be waiting for a portion of their returns because the society has only succeeded in raising prices by withholding part of the crop from the market. The "outsiders" would not be human if they did not boast about their advantages, and English farmers were as yet too easy-going and too much merged in the general community to counter with a social boycott. Similar occurrences in certain of the British dominions resulted in legislation to force recalcitrants into any combination which secured the adhesion of three-quarters or four-fifths of the producers; but such procedure was quite alien to the English farmers' declared policy of "no control." Yet the acceptance of voluntary control is the essence of co-operative organization, and by virtually compelling farmers to produce the article wanted by the market, rather than that which they fancied, exerted a powerful educational influence. On the other hand if he did not accept the voluntary control of his own organizations the British farmer was likely to drift into subjection to the much less sympathetic control of big businesses which would make of him a tied producer.

Thus the prospects of agricultural co-operation did not appear bright, though the situation was not without hope; a sense of the necessity for combination was growing. Nothing could be gained by preaching co-operation at large, but little by little particular instances were making good, especially where the association only attempted to sell and not to manufacture the raw material provided by the farmer. An alliance might be possible with the great co-operative organizations among consumers, which indeed had hitherto been spending their efforts in organizing foreign rather than home producers. But it was only by combination of some sort, from within or from without, that British farmers could hope to retain a remunerative share of the best of all agricultural markets—that of Great Britain. (*See AGRICULTURAL CO-OPERATION.*)

British Farming Systems.—British farming is characteristically an affair of small capitalist businesses employing paid labour. Characteristically, too, the farms are tenancies held under yearly agreements, though the tenant is largely protected from disturbance by the Agricultural act. The landowner provides the permanent equipment of the farm buildings, gates and fencing, water supply, drainage. The landowner also is responsible for repairs to the fabric, but minor improvements of which he will remain possessed are generally carried out on the basis of the landowner finding materials—timber for fencing, bricks, stone, gates, drain tiles, seeds for permanent pasture, etc., and the tenant finding the labour. The landowner's capital has been estimated to

amount on the average to £31 per acre, the tenants to £12-£15 per acre, and the average rent to 31s. per acre. Under such a system the entry upon and leaving of a farm, at whatever date, necessitates a considerable adjustment of account between landlord and tenant, since the farm must be left as a going concern. These adjustments were formerly regulated entirely by custom and though they were now governed by the various Agricultural Holdings acts (consolidated in 1923), custom was recognized and still played a large part. The basis of the act was that the outgoing tenant was entitled to compensation from the landowner for all improvements he has effected, the amount of compensation being determined by the value of the improvement to the incoming tenant. For certain types of permanent improvement, e.g., buildings, fruit trees, etc., the tenant was not entitled to compensation unless the consent of the landlord had previously been obtained. The purpose of this exclusion was to prevent the tenant from committing the landowner to payment for an improvement which the latter might not be able to realize. For example the improvement effected by planting land with fruit or hops might be valued as high as £100 an acre, with embarrassment to the landowner if he had to pay out this sum on the determination of the tenancy without any assurance of being able to find a tenant willing to pay an adequate rent for it. An exception was made in the case of holdings let as market gardens. Here general legislative sanction was given to what was known as the "Evesham custom." The tenant possessed the right of free sale of the improvements he had made, e.g., beds of asparagus, fruit plantations, etc., but had to find the purchaser, the landowner being obliged to accept the tenant proposed by the outgoing tenant, who had made his own bargain for the improvement with the new tenant.

In ordinary cases the negotiations with regard to improvements proceeded between the outgoing and the incoming tenant, in whose agreement with the landowner was a clause that he should pay whatever compensation was due to the outgoing. Each tenant appointed a valuer who between them prepared an agreed valuation of the tenant right, there being provision for an arbitrator in cases of dispute. The account included the cost of cultivations carried out before leaving the tenancy, standing crops and manurial residues whether of fertilizers applied or purchased feeding stuffs consumed during the latter years of the tenancy; but as farms were vacated at different dates in different parts of the country, though most commonly at Michaelmas or Lady day, custom still played a large part in determining both what things were the subjects of compensation and the basis of assessment.

Tenancy.—The British tenancy system possesses many advantages. The handicap that farming is under as compared with other industries lies in the large amount of fixed capital involved in comparison with turnover and in the lag that exists between expenditure and returns. For the farmer who has to own his farm this implies a considerable degree of credit, and in other countries it has generally been found necessary to give some state support to landbanks or other long term credit organizations which will take the burden of the capital outlay on land and buildings. The short term credits required for the conduct of the business proper are supplied by co-operative associations or the banks. Otherwise mortgages rule and mortgages have universally proved destructive to the farmers whenever a run of bad seasons occurs. In Britain the landowner has supplied the cheap capital the industry requires for its permanent equipment, and the banking system so far pervades the community that it can furnish a not unreasonable proportion of the working capital the farmer should have. Even so the farmer would have to work upon a much smaller proportion of borrowed capital than prevails in other business, and in practice in Britain the farmer resorts to a dangerous extent to the tradespeople with whom he deals. The merchants who sell to him his requirements in manures and cakes and buy from him his grain and hay, and the auctioneers through whose hands pass the store cattle he buys and the finished cattle and sheep he has to sell, provide to a very large extent the financial backing of the industry. This custom obviously limits the power of the farmer to buy and sell in the best market, and it was pro-

posed by legalizing the creation of chattel mortgages to enable the banks to accord greater credit facilities. The farmer could then assign his livestock or his standing crops as security for advances.

The tenancy system undoubtedly assisted in the development of British farming in the 19th century, though it produced a certain number of cases of oppression when the power of the landowner to turn out a tenant for causes unconnected with farming remained unrestricted. The condition, however, of success in a tenancy system is the possession by the owner of a real knowledge of, and interest in, the conditions of farming. He (or, in the case of large estates or other interests, his agent) must have considerable technical knowledge, if he is to be a working element of the system, the adviser and leader of his tenants. The declining interest of landowners in agriculture and the inadequate training of so many of the agents employed by them were a main cause of the weakness that the tenancy system displayed and its hampering effect upon enterprise and innovation among the farmers. Many people, therefore, aiming at a return to a system of occupying ownerships pleaded the necessity of freedom for the cultivator and the stimulus of the "magic of property"; though it would be within the experience of those who had occasion to survey the countryside in detail that even if some of the best, so also many of the worst-managed farms are the property of their occupiers. Further in a modern state no ownership system persists; minors, females or men with other interests inherit, and the new owners prefer to let rather than to sell. For these reasons it was argued that the welfare of the industry demanded the state ownership of all agricultural land and a stricter exercise of the continuing owner's interest in good farming.

Small Holdings.—Other observers who were impressed by the straits of wage-paying farming, even at the low rates for agricultural labour, sought a solution in a break-up of the larger holdings characteristic of British farming and a return to the peasant system of family farms, still customary in most parts of the world. Even in the depression of the 1920s flourishing colonies of small holders could be found in many parts of the country, and the creation of small holdings was attended by an increase in the production from the soil. For instance in the vale of Evesham grass farms on clay land which were indifferently grazed and yielded but a poor return of milk and store stock, became intensively cultivated for asparagus, plums and other vegetables and fruit; where there had been perhaps one man employed per 100 acres, the small holders would make a thrifty living on 15 acres of the new cultivation. Consideration of such cases led to the Small Holdings act of 1908 and to a widespread demand for a general policy of dividing up the land. It was doubtful, however, whether the admitted success of small holdings was a sufficient basis to justify their general application to British conditions. The success of small holdings depends upon two factors. The small holder, being his own master, works harder and more intelligently and for longer hours than the paid labourer; he also throws in the work of his family, often of considerable amount. Large farmers would agree that if they could get from their labourers the quality of work put in by the small holder they could pay wages even higher than the returns obtained by the small holder. Small holders, therefore, are concerned with the production of those things in which manual labour bulks largely, but also they must engage in a branch of the industry that has a rising market, and preferably one that is naturally protected. With their ears to the ground they have been quick to seize upon small things that the large farmer neglects. Milk, potatoes, vegetables, fruit and poultry, and occasionally pigs have been the produce upon which the small holders have depended. They rarely touch the main lines of farming—grain, beef, or sheep and even with milk they often make their profit by combining retailing with production. Thus the opportunities for small holding are limited and the markets they cater for are easily overstocked, although as regards milk and vegetables they had reaped the advantage of a demand that had been steadily rising for years. As a rule small holders require good land and can make little use of the great areas of the chalk and clay soils.

While it is generally agreed that small holdings are unsuited

to the production of grain or cattle and sheep breeding, it is argued that even these branches of agriculture could be pursued if they were organized for the co-operative use of machinery, pedigree sires, etc. But this is only equivalent to saying that small holding farming could be successful if imperfectly and by agreement it adopted the methods of large farming. Co-operative farming has not been realized and the mark of the small holder is his independence; as a rule he has only become united with co-operative selling societies when he has been under the necessity of working for an export market. Nor is there necessarily any greater production from land under small holdings; in the instance quoted above the increases are due to a change in system introduced by the small holder. But the large-scale fruit grower or market gardener or milk farmer will produce more per acre and that of better quality than the small holder working single-handed. Organization and the command of capital in the large businesses tell even against the individual attention which is the asset of the small holder; spraying is more suitably undertaken on an extensive scale; clean milk more often comes from the large herds. The greater production per acre of the small holder is often a consequence of the more intensive farming which he is forced to adopt but which would be uneconomic if the labour had to be paid for. There are thus two cardinal difficulties attending upon a revival of a peasant system of farming in Britain, one economic, the other social. The economic drawback is the higher capital outlay involved; the creation of a colony of small holdings necessitating expenditure on buildings, roads, fencing, water supply, etc., that is much greater than would be required on a farm of equal area and engaged in the same type of farming. But it is not germane to quote the excessive cost of the small holdings set up after the war, which reached £2,000 and upward per holding, because at that time no farm, large or small, could have been equipped on bare land so as to produce an economic rent. The old peasant holdings inherit in their buildings and equipment, the results of the gradual unpaid labour of many generations, and when the holding is sold this accumulated capital is counted cheap, because the price is based upon the farm's earning capacity, not upon what it would cost to reproduce it: hence the prime economic difficulty of building up small holdings *de novo*. The second question is whether small holdings can persist on any large scale under modern conditions. Depending on the basis of the occupier giving his labour cheaply as measured in terms of hours and wage rates, the total cash returns from a small holding are often little or no better than the wages of the agricultural labourer and still less than those of the industrial worker. A certain number of men are always prepared to give this price for their independence and for the chance of getting on, and upon this fact depends the social value, even the necessity, of small holdings. But it cannot be expected that a whole class of the community will permanently consent to lower wages and longer hours. Looking back at the history of British farming the merger of the smaller into the larger farms had always been going on. In other countries peasant farming had persisted longer because of the slower development of the industries, though even in France the peasant was being attracted from the land, and in the U.S. the younger generation looked askance at continuing the family farm. It was in China, Japan and India that the sheer pressure of population maintained the one man farmer at a standard of living barely above the starvation level. Some small holdings are a necessity as a social safety valve; but a general return to small holdings would not solve the problem of increased food production. Farming is an industry like any other and a return to small holdings would be as much a retrograde step as would be a return to hand weaving. Nor is the argument valid that the state would gain by having more men employed upon the land. If extra men are employed on the land because the production has been intensified there is a gain, but if the extra labour has only to make up for an inefficient method there is loss. To prohibit machinery and return to spade labour would ensure the greatest number of men upon the land but the community would lose thereby. That community is the richer which employs the smaller proportion of persons in the production of its necessary food, leaving thereby

a greater number free for the production of clothes, houses, etc., and other elements constituting wealth.

Industrialized Farming.—It is obvious that on the large farm very considerable economies of working can be effected, especially from the use of machinery. The cheapening of costs of production depends upon making manual labour more effective. Modern power cultivators are likely to be large in order to secure that speed and depth of working proper to their work; they therefore require large fields to save turning about and only broad acres defray their heavy overhead cost. Farming is no exception to other industries in that large-scale working by its powers of organization and concentration of effort can obtain better work done at a lower cost. The improvement of livestock by breeding and selection is only possible with numbers upon which to work. Buying and selling is better done on a large scale, however much the small holder may be able to obviate his weakness by co-operation. Large-scale enterprise can employ those methods of costing and recording upon which good management is based. In his technical methods the small holder must work by tradition; he cannot afford to experiment and is therefore slower to accept new ideas. Furthermore the land still requires considerable capital expenditure if it is to be put to its best use; and drainage, the straightening of boundaries, and similar wholesale improvements are not practicable except on a large tract of land. It seems inevitable that as intensified production becomes imperative to provide food for a growing population it can only be obtained by large-scale industrialized working. Two conditions, however, must be fulfilled before large-scale farming can be attempted with confidence. First of all a new art of management must be evolved, based upon systematic cost accounting and a critical knowledge of average standard costs. Good farming has hitherto been very much a personal affair depending upon the experience, intuition and determination of the individual. Industrialized farming will always require the qualities of the old farmer—his eye and energy; but it also calls for more calculated management even though farming cannot be standardized like other industries. The other condition of success is the formation of a corps of workers trained for their job and rewarded accordingly. The old type of agricultural labourer was a highly skilled man; much of the work of farming is now being done by men who have been prevented by some defect from entering other walks of life, or by youths who have been left to learn their craft haphazard. Efficiency demands efficient men, for however much machinery may be employed a farm cannot be supervised like a factory. But if the future of agricultural production lies with industrial farming, a bigger unit will be required than the present average British holding. Successful as was the farm of 200–500 ac. as a first step toward intensive production, it has become an uneconomic unit today; it is too small to take full advantage of machinery, is still retail in its buying and selling and demands too large a proportion of its turnover for management. With an average ratio of six labourers to one farmer on English farms, the business is insufficient adequately to pay one man solely engaged in management, and even units of 500 ac. are not large enough. The proper unit is probably something of the order of 5,000 ac., with some hierarchy of managers and under managers into which young men who have been trained for the work could enter in subordinate positions. But it is also one of the handicaps of the present system of British farming that its management is too rarely recruited from school or college as other businesses are. The possession of capital is more often the condition of entry and too often is regarded as dispensing with the need for any technical training; but the industry would be the gainer from a greater leaven of men who began on a more educated plane.

World Agriculture.—The depression under which agriculture laboured between World Wars I and II would seem to offer little chance of a reorganization of the industry along industrial lines, there being nothing to tempt the large capitalists to take up food production. This depression was felt in all countries and, as the Economic conference at Geneva in 1927 indicated, it was the outcome of the deficient purchasing power of Europe and of China due to industrial depression. It was perhaps initiated by the de-

flation policy of the leading states, because it was evident that the low prices were not due to overproduction in the usual sense of the word.

If we exclude from consideration Asia and tropical Africa, as being both self-contained in the matter of food, the population of the rest of the world, constituting roughly the countries inhabited by the white races of mankind, increased between 1913 and 1926 by approximately 50,000,000, or $7\frac{1}{2}\%$. The corresponding increase in the area of cultivated land was susceptible of even less accurate estimation, but according to the best figures available was about 36,000,000 hectares. Meantime, however, agriculture was not intensified, rather the reverse, and on the basis of current farming one hectare of land ($2\frac{1}{2}$ ac.) was required to produce the food and other agricultural materials consumed by one unit of population. On this showing the increased food production since 1913 had not kept pace with the growth of population. Considering again the countries making returns to the International Institute of Agriculture, the wheat acreage increased in the same period from 109,000,000 to 119,000,000 hectares, the production from 1,029,000,000 to 1,139,000,000 quintals, *i.e.*, nearly 11%. But part of this increase in wheat was purchased at the cost of other crops. In the countries other than Asia and Africa the four chief cereals for human consumption, wheat, rye, barley and maize, taken together, only increased in area by 4% and in production by 5%. Food animals increased, cattle by 12%, sheep by 2%, while pigs declined by 4%, from which an increase of 8% in the meat production may be estimated. These figures lead to the conclusion that latterly the expansion of world food production had not been keeping pace with the growth of world population, even taking account of the relative checks imposed by World Wars I and II and by their consequences. The low prices result from the deficient purchasing power of the larger population and from the fact that the greater part of the food production of the world is carried on by peasant farmers. This method of farming can neither alter its production in response to a lower demand nor combine to maintain prices. The men who are engaged in it accept the bad times because in the main no alternative is open to them, and by their capacity to endure hardships and yet persist in production at the low prices prevailing, they ruin the capitalist farmers who have to pay wages. But there are signs that the indifferent returns of peasant farming as compared with wage earning in the industries is beginning to tell in the withdrawal of men from the land. It is clearly happening in the United States and in France, where may be seen in progress the movement that characterized England in the latter part of the 18th century. Peasant farming does not persist when industry and commerce come near and display their openings to the farmer. Moreover the opportunities for creating new peasant communities of farmers have become smaller; great stretches of unoccupied fertile land in temperate climates, such as were settled in the 19th century and provided food for the then unprecedented growth of population, have diminished. The demand for food and other raw materials produced from the land must soon be felt by the still growing population, and any return of industrial prosperity is likely to be followed by a sudden upward rush of prices because there is no margin of overproduction and accumulated stocks behind the present low prices. Production adequate to meet the real needs of the existing population cannot be met by extending the cultivated area but will require an intensification of farming on the land now available. Intensification will only be prompted by better prices and will then best be realized by large-scale farming on industrial lines. (A. D. H.; E. E. Es.)

World War II.—The heroic achievements of British agriculture during World War II will long be chronicled. The starting point was a general plan drafted in 1936–37. The basic objective was the production at home of as much as possible of the foods most needed in wartime. The chief means was the plowing of as much grassland as quickly as possible for sowing and planting. An acre of permanent grass feeds only one or two persons, but an acre sown to wheat feeds 20 and an acre planted with potatoes feeds 40. In May 1939 the ministry of agriculture offered farmers a grant of £2 per acre toward the cost of plowing up land that

had been down to grass for seven years or more. Steps were also taken to build a reserve of tractors. By the time the war came, 350,000 extra acres had been plowed for planting.

Although the over-all war plan for agriculture was drafted and directed from London, its execution was carefully decentralized. On the day preceding the declaration of war, the minister of agriculture appointed county war agricultural executive committees consisting of 8 to 12 local agriculturists for each of the 62 administrative counties of England and Wales. The chairmen were carefully selected for their knowledge of local agricultural conditions and practices, their quality of leadership, and the confidence they would receive locally. Appointment made the committee personnel responsible to the minister and not dependent on local votes. Yet the fact that they were representative of the landowners, farmers and labourers enabled them to work with all the elements of their countryside in a democratic way. Each committee ultimately had a paid executive officer with technical assistants drawn in part from the agricultural education establishments which were closed in 1940. The committees retained the powers delegated to them by the minister but designated sub-committees on cultivation, labour, machinery, land drainage, livestock, horticulture, technical development, feeding stuffs, insects and pests, finance, goods and services, and war damage which supervised the day-to-day work. The county committees also set up 478 district committees. The main reliance was on informal advice and instruction in securing fulfilment of cropping programs, but compulsion after approval by the minister was resorted to in some 3,000 cases where the farmers refused to meet the efficiency standards set by the committees. The Agricultural Improvement council, appointed in 1941, was responsible for seeing that the results of research were incorporated in farming practice as quickly as possible.

In 1941 the county committees conducted a national farm survey to ascertain the exact status of British farming and thus provide a factual basis for knowing how far the general standard of farming could be raised. Practically every farm in Great Britain was visited, and the details concerning its condition, management, equipment, capitalization and efficiency were tabulated. A census of all farm stock and crops was taken, and a plan of every farm made. The farmers were classified A, B and C—good, second rate and bad, and concerted steps were taken to improve all three categories. This modern Domesday survey not only provided invaluable data for the wartime mobilization of the nation's resources but supplied a blueprint for postwar agricultural planning.

The problem of labour supply was met in a number of ways. The great and necessary increase in arable acreage called for more labour, and yet some 98,000 men left the land to enlist during the war. Provision was made for a Women's land army on June 1, 1939, and some 5,000 volunteers were accepted before the war came. The age limit was set at 17 to 40. The applicants also had to pass a medical examination and give evidence in an interview of their aptitude for farm work. The women were given a month's training at agricultural centres or on approved farms. Their minimum weekly wage was set at 45s. Part-time volunteers were also organized; school boys and girls and young students, office and factory workers and retired folk served on this basis. Soldiers, including many from overseas, also aided at harvest time. In all possibly 150,000 volunteers helped with the harvest of 1942. In some 50 communities voluntary land clubs consisting of persons who gave their weekends and after hours to farm work were organized. Early in the war the government decided that men must not be allowed to leave the farms for the higher wages of industry, and farm wages were set at a national minimum of 48s. and later 60s. per week.

Due to war necessity Great Britain became the greatest user of farm machinery of any country in Europe. The number of tractors rose from 52,000 before the war to some 175,000 in 1944. The implement units drawn by tractors increased from 200,000 to 1,175,000. Although combine harvesters had been little used before the war because of the moisture problem, their number rose from 150 in 1939 to 1,500 in 1942. In counties with a scar-

city of machinery, implements depots were organized; in others the farmers pooled their machinery in order that their maximum use could be effected. The business of firms that contracted to do plowing and similar work expanded greatly. To popularize new machines, demonstrations were held.

Many new machines were introduced. An Agricultural Machinery Development board was set up to guide this rapid mechanization. It consisted of implement manufacturers, progressive farmers, representatives of the farm workers and associations for agricultural and industrial research. It tested machinery, promoted standardization, provided educational and advisory services, encouraged new inventions and ideas, and generally acted as the link between research workers and practical farmers. A national Institute of Engineering functioned under the board. Although large consignments of machinery came from overseas, more than two-thirds of the new units were supplied by home manufacturers.

To meet the food needs much land was reclaimed for agriculture. As the limitations were the scarcity of labour and machinery, it was necessary to take the most promising lands first. The ditches on farms were cleaned and many neglected acres reworked. Golf courses, private parks, building sites, bare downs, commons and moors were plowed and planted. Bogs and swamps took more expenditure, and it soon became necessary to have the many schemes of reclamation submitted to the government for approval. If approved the government bore half the cost. Inspired by the experimental work of Sir George Stapledon, many pastures of poor quality and rough grazings were reseeded, thus greatly increasing the pasturage for livestock.

As a result of the war effort Great Britain came to produce about two-thirds of the food it consumed whereas before the amount had been barely one-third. It is true that the consumption of some commodities was reduced, but on the other hand the increase was achieved in spite of the loss of more than 7,000,000 tons a year of imported feeding stuffs formerly processed into milk, meat and eggs. This represents an increase of about 70% in the net output of Great Britain's soil. The net arable acreage was increased from 12,000,000 to 19,000,000, the largest total since the early 1870s.

Despite the loss of more than 5,000,000 acres of pasture and most of the feed formerly imported, the dairy farmers broke all previous records and met the demand for fresh milk which came as a result of the National Milk scheme which guaranteed all children under five years, expectant mothers and invalids a pint a day at half price. The flax acreage was increased from 1,600 to 51,000 acres, and in Ulster the acreage was trebled. The production of sugar from sugar beets was sufficient to meet the home ration, though not the manufacturing needs. The wheat and potato acreages were doubled, and the increases in oats and barley were only slightly less. The annual production of vegetables was increased from 2,500,000 to about 400,000,000 tons. The number of sheep declined 20%, pigs more than 50% and poultry about 20%. The number of allotments and gardens in back yards were greatly increased. More than 6,000,000 families raised at least some of their own vegetables and 1,000,000 their own eggs. Although the disastrous weather conditions during the harvest of 1946 and the winter following brought deep gloom to the British countryside, it was hoped that the lessons of its wartime experience and achievement could be salvaged for the future.

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AGRICULTURE IN THE UNITED STATES

In the Americas the white man's agricultural endeavours extend back only to the middle of the 16th century, but the agricultural achievements of the natives, whom the white man for the most part thrust aside, date back to many centuries earlier. The early Europeans may have willed that the agriculture of the newly discovered continents was to be a projection of that of their homelands, but necessity compelled them to adopt native crops and methods to sustain their colonies. It was the union of American Indian and European agriculture that provided the essential basis for the ultimate agricultural development of the new world.

Although the pre-Columbian agriculture of the Americas was deficient in certain fundamental respects, it had many contributions to make to the civilization which the Europeans carried around the world. The agriculture of the old world consisted of both cereals and animal husbandry, whereas that of the new world centred about a group of cereals known as maize (corn) and lacked animal husbandry of significance. Neither cattle, horses, sheep nor swine were known in the new world before the coming of the white man. The natives knew that animals could be tamed, but they had failed to propagate them for their flesh or for use as traction power. The new world also lacked the wheel and its common applications in the cart, the pottery wheel and the rotating hand mill. Instead of a plow, the new world used the digging stick and its specialized form, the spade or foot plow. On the other hand, the number of economic plants domesticated by the natives and adopted by the white man for world-wide use is extensive; the more important include maize, tobacco, potatoes, beans, peanuts, squashes, cassava, tomatoes and pineapples—a list that the old world could scarcely rival. The fact that the intruding Europeans found no wild plants of outstanding economic importance not previously utilized by the natives is evidence of their thoroughness in this field of endeavour.

So far as the agriculture of the Thirteen Colonies is concerned, the European background is primarily England of the years 1580–

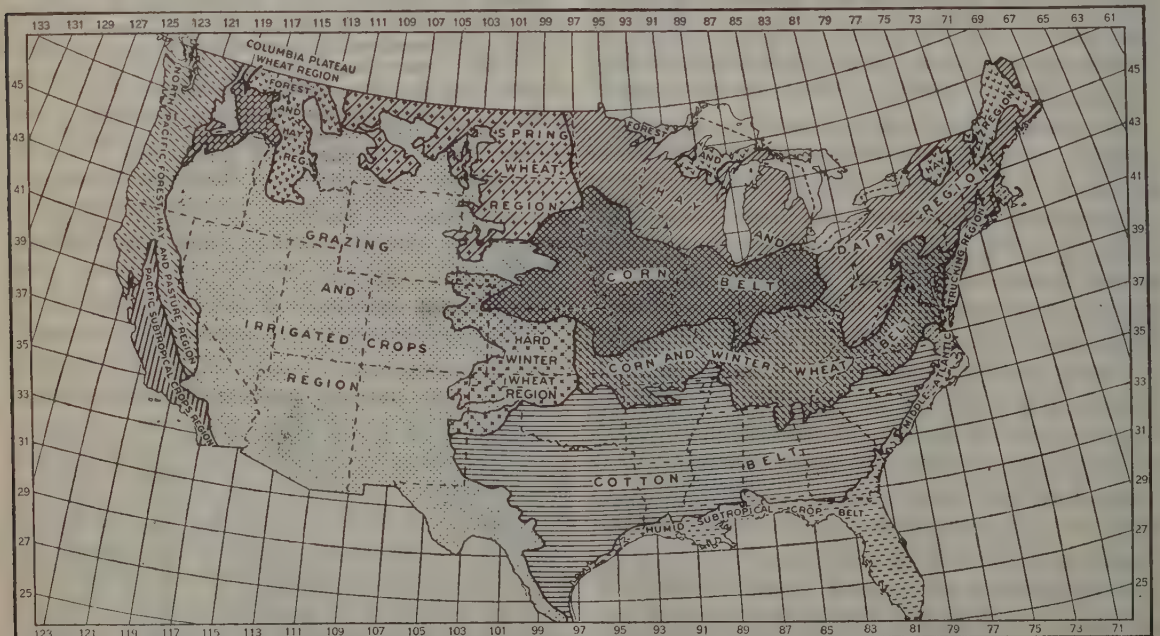
1660. The mother country was then predominantly rural in its way of life. The statement of William Bradford that the Pilgrims were "used to a plaine cuntry life and ye incoente trade of husbandrey" serves as a description of the English colonists generally. England of the 17th century was comparatively undeveloped agriculturally. Its great agricultural achievements came long after the founding and acquisition of the Thirteen Colonies.

The earliest efforts of the pioneering colonists to derive a livelihood from the soil can hardly be called agriculture. In general their activities resembled those of primitive tribes in the hunting and collecting stage of development. All of the initial settlements were to a considerable extent dependent on the native plants and wild animals for food until they could ascertain by trial and error what their lands could produce agriculturally.

The natural food resources of the Atlantic coastal plain where the English planted or acquired the Thirteen Colonies varied somewhat according to the latitude, but there was usually an abundance. Berries of various kinds, including blackberries, raspberries, huckleberries, gooseberries, strawberries, cranberries, and fruits such as wild cherries, grapes and crab apples, as well as nuts and certain edible roots were available in season. There was also plenty of fish, oysters and clams, and wild game such as geese, ducks, pigeons, partridges and turkeys, as well as deer. Yet the early colonists were often on the verge of starvation. This suffering amidst what appears to have been abundance has been variously explained, but basically it was because the first settlers found it difficult to revert to a different stage of living; furthermore, it was difficult to transpose and adapt the agriculture of the old world to conditions in the new.

Colonial Land Policies.—In 17th century England, land-ownership was the key to political, economic and social privilege and prestige. It was natural, therefore, that much stress should be placed on landownership in the English colonies. The early explorers had taken possession of practically the entire continent in the name of the king and thus provided him with a vast domain to dispose of as he wished.

Although the ways by which land passed from the king to actual farmers were many and varied, three distinct procedures stand out, namely the manorial system, the New England system and



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FIG. 5.—AGRICULTURAL REGIONS OF THE UNITED STATES

the southern system of headrights:

The attempt to recreate mediaeval manorialism in the new world, although it had long since outlived its usefulness in the old, was suggested by the sheer abundance of land. Although the king made grants of large tracts to friends with a view to their establishing landed estates, their successful development was contingent upon revenue returns from the land. Accordingly the grantees sought to collect quitrents from the actual occupants of the land, but the result was social friction which did not end until the quitrents were swept away during the American Revolution. The land available in other ways far exceeded pressing needs, and those with sufficient initiative to venture to the colonies were loathe to settle voluntarily on manorial holdings, albeit American versions.

Another distinctive procedure of land disposition was the New England system which emphasized group action and theoretically shunned the profit motive. The leading New England colonies were established by trading companies which received extensive grants of land from the crown and which served as, or evolved into, governing bodies. When a relatively old and settled community became crowded, at least according to contemporary standards, a group wishing to move into the wilderness selected representatives to look up a tract, usually contiguous to a settled community, which was deemed suitable for a new settlement. Having found what they needed, they petitioned the colonial government for permission to migrate there. The government, in turn, sent out a committee to examine the tract with reference to its suitability for settlement and to report on the qualifications of the would-be movers and especially of their leaders. If the committee's findings were favourable, the grant was made. It was usually a rectangular area approximating the traditional U.S. township in size.

The group receiving the grant became in essence a quasi corporation and proceeded over a period of years to divide the land in severalty among the settlers. Near the centre of the tract or in some other strategic location a village was laid out, the focal point being a green with the meeting house, the minister's house, a burial ground, a market place and a school. From the green extended the village streets with the house lots, which were plots of sufficient size for a dwelling and outbuildings, a dooryard, a garden and an enclosure for feeding stock. Then a large block of the grant was roughly surveyed and divided into strips which were distributed among the settlers by lot, each family receiving some of the best as well as some of the poorer land. When these 'lots' had been developed into tilled fields, a comparable division of another block of the grant was made, and this process of distribution was continued until all of the land received by the original group had been brought under cultivation. The uncultivated land was used as a common pasture by the community, and one or more herdsmen were employed to watch the stock.

This plan of land distribution had important social and political consequences. It developed habits of group action and afforded a compact social life. It facilitated the ideal of a Biblical commonwealth and a Puritan theocracy. The town meeting, at which plans for land distribution were worked out and the officers who cared for the village property were chosen, was a vital factor in the evolution of democracy in America. The system provided an effective and equitable method of distributing large areas of land directly to actual farmers in amounts proportioned to their ability to use the land. It also afforded a security of title that facilitated an orderly settlement of new lands. It provided a sure protection against overlapping surveys and title disputes and made the town or colony responsible for the accuracy of the survey and title. The ease with which new land might be acquired and an independent living assured practically obviated a nonlandholding class and necessitated co-operation among farmers.

The idea of headrights—the granting of 50 acres of unoccupied land to immigrants landing in Virginia—grew out of the view that any person who "adventured" himself to America acquired a share in the Virginia company, but in practice the system changed greatly from the original conception. It was extended to include the members of a settler's family and his household servants, then

white indentured servants, and eventually even slaves. Sea captains and merchants who brought in servants or slaves also acquired and sold headrights on their importations. Indentured servants received headrights on the expiration of their periods of service. Eventually fraud and evasion developed in the administration of the system. Men whose business took them back and forth across the Atlantic customarily received headrights each time they landed in the southern colonies, and the sea captains even claimed rights for their sailors. Ultimately, at least three persons—a captain, a merchant and a planter—might acquire a right on the same individual.

Finally the applicants for headrights resorted to copying names from old record books and tombstones for use on the required forms, and at about the same time the secretary of the colony began to sell headrights for one to five shillings each. The Virginia council, recognizing realities, then authorized the sale of rights to 50-acre tracts for 5 shillings. This substitution, known as a treasury right, was a reversion in legal theory to the right of acquiring land under the Virginia company by the purchase of stock, the commonwealth being regarded as a lineal descendant of the company.

Having secured a headright or a treasury right, the individual located the amount of land to which he was entitled on any part of the unappropriated domain. Surveys were supposed to be made by public surveyors, but as most of these officers were inexperienced deputies the possibility of error was always present.

So far as the disposition of land was concerned, the southern system left much to individual initiative. A person could select any desirable tract of unappropriated land and have it marked off by a surveyor under his direction. There was no compulsion to consider the relation of his holding to those of others, and there was ample opportunity to engross the best land, leaving the less fertile soil for the later comers. The system was suited to the needs of a society where large plantations and slave labour, fewer hostile Indians, and a favourable climate permitted the extension and scattering of settlement over the coastal lands. In the hinterland the system enabled the pioneers to locate on the good lands adjacent to streams.

Colonial Farm Equipment.—The common tools and implements were hoes, spades, scythes, reaping hooks, shovels, carts, harrows and plows, but the supply was probably inadequate in the early settlements.

Although a basic implement, plows were scarce during the first half of the colonial period. The Plymouth colony had none for 12 years and used only hoes and mattocks for breaking the soil. The Swedish colony along the Delaware likewise had few tools of any kind until it was taken over by the Dutch in 1655. On the other hand, the farms of Massachusetts Bay had 30 plows by 1636. The early settlers in William Penn's domain around Philadelphia were also relatively well supplied. The possession of a plow made the owner the plowman of his community, and his services were in demand at practically all seasons. Many communities paid bounties to farmers who bought plows and kept them in operation.

The plows of the 18th century were very heavy and awkward contrivances. The mouldboard was not constructed on scientific principles; its iron plating, intended to cut and turn the soil, was rough and uneven, causing excessive friction, and the pull on the drawbar was much greater than on that of a modern plow. It took two men, or a man and a boy, using two or three horses or four to six oxen, an entire day to plow one to two acres. A lighter type of plow was used in cultivating corn. At the close of the 18th century, experiments with improved mouldboards and cast-iron plowshares were being made.

The procedure and the implements used in harvesting, threshing and cleaning grain were comparable with those of ancient Palestine as recorded in the Bible. Wheat and sometimes other small grains were reaped with a sickle. Grass and occasionally grain were cut with a scythe. Grain cradles were introduced in the middle colonies by the middle of the 18th century but were unknown in New England until after 1800. A good reaper usually averaged three-fourths of an acre a day, but if the crop was heavy

he was unable to cut more than half an acre. A cradler could cover $2\frac{1}{2}$ acres. In the middle colonies, grain was threshed by treading it out with horses; in New England, the flail was used. After threshing, the grain was winnowed as in Biblical times. A few farmers were experimenting with horsepower threshing machines by 1780.

Colonial Labour.—The abundance of free land at the back gate of every community stimulated independence, with the result that there was practically no voluntary hiring out. In the New England and middle colonies, as in nearly all frontier settlements, the problem of a labour supply was met to some extent by community co-operation. In the southern colonies, however, where staple crops were raised on large plantations, the need was greater and consequently they resorted more largely to indentured servants and slaves.

There were two general forms of indentured servitude, voluntary and involuntary. Voluntary indentured servants were persons who were so anxious to start a new life in America that they were willing to sell themselves for a period of five to seven years to shipmasters or immigration brokers in payment for their passage. German settlers, and occasionally those of other nationalities, sometimes voluntarily indentured themselves in order to obtain funds to make a more advantageous beginning on the frontier when they were able and ready to set up farming for themselves. Most of these "free-willers" came during the latter part of the 17th and early 18th centuries. As a type of immigrant they were practically nonexistent by the time of the American Revolution.

The involuntary indentured-servant group consisted of debtors, criminals deported by order of English courts, and unfortunates who had been kidnapped. The vagrancy laws in England during the 17th century were extremely harsh; the free movement of labour from one parish to another was forbidden; imprisonment was the penalty for debt; and more than 300 crimes were punishable by death. Many judges felt that shipping paupers, debtors, vagrants and petty criminals to the colonies was a humanitarian act. Only a few could pay their own passage, and consequently the vast majority were sold, the term of indenture ranging from seven to ten years. Eventually the demand for this type of labour became so great that professional kidnappers seized thousands, particularly in London and other seaport towns, and hurried their victims off to America. During Oliver Cromwell's ascendancy, many political prisoners also were exiled to the new world.

By the terms of their contract, indentured servants were promised food, clothing, shelter, medical aid and the right to own property. For the most part they were well treated, but there were frequent instances of brutality. Masters did not have as strong an economic motive to protect these short-term servants as they did Negro slaves, who were a lifetime investment. At the end of their period of service the redemptioners were to be provided with an outfit as defined in the contract; in the southern colonies they usually had a headright entitling them to 50 acres of free land. The initial transportation cost was fairly heavy, the servants had to be acclimated, and the death rate was high, particularly in the last half of the 17th century. They provided only a temporary and constantly fluctuating labour supply. Of the immigrants who came after the initial settlements were established, probably one-half landed as indentured servants.

Following the example of the French, and more particularly the Spaniards, the English colonies, especially New England, attempted enslavement of the native population, but with little success. The first Negro slaves in the English colonies were landed by a Dutch privateer at Jamestown in 1619. From 1635 on, a small number was imported nearly every year, partly from England and New Netherlands, but mostly from the West Indies. Despite the shortage of labour, Negroes were not popular at first, and even in 1690 there were only 5,000 in the tobacco colonies. However, at the end of the 17th century the English government restricted kidnapping and attempted to check the sending of convicts to America. As a result direct slave trade with Guinea developed, and slaveholding began in earnest.

There were about 400,000 slaves in the colonies in 1760, three-fourths of them being in the southern colonies where they con-

stituted about two-fifths of the entire population. They constituted only a small percentage of the inhabitants of North Carolina and Maryland but in South Carolina outnumbered the whites two to one.

In the early days the legal status of the Negroes was vague. The court records of 1661 speak of Negro servants or merely Negroes and never refer to them definitely as slaves. A few were described as servants for a term of years, others were conceded property rights, and some were liberated by the courts as having served their terms. Gradually the Negroes came to be considered servants for life. If well directed, they were capable of tending tobacco, rice, indigo or other staple crops, and with their labour a planter could produce staples at a profit. Yet even at the time of the American Revolution many southerners were urging the abolition of Negro slavery, and had it not been for the rising interest in sea-island cotton and the problem of the disposition of the Negroes in the Charleston district, manumission might have occurred at that time.

Slave labour was poorly adapted to the varied activities of economic life in the northern colonies. Generally speaking, their agriculture could not employ gang labour; nor were there any year-round tasks to occupy the slaves. Slavery did prove profitable, however, to Yankee merchants and shipmasters who shared the monopoly of the slave traffic with the British. New England vessels carried rum and other commodities to the slave coast of Africa and exchanged them for Negroes. This cargo in turn was taken to the plantations of the West Indies or the southern mainland colonies and exchanged for sugar and molasses or tobacco, which was then taken back to the home port. The "middle passage," that is, the trip between Africa and the West Indies, revealed slavery's gloomiest aspect.

The Negroes who had been kidnapped in the interior behind the slave coast were placed in heavy chains and packed in the holds of the ships, where they suffered during the many slow weeks of transit. It was on this sort of trade that many New England fortunes were founded.

Colonial Crops.—In growing their first field crops, the early colonists turned to the numerous natural clearings or openings of the Atlantic coastal plain. Many of them were probably old cornfields abandoned by the Indians, while others resulted from the Indian practice of burning underbrush as an aid in hunting. Shortly, however, the colonists had to clear land of vegetation, and this proved a formidable task. It continued to be the first step in making farms until the pioneers of the westward movement reached the prairies of western Indiana and Illinois in the early 19th century. The sunlight had to be admitted to the soil, and the obstructions to tillage, such as stumps, roots and stones had to be removed. Whatever their original conception of the task, the English settlers soon adopted the Indian method of girdling and burning trees in order to prepare land for cultivation.

Maize or Indian corn became the universal crop, owing to its advantages under pioneer conditions of cultivation. Since it was indigenous, there was always reasonable assurance of a successful crop. The manner of cultivating it fitted in with primitive methods of clearing, and therefore it was a labour-saving crop. It also yielded more food per acre than did European grains.

Probably all of the crops familiar to the colonists in their homeland were tried at some time or other. Wheat, rye, barley, oats, buckwheat and peas became important crops, in the order named.

The first attempts to raise wheat were not successful, but by 1640 it became important in New England, judging from the fact that it was then received in payment of taxes. The Connecticut valley with its fertile alluvial soil was the best grain-producing region of New England and may well be designated as the first wheat belt of America. About 1660 the wheatfields of eastern Massachusetts began to be affected by what was called the wheat blast, now recognized as black stem rust. Within a few years it had spread to the Connecticut valley. In spite of the divers explanations given by learned contemporaries, a general relationship between the presence of common barberry and the "blast" was

recognized, and legislation was enacted to encourage the eradication of the bushes. Wheat also became important in the middle colonies, to such an extent, in fact, that they came to be referred to as the "bread colonies."

Rye yielded better than wheat on light sandy and gravelly soil and was especially important along the banks of the Delaware, where Swedes and Finns had attempted to found a new Sweden. Just as this particular specialization was due to a racial emphasis, so was the production of oats. This grain was produced in abundance as feed for livestock, but only after the Scotch-Irish had come in considerable numbers did the colonists of English descent begin to use oats for human food.

Colonial Livestock.—Because the Indians had no animal husbandry, it was necessary for the European colonists to import livestock. Because of distance and the small size of the ships, there was a pitiful scarcity of livestock in some of the settlements during the early years. The losses incident to transit across the ocean were heavy, and it was difficult for the early settlers to provide forage, shelter and protection for the animals. Another factor was the amount of capital behind the particular colonizing enterprises. Plymouth, for example, was without cattle for three years and had no horses or sheep as late as 1627. The Swedish and Finnish communities along the Delaware were also without an adequate number of livestock for many years. The Massachusetts Bay colony, on the other hand, seems to have had a sufficient supply practically from the start.

Eastern North America did not have an abundant supply of indigenous nutritive forage plants, and it was some time before the early settlers realized this fundamental deficiency. Their livestock was dependent for pasturage on the forage in the open places in the woods where fires had destroyed the underbrush or where natural openings occurred. To the early settlers two native grasses, wild rye (*Elymus* sp.) and broom sedge (*Andropogon* sp.), looked promising, but it was soon discovered that although cattle could subsist on these in the summer, the hay made from them had too high a proportion of roughage to be adequate for winter feeding. Eventually the familiar forage plants of old England were introduced, either consciously or accidentally, and once started they spread rapidly. The important hay and pasture plants of today—timothy, bluegrass and red and white clovers—are thus a product of the initial necessity of the livestock industry in the U.S.

The need of an adequate supply of hay and pasture continued to be a pressing problem not only throughout the 17th century but during the 18th as well. The cattle were dependent on the annual grasses in the forest openings, and with the increase in numbers of stock the grasses were grazed so short that natural reseeding was prevented. The custom of burning underbrush during the fall months also tended to hold back this process, and droughts further decreased the supply of pasture and hay. As the 18th century progressed, more attention was given to what were called "artificial meadows," that is, uplands seeded with red clover, timothy and other English grasses. This movement was probably inspired by the German-settled communities in the neighbourhood of Philadelphia.

The management of livestock during colonial times, as in most pioneer periods, may be politely described as rudimentary. The problem of confining the animals to definite localities was not easy to solve. Erecting fences required considerable labour and was especially difficult in the middle and southern colonies, where the settlements were largely individual rather than community undertakings. In New England, community settlement made common pasturing possible. There the fences were usually around the cultivated fields rather than the pastures, and the community hired one or more herders to watch the livestock. Hogs, being difficult to confine, proved very troublesome, and in consequence they were probably the subject of more legislation than anything else in agriculture during the colonial period. There was also much legislation concerning brands and earmarks.

Livestock received little shelter in the 17th century and very little more in the 18th. This was largely the current practice in the mother country at that time, and there are indications that

the settlers did not immediately realize the effect of the severe American winters on livestock. Besides, the scarcity of labour made it difficult to erect barns or even sheds, and there was also the problem of a feed supply. In the course of the 18th century, housing the livestock in winter became a regular practice in New England and New York, but in the colonies to the south, the livestock continued to shift for themselves as best they could. There was, however, one striking exception—the thrifty German farmers of Pennsylvania kept fewer animals but stabled them during the winter and fed them well.

Agricultural Policies of the Colonial Period.—Legislative regulation of American agricultural production began with the earliest settlements. Like the other imperial powers of the 17th and 18th centuries, England expected its colonies to furnish raw materials and serve as a market for the mother country's finished products. Particularly was Britain anxious to stimulate colonial production of commodities for which it was then dependent on other European countries. The measures taken to foster this general policy, commonly known as mercantilism, included tariffs and rebates, subsidies, price regulation, seed distribution and even acreage control. Conforming in large measure with imperial legislation were enactments of the separate colonies seeking to stimulate or discourage the raising of certain crops.

The history of tobacco regulation is probably the most illuminating example of the methods and effects of mercantilism. In 1612 it was found that tobacco could be grown profitably in Virginia, and the colonists, stirred by the high returns, began planting it almost to the exclusion of the essential food crops. In 1616, the governor found it necessary to order each person to plant at least two acres of corn for himself and for each male servant. Tobacco growing continued to increase, however, and the acreage devoted to it was restricted again and again in order to prevent glutting the English market and to ensure an adequate food supply.

Various steps were taken between 1619 and 1652 to give Virginia and Maryland a monopoly of the tobacco market in the mother country. Planting in England was restricted, and Spanish importations were discouraged by discriminatory tariffs. The supply, however, soon exceeded the demand. Prices were depressed, and because tobacco had become the chief exchange medium for Virginia, price fixing seemed particularly desirable. In 1631-32 the Virginia assembly provided that tobacco exchanged for English goods could not be sold for less than 6d. per pound, under penalty of imprisonment. By 1639 production had become so excessive that a crop-curtailment and price-fixing agreement was made between the colonial authorities and the principal merchants. The crops of 1639, 1640 and 1641 were to be limited to 1,200,000 lb. of good quality, and the merchants agreed to accept 40 lb. for each 100 lb. of indebtedness due them. Viewers were appointed to destroy inferior tobacco, and if necessary to burn excess crops, and in return the tobacco was to be rated at not less than 3d. per pound. When it became apparent that monopolization of all the colonial tobacco exports would be ruinous in view of the glutted market, re-exportation to other European countries was permitted. To temper the restriction requiring all shipments to be sent to England and then re-exported, thus subjecting them to English as well as foreign custom and excise levies, an elaborate drawback system by which part of the tariff was remitted on re-exportation was begun in 1631, and after 1723 the entire duty on the re-exported commodity was remitted.

The spread of tobacco growing from Virginia to Maryland and North Carolina aggravated the surplus problem. As a result, various intercolonial pacts were projected with a view to restricting production. More successful were the efforts at standardizing quality by a system of central warehouses and the inspection of export crops by licensed officials. These provisions were enacted in Virginia in 1730 and in Maryland in 1747. Despite all attempts at limitation, the volume of tobacco exports grew from 27,750,000 lb. in 1665 to more than 100,000,000 on the eve of the American Revolution, with a value of £900,000 in 1770. On the whole production was profitable, at least for planters who were able to employ slave labour.

Rice became a money crop before the end of the 17th century and like tobacco was subject to detailed regulation. In 1677 the proprietors of South Carolina stated that they were attempting to secure rice seed for distribution, and an act of the assembly of 1695-96 included rice as one of the commodities that might be tendered in payment of quitrents. Considerable experimentation in rice planting took place between 1695 and 1715, and with a surplus available for exporting, the colonists sought the repeal of the English tariffs on rice. Portugal and the West Indies offered profitable markets, but the direct trade that resulted was contrary to the purpose of the navigation acts, and in 1704 rice was added to the list of commodities required to be sent to England and subjected to payment of duty before being re-exported. The Portuguese trade, as a result, was greatly diminished; the colonists memorialized parliament and smuggling increased. Parliament relented in 1730 to the extent of permitting direct trade to any part of Europe south of Cape Finisterre in Spain. This encouraged the rice planters to increase production. Later, however, it became apparent that the northern markets were far more important than the southern; in the decade 1730-39, for example, 74% of the rice exports went to Holland, to Hamburg and Bremen, Germany, and to Sweden and Denmark. Like tobacco, the bulk of the rice crop was then sent to England to be re-exported and through drawback provisions largely escaped British duties. In South Carolina legislative decrees attempted to establish the exchange value of rice, and there were also laws to prevent deceitful packing and to standardize the quality of exports.

To stimulate the production of indigo, instructions to accept it in payment of quitrents were sent to the South Carolina authorities in 1690, and an act passed in 1694 provided special encouragement for growing it. It was not until the 1740s, however, that the indigo industry became important. In 1734 parliament placed indigo on the free list, and a decade later the South Carolina assembly offered a bounty which was in effect for one year. Great Britain, in response to petitions from English clothiers and dyers and colonial planters, granted a premium in 1748 that was continued, although at a modified rate, until 1777. This gave the industry a tremendous impetus, and it is said that the indigo planters were able to double their capital every three or four years. England received the entire indigo crop, which before the Revolution exceeded 1,000,000 lb. a year.

Prior to 1700 Great Britain imported all its hemp and flax from the Baltic countries and Holland. To escape this dependence, a bounty of £6 per ton was placed on colonial-grown hemp, and in 1721 it was exempted from duty, and the bounty was continued for 16 years. These measures had very little effect, but after 1764 there was a revival of interest, and new bounties of £8 per ton of hemp or flax were offered from 1764 to 1771 and of £6 from 1771 to 1778. In addition to these imperial bounties, numerous subsidies were offered by the various colonies. Despite all the legislation these products never became important items of exportation.

Lumbering and the production of naval stores were essentially agricultural pursuits in the colonial period, being carried on mainly by farmers and planters. Despite the abundance of timber these industries did not develop in America until the opening of the 18th century, and then only under the stimulus of the mother country's desire in typical mercantilistic fashion to escape dependence on Baltic imports. A schedule of premiums was drawn up by parliament in 1704-05, and arrangements were made for a surveyor of woods to instruct the colonists in methods of naval stores production. In 1713 parliament further set aside £10,000 to employ skilled people and purchase the necessary tools for fostering the industry.

In all the colonies the production of tar and pitch as well as the lumbering industry were subject to considerable legislative regulation and aid. Qualitative standards were set up with penalties and officials to enforce adherence.

With the Italian Piedmont alone draining more than £200,000 in bullion from England for silk, the efforts to raise this product in the colonies were especially persistent. Numerous mulberry

trees were found growing in Virginia, and silkworm eggs were imported by the Virginia company from Italy, France and Spain. The colonial assembly in its first year, 1619, supplemented these efforts by an enactment requiring each man to plant six mulberry trees annually for seven years. In 1654 Armenian silk experts were imported, and in 1656 an allowance of 4,000 lb. of tobacco was voted to one of these experts by the Virginia assembly. Bounties for production were offered in 1658, and in 1662 every landowner was ordered to plant 10 mulberry trees properly fenced and tended for every 100 acres of land he owned. As late as 1730 it was reported that 300 lb. of raw silk had been exported from Virginia. The Huguenot settlers of South Carolina were also interested in the silk industry, and acts of 1736 and 1744 offered sizable rewards for silk growing. Results were meagre, only 651 lb. of raw silk being exported from 1742 to 1755. In Georgia particularly every effort was bent toward stimulating silk production. Foreign experts were sent to the colony; a nursery of mulberry trees was established at Savannah, and four public filatures—establishments for reeling silk—were erected; books and free instruction were provided; and each grantee of a 500-acre tract had to plant at least 2,000 white mulberry trees. In 1740 membership in the newly established assembly was made conditional upon the planting of 100 mulberry trees, and after 1753 no one was to be admitted who did not annually produce 15 lb. of silk and conform to the law requiring a certain number of female slaves to be sent to Savannah for instruction in the silk industry. The high point in Georgian silk exports was reached in 1766-67, when 1,084 lb. were shipped out; by 1772-73 the figure had declined to 485 lb.

Attempts to grow silk were not confined to the southern colonies; similar visionary hopes were entertained in the north. Mulberry trees were common, and many families succeeded in actually producing some silk.

Colonial Heritages.—Despite the wide diversity in the geographical settings of the Thirteen Colonies, two generalizations may be made for the colonial period. The social and economic structure of all the colonies was predominantly agricultural, and the small-scale farmer of the period embodied the habits of action and attitudes of mind which were long characteristic of the American people as a national group.

In New England of the 18th century, where commerce and industry were most developed, at least nine-tenths of the population were engaged in farming. In the other colonies the proportion was even larger. The economic life of the southern colonies came to be based on large holdings of land, slave labour and surpluses of exportable staples; the plantation system determined their economies, and the planters dominated their colonial governments. Yet the small farmers with their self-sufficing holdings far outnumbered the dominating group.

It was these small-scale farmers who epitomized American characteristics. They were jacks-of-all-trades; at some time or other and often within a single year, they engaged in hunting, trapping, farming, fishing and even went to sea. They turned to any of the various rudimentary occupations as occasion required. The result was a general facility at tasks rather than the thoroughness of specialization. It was this versatility which served the American people so well as they developed the new horizontal and vertical frontiers that ultimately crossed a vast continent.

These typical colonial farmers, like their descendants, were preoccupied with the practicalities of existence and developed a self-reliance that amounted to intense individualism. The lack of opportunities to travel—either in the physical or intellectual sense—also bred provincialism. The colonial farmers were generally optimistic. With a nondescript past and a humdrum present, they looked to a future that was unhampered by realities. Through the exigencies of their economic existence they came to have a profound faith in work, preferably manual, as the duty of all.

Agriculture during the Revolutionary Period.—The small farmers and the frontiersmen were a mountain of strength for the revolutionary cause. They resented the Proclamation of 1763, which they believed would bar further westward expansion; they opposed the prohibition of the issuance of paper money;

they sought more liberal land policies; and they had a sense of local self-sufficiency that was hostile to outside interference. Even more immediate was their resentment of the political and economic domination of the seaboard areas over the colonial governments. The planters indebted to London merchants also adhered to the patriot cause.

On the whole, agricultural life went on much as usual during the Revolution. New England, after the first year of the war, except for the occupation of Newport and a few raids along the coast, was free from invasion. New York, New Jersey and Pennsylvania suffered from the depredations of both armies. This was in part compensated for by the liberal prices paid in gold by the French and British for supplies from the farmers, many of whom were only too willing to sell.

American agriculture as a whole was stimulated rather than injured by the war. Blockade runners carried Virginia tobacco to Europe, and the last two decades of the 18th century were comparatively a golden age for that crop. In 1774 production totalled 101,800,000 lb. of leaf tobacco; by 1790 the figure had risen to 130,000,000, with one-half of the southern population engaged in or dependent on tobacco growing. Rice cultivation and export also went on with little interruption. In 1778 the first water mill for cleaning and preparing rice for market was erected on the Santee river. The cessation of imperial bounties cut the ground from under the indigo industry, but cotton came to supplant it. The legislatures of Maryland, Virginia and South Carolina encouraged cotton growing to fill local needs during the war. The same was true of wool production, which was stimulated by interference in trade caused by nonimportation agreements and the outbreak of war.

The exodus of the Tories in the course of the war permitted division of many large estates and the abolition of the last vestiges of the manorial system. As late as 1769, five-sixths of the population of Westchester county, New York, lived on manor lands. In 1777 the continental congress recommended that the colonies confiscate and sell Loyalist property and invest the proceeds in loan certificates. Little external stimulus was needed; New Hampshire appropriated 28 estates; Massachusetts seized the estates of all who sided with England; New York confiscated the 50,000-acre manor of Sir John Johnson, the Philipse manor of 300 square miles, the Morris estate, and other large holdings, which were broken up and sold in 500-acre lots; and Pennsylvania took over the property of the Penn family.

Along with confiscation and land division came the democratization of land tenure. Under the leadership of Thomas Jefferson and his adherents, quitrents were abolished; by 1786 entail, by which land was settled permanently on a person and his heirs, had been made illegal in every state but two; and the other aristocrat-fostering device, primogeniture, the exclusive right of inheritance of the first-born, disappeared by 1791 so that a farmer could hold his land in fee simple and dispose of it as he wished.

Agriculture was affected by the quickening of national consciousness that followed the triumph of the patriot cause. Practical farmers in regions where agriculture was rapidly becoming commercialized began to use gypsum on wheat fields and grasslands. Clover and other cultivated grasses also became fairly common in these regions. Although such changes had no immediate and widespread influence on agricultural production, they indicated the awakening of a new and enthusiastic interest in agricultural improvement. Washington, Jefferson, and many other prominent leaders were familiar, either by correspondence, reading or personal observation, with the revolutionary changes that were taking place in the agriculture of England, and the contrast with the generally haphazard conditions at home was a challenge. To popularize the knowledge of new methods of farming, agricultural societies which became the pioneers in the great task of agricultural education were organized.

Land Policies to 1862.—Having won the world-wide conflict which ended in 1763, the British were confronted with the problem of governing and settling the vast empire consisting of what became Canada and the region from the Appalachian mountains westward to the Mississippi river. The halting efforts to

solve this problem ended in failure. The treaty of 1783 which recognized American independence gave the United States control of the land south of the Great Lakes and west of the Alleghenies and thus passed the problem on to the new nation. The states with colonial claims to portions of this western land were induced to cede them to the congress of the confederation which enacted the ordinances of 1785 and 1787.

The first of these laid down the basic principles of land disposition to which the United States adhered thereafter, and the second provided the principles of procedure which were generally followed in the government of all territories from the Appalachians to the Pacific ocean.

The federal land policies which developed from the ordinance of 1785 were conditioned by clashes between different schools of political thought, different sections and different economic groups. On one side were those who urged that the government should dispose of its land with prudence; in opposition were those who demanded a generous land policy. The clash of these divergent views constitutes the central theme of the history of U.S. land policies during the eight decades preceding the enactment of the Homestead Act of 1862. The conflict tended to concentrate on three specific details: the minimum amount of land to be offered for sale; the price per acre; and the terms of payment.

As early as 1800 the political pressure of the frontier farmers, a group traditionally disposed to demand "liberal" land legislation, had begun to show its influence, and within 20 years their cause had definitely won. Whereas the act of 1796 had specified that the smallest amount purchasable was 640 acres, 80 acres was the minimum unit by 1820, and this in turn was reduced to 40 acres in 1832. The minimum price was reduced from \$2 an acre in 1796 to \$1.25 in 1820. Furthermore, in practice the minimum price tended to become the maximum price, only a few choice areas being bid for higher amounts at auction time. Thus abundance of land, plus a united public opinion, circumvented the intent of the laws.

Only in one respect was there a nominal reversal of this general trend toward a liberalization of the terms of land acquisition. In 1796 the purchaser was required to pay one-half the price in cash within 30 days and the remainder within 1 year. Four years later the credit terms were considerably liberalized—one-fourth cash, one-fourth within 40 days, one-fourth within 2 years and one-fourth within 4 years. In 1820, owing to the fact that speculators and actual settlers were in arrears amounting to \$21,000,000, the credit provisions were repealed and thenceforth immediate cash payment was required.

The history of land legislation during this period also centres about three political and economic issues—graduation, pre-emption and homesteads. The first two were a result of the rapidity with which the public domain had been occupied, and they evolved logically into the third.

The frontier farmers and speculators, having before them what seemed to be an inexhaustible supply of land, selected only the better lands as they pushed westward. Gradually the existence of islands of poorer land which had no buyers became obvious and resulted in a demand to lower its price. Finally in 1854 congress passed a graduation act reducing the minimum price to \$1 an acre on land that had been open to sale for 10 years and to 12½ cents on land that had been listed for 30 years.

The pre-emption issue evolved from a correlative if opposite situation. Frontiersmen, becoming impatient of or even being oblivious to the progress of the official land surveys, frequently pushed into the public domain and settled on choice locations without further formality. In doing so they were reverting to the so-called "indiscriminate location" of colonial times. With reference to the land laws, these settlers—usually referred to as squatters—were criminals. When the first townships in Ohio were surveyed there were already a considerable number of settlers in the region, and attempts were made to dislodge them with militia. The frontier attitude ultimately prevailed to a large extent. The pioneers banded together into claims associations which maintained a list of each member's holdings; they selected a bidder to

speak for them at the land auctions and attended the sales as a body pledged to ensure the purchase at the minimum price of those lands which were already occupied. Again and again congress passed laws sanctioning the action of particular groups; and ultimately, in 1841, it enacted the pre-emption law by which heads of families, men over 21 and widows were allowed to settle on 160 acres of unsurveyed public land with the right to purchase their holdings at the minimum price when the land was actually placed on sale.

The Pre-emption act of 1841 and the Graduation act of 1854 were, however, merely preludes to the complete triumph of the advocates of a liberal land policy in 1862, when the homestead principle was enacted into law.

The general idea of free grants of land to actual settlers went far back into colonial times. The headright system of land disposition as practised in the southern colonies embodied the essential features of the homestead principle. Insofar as the quitrent system was unenforceable, it also resulted in actual settlers acquiring land. There was the further precedent of gifts of land to individuals or groups, sometimes as a reward for services rendered to the national welfare or for services anticipated. In all these three procedures settlers got land without money payments.

In spite of these colonial precedents, congress was slow to abandon the conservative and conserving policies adopted during the two decades immediately following the American Revolution. Many regarded public land as a great national resource which should be administered carefully and prudently with a view toward ensuring an income to be used for the well-being of the American people. Many, notably the landowners and manufacturers of the eastern seaboard, opposed liberalization of the land policy. They saw the value of their real estate undermined by the cheaper and newer lands in the west; they also saw western land competing for their labour supply and thus compelling higher wages. The opposition soon rationalized this self-interest and found itself expounding the view that government generosity with land pauperized the beneficiaries and encouraged laziness. Even as late as 1832 the western leader, Henry Clay, opposed any reduction in the price of public land.

In contrast, the self-interest of the pioneer farmers and land speculators in the west generated a notable enthusiasm for cheap and ultimately free land. To secure effective action, they joined forces with city workers who hoped to escape westward and benefit thereby. In the 1840s the National Reform association took the leadership, propounding the doctrine that the public land should be distributed in equal amounts to actual settlers. One of its most effective pamphlets was entitled "Vote Yourself a Farm," and much emphasis was placed on the idea that land ownership was an essential ingredient of the political philosophy to which the United States was dedicated.

At its best the cause of the liberal land policy which came to be epitomized in the idea of free homesteads of actual settlers transcended mere economic self-interest. Many contended that land sold on liberal terms or even given away promoted true democracy. Perhaps the most eloquent spokesman of this view was Senator Thomas Hart Benton of Missouri. It is certain that beneath the passing arguments of the politicians and the pamphleteers lay the conviction that equality of economic power was essential if genuine freedom and democracy were to thrive in the U.S.

The homestead bill introduced by Andrew Johnson passed the house of representatives in 1852, but complete enactment was destined to be held up for a decade because it became a part of the slavery controversy. In the first vote a majority of the southern congressmen supported the bill, but as sectional tension intensified they veered away, and final passage awaited the withdrawal of the southern representation from congress after secession.

Agricultural Settlement, 1776-1850.—At the beginning of the struggle for independence the colonies had a population of 2,750,000. In 1790, when the first census was taken, there were approximately 4,000,000 people of the United States. Of these, 94% inhabited the Thirteen Original States; only 250,000 had

settled in the west of that day—principally in Vermont, Kentucky, Tennessee and Ohio. By 1850 the nation consisted of 31 states and a population of more than 23,000,000. The frontier line had leaped the Mississippi river northward into Minnesota and Iowa, and southward into Texas; skipping the Great Plains, it had followed the trail of gold into California. All this had been effected in one lifetime.

The migration, one of the greatest in world history, streamed across the Atlantic and swelled through the settled regions of the east. More than 2,000,000 immigrants swarmed in from 1820 to 1850, and in the next ten years 2,600,000 more arrived. Land was the great magnet. Rich virgin soil, seemingly unlimited in extent and available almost for the asking—such was the common theme repeated by shipping agents and in letters, pamphlets, newspapers and handbills. It was an irresistible temptation to farmers sweating over worn-out lands and to city folk who were restless, adventurous or unsuccessful.

Agriculture in the Old Northwest.—Until the prairies of western Indiana and Illinois were reached, the farming in pioneer communities west of the Alleghenies was essentially a repetition of the experience along the Atlantic seaboard during the two centuries of the colonial period. The frontiersman cleared from one to three acres by girdling and grubbing and then planted the field to vegetables and corn. At this stage the family depended on game and other wild products to supplement the food raised. Maple sugar was also important, but potash was the only cash product. With more land cleared, additional corn and some wheat were added. Gradually a farm capable of producing surpluses for outside markets was developed.

The responsiveness of wheat to new lands is patent to students of agricultural tendencies, and its development in the region northwest of the Ohio river is an excellent illustration. New York and Pennsylvania were the leading wheat-producing states during the first quarter of the 19th century; but during that time there was a westward shift even within their borders, the Genesee country supplanting the Hudson-Mohawk valley. Ohio became an important producer of wheat during the '30s, but the big shift westward came during the '50s. Whereas Pennsylvania, Ohio and New York—in the order named—had been the top-ranking states in 1849, Illinois, Indiana and Wisconsin took their places within a decade. In that time Wisconsin rose from ninth place to third, and New York and Pennsylvania experienced not only a relative but an absolute decline. By 1860 the five states of the old northwest were supplying about half of the wheat produced in the entire United States. Within the region, the hilly counties of Ohio and the prairies and oak openings of Indiana, Michigan, Illinois and Wisconsin were the areas of concentration.

When the pioneering farmers reached the edge of the prairies in Indiana and Illinois, they hesitated, believing that land which did not support trees was not rich enough to produce farm crops. The lack of a ready supply of wood for buildings, fences and fuel was also a factor. The dependence of these frontiersmen on the rivers as avenues of transport to markets and the scarcity of water and lack of shelter for livestock on the prairies also made them reluctant. The thick and heavily matted prairie sod was a formidable challenge to the customary wooden and cast-iron plows, and from three to seven yoke of oxen were required to break new fields. Even then it was two or three seasons before the grass roots had rotted sufficiently so that the fields could be worked easily. Higher prices for grains after 1845, reflecting conditions in Europe, together with the coming of the railroads, affected the occupation of the prairies. The challenge of the sod led to the development of the steel plow and eventually, after experiments with various fencing materials such as sod walls, smooth wire and Osage hedges, the fence problem was solved by the invention and perfection of barbed wire.

Corn production, like that of wheat, responded, though less quickly, to the pull of the new lands in the old northwest. In general it tended to occupy a belt directly south of the wheat region, but prior to the end of the '60s a corn belt was not clearly delimited except for special areas, such as the rich bottom lands along the Scioto river and the limestone basins of Kentucky and

Tennessee. The census of 1840 revealed Kentucky, Tennessee and Virginia as the leading corn states, but within two decades the centre of concentration had shifted northwestward to Illinois, Ohio, Missouri and Indiana, with Kentucky and Tennessee in fifth and sixth places. By this time Iowa and the eastern parts of Kansas and Nebraska had become important centres. The older states in the east continued to produce corn for their own needs.

The corn of this northwestward-moving belt was marketed in the form of whisky and hogs, the first because it was valuable in proportion to bulk and the second because hogs furnished their own motive power. The hogs of the frontier were a special type, essentially a product of the rigours of life in the open and were known aptly as "wind-splitters" or razorbacks. Many pioneers raised several hundred hogs a year. If they were left to feed on the forest mast alone, they put on flesh that was soft and difficult to preserve. They also became untractable and lacked the stamina to survive the rigours of severe winters. It was therefore essential to supplement the mast with corn, and eventually, as markets developed, corn-feeding and marketing hogs became the basic activities of agriculture in the old northwest.

In the early 19th century the hogs were taken down the rivers on boats to be sold to the plantations in the south or driven overland to eastern markets. At first the farmers drove their own hogs eastward, but gradually a profession of drovers developed and the trade became standardized. Some herds numbered as many as 5,000 and moved eastward at the rate of 8 or 10 miles a day. Although the ultimate destination was usually Philadelphia, Pa., Baltimore, Md., or New York, many herds were taken to the plantations of Tennessee, Virginia and the Carolinas. This method of marketing declined with the development of meat packing along the Ohio, especially centring about Cincinnati, which became known as "Porkopolis." The coming of the railroads was a final factor ending this trade.

The range-cattle industry has always been associated with the frontier, and the region north of the Ohio river was no exception. As early as 1805 George and Felix Renick of Ohio drove a herd of range cattle overland to Baltimore, where they cleared a profit of more than \$30 a head. Their success led to other similar drives, and shortly the marketing of range cattle in the east became a well-defined source of cash income for the farmers in the west of that time. The drives were started in the early spring and continued through the summer. Each night the herds were halted at "drove stands," where food and shelter were provided for both the drovers and their charges. Four-year-old steers were driven slowly and sold directly to the abattoirs. Three-year-olds were often sold to the farmers in the hinterland of Philadelphia for feeding. By 1840 the farmers of the Ohio valley had taken over the fattening of their own cattle, and this development became specialized in a zone bounded on the south by the 36° parallel and on the north by the 40° parallel. The bluegrass region of Kentucky and the Scioto valley were the centres for corn feeding, and many of the leaders in this development were former Virginians who had known of similar methods on the banks of the Potomac in the days of Washington.

Eventually these feeders reached out for additional stock from the prairies of Illinois, Iowa and Missouri and from the wheat farmers to the northward. Before large-scale refrigeration, it was difficult to preserve beef in a palatable form, and beef packing did not develop on a scale comparable with that of pork. The eastern cattle drives, therefore, continued long after the hog drives had ceased. The advent of railroads after 1850 brought an end to the drives, and the cattle-feeding industry pushed westward to the corn belt.

Eastern Agriculture and Western Competition, 1775-1860.—In the New England and middle Atlantic states the colonial pattern of agriculture continued dominant until the second decade of the 19th century. Cultivation was extensive and exploitive, tools clumsy, systematic crop rotation and fertilizers generally absent, livestock neglected and orchards and woodlands badly managed. Each farm was a self-sufficing unit, growing food for home needs and a scant surplus to be exchanged at the local store for salt and sugar. For the most part tools and cloth-

ing were made in the farm home. In New England wheat had been generally abandoned, except in a few favoured regions, and root crops such as potatoes and turnips were noticeably lacking. The prevailing mode of crop rotation was the mediaeval practice of alternating grain, grass and fallow. Implements were few in number, most farmers being able to carry all they possessed on their backs, and the plows were home-made wooden contrivances with a plating of iron strips added by the local blacksmith. Oxen were the chief draught animals, and cattle generally were noted more for their hardness than for beef or dairy production. A fundamental cause of this retardation was the lack of markets for surplus production.

There were exceptions to the prevailing agricultural backwardness. Between 1801 and 1811 Merino sheep were imported from Spain, and the result was a vast improvement in U.S. flocks. Pennsylvania as late as 1840 was the leading wheat-producing state, and considerable grain was also raised in the Hudson-Mohawk valley of New York; the middle states were to a considerable extent the bread states for New England and the south. Corn was a leading staple in New England, the output per acre averaging 25 to 30 bushels; in the Connecticut valley, it occasionally averaged as high as 40 or 50 bushels. The Connecticut valley in general was a prosperous farming country still able to raise wheat commercially, and its more progressive farmers used gypsum to restore the soil.

Other outstanding areas were the Narragansett country of Rhode Island, where dairying for exportation was extensive, and the western counties of Massachusetts, which produced grain commercially.

When the rise of manufacturing resulted in the concentration of a large nonagricultural population in towns and cities, a spirit of commercialization became evident in northern agriculture. This change began after 1810; the population of the eastern states increased from 3,487,000 in that year to 6,761,000 in 1840; urban centres of more than 8,000 inhabitants increased from 3 in 1790 to 33 in 1840; while in southern New England all but 50 of the 479 townships had at least one manufacturing village clustering around a textile mill, an iron furnace or some other industry. To meet the demand of this new market the farmer turned to lighter and better-designed agricultural tools; the grain cradle displaced the sickle, the iron and later the steel plow superseded the wooden plow, and the cultivator supplanted the hand hoe. Improved machinery brought increased production and decreased labour time and costs. In Pennsylvania and New York the horse replaced the slow-moving ox as the main draught animal.

Creation of a home market brought a shift from general to specialized farming, and each locality tended to concentrate on the products for which its soil, climate and geographical position were best suited. Market gardening and dairying developed in the immediate vicinity of urban centres, notably around Boston, Mass., New York, N.Y., Philadelphia, Pa., Providence and Newport, R.I. Lands were reclaimed, meadows drained, and dry lands irrigated; the soil was repaired by the planting of clover and the use of gypsum; more labour was hired; and the teachings of the new agricultural societies were heeded. One effect of these changes was a sharp rise in land values; an acre outside of Philadelphia brought \$150 in 1837, and near New York land prices in some instances increased fourfold between 1800 and 1840. Tenancy also appeared as immigrants leased truck farms before purchasing their own lands. The production of fluid milk to meet town and city needs became prominent in these decades and continued to expand even after the centre of dairying had moved westward.

Feeding cattle for beef received increased attention in the east, concentrating in the Connecticut valley, which supplied the Brighton market near Boston, and in southeastern Pennsylvania. Specialization in butter and cheese making developed chiefly north of New York city and in central New York after the completion of the Erie canal. Around other cities the sale of fluid milk had largely supplanted cheese and butter production by 1840. Striking improvement was effected in swine husbandry by crossing with improved breeds, but there was no marked geographical con-

centration.

Eastern wool growing enjoyed its greatest prosperity in the decade of the 1830s. The domestic manufacture of woollen goods was firmly established, and, stimulated by protective tariffs, it increased its output and demand for raw materials. In 1837, 28,000,000 of the 38,000,000 lb. of wool used in the mills were of local origin. In 1840 the eastern wool growers owned 60% of the country's sheep, but specialization was already well developed. In New England production was limited to Vermont and the hills of western Massachusetts and Connecticut.

Among other changes in northeastern agriculture that came in response to urban needs were the increase in hay production to feed the horses in city and town stables and the growing of potatoes in considerable quantities, particularly in Maine and on Long Island. Farmers also conducted a profitable business in supplying city dwellers with firewood and charcoal and furnishing sand, stone and timber for buildings.

Now that the farmer received a cash income he turned to factories for the clothes, tools and furniture he had formerly made for himself. The decline of household industries had as revolutionary an influence on rural life as the growth of industrialization had on the formation of a wage-earning class. As self-sufficient farming waned, long-established habits and traditions in thinking and living were uprooted. The family as an economic unit became less important, with all that implied for rural mores; farmers' sons and daughters began migrating to mill towns to take up a new way of life. Those who remained behind developed a taste for urban standards of living. Others were stirred to action and turned westward.

These changes did not appear overnight, and they did not affect all farmers uniformly. Ingrained habits tended to keep many farmers in the old ways of producing what they needed for their own uses, buying and selling little. Lack of working capital was another serious hindrance; the farmer marketed his produce once a year and had to maintain his family on the returns until the next year. The country store was the chief source of short-time credit, and interest rates were high because losses were frequent. Where the farmer realized a surplus, he preferred to invest in lands, in larger homes, or in outside enterprises, rather than in labour-saving machinery. Mortgages increased noticeably in number after 1830, but the money was used for paying bills or in outside speculation instead of for financing farm improvements. The imperfect organization of markets was another obstacle; the country merchant, the chief middleman for farm produce, performed his function badly and at a high cost.

While the eastern farmer was still adjusting himself to commercialized agriculture he was faced with a second transforming influence, namely, western competition. The Erie canal was opened in 1825 and brought steadily increasing quantities of food-stuffs to the eastern markets, but the pressure greatly increased after the railroads reached beyond the Alleghenies. By 1850 there were 7,000 miles of railroad in the country, largely concentrated in the northeast and northwest; and ten years later Minnesota, Iowa, Nebraska and Kansas were already pouring surpluses eastward. From the west came wool, wheat and pork in such quantities and at such low prices as to discourage local production. Sheep raising in southern New England declined nearly 50% between 1840 and 1850, with a further drop of 35% in the next decade. The products of the eastern wheat growers, suffering from soil deterioration and crop blights, could hardly compete with the products of fertile lands newly opened in the west; and by 1840 flour from western wheat was used generally in New England, not only by city folk but by farmers as well.

Before the advent of refrigerator cars the effect of competition in beef and pork production was somewhat tempered, although by 1859 half the beef supply of Massachusetts came from outside New England, and Philadelphia received 32,552 tons of livestock from Pittsburgh over the Pennsylvania railroad. Between 1840 and 1860 the number of swine in Massachusetts, Rhode Island and Connecticut fell from 306,000 to 167,000.

Serious as these inroads were, they by no means crowded out eastern production entirely. If local farmers almost completely

lost the markets for wheat and wool and to a lesser extent for live cattle and hogs, the advantage of their proximity to industrial centres could not be overcome altogether. More attention was given to growing vegetables and supplying fluid milk. Cheese and buttermaking increased, and by 1860 New England and the middle Atlantic states accounted for 70% of the country's cheese and close to 50% of its butter. In New York, the nation's leading dairy state, production was centred in the Mohawk and Hudson valleys, with some expansion into the central counties; Vermont led in New England, although Litchfield county in western Connecticut was famous for the fine quality of its cheese; while southeastern Pennsylvania supplied butter and milk for the Philadelphia, Wilmington and Baltimore markets.

The New England and middle Atlantic states grew more hay and forage in 1860 than in 1850, although their share of the country's total dropped 15%. Corn production increased in New England between 1840 and 1850 but then declined; on the other hand, the crop of potatoes in Maine in 1860 was almost twice as large as that of 1850. A final example of adaptation to city needs was the increased planting of orchards. Horticultural societies were formed, improved varieties of apples planted, and old native fruit trees grafted. By 1847 Oneida county in the Mohawk valley shipped nearly 18,000 barrels of apples.

Eastern agriculture thus underwent two major changes by 1860. In response to the growth of a home market, farmers gradually shifted from self-sufficing to commercialized agriculture between 1810 and 1840. While this change was still taking place, the farmers on rich virgin soil to the westward began to ship their produce by canal and railroad to eastern markets. As a consequence, local farmers were forced to specialize in articles such as milk, butter, cheese, vegetables, fruit and hay, which, by reason of their perishability or bulk, escaped western competition and enjoyed a ready market in the expanding urban centres close by.

Southern Agriculture to 1860.—Despite an ever-growing rivalry with the northwest, the south continued as the principal centre of commercial agriculture from the Revolution to the American Civil War. Its pre-eminence, however, was due chiefly to the rise of cotton production and its expansion into the old southwest. Tobacco fell off greatly in relative importance. Indigo cultivation waned, having suffered a death-blow by the removal of the British bounty. Rice farming underwent a transition incident to the adoption of the tide-flow system. Hemp and flax later became crops of some importance in Kentucky and Missouri, and sugar growing achieved considerable success in Louisiana. It was cotton, though, and particularly cotton on western land, that predominated.

Cotton had been grown in the southern colonies but only for domestic use. Yet the revolution in textile manufacture in England that made possible mass production of cotton textiles for a world market created a comparable demand for the growth of cotton fibre. Soil and climate favoured the green-seed short-staple variety, but separation of the seed from the lint was difficult, slow, and expensive because the fibre had to be cut or torn away. Sea-island cotton, a longer-fibred variety, was introduced in 1786. Its seeds were easily removed by running the fibre between rollers that revolved in opposite directions. Although sea-island cotton brought high prices and was raised, often on a large scale, until the American Civil War, the acreage devoted to it was limited, as it could be successfully grown only on the lowlands along the southeastern coast.

The cotton gin invented by Eli Whitney in 1793 solved the crucial problem incident to large-scale production of the green-seed short-staple cotton, and its invention marked a turning point not only in southern agriculture but in U.S. history. Upland or short-staple cotton became the largest commercial crop in the south and the basis of its economy. Each decade cotton production approximately doubled. In 1800, 73,222 bales of cotton were produced; in 1840, 1,347,640; and in 1860, 3,841,416. It overflowed the domestic market and became the largest single export of the United States. In 1810 cotton represented 23% of the value of total exports, or a little more than \$66,000,000; by July 1, 1860, it had increased to 61%, or more than \$333,000,000.

As the south concentrated more and more on cotton growing, it also offered a larger market for northwestern grain and livestock products.

Cotton expansion revived the moribund institution of slavery, as the growing of cotton was very well adapted to unskilled supervised gang labour. In the five years before the federal prohibition of the slave trade became effective in 1808, South Carolina alone imported 39,000 slaves, and by 1860 its slave population increased to 57.2% of the total population. Another institution, the plantation, similarly became prominent, and the three together—cotton, slavery and the plantation—acquired a dominating influence over the political and social as well as the economic structure of the south.

Cotton growing centred first in the tidewater region of South Carolina and Georgia. Many planters shifted to it from indigo and rice cultivation. The methods of cultivation were crude and wasteful, not because of slave labour but because land was abundant and cheap. Squandering natural resources was as characteristic of the southern planter as of the western pioneer. Cotton growers reached out to the Piedmont of North Carolina and Virginia and then turned southwestward. The War of 1812, the acquisition of east and west Florida, and the removal of Indians to reservations beyond the Mississippi were, in part at least, due to cotton. The belt of heavy black and brown loam soils in Alabama and Mississippi were found to be unsurpassed for cotton, and this region long remained the foremost cotton district in the world. Nevertheless the migration of cotton planters continued westward into the second area of great cotton production along the lower Mississippi. Even these conquests were not enough, and the land-hungry and restless pushed on to the prairie region of Texas.

Until 1821, more than one-half of the cotton had been grown in Georgia and South Carolina. By 1850 Alabama ranked first, Georgia second, Mississippi third and South Carolina fourth. In 1860 Mississippi, Alabama and Louisiana produced more than one-half of the total cotton crop in the United States, while Texas grew more than South Carolina. In the north, when the Atlantic seaboard states could not meet the challenge of western agriculture, industrialization was intensified; in the older south no such compensating factor was present, and economically it fell steadily behind the southwest. Land values declined, and Savannah, Ga., and Charleston, S.C., were supplanted by New Orleans, La., and Mobile, Ala., as trade centres. Even by 1820 the areas first devoted to cotton presented a sorry picture of eroded lands, bare of vegetation except for scrubby growths.

The southeast blamed its decline on the tariff, the federal banking policy, the lack of credit facilities and heavy taxation. All these factors were present, but the problem was primarily accentuated by the rapid westward expansion. Despite many pamphlets, resolutions and conventions, a movement for industrial diversification did not progress far because the capital available was too closely tied up with landed investments, while the labour supply, whether slave or "poor white," needed wholesale readaptation. As an alternative, the southeast sought to establish itself as the trade centre for both the southwest and the northwest, but the former developed its own ports, and the latter became tied to the northeast by railroads.

Attempts were made to adjust and reform the agriculture of the southeast to the changed conditions. John Taylor "of Caroline" sought to halt the retardation of Virginia agriculture by improved methods of farming, and Edmund Ruffin sounded an even more clarion call to check soil depletion. When the older region first felt western competition, it found itself with too much slave labour. Transfer of that surplus westward only strengthened the competition. Finally, in the '40s and '50s, when labour was needed for agricultural diversification, slaves were scarce. The old south could not afford to pay \$1,000 to \$1,400 for prime hands and was outbid by the southwest, where fertile lands yielded a much greater output per unit of labour. In desperation the southeast sought a reopening of the slave trade; though the attempt failed, slave smuggling probably was increased. More important for later development was the fostering

of progressive methods such as deeper plowing, the introduction of new crops, the increased use of labour-saving devices, and the importation of improved breeds of livestock. Agricultural journals and societies were begun and fairs and exhibits held. General farming became a prominent feature of the agriculture of the border states, and just prior to the outbreak of the American Civil War Virginia achieved a moderate prosperity as a result.

Tobacco, the south's chief colonial staple, reached its height in the 1790s, when more than half the population of Virginia, Maryland and North Carolina were engaged in or dependent upon its cultivation. In 1790 it ranked first on the list of U.S. exports, with a value of more than \$4,000,000. After 1800, however, it declined rapidly in relative importance, and production remained stable until 1850. The disturbed trade conditions resulting from the Napoleonic Wars, the post-1815 attempt of England to stimulate domestic tobacco production or West Indian importation, the high duties imposed by countries of continental Europe anxious for revenue, and the competition of Cuba, Sumatra and Colombia all helped to undermine the position of United States tobacco in the world market.

At home, meanwhile, cotton was outbidding tobacco for the available land and labour. By 1850, tobacco production had passed its lowest point and had begun to revive. Flue curing supplanted the old-fashioned, charcoal-fire, open-air methods, while a new yellow-leaf variety, lighter than the old varieties, won popular favour. Between 1850 and 1860 production doubled, North Carolina and Virginia being affected most.

Tobacco, like cotton, expanded to new fields in the west in the years before 1860. Extractive pioneer cultivation laid waste the older lands, while low prices on the world market called for decreased production costs. It was cheaper to move to fresh soil than to struggle with worn-out fields. Virginia maintained its lead till 1860, but Kentucky was close behind, and Ohio, Tennessee and Missouri had made a considerable advance. Two important trade and manufacturing centres for tobacco, Louisville, Ky., and St. Louis, Mo., developed in the west.

Sugar production, like that of cotton, grew from insignificant proportions to outstrip tobacco in importance. The cane was introduced into Louisiana by Jesuits from Santo Domingo in 1751, but it was not until the last decade of the same century that the crop was grown on a commercially significant scale. The sugar district centred along the rivers and bayous of southeastern Louisiana, where the soil was rich and the growing season was sufficiently long for the plant to mature. Despite fluctuations caused by floods and occasional early frosts, production increased from approximately 20,000 short tons in 1823 to 270,000 in 1861. Unlike most other southern staples, sugar enjoyed the protection of a high tariff, and the industry was highly mechanized; sugar production expanded slowly, either to the west or to the east. It did extend over to the Brazos river area of Texas and to a lesser degree into Florida and Georgia, but in these states it was relatively insignificant. Though the industry was limited in the main to Louisiana, it affected the southeast. Many South Carolinians, for example, migrated to Louisiana, taking their labourers with them. By 1860 the sugar plantations were using a total of 180,000 slaves; this involved a considerable drain of labour from the Atlantic seaboard and sent slave prices upward.

Rice continued to be a leading agricultural crop along the coast of South Carolina and Georgia until the American Civil War. Production increased threefold from 1820 to 1850 but suffered a distinct decline in the next decade. In the banner year of 1850, South Carolina and Georgia together accounted for almost all the rice grown in the United States. There was some development of the industry in Louisiana, Mississippi and Alabama, but it was of little consequence. Rice planters felt western competition most when they had to bid for labour on a market dominated by the cotton growers of the southwest.

Almost from the first settlement of Kentucky, hemp raising was found well suited to the rich limestone areas. Unusually favourable prices from 1826 to 1828 stimulated production, and hemp growing expanded into middle Tennessee and, during the '30s into the rich valleys of Missouri. The cotton industry had a

considerable interest in hemp, since it was manufactured locally into baling cloth, rope and clothing for Negroes. In 1859 Kentucky and Missouri together produced more than three-fourths of the 57,000 tons of hemp raised in the United States. Soil deterioration, scarcity of labour and Russian competition, however, had already influenced Kentucky to turn more toward wheat growing and cattle raising.

While the south raised all of the cotton, rice and sugar grown in the United States and more than 80% of the tobacco, its other crops also ranked high. It produced more than 50% of the country's corn, more than 70% of the peas and beans, 94% of the sweet potatoes, and a little less than 30% of the wheat. In producing each of the principal classes of livestock the south ranked higher per capita than the United States as a whole. Kentucky was famous for its race horses, horned cattle and Hampshire hogs, while Virginia was a leader in sheep raising. Eighty-six per cent of the south's general farming was located in the border states in 1859.

In the south the landowning class was divided into gradations of small, intermediate and large farmers, and small, intermediate and large planters. In 1850 only 18% of the south's 569,000 farms and plantations were actually plantations, and this estimate includes as "plantations" many thousands of small cotton and tobacco holdings with but one or two working hands. Even in the black belt of Alabama almost 80% of the nonslaveholding landowners, who in 1850 constituted 44% of the region's agricultural population, owned farms ranging up to 200 acres. Of the slaveholding landowners, more than 50% owned 10 or fewer slaves and 500 acres of land or less, which classed them as farmers. Together the small planters and the slaveholding and non-slaveholding farmers owned approximately 75% of the landed wealth in the black belt—the so-called stronghold of the plantation system. As late as 1860 only 348,000 families out of a total of 793,493 white and free Negro families owned slaves in the south.

While the yeoman farmer was more truly characteristic of the landholding class, even in the ante-bellum south, it was the 2% holding plantations with more than 50 slaves that dominated economically, politically and socially. Not until the American Civil War overthrew this planter aristocracy did the yeoman or dirt farmer begin to come into his own.

Agricultural Revolution.—The transformation of U.S. agriculture from a simple, pioneer, and largely self-sufficing occupation into a modern business organized on a scientific, capitalistic and commercial basis is frequently referred to as the agricultural revolution. Simultaneously industry shifted from hand labour in homes to machine production in factories, and local markets were transformed into a world market.

Like all striking changes this vast reorientation of the country's economic life did not begin suddenly or in all regions simultaneously. Even in the colonial period many American communities concentrated on the production of surplus crops for distribution in markets beyond their confines. During the latter half of the 18th century the agriculture of England underwent a similar change, and the accompanying desire to utilize improved methods in order to make farming profitable was not without influence in the United States in the years following the American Revolution. While the forces of the so-called agricultural revolution had long been at work in the United States, it was not until the last half of the 19th century that they began to manifest a fruition which captured general recognition. Careful study of the agricultural history of the United States reveals that its agricultural regions and perhaps also the country as a whole experienced a number of quickenings of agricultural progress and that it would be more accurate to speak of a congeries of agricultural revolutions rather than merely one. Perhaps, indeed, the over-all agricultural revolution is the adjustment and response of agriculture generally to world opportunities and conditions that followed the so-called Europeanization of the world, a process which included the merging of the old and new world agricultures.

The forces underlying the so-called agricultural revolution in the United States may be summarized as follows: The passing of

the public domain into private ownership by means of liberal land policies; the completion of the westward movement of settlement; the invention and popularization of improved farm implements and machinery; the extension and development of transportation facilities; the expansion of domestic and foreign markets; the migration of industries from the farm to the factory; the resort to conscious and concerted political organization and action by farmers in an effort to retain an equitable place for agriculture in the economic structure of the nation; and the establishment of agencies for the promotion of scientific knowledge relating to agriculture—agricultural societies, agricultural fairs, periodicals for farmers, the federal department of agriculture and agricultural colleges and experiment stations. These forces, it should be emphasized, did not reach their maximum impact simultaneously, and some of them were still operating with increasing potency after World War II.

Passing of the Public Domain.—Under the Homestead Act of 1862, the head of a family or a person over 21 who was a United States citizen or had filed intention of becoming one received title to 160 acres of the public domain after proving five years residence, by evidencing good faith by cultivation and paying a nominal registration fee. After 6 months (raised to 14 months in 1891) the entry might be commuted by the payment of the prevailing minimum price, usually \$1.25 per acre. Later amendments permitted veterans of the Union army and of succeeding wars to count the time of their military service against the five-year residence.

The homestead policy was not well adapted to much of the public domain to which it applied. By this time agricultural settlement had reached the eastern edge of the Great Plains. To the west the average rainfall ranges from 10 to 18 inches and falls much lower during seasonal and cyclical dry spells. The farming techniques developed for the humid soils to the east were unsuitable for these new conditions. Effective land utilization required dry farming, grazing or intensive cultivation with irrigation, but 160 acres was too much land for irrigated farming and too little for grazing or dry farming.

Moreover, the homestead method of distribution was merely an addition to others already authorized by previous statutes, and the result was an incongruous land system. The cash sale of land was continued to 1891, and more land was bought than homesteaded. Between 1862 and 1871, the railroads received about 125,000,000 acres as subsidies, and homesteading was not permitted except 20 to 40 miles back from the projected routes. By the Dawes Act of 1887, modified by the Burke Act of 1906 and later measures, about 100,000,000 acres of Indian lands were opened for sale. More than 7,000,000 acres were given to the states in accordance with the Land Grant College Act of 1862.

With such a vast empire of land purchasable, speculation and land monopolization became rife. Syndicates purchased land in large blocks and generally secured the most desirable lands. Actual settlers might get free lands that were less fertile or less advantageously located or buy at prices set by the speculators, the railroads or the states.

The administration of the land laws was even less satisfactory. Fraud became rampant, and the general land office which supervised disposal of the public domain did not have the organization, the personnel, or the public and official backing to ensure careful and honest administration.

Efforts were made to adapt the homestead principle to special situations. Measures were passed from time to time to aid homesteaders affected by droughts. In 1873 the Timber Culture act promised 160 acres to any homesteader who kept trees growing not more than 12 ft. apart on 40 acres, and 5 years later this minimum was lowered to 10 acres. In 1909, the size of homesteads was increased to 320 acres in portions of eight western states. A quarter of the tract was to be cultivated, and no commutation was allowed. In 1916 the maximum was increased to 640 acres for farmers who wished to raise stock.

By the Desert Land Act of 1877, 640 acres of arid land could be purchased at \$1.25 per acre provided the buyer irrigated and cultivated at least one-eighth of the tract. In 1890 the amount

that could be secured in this way was decreased to 320 acres. In 1878 the Timber Cutting act and the Timber and Stone act authorized for the first time the legal cutting and purchase of timber from the public domain.

As the 19th century neared its close, the rapid passing of the best farming lands into private hands, the rise of tenancy, and the emergence of land monopolies gave strength to the principle, long dominant and submerged, that the nation's natural resources should be conserved. In 1891 the Pre-emption and Timber Culture acts were repealed, the amount obtainable under the Desert Land act was reduced to 320 acres, the period that must lapse before homesteads could be commuted was extended to 14 months, and the president was authorized to reserve timber areas. In 1894 the Carey act granted 1,000,000 acres to certain states-provided they were settled and irrigated. In 1902, under the Reclamation act, the federal government began to initiate irrigation projects on the public domain. Following the publicizing stimulus of President Theodore Roosevelt, there was steady progress in the reclamation, conservation and scientific use of land after the beginning of the 20th century. In the 1930s the National Resources Planning board studied the classification of all land in terms of inherent characteristics, current use, capacities, recommended use and program effectuation.

The Taylor Grazing Act of 1934 authorized the withdrawal from private entry of about 80,000,000 acres not suitable for crop farming and their use as grazing districts. The next year all the remaining unreserved public domain of any value was withdrawn from private entry. In 1936 the Soil Conservation and Domestic Allotment act authorized farmers to preserve and maintain soil fertility.

Completion of Agricultural Settlement.—By 1850 the westward-moving frontier of settlement had halted at the edge of the Great Plains, because of the Indian policy inaugurated a generation before and because the unoccupied region presented a challenge to the accepted methods of agricultural conquest. There were already isolated islands of settlement in California, the Willamette valley of Oregon, and Utah. Within 40 years the entire territory of the trans-Missouri west was occupied and began to add to the surpluses of agricultural products and to serve as a growing market for manufactured goods.

The population of continental United States numbered 23,191,876 in 1850 and 62,947,714 in 1890. By 1920 it totalled 105,710,620. That is to say, the population increased by two and one-half times in 40 years and by four and one-half times in 70 years. Immigration supplied 31,406,943 from 1850 to 1920. Reduced to simple terms, this increase in population meant more farm surpluses; but it also created a greatly expanded home market for agricultural products.

The population of the United States continued to be predominantly rural after World War I, but the rapid increase and ultimate triumph of urbanization predestined the future of the United States to a quite different social and economic configuration. The census of 1880 showed that the rural population, including towns and villages with fewer than 2,500 inhabitants, numbered 35,797,616, or 71.4% of the total population. This was more than the population of the entire country in 1860. By 1910 the rural population numbered 49,806,146, which was 54.2% of the total. By 1920, however, the census showed that the majority of the U.S. people lived in towns and cities—48.6% being classified as rural and 51.4% as urban.

Mechanization.—The process of agricultural mechanization began in the 18th century and is still going on. The implements used in the colonial period were largely operated by hand, supplemented to a slight extent by animal power. The first half of the 19th century brought initial inventions and improvements in machines operated by animal power for use in planting, cultivating, harvesting and threshing. The reaper was especially important because it was used at the crucial period in the production of grain crops when delay often spelled disaster. The general displacement of men by horses developed most rapidly between 1860 and 1910. The substitution, however, had hardly begun before manufacturers of farm machinery began to experiment with

the use of mechanical power in place of animals. Considerable use of steam tractors in preparing and planting land was made on the prairies of the middle west. By 1905 the practicability of using the gasoline engine for power had been demonstrated. Its use on tractors was quickened by World War I, but the adaptation and perfection took place in the '20s and '30s. Almost as revolutionary in their effects were the use of automobiles and trucks; they put rural communities in closer touch with urban life and facilitated marketing. Beginning in the '30s the government program of extending electrification to farms brought illumination and power for indoor machines that did much to decrease household and farm drudgery.

Mechanization of farming brought many changes. The productivity of farm labour was increased (one estimate says 400%), and manpower was released for other activities. The farmer who could buy expensive machinery had an advantage over those who could not, and it became increasingly difficult for the man without capital to farm. The production of agricultural products and the output per capita was greatly increased. The result was the accentuation of the problem of overproduction. Mechanization prolonged extensive as opposed to intensive cultivation and gave large-scale operations an advantage. An increasing number of acres once devoted to the raising of feed for animal power could be used for the production of human food. The isolation and much of the drudgery of farm life disappeared. (See AGRICULTURAL POWER AND MACHINERY.)

Improved Transportation and New Markets.—As a generalization it may be said that the roadbuilding era of the early 19th century was superseded by a canal building and river transportation era. This, in turn, was displaced in importance by the building of a national network of railroads which provided rapid means for marketing the surpluses of the farms and ranches. In the 20th century attention was given to surfaced roads that would facilitate the farmers' access to primary markets. The increased speed of trains, specialized livestock and refrigerator cars, and systems of through transportation widened the area of competition for many commodities and hastened regional specialization. This development of a national transportation system was accompanied by comparable modernization of the marketing organization.

The transportation and trading agencies enabled an enormous volume of farm commodities to pass from the farms to the urban consumers, both in the United States and in other countries. By 1900 agricultural production was also providing more than four-fifths of the raw materials manufactured. The repercussions of U.S. agricultural exports on European economic life were far-reaching. The labouring classes were provided with cheap and abundant food, but unless protected by tariff walls the European farmer was unable to compete. The results of this situation were mirrored partly in the tremendous migrations from Europe to the United States during the 1870s and 1880s, partly by the flocking of farmers to cities, and partly by agrarian movements that clamoured for governmental relief in various forms. After the '80s, new agricultural regions were opened in Russia, Argentina, Australia and Canada, and their produce began to compete with U.S. foodstuffs in the European markets. As an exporter of foodstuffs the United States began to decline in importance after 1900. The domestic market continued to expand, but relative overproduction and maldistribution continued to plague the U.S. farmer.

Migration of "Industries" from the Farms.—Until well into the 19th century a distinctive feature of the U.S. farm was economic self-sufficiency. The average farm produced and processed practically everything that it needed—food, clothing, furniture, soap, candles and the many other articles essential to the farm family. The transfer of their manufacture from the farms to factories is a significant aspect of the transition from self-sufficient to commercial agriculture. It was, furthermore, the central fact of both the agricultural and industrial revolutions. This cityward migration of industries resulted in vast changes in the technical processes of manufacturing. The growth of urban communities centring about factories greatly enlarged the markets

for agricultural commodities. Specialization in agriculture was also intensified.

The industries transferred from the farms to factories may be grouped as follows: The processing of foods; the making of textiles and clothing, including boots and shoes; and the preparation of tobacco and other products for use. The first group includes slaughtering and meat packing, flour milling, the manufacture of butter, cheese and other dairy products, and the canning of fruits and vegetables. Many new industries were developed, notably the processing of beet sugar, the baking of bread and pastries and the making of confections. In 1860 flour and grist mill products ranked first among the food-manufacturing industries. By 1919 the slaughtering and meat-packing industry had taken first place. In that year the products of all food industries constituted 20% of the total value of all U.S. manufactures.

Political Organization and Action.—The great increase in agricultural trade did not bring prosperity to the farmers. Instead the three decades following the end of the American Civil War brought acute distress to many. The census of 1880 showed that the proportional share of agriculture in the nation's income was decreasing steadily. In addition to the problem of relative overproduction, the appreciated gold standard resulted in a general fall in the price level from 1875 to 1897. The farmer, by the nature of his industry, was unable to adjust his production to depressing conditions as quickly as other businesses could.

As the farmers expanded commercial agriculture, physical limitations bore down on them. Those who extended cultivation into the semiarid Great Plains were confronted with seasonal failures. Deforestation, improper drainage and faulty tillage resulted in destructive floods and unscientific cropping practices exhausted the soils in the humid regions.

All agricultural regions had particular difficulties. Eastern farmers had to compete with the cheap production of the west or turn to specialties. Western farmers were burdened with mortgages held by eastern investors. The price of land increased disproportionately to the returns that could be expected.

Living conditions on farms came to reflect the relatively small returns upon the farmer's investment and the meagre awards for his labour. The educational and recreational opportunities fell behind those of the cities. It was also apparent that the farmer was less influential in state and national politics and that policies were being shaped more and more in the interests of the rising industrialism.

The situation called for concerted organization if the farmer was to have a relatively favourable position in the national economy, but this was not forthcoming. Traditionally the farmer held back from common action. The dispersal of the farming population, the number of farmers involved, their varied and competing commodity interests, and the lack of leaders tended to thwart organization. (See FARMERS' ORGANIZATIONS.)

In spite of these difficulties, the distress became so real and pressing that a number of class-conscious farmers' movements were generated. Together they came to be known as the agrarian crusade. Each movement reflected the particular need and the special centre of distress of its time.

The first in order of time was the Granger movement (see GRANGE, THE) of the '70s in the upper Mississippi valley where the farmers had special grievances. With no regulation of their capital structure, methods and rates, the railroads and the marketing agencies that they dominated practised discriminations which so inflamed the farmers that they organized independent and antimonopoly parties between 1873 and 1876 and thus gained control of state legislations which enacted laws to fix and regulate the rates charged by railroad and elevator companies. Although lack of precedents and adequate information thwarted these attempts at regulation, the contention that such corporations were public in nature and therefore subject to governmental regulation was upheld by the supreme court of the United States. In 1887 the responsibility for railroad regulation was assumed by the federal government. The grangers sought to assuage their grievances against wholesalers, distribution and credit agencies, and merchants by organizing co-operative buying and selling agencies

of their own. Co-operative credit and insurance companies were also developed on a modest scale. A co-operative industrial program which called for the manufacture of a full line of farm machinery and household implements fell far short of expectations.

The Greenback movement from the late '60s onward sought to check deflation by stopping the contraction of the amount of greenback money in circulation and by having the war bonds redeemed in legal tender. This type of inflation interested eastern labour and the debtor farmers of the middle west but failed to win support from the agricultural interests generally. A temporary price rise in the early '80s ended the movement, but the basic problems of currency, credit and marketing remained unsolved.

In the 1880s a variety of local organizations that developed spontaneously among the small farmers and tenants of the southwest and the wheat farmers of the northwest became the basis of the Farmers' Alliance movement, whose general program emphasized co-operative activities. In addition, the southern group proposed a federal system of warehouses and elevators where crops might be deposited in return for negotiable certificates and loans in legal tender up to 80% of the local price of the product. The northwestern group urged a federal land-loan agency that would make loans upon farm land up to half of the appraised value at 2% per year. In spite of leader emphasis the members of the alliances turned to politics and eventually became part of the Populist movement.

The extremely depressed economic conditions of the early 1890s bore particularly hard on farmers and led to the formation of the People's or Populist party. Its three main objectives were reform and regulation of the disposal of the public domain in the interest of actual settlers, strict regulation of corporations and public ownership and operation of transportation and communication facilities, and raising the price level by federal note issues and the restoration of the free coinage of silver at the old ratio of 16 to 1. In the campaign of 1896 the Populists joined with the Democratic party under William Jennings Bryan and lost.

Science Applied to Agriculture.—In the colonial period there were individuals who applied their powers of observation to farm problems and even conducted experiments to ascertain the ways of nature and to develop better methods. In the latter half of the 18th century, leaders who sought to spread information concerning the findings of improvers and innovators began to form agricultural societies to function as educational media. In the first third of the 19th century agricultural fairs and farm periodicals were developed as additional instrumentalities in the movement. (See AGRICULTURAL SOCIETIES AND SHOWS.)

Public aid for agricultural improvement came slowly because the seemingly inexhaustible abundance of natural resources appeared to negate the necessity. Before 1860 state aid was limited mainly to small grants to agricultural societies to assist them with their fairs. By the '50s a few states had boards that collected information deemed pertinent to farmers. The cumulated necessity of regulating the food-processing industries and of combating animal and plant diseases and pests systematically led to the creation of state departments of agriculture in the '70s.

In the national realm, President George Washington had urged the creation of a U.S. counterpart of the board of agriculture then functioning in England, but it was not until 1839 that a unit of the patent office received appropriations with which to collect and distribute seeds and to assemble and publish information. This work was continued by the separate department of agriculture created in 1862. In addition experienced staff members conducted scientific research. The department's regulatory powers became important in 1884 when a bureau of animal industry was created to administer meat inspection and check livestock diseases. In 1880, because of increased functions and the potentialities of the agrarian unrest, the department was given full executive status and a secretary who served in the president's cabinet. The rapid and profound changes in agriculture necessitated the expansion of research, regulatory and educational functions in the department. (See AGRICULTURAL RESEARCH.)

There were a fair number of undertakings which offered formal instruction in agriculture during the first half of the 19th century, but it remained for the Morrill Act of 1862, which granted land endowments to state colleges offering courses in agriculture and mechanic arts, to provide the basis for the extensive system of agricultural education and research that was peculiarly American. The institutions receiving the benefits of this act were slow in finding their particular place and function. In the end it was the experimental work that won recognition for the agricultural colleges from scientists and eventually dirt farmers as well. (See AGRICULTURAL EDUCATION.)

The Main Agricultural Regions.—During the last half of the 19th century, the various systems of agricultural production were adapted to geographical conditions, and in consequence relatively stable agricultural regions evolved. Each region became dominated by one commodity, grown in conjunction with subordinate products and with specialties having preference in limited areas. Market opportunities, mechanization and scientific methods accelerated this regionalization.

The humid subtropical crops belt consists of comparatively undeveloped low coastal plain bordering the Gulf of Mexico and extending from Matagorda bay, Texas, to Charleston, S.C. The soils have been very influential in determining which of the subtropical crops are grown in the different parts of the region and together with local differences in temperature cause the region to be divided into subregions.

The rice subregion centres in the heavy clay coastal prairie of southeastern Texas and southwestern Louisiana. In the 1880s settlers from the grain-growing middle west migrated there and began to grow rice. Irrigation was provided by artesian wells and pumping stations. About 1900, the federal department of agriculture introduced Japanese varieties that flourished. The use of machinery in the cultivation and the harvesting of the crop made the cost of production so low that the area could compete in practically any market. In 1902 mechanized rice growing was also undertaken on the grand prairie of Arkansas and in 1908 in the Sacramento valley of California.

Sugar-cane production was centred on the rich alluvial soils of the Mississippi delta after its successful introduction there near the end of the 18th century. Even after the abolition of slavery, it continued to be a large-scale capitalistic enterprise. In view of the high production costs, the industry was especially dependent upon tariff protection. The U.S. acquisition of competing areas, namely Puerto Rico and the Philippines, and a reciprocal treaty with Cuba brought new difficulties. The disastrous floods in 1874, 1882 and 1884 necessitated large-scale levee construction. After 1900 special attention had to be given to the checking of diseases and the development of new varieties. The muck soils around Lake Okechobee in Florida also proved well adapted to the production of sugar cane.

Favoured districts of the remainder of the humid subtropical crops belt gradually developed importance as producers of subtropical fruits and trucking crops. Winter vegetables and citrus fruits flourished in Florida, and the problems were those of adaptation to local conditions and specialized marketing.

The boundaries of the cotton belt are determined largely by climate, but the density of cotton production is largely dependent on the soils. The northern boundary follows the line of 200-day average frost-free season and of 77° F. average summer temperature. The southern boundary is the line of 10-in. autumn rainfall. In the decade following the American Civil War, the attempt to continue the plantation organization with hired labour of freedmen failed, and cotton growing was shifted to small units of land operated under a share-cropping system. The crop lien given in return for the advance of supplies chained the cropper to the landlord or local merchant, but they in turn were dependent on the bankers and commission men. As cotton was a standardized marketable commodity, diversification for the market and even for subsistence was discouraged. Production was inefficient, and the costs remained relatively high. Falling prices hit the cotton south as hard as the wheat area of the west in the '80s and '90s.

The demand for cheap fibre and the utilization of cottonseed in the manufacture of feed, oil and fertilizer led to the expansion of cotton growing westward to the subhumid line in Texas and northward to the frost line in Oklahoma, Arkansas and Tennessee. Simultaneously the use of commercial fertilizers revived the industry in Georgia and the Carolinas. By 1880 cotton manufacturing began to be established in the southern Piedmont, and eventually these mills fabricated more than half the cotton crop.

Cotton growing was imperilled by the ravages of a devouring beetle known as the boll weevil which crossed the Mexican border into Texas in the 1890s and progressed eastward across the cotton belt. To offset the losses, cotton farmers turned to other crops to some extent, but the main relief came from the introduction of improved methods of cultivation and hardier varieties of cotton. This campaign for improvement directed by Seaman A. Knapp provided the basis for the extension service of the federal department of agriculture.

Tobacco growing is widely distributed in the United States, but the cultivation of the main types has centred in the borderland between the south and the north which is sometimes known as the corn and winter wheat belt. The bright-leaf flue-cured tobacco, used in cigarettes, became the major crop in northern and eastern North Carolina, and Durham and Winston-Salem became great centres of tobacco manufacture. The heavy dark burley tobacco needed for foreign markets centred in western Kentucky.

The middle Atlantic trucking region extends along the Atlantic coast from Charleston, S.C., to Portland, Me. It developed mainly because of three conditions: the large markets for fresh vegetables and fruits provided by the large cities within or near the area; its sandy soils that respond to cultivation and fertilization; and its mild climate with a long frost-free season.

The hay and dairying belt includes the portions of the cool humid northeastern United States and adjacent Canada in which agriculture generally is more important than the forest industries and dairying is the dominant interest. The southern boundary is approximately the line of 69° mean summer temperature in the west and 70° to the eastward. With the growth of industrial centres the eastern portion of the region gave increasing attention to the production of fluid milk. Wisconsin became the leading cheese-producing state, and Minnesota and Iowa specialized in buttermaking.

Between 1880 and 1914, dairying made notable progress in production, processing and marketing. Better dairy cattle were introduced and developed. The silo was adopted as a method of preserving corn and its green fodder for feed, and increased attention was given to forage crops. The cream separator simplified a hitherto time-consuming process, and the butterfat tester provided an accurate and quick method of measuring butter content. The condensing process was perfected. Milking machines were invented. Dairymen pioneered successfully in the co-operative processing and marketing of their products. Between World Wars I and II the dietary habits of the U.S. people gave greater emphasis to the value of dairy products.

The wheat regions developed in accordance with the conditions necessary to wheat growing. Wheat was the characteristic crop on each frontier across the northern and western United States. The prairies of Illinois were the main centre from 1860 to 1880. Minnesota ranked first during the next two decades and then gave place to North Dakota. During World War I Kansas became the leading centre. Winter wheat was continued as part of the general farming of the borderland corn and winter wheat belt. In contrast, hard spring wheat continued northwestward in a region having the bare requisite humidity and also to the Pacific northwest. This movement was made possible by the development of new varieties of wheat, resistant to drought and rust, and to innovations in methods of cultivation, especially power mechanization.

Corn continued to hold the basic place in crop systems and stock raising that it had early assumed in the colonial period and was, therefore, grown in all cultivable belts. Like wheat, its main centre of production moved westward but, unlike the other cereal, it halted when it reached the prairies of the middle west which

were predestined by the unique combination of soils and summer temperature and humidity to become the corn belt. The large-scale preparation of hogs and cattle for market followed corn into the region.

Because of the importance of corn and hogs to the region, special attention has long been given to the improvement of both. In the 1890s corn breeders followed the mirage of uniformity and symmetry, and it was not until after World War I that the importance of hybridization came to be recognized. In response to consumer demand, the old heavy lard hog was evolved into a younger light bacon type. The value of hogs made the checking of virulent diseases imperative, but it was not until 1913 that a preventive serum was developed for hog cholera.

The valleys of central and southern California and the coast south of Santa Cruz have been designated the Pacific subtropical crops region. The Spaniards utilized three institutions—the presidio or military establishment, the pueblo or colonial settlement, and the mission—to occupy the region. Of these the last was by far the most significant as missions became centres of agricultural development. Although the friars introduced the fruits of their Mediterranean homeland to the mission gardens, cattle raising was the dominant occupation during the Spanish-Mexican period, 1769–1848, and continued to be until droughts in the '60s ended it as a distinctive industry. Sheep raising recovered from the droughts, reached its peak in 1874, and then began to decline. In the years 1870–90 wheat farming reached bonanza proportions in the San Joaquin valley. Although the gold rush following 1849 stimulated attention to fruit raising, the experimentation and development necessary to capture a national market took place only after 1869, when the first transcontinental railroad was completed. By 1890 the people of the region knew what crops to emphasize and where to raise them, and the solutions of the problems of water supply for irrigation and of marketing were generally evident.

The humid portion of the Pacific northwest and also its irrigable valleys, like semiarid California, became a region of special crops. The Hudson's Bay company had farms to supply its helpers with food. The pioneers who migrated over the Oregon trail and settled in the Willamette valley in the 1840s also carried on general farming. Once the prairies were occupied, the high cost of clearing land in the region became and remained a big factor. It was necessary, therefore, for each valley and locality to specialize on crops which, by virtue of quality, could hold their places in the national markets.

The grazing and irrigated crops region was initially merely a strenuous barrier to those of the east who wished to reach the gold of California and the fertile lands of Oregon. As the gold production of California declined, the miners turned to the unoccupied valleys and mountain ranges to the eastward. Their rush into what is now Colorado laid the basis for permanent settlement there. The miners' occupation of Nevada, Arizona, New Mexico, western Montana, Idaho and eastern Washington took place during the American Civil War. The need of food supplies for the mining camps prompted the beginning of agriculture in the valleys. The completion of the Union Pacific railroad in 1869 brought a flood of hunters who exterminated the buffalo and thus left the Great Plains for occupation by the range-cattle industry. The success of the Union Pacific led to the building of four other transcontinental lines. Thus, the region, in contrast with the east, had facilities for rapid transportation prior to, rather than after, intensive settlement and exploitation. For two decades after the American Civil War, a vast cattle industry thrived on the open range. Then the railroads brought homesteaders and other land seekers who disrupted the range and forced the cattlemen to shift to a ranch basis. The invention of barbed wire for fencing in 1874 facilitated this step.

The fact that much of the land received less than 20 inches of rainfall annually foredoomed the transplanting of eastern ways of agriculture and necessitated the development of new methods and crops. Irrigation and dry farming became important in the United States for the first time.

World War I.—In terms of agricultural production and mar-

keting, the war period extended from the fall of 1914 to the spring of 1921. During the first two years production was not markedly stimulated, and the trade in certain commodities, notably cotton, was depressed. With the entrance of the United States into the conflict in 1917, an unprecedented program of agricultural production, especially of cereals and meat, was undertaken. To this end the new extension service created by the Smith-Lever Act of 1914 and the county-agent system acting with farmers' organizations were utilized.

Wheat was the cultivated crop most needed. The price was fixed by the federal government to encourage its production. The acreage increased more than 50% and its production 38%. More than one-quarter of the expansion was in the corn belt at the expense of other small grains, corn and grassland; most of the remainder was in the Great Plains. The demand for fats greatly stimulated hog production; more than 1,000,000,000 lb. of pork were exported in 1918 as compared with a prewar 5-year average of 450,000,000 lb. The dairy industry also expanded notably to supply the export demand for concentrated milk and the larger domestic demand which resulted from increased purchasing power.

The war years accentuated a complicated economic situation for the farmers. Their returns varied greatly according to commodities; the prices of wheat, hogs and tobacco were relatively high, whereas those for horses, cattle, butter and eggs were relatively low. Inflated values largely accounted for the general high level of prices, and this influence increased markedly the farmers' living and production costs. Land values rose as much as 70%.

Postwar Depression.—The price decline that began in 1920 affected agricultural products first and hardest. Following the withdrawal of credits, the foreign markets disappeared, and yet the farmers' fixed costs continued. Instead of curtailing output, the agricultural industry sought to meet the situation by increasing production even though it had to sell at low prices. The industrial and financial boom of the middle '20s brought only a limited improvement to agriculture. At the boom peak in 1929 the index of agricultural prices was only 91% of the prewar level, and it had fallen to 50% by Feb. 1933. Gross farm income, which had risen from \$7,000,000,000 in 1914 to \$17,000,000,000 in 1919, fell to a little more than \$5,000,000,000 in 1932.

This agricultural distress of the 1920s affected the various regions at different times and with varying degrees of intensity. During 1920–22 the spring-wheat region was the centre of distress and protest. In 1923 the decline in the hog market resulted in farm foreclosures and bank failures in the corn belt. Although the south early sought relief for specific products, it was not ready to demand a general program of relief until 1926.

Beginning in 1921 an agricultural bloc of western and southern congressmen sponsored emergency and long-time measures of relief and stabilization for agriculture. In 1923 intermediate credit banks were authorized to make short-term loans on livestock and farm commodities. The McNary-Haugen plan proposed to dispose of the farm surpluses abroad and to finance this procedure by an equalization fee assessed on the producers, but bills embodying the plan were twice vetoed by President Calvin Coolidge. In spite of the fact that the nation had shifted from a debtor to creditor status, the successive administrations from 1921 to 1933 placed much emphasis on protective tariffs to establish and maintain cost-of-production prices for the leading farm products in the home market.

Although the administrations were against large-scale government action, continued distress led to the creation of the Federal Farm board in 1929 to support and promote co-operative marketing associations as a means of controlling output and thus ensuring profitable returns.

New Deal Measures.—The agricultural policies of the Franklin D. Roosevelt administration from 1933 to the outbreak of World War II passed through several stages. To meet the emergency of price collapse, the Agricultural Adjustment Act of 1933 authorized extreme measures for the reduction of production and compensation payments from a tax on processors. The success attending the program for cotton, wheat, corn, hogs and tobacco in 1933 led to its expansion in 1934 to include beef and dairy

cattle, peanuts, rye, barley, flax, grain sorghums, sugar beets and sugar cane. At the same time submarginal farmers were encouraged to withdraw from commercial production, and the administration initiated a policy of reciprocal tariff agreements with other countries to encourage the export trade in agricultural products. Despite the widespread criticism of crop reduction by the consumers who were saddled with its cost and despite the disadvantages attending it, the economic conditions of the farmers rapidly improved. Supplementary legislation expanded the credit facilities for farmers and attacked the problem of tenancy. In Jan. 1936, the supreme court held the act of 1933 unconstitutional, and the administration had to turn to other media of action.

The danger of shortages and the tragic results of soil destruction were emphasized by the droughts that culminated in the dust storms of 1935 and 1936. The soil conservation service was created in 1935 to conduct soil erosion surveys and carry out preventive measures. The Soil Conservation and Domestic Allotment Act of 1936 provided \$500,000,000 for the preservation and improvement of soil fertility, the promotion of the economic use of land, and the protection of rivers and harbours from soil erosion. For two years co-operating farmers received direct aid, after which responsibility for the program was shifted to the states that enacted suitable legislation and provided a conservation plan acceptable to the federal department of agriculture.

A comprehensive and long-time program was provided by the Agricultural Adjustment Act of 1938, which emphasized and provided for an "ever-normal granary." As in earlier acts, the initial aim was the establishment of prices for wheat, cotton, corn, tobacco and rice at a level in relation to the cost of commodities bought by farmers in 1909-14 (for tobacco the parity base was 1919-29). The act provided machinery for soil conservation and balanced output, loans, marketing quotas, marketing aid and promotion and parity payments. A new feature was crop insurance for wheat.

During the years 1933-38 economic planning was carried further with respect to agriculture than for any other economic interest. The federal government assumed responsibility for determining both production and prices as well as maintaining soil resources and providing most of the farmers' credit needs. Before the full program as outlined in 1938 could be tested, agriculture as part of the national economy became involved in a global war.

World War II.—The production record of U.S. agriculture during World War II was phenomenal. The increase in total production from 1939 to 1944 was twice as large as during the preceding 20 years. The gross farm production in 1944 and again in 1945 averaged 124% of the prewar years 1935-39. The wartime achievement was accomplished without significant expansion in the crop acreage and in spite of shortages of labour, machinery and other supplies. Even though one-fourth of the food output went to military and other emergency uses, there was food enough in 1944 and 1945 to provide the civilians with a per capita food consumption about 10% higher than before the war. Although extremely favourable weather was a factor, it accounted for only about one-fourth of the total increase. The main motivation for increased production was the doubling of the prices received by farmers for their products which resulted from the wartime needs, but the large-scale increase was made possible by a number of factors that had been building up potential production capacity during the 1930s.

Mechanization was the most important factor. The number of tractors on farms increased from less than 250,000 in 1920 to more than 2,000,000 in 1945. The shift to mechanical power during these years released for the production of commodities for human use about 55,000,000 crop acres, or about 15% of the available cropland, once used to grow feed for draught animals.

Another important factor was the increased use of lime and fertilizer. In terms of plant nutrients the total consumption of commercial fertilizer in 1944 was 85% above the quantity used in the years 1935-39, and the use of lime was nearly three times as large. Official estimates placed the increased production resulting from the additional use of lime and fertilizer in 1944 at about 15% of the total increase in output after 1935-39.

The adoption of improved crop varieties was another important source of increased production. The use of hybrid seed corn added 400,000,000 bushels to the 1944 crop. New varieties of oats were introduced in the corn belt, the Great Lakes states, and the southern states. The war years also accelerated the adoption of more productive and more nutritious legume hays.

The production of crops especially needed during the war was greatly expanded. The harvested acreage of hemp for hard fibre was increased from 1,246 acres in 1935-39 to 146,200 acres in 1943. The acreage of soybeans harvested for seed and for crushing in 1944 was 241% of that acreage in 1939. The acreage of flaxseed for oil in 1943 was more than three times the average of 1935-39. The production of peanuts, beans and peas for human food was greatly increased. In addition to these crops which affected large areas, there were others whose production was concentrated in small areas, notably vegetable seeds, mung beans, castor beans and some pharmaceutical plants grown to alleviate war shortages.

A number of forces accounted for the increased marketings of livestock and livestock products. The current feed production permitted an increase in livestock. In addition, the shift to mechanical power released additional feed for animals that are grown for human use. The supply of feed was also more balanced with respect to protein and other nutritive elements. Livestock production also increased in output per unit of feed.

The wartime production record was achieved despite a decreasing labour supply. The total farm population dropped from 30,000,000 in 1940 to 25,000,000 in 1945, and the number of farm workers was 8% less in 1944 than in 1935-39. Nevertheless, by utilizing all the mechanical power available and working longer hours, the farmers and their families were able to develop the potential agricultural production capacity of the nation and make it the great food arsenal of the United Nations.

Agricultural Chemistry.—Agricultural chemical investigations in the United States are conducted in all the bureaus of the federal department of agriculture except those concerned exclusively with economic research and action and regulatory programs, in the agricultural experiment stations of the states and territories, in the universities and research institutions, and in the laboratories of the food-processing plants and industries which utilize agricultural products.

At first the agricultural chemists were almost exclusively concerned with the chemical control of commercial fertilizers and the study of fertilizer action upon the growth of plants. The study of cattle feeds for regulatory and research purposes was next taken up, and finally, with the passage of state and federal pure-food laws, the diet of man began to be investigated—first for the prevention of adulteration and then for the improvement of human nutrition. The sequence of plants, animals and man, although seemingly illogical as regards importance, was the natural order of research development. The passages of state and federal laws governing the purity of insecticides increased further the regulatory work of agricultural chemists, and most of the experiment stations shortly found control work so disrupting to research that the former was separated from the latter and transferred to state chemists.

The policy of separation was also adopted by the federal department of agriculture in 1927 when the inspection control of food and drugs, insecticides, tea and naval stores was transferred from the bureau of chemistry to a purely regulatory Office of Food, Drug and Insecticide Administration. By this time agricultural chemistry had become so vast a field of research that scientists spoke and worked in terms of its subsidiary sciences rather than the subject as a whole.

The lines of chemical research emphasized in the various experiment stations depended naturally upon the predominant agricultural needs of their states. Chemical investigations relating to dairy products were stressed in New York, Wisconsin, Minnesota and other leading dairy states; those concerned with flour in the wheat-growing states; those upon sugar production in the cane-growing states of the south and the beet-producing states of the west; and those upon corn in Iowa and the other large corn-grow-

ing states.

Examples of pioneer specialization with more than regional applicability were the lysimeter studies upon percolation in soils in Tennessee, the research on alkaline soils in California, and the studies of vegetable proteins in Connecticut and of animal calorimetry in Pennsylvania.

Among the more important chemical projects of the federal bureaus were investigations upon soils, fertilizers and nitrogen fixation; foods and food technology; human and animal nutrition; plant constituents; insecticides and fungicides; chemistry and technology of tanning materials, leather, paper, fabrics, sugar, starch, oils and fats; meat, dairy and forestry products; storage of cereals, vegetables and fruits; deterioration of agricultural products; spontaneous combustion; dust explosions; and methods of agricultural chemical analysis. In the 1930s greatly increased attention was given to studies of the industrial uses of agricultural products, by-products and wastes. Simultaneously the research work was largely transferred from Washington to the Agricultural Research centre at Beltsville, Md., and to four regional laboratories at Wyndmoor, Pa., Peoria, Ill., New Orleans, La., and Albany, Calif.

During World War II agricultural chemistry research made many notable contributions to the war effort, including the development of penicillin, synthetic rubber and plastics, the dehydration and compression of vegetables and eggs, and the stabilization of nitrated cotton for explosives; many of these and similar projects will be redirected to peacetime needs. (For the early history, see Charles A. Browne, *A Source Book of Agricultural Chemistry* [1944]; for the United States, see Charles A. Browne in the American Chemical Society's *Journal*, v. 48, no. 8a, pp. 177-201 [1926].)

Experiment Stations.—In the United States agricultural experiments were early conducted by the agricultural colleges, but not until 1875 was the first experiment station with state support established. It was located at Middletown, Conn., under Wilbur O. Atwater and later was moved to New Haven with S. W. Johnson as director. The University of California next provided for a station at Berkeley, under the leadership of E. W. Hilgard. Other states followed, and by 1887 there were 18 stations.

The movement for a nationally supported system of experiment stations culminated in the Hatch Act of March 2, 1887. It authorized an annual appropriation of \$15,000 for a station connected with each of the agricultural colleges established under the Land-Grant College Act of 1862. This gave a marked impetus to the experiment stations, and states which had not previously provided them promptly took advantage of the act. In 1906 the fund was supplemented by the Adams act, designed especially to promote original scientific research on agricultural problems. On its maturity in 1911 this act doubled the annual federal support. As the nature of the Adams fund required separate accounting, the project plan for experimentation came to be adopted generally at the stations.

Federal aid was again enlarged in 1925 by the Purnell act, which authorized an increase of \$20,000 to each state the first year, with annual additions of \$10,000 until \$60,000 was reached. It also extended the research covered to include agricultural economics, home economics and rural sociology. By 1930 each state was receiving \$90,000 of federal funds and providing an average of about three times as much for station work. The Bankhead-Jones Act of 1935 provided substantial funds for federal regional laboratories which co-operate closely with the state stations.

The state stations established experimental fields and trial grounds, accommodations for experimental animals, insectariums, creameries and cheese factories, veterinary hospitals, and laboratories for chemical, botanical and bacteriological research. They publish bulletins, circulars and annual reports containing the results of their work. Popular articles are prepared for the press, while the more technical features of research are published in appropriate scientific journals.

The stations have close contact with the farming public and with extension workers. The results of experiments are thus spread broadcast, often being applicable far beyond the states

where the investigations were carried out.

The experiment stations in Alaska, Guam, Hawaii, Puerto Rico and the Virgin Islands are maintained under the federal department of agriculture with special congressional appropriations. Many of the states have branch stations dealing with special enterprises, such as citrus fruits, sugar, rice and tobacco or with the special problems of localities. There are also a number of special stations in the states without federal aid.

In addition, there are a number of privately supported centres like the Boyce Thompson Institute for Plant Research at Yonkers, N.Y., and the Marble laboratory at Canton, Pa., for the study of fruit storage.

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AGRICULTURE, CENSUS OF. A national census is a periodic stocktaking or inventory of the population, material resources, production and social conditions of a country and its people. The early censuses were simple counts of population by age and sex mostly for political and military uses. In a modern census schedule, scarcely any subject about which a group may have developed an interest or curiosity is too particularized to find a place—such items, for example, as the number of deaths from cancer, the number of restaurants selling cigarettes and tobacco, and the state of repair of plumbing equipment in buildings. Or to cite items from agriculture, immigrant farm operators in Canada according to period of residence and farming experience, pounds of grain fed to fish in artificial ponds in Czechoslovakia, amount of peat used for litter on farms in Finland, or number of farm dwellings with running water in the United States. Censuses of agriculture, however, concern themselves especially with the number and size of farms or holdings, the uses of the land, the acreage and production of crops, the numbers of livestock and volume of livestock production, quantities of wood cut for various purposes, and the numbers and classes of farm workers. At least these were the subjects included in the First World Agricultural census, taken in 1930.

Supplementary subjects, to be included by those countries that could afford them, were farm tenure, farm machinery, use of fertilizers, nursery and greenhouse establishments, and irrigation and drainage.

Purposes Served.—A distinction is usually made between an agricultural census, taken perhaps at intervals of ten years, and the customary annual reports of acreage of crops, numbers of livestock, and crop and livestock production, summarized in the *International Yearbook of Agricultural Statistics* by the International Institute of Agriculture (see AGRICULTURAL STATISTICS). A census is likely to be more comprehensive and to include items in which changes from one year to the next are not very significant, or for which a full record over the years is not needed. Data on food production, for example, must be complete for successive years if they are to answer important questions on the food supply. If only decennial census data were available, the production of the intervening years would need to be interpolated.

The distinction between a census and an annual report, however, became less clear as more items were included in the annual inquiries. For many of the remaining items, new sampling procedures were developed to provide reasonably accurate statis-

tics at much lower cost. Thus a 5% sample of farms may furnish the facts needed as to the increase in electrical installations on farms, or introduction of a new variety of cotton, or change in the method of hiring labour or leasing systems. Some countries, like the U.S.S.R., rely almost entirely on annual statistics. If information on a particular subject is needed at any time it may be added to the next annual enquiry. Some countries, like Great Britain, were collecting annual statistics long before their first agricultural census. Great Britain took her first agricultural census in 1908, and her third in 1932 in connection with the first world agricultural census. The United States took its first agricultural census in 1850. A few of its annual series were begun in 1860.

It appears, therefore, that a census of agriculture does not stand by itself. It is only one part of the large undertaking of keeping a running inventory of the agriculture of a country and recording and measuring the changes in its structure, organization and social conditions. A census takes a somewhat detached cross section every ten years or so; and an annual enquiry a more frequent but less inclusive cross section. Certain other types of change, such as in livestock production, in condition of crops and pastures, in market receipts and prices, and in stocks on farms and in warehouses, need reporting monthly or oftener. All three of these types of enquiries fit together to give the full record. Properly integrated, each also assists and strengthens the other. The census data become benchmarks against which the year-to-year changes are measured. Each new census provides a check on the accuracy of the annual estimates that have been projected forward from the last census. The annual reports similarly become benchmarks for the monthly reports. Data on market receipts provide checks on census data on production.

Since these three types of enquiries are so interrelated, it is important that they employ a common statistical language. This means using the same terminology, units, classification and area subdivisions. The data from any one of these sources need to be comparable with those from the other two. For example, the census should not assemble data on crop land sown and the annual enquiry report only crop land harvested. Hence, a country should either have only one statistical organization for assembling and compiling these three types of agricultural data, or it should give some unit of government the authority to co-ordinate the work of the separate organizations.

THE WORLD AGRICULTURAL CENSUS

Agricultural statistics need to be comparable among countries as well as within a country. This need and that for a more complete coverage of the agriculture of the world, led to the attempt, under the leadership of the International Institute of Agriculture, to obtain a world agricultural census in 1930. The general assembly of the institute adopted a resolution to this effect in 1924. By 1928, a standard form or schedule of questions had been developed and approved by the general assembly. Committees of statisticians and agricultural economists from the countries adhering to the institute met at Rome in 1925, 1926 and 1928 and helped plan this enquiry. The Rockefeller foundation assisted with a five-year grant. Leon M. Estabrook, previously in charge of the crop and livestock reporting service of the United States department of agriculture, directed the institute's part of the work. In 1926-28, he visited 61 countries in order to interest them in taking part in the proposed census of 1930-31 and to discuss with the statistical authorities in these countries the details of the task of taking the census. As a result, 63 countries, out of a possible total of 200, participated either by carrying out a complete census, or to use the exact language of the census report (Vol. I, p. 71) "by making special inquiries or by attempting to obtain and furnish the Institute with information, for the census year, more complete and exact than normally available." These 63 countries included more than half the area and population of the world, and if China and the U.S.S.R. were excluded, about two-thirds of the remaining area. The list of 63 countries included 23 in Europe, all of North America, 6 countries in Asia, 11 in Africa, 6 in Oceania, 5 in South America and 8 in Central

America.

The individual countries handled the tabulation and compilation of the data of the census returns and in most cases published the results in their own principal language. The International Institute of Agriculture undertook to prepare summaries of the census reports of the individual countries as they became available, and to publish these summaries in English and French. In 1939, 39 of these summaries were assembled in Vol. I to V as the *First World Agricultural Census*, together with "the standard form," a "methodological study" on the experience of taking this census, and "Notes on Tabulation of the Census Results" (in Vol. I).

In the meantime, preparations were made for the second world agricultural census to be taken in 1940-41. The bureau of statistics of the institute prepared a revised standard form, and this was reviewed by a group of statistical experts from different countries in Oct. 1936. The revised standard form resulting was then sent out to all the nations for criticism and suggestions. The replies received were summarized in a pamphlet, "The World Agricultural Census of 1940, Documentation for the Second Conference on Agricultural Statistics," published in 1937. The second conference was held in Dec. 1937, and the revised schedule was sent out in 1938. During World War II the staff of the institute summarized the census reports of the different countries as they became available. Part of them never became available because of the war.

The 1930 world census of agriculture made a special effort to collect useful data on the subject of labour employed in agriculture, because of the interest in this subject developed by the International Labour office. The 1940 census undertook to expand further this phase of the enquiry. The League of Nations also developed a strong interest in nutrition in the 1930s. Following a resolution introduced in 1935 by High Commissioner S. M. Bruce of Australia, a Mixed Committee on Nutrition of the League was appointed to consider the possibilities of relieving agriculture by getting its surpluses consumed by the world's underfed peoples. By 1938, national nutrition committees had been formed in 21 countries. This rapidly-growing interest in nutrition was recognized in the 1940 world agricultural census by an attempt to get a fuller reporting of all food production, and especially of the production of milk and other foods of high nutritive value. The resolutions of the United Nations Conference on Food and Agriculture held at Hot Springs, Va., in May 1943 called for still more emphasis on collecting the data needed for a world program designed to place "adequate food . . . within the reach of all men in all lands within the shortest possible time," and the program for the international Food and Agricultural organization calls for developing more complete and accurate statistical information, and devising more effective methods of obtaining it.

THE CONDUCT OF AN AGRICULTURAL CENSUS

Most persons who know about censuses at all think that there is only one way of conducting them—the way in which they are conducted in their own country. Actually the methods differ widely, usually for historical reasons. The original need for information determined the method which was followed after that. The original need may have been for a list of all the persons of age suitable for military duty, or for a listing of property for taxing purposes, or, as in the United States, for a count of the people in order to apportion them into voting districts.

Methods of Collecting Data.—The "Methodological study" Vol. I, p. 72, *The First World Agricultural Census* distinguishes between two major methods of collecting census data: making a record for each farm, and making estimates on the basis of data from existing sources or from samples. All but 17 of the 63 countries participating in the 1930 census used the first method. In 6 of these 17, France, Algeria, Peru, India, Japan and "probably El Salvador," the data were reported by communes or other administrative units. In making up the report for the commune, the local officials may have obtained some of the information directly from individual farmers, or may have depended in part on the annual data collected from individual farmers. The remaining 11 countries, all colonial, made approximate estimates by

combining the results of special surveys with pre-existing information.

The countries making a record for each individual farm may not have made an actual farm-to-farm canvass. Instead they may have filled in a schedule for each farm without visiting it by combining existing cadastral or other information for each farm with estimates of yields and crop acreages obtained from annual crop and livestock reports. Numbers of livestock for each farm may have been obtained in the same way or from tax records. Many countries making a farm-to-farm enumeration before 1930 had obtained data only on acreages of land and crops and numbers of livestock, and had compiled their production data by applying to these data average yields per acre or production per animal obtained from other sources. Most of these countries continued this practice in 1930, and the instructions for the 1940 census contain explicit directions for this as an alternative method of determining production.

The actual farm-to-farm enumeration may, in turn, be made in several ways. The method favoured by the International Institute of Agriculture is to have specially-trained enumerators obtain the information verbally; or to mail the schedule to the farmer to be filled in by him before the enumerator calls in person to collect it. In the latter case, the schedules need to be checked carefully before the enumerator leaves. In many countries, however, a local administrative official, or the rural police, distributes and assembles the schedules. This may result either in an incomplete census, or in one not very reliable because many schedules are completed in the office.

If special enumerators are employed, they need to be properly equipped and trained. In the United States and several other large countries, a new staff of enumerators is organized for each census; and under these circumstances very little of the training and experience gained in one census is carried over to the next. The best administrative setup is a regular staff which collects the annual as well as the periodic census data, and also helps with the monthly reports and the office work. This setup is easily arranged when all three types of agricultural statistics are collected by one organization.

Date of the Census.—The desire of the planners of the 1930 world census of agriculture was to obtain crop and production data for the calendar year 1929 in the northern hemisphere, and for the comparable year beginning July 1929 in the southern hemisphere; and to have a similar census taken each ten years thereafter. It was hoped that the different nations would shift the year of their enumeration to fit into this schedule, by 1940 if not for the first census, so that thenceforth the data would be comparable in time. Germany had taken an agricultural census for the crop year 1925 and waited until the crop year 1933 to take another. Sweden, Great Britain, Canada and four other countries were from one to three years late for similar reasons. The same difficulties arose in 1940. For example, Argentina and Chile had taken censuses in 1937 and were not able to repeat them.

The United States and a number of other countries take quinquennial as well as decennial censuses of agriculture. Great Britain made plans for this at the time of its census of 1908, but World War I interrupted the 1913 enumeration and the returns were never tabulated. The reason for shifting to a 5-year interval in the United States was that some of the annual estimates projected forward from the last census were proving to be seriously in error after seven or eight years.

The time of year for taking an agricultural census is also important. The best time for a census that includes production is after the principal crops are harvested and before the date when tenants and other operators customarily do their moving from farm to farm. This means November to January in the northern hemisphere. The countries which obtain only crop acreages and livestock numbers, however, are likely to prefer the summer months when livestock numbers are largest. The census officials of the United States asked that the date of enumeration be shifted from April to a winter month, but congress, after acceding to this request in 1920, refused to do so again for any decennial census—too much of the population gets counted in Florida or California in the wintertime.

What Farms to Include.—No problem in census taking has caused more difficulty or dispute than that of what types and sizes of rural establishments or holdings to consider as farms. Those which have looked at the problem from the point of view of classifying the

population according to its major source of income have wanted to set a relatively high requirement. Those which have been concerned over obtaining a full inventory of all agricultural production have wanted a low minimum limit. Most countries have a large number of very small farms, or of families producing small amounts of agricultural products for use of the family or for sale, or for both, and a slight change in the definition of a farm will change the count greatly. Part of these families have another principal occupation or source of income. Others have only very small incomes which are nearly all in the form of food and other products consumed directly by the family. Although the United States kept the same definition of a farm after 1910, changes in the instructions to the enumerators in 1930, 1935 and 1940 caused the number of farms to fall from 6,448,000 to 6,289,000 between 1920 and 1930, to rise to 6,812,000 in 1935, and to fall to 6,100,000 in 1940. In one eastern seaboard state, the number of farms reported almost doubled from 1930 to 1935.

The standard definition of a farm in the first world agricultural census was as follows:

"A farm, for census purposes, is all the land used wholly or partly for agricultural or live stock production, that is operated, directed, or managed by one person, alone or with the assistance of others, without regard to ownership, title, size or location, and may be in one or more separate pieces if they are in the same neighbourhood and are known and operated as a single holding or property. The person who operates or directs the farm may be owner, tenant, hired manager, or one who holds or controls the land and its products under a special form of tenure. . . . The farm may be known as a lot, piece, or parcel of land, garden, orchard, estate, ranch, plantation, rural establishment, proprietorship, or other name, but in any case must be operated, directed or managed by one person. Woodland and forest land that forms a part of the farm or holding and is controlled, directed or managed by the farm operator will also be reported, as well as the plots of ground and buildings occupied and utilized by the laborers employed and living on the farm."

Thus no common lower limit was placed on size. The Netherlands and Austria, at one extreme, set the limit at one-eighth of an acre; the United States, at the other extreme, at three acres, or less if the value of the product was \$250. In Great Britain and the empire countries, the limit was commonly one acre. In Northern Ireland, however, it was one-fourth of an acre, as also in Eire; and in the Union of South Africa, one morgen (2.1 ac.). The other continental European countries set limits ranging from a quarter of a hectare (Switzerland, Finland), to a half-hectare (Germany and Belgium), to one hectare in Latvia, Estonia and Lithuania. (Hectare=2.47 ac.) These Baltic countries, however, had a special schedule for establishments of less than a hectare.

Qualitative differences also enter into the problem of what constitutes a farm. In some countries, kitchen gardens and backyard poultry flocks on land adjoining the family dwelling are not included as farms. In Switzerland the distinction is whether or not any of the product is sold. In New Zealand such production is excluded if it is within borough boundaries; in Italy, if it is in cities of 15,000 or more inhabitants. Practice also varies with respect to livestock not on farms.

Much confusion also arose in the first census over considering separate units under one landlord as all one farm, or each unit as a farm. In France, the practice was to call them one farm. The general rule which the census makers would like to apply is that any land under a single management should be considered a farm. But sharecroppers contribute only part of the management, in many situations less than half of it. Italy and Yugoslavia met this problem by having a supplementary schedule for central managements. The United States used a supplementary "plantation" schedule in its 1940 enumeration. The 1940 world agriculture census tried to meet this difficulty in part by using the terminology "farm or holding" in place of "farm." But in some countries, any parcel of land is called a holding whether or not it is independently operated. Also in the countries of central Europe, where much land is operated under managers, one overseer may look after several holdings.

It follows from the foregoing that the census totals on number of farms and farm operators for the various countries are far from being comparable; yet these are among the most significant measures of agricultural change. This difficulty will not be overcome until the enumerators are required to return a schedule for all agricultural production down to a very low minimum, and the final classifying is done in the office subsequently. One cannot expect enumerators to apply uniformly an involved census definition like that for a farm or holding.

Tabulation of the Returns.—Before tabulation can begin, the returned census schedules must be edited. This involves checking the figures on each schedule for internal consistency and comparability with other returns, and perhaps a good deal of filling in of gaps in the schedules. Practice varies as to the extent of the latter. If the gaps are not filled in, either the farms with partial returns must be omitted or the published tables must report for each item the number of farms with no reports, letting the user of the tables do his own estimating if he wishes. Most statistical offices follow a combination of all three of these procedures, the choice in each case depending upon which introduces the least error. For example, the debt status of farms with

no report on mortgage debt cannot safely be estimated, whereas production frequently can.

The comparability of the census data of different countries may be improved greatly if a uniform classification of farms according to size can be applied in the tabulation process; and similarly for land according to use, livestock according to age, farm labour according to age and employment, etc. The planners of the two world agricultural censuses gave much attention to developing such classifications, and the data published in Vol. II to V show the effects of this.

SUBJECTS OF CENSUS ENQUIRY

The conduct of an agricultural census, even in any one country, in such a way as to obtain data that are comparable from one enumeration to the next and from one region or province to another is an unusually difficult undertaking. Adding comparability by countries makes the task seem imponderable. The world was not made to fit the requirements of simple and accurate census-taking. Rather, a census must adapt its methods to the infinite variety and complexity that man has introduced into a physical environment already diverse enough in itself. In the sections following, these adaptations will be considered according to the main subjects included in the two world agricultural censuses of 1930 and 1940.

Farm Labour.—In spite of the growing interest in farm labour, only questions relating to "permanently employed" workers were considered safe to include generally in the 1930 census. The questions included age over or under 15, sex, and whether or not members of the farm family. Even then, only 35 of the 63 countries included these questions in their enquiries. Similar questions as to temporarily employed workers on the date of the census were included under the supplementary questions; also questions as to number of days worked, wages, housing and hours worked per day. Only 14 countries, however, included any of these questions in their schedules. Some of the 35 countries attempted to classify farm labour in other ways than suggested in the standard form, using such designations as administrative staff, overseers, foremen, farm servants, artisans, shepherds, cowmen, ploughmen and vine workers. The farm labour part of the standard form was discussed at length in planning the 1940 census. The principal change was to define the term "permanently employed" to mean employed during a crop season only, or regularly over the year. In both censuses, the countries were also asked to report the particular employment conditions on the date of the census, and something about number employed at other seasons.

Land Use.—Since land is the basis of all agriculture, the most important classification in any agricultural census is that of its lands by major uses. A major problem is that of classifying lands that have mixed use as pasture and woodland. The United States census uses the designation "woodland pasture" for such lands. The world census calls for classifying it either as woodland or as permanent pasture or meadow—according to which is the more important object. This is a definite advantage in case one wishes to work out ratios of farm population, workers or animal units to agricultural land; or analogous ratios for woodland and forest.

A similar problem is that of classifying land once tilled but in pasture or meadow for some years past. If it is to continue in grass, it should no longer be called arable. In England and Wales at one period, much of such land was kept in the arable class for a decade or more after it had ceased to rotate from tilled crop to grass. The standard form calls for classifying such land as arable for only four years after its last ploughing, and as permanent meadow or pasture after it has been in grass five years. This is too short a period for some of the rotations in which alfalfa and similar forage crops are grown; but apparently the world census planners assume that land in grass for five years or more in a rotation is in hay most of the time, and hence is more properly classed as meadow than as arable. The term arable, it must be kept in mind, means ploughed or tilled, not tillable or cultivable.

In intensively-farmed countries like those of southern Europe, one finds much intermingling also of tilled crops and fruit or nut trees or bushes—"two-story agriculture." In this case, the world census asked to have the division of the area estimated, and if this was not possible, that it be classified according to its chief object.

The remaining land-use classes in the world census are "productive marshlands, heathlands and other productive but uncultivated lands," and "unproductive lands." The first of these seems necessary to take care of a good deal of land that was never "improved," but furnishes grazing, wild hay, berries and other wild plants and fruits.

Seventeen countries adopted the classification about as outlined, and 21 adopted it with modifications. The principal variations were those found in the censuses of the United Kingdom, Denmark, Norway and India, in which "cultivated land," or "land in crops and grass" were not separated into arable, permanent meadow and grass, and trees and shrubs; and that of the United States and Australia, in which cropland and pasture are the two sub-classes, and trees and shrubs are included in cropland.

Crops.—The classification of crops outlined for the 1930 census was as follows: cereals harvested for grain, legumes for grain, tuber and root crops for food or forage, cultivated hay and forage crops (that is, grown in a rotation system), crops for industrial use, vege-

tables, crops grown for seed, crops sown but not harvested in the year of the census, fallow land, permanent meadow and grass, vineyards, oliveyards, orchard fruits and nuts, small fruits, and miscellaneous plantations (including coffee, tea, cacao, pepper, chinchona, rubber, bamboo, sago palms, etc.). Under these heads, more than 100 different species of plants were listed, and others were provided for under such headings as "other vegetables," "other fruits and nuts." A major problem is introduced by the growing of two or more crops in the same land in one year, or the planting of two crops on the same land at the same time. The instructions issued were, in the first case, to enter the areas of the later crops in brackets on the same line, and in the second, to divide the acreage if possible, and, if not, to list the combinations on separate lines.

Needless to state, the various countries introduced a great many variations on their schedules. Most of them, however, were details under the headings named. For example, 36 vegetables were listed separately in one country or another, in addition to the 9 in the standard form, and 8 tuber or root crops in addition to the 9 in the standard form.

Livestock.—Nine species of livestock, including bees, were listed in the general form, and 10 more in the supplementary questions (including camels, llamas, reindeer, elephants, buffaloes, ostriches, foxes, skunks and rabbits). The principal problem was that of age classification. The general system adopted was that of one class to include animals born recently enough so that they measure the reproduction of the year past, or the last gestation period—like calves under 1 year, and pigs under 6 months; another class for female breeding stock; and another for male breeding stock. For poultry, only total numbers were asked for. Most of the countries adopted this system of classification, but some of them introduced more detail. For example, 26 of them, including the United Kingdom and the United States, listed cattle 1 to 2 years separately, and 16 of them listed young chickens separately. It was apparent that even with these age classifications, the difficulty introduced by taking the census at different times of the year in the different countries was met only in part. Supplementary estimates of maximum and minimum would help, but were difficult to obtain.

Production.—The standard form in both world censuses asked for quantity produced as well as acres of crops and livestock numbers. Half of the purposes which agricultural statistics serve require data on production. Nevertheless, only 31 of the 46 countries reported production of annual crops, and fewer reported production of orchard fruits. Only 29 reported production of milk, butter and cheese, and 21 the production of eggs. These results followed even though the alternative procedure was allowed if necessary of estimating production by multiplying acres and numbers of productive livestock by yields per acre and per animal. Clearly the international Food and Agricultural organization has a large task ahead before it will be able to measure the food supply and nutrition levels of large sectors of the world's population.

Other Subjects.—Of the remaining subjects covered in the supplementary questions, farm machinery called forth the largest response. Not only did more than 30 countries collect data on the six types of machines named in the schedule, but many of them listed additional types or subtypes—for example, nine kinds of power machines. Only a limited number supplied data on the acreage of land drained or irrigated, but most of these included additional details. Most of the countries limited their census of woodland to land within agricultural holdings. Nine, however, all but one in Europe, also included independent forest holdings. Also eight countries followed the standard form in asking for a report on woods cut every few years, usually referred to as coppice in the enquiries. Only 15 asked for a report on the quantity of wood cut for fuel, pulp and other purposes. Finally, five European countries collected data on the total area of ponds stocked with fish and fish production.

Tenure systems are exceedingly varied, and the attempt in the supplementary questions to fit all farm land into the categories of owner-operated, cash-rented, share-rented and managed was not very successful, only 19 following the schedule outlined.

It would be a serious error to adjudge the scope of agricultural censuses by the subjects considered wise to include in world censuses. Other important subjects included in some enquiries are farm buildings and transport and communication; farm population; age, nationality and race of the farm operator; value of farm property, value of products raised or sold, farm expenses, farm income, farm debt and membership in farm co-operatives. The United States, France and some of the British dominions took the lead in expanding the census to include economic and other social information.

It would also be a serious mistake to judge the adequacy of world statistics on agriculture by the contributions of the 63 countries to the first world census. First of all, several countries, like the U.S.S.R., had other methods for keeping a running inventory of agriculture. Second, a considerable list of countries had taken censuses of a sort one time or another, but could not arrange to take one in 1930. Finally, most countries have official statistics or records that furnish a rough measure of agricultural developments.

Most agricultural censuses begin with a simple counting of farms, livestock and acres in different crops. A majority of the censuses of agriculture by the time of World War II were still in this counting

stage. While still in this stage, however, the number of items can be expanded considerably to include land use, workers, farm machinery, and more details as to crops and livestock. The second stage of development is the inclusion of data on production. The third step adds values and prices to the crop and livestock production, and to farm equipment and livestock. If farm expenditures are then added, it becomes possible to estimate the gross value of agricultural production, and gross and net farm income, which can be included in estimates of the national income. Only a limited number of countries had reached this stage by 1944.

(For agricultural statistics of various countries, see *Individual articles* on those countries; likewise for states, provinces and other geographical divisions; see also *AGRICULTURAL STATISTICS*.) (J. D. BL.)

AGRICULTURE, CHAMBERS OF. The Central Chamber of Agriculture in Great Britain was founded in 1866 simultaneously with the formation of local chambers in the country. These were combined into one association, known as the Central and Associated Chambers of Agriculture. The objects of the Association are to promote the interests of agriculture, and with that view to watch over all measures affecting agriculture both in and out of parliament, and to take such action thereon as may seem desirable in its interests. The scope of the association has widened, and it now comprises not only chambers and farmers' clubs, but agricultural societies, unions, federations, dairy associations and other agricultural institutions. Its aim is to form a common centre for all the different sections and groups in the industry. The work of the chamber is governed by a council of twenty-four members chosen by the subscribing members of the central chamber, and about 70 deputies appointed annually by the various federated bodies.

AGRICULTURE, DEPARTMENT OF: see GOVERNMENT DEPARTMENTS.

AGRICULTURE, ELECTRICITY IN: see RURAL ELECTRIFICATION.

AGRICULTURE, INTERNATIONAL INSTITUTE OF: see INTERNATIONAL INSTITUTE OF AGRICULTURE.

AGRICULTURE, PRIMITIVE. Agriculture (cultivation or tillage of the ground for the production of plants for food) is the basis of civilization, and primitive agriculture marks the transition from the lowest cultural stage, commonly called savagery. When and where, how and why were the first steps taken? No simple answer can be given. As to the date and place, a few hints are given by archaeology, but where primitive agriculture is now established there is rarely even a tradition of its origin. "God Almighty first planted a garden" is the general belief, God being represented by Osiris in Egypt, King Kintu in Uganda, Sidi or Soidi in Torres Strait, Ofanu in Tahiti, Tupan in Brazil, and by all the other local culture-heroes who brought the good gifts to men. As to the how and the why, information must be sought in areas where beginnings are being made.

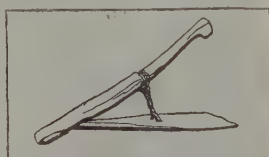
There is as yet no cultivation of the soil or raising of crops in the Arctic regions, in the semi-desert regions of north and south Africa and Arabia, the high plateaux of Tibet and Mongolia, or the whole of central Australia. It is unknown also in certain jungle areas inhabited by groups of pygmy peoples, such as the Negrilloes of the Congo, the Andamanese, the Semang of the Malay peninsula, and there is no record of it among the extinct Tasmanians.

The first steps have been noted in various parts of the world. In Western Australia a species of flag was cultivated to the extent of burning down the crop at the end of the season to improve the next crop. Also, when digging up yams, the natives replaced the heads in the holes. Purslane (*Portulaca*) was also encouraged if not artificially cultivated. The Besisi of the Malay peninsula used to carry fruit they were eating to fresh spots so that the seeds might spread over the country. In Arizona a company of Cocopa, Mohave or Pima women, safely guarded by a number of men, set forth to a rich and favourable spot on the side of a cañon. Each woman has a little bag of gourd seed, and she plants these, one by

one, in rich crannies or crevices where the roots can find sustenance, the sun may shine in, and the fruit may later swing down, as from a trellis. The planters go home and take no further notice of their vines until they return in the autumn to collect the gourds. In manioc areas, the natural means of procuring food is still by hunting. Cassava forms a useful alternative, and when game is scarce or hunting unsuccessful, manioc culture increases in importance, yams, beans, peas, pumpkins and maize being added to the crops, while if hunting fails altogether, the group perforce turns to agriculture. Examples are common in the Congo region. Similarly compulsion turns pastors into agriculturalists. In Africa the women have no share in cattle tending and are often mainly occupied in cultivating the crops of maize and vegetables. Should war or disease cause the herds to dwindle, or encroachments diminish the extent of the pasturage, the necessity for agriculture is increased until it absorbs the whole community. Sometimes the stimulus is given by political pressure, as in the case of the Bashkir Tatars, whose pasture lands were encroached upon by Russians to the north and west, and by the Ural Cossacks to the east, so that they could no longer support flocks and herds in sufficient numbers. Sometimes, however, although the first steps are taken, progress goes no farther, as in the wild rice districts of North America in the neighbourhood of the Great Lakes. Most of the Indians who had access to the rice fields collected the rice, ate it at every meal until it was finished, and then turned to other sources of food. There was a common belief that if any seed were sown no more would ever grow wild, and while food was plentiful and space and game were abundant, no further steps were taken.

Assartage.—In tropical or semi-tropical countries the common method of agriculture is assartage or essartage (from Lat. *exsartare*, to grub up trees and bushes from forest land to make it arable). For example, in South America a tract of specially productive forest land is chosen as a site for a maize field, smaller trees and undergrowth are cut down at the end of the rainy season, except those of greater size or of very hard wood, and the fallen masses, dried by sun and air for a few weeks, are then fired. On this charred surface, among half-burnt branches and blackened trunks, the maize is planted in holes a few feet apart, and when it reaches the surface the Indian clears and stirs the ground with the hoe. Immediately after harvest the ground is prepared for a fresh crop, which, however, yields much less, and the clearing is then abandoned for several years. It soon becomes overgrown with weeds and undergrowth, and after a time, if no virgin land can be had, these will be burnt down and the land replanted as before; but the crops are poor, the soil is exhausted, the ashes of the undergrowth have not sufficient fertilizing value, and the clearing is finally abandoned. The burning of the felled trees enriches the land, and the same clearing can be used two, three or more times, but is less and less productive each season, so that new land is prepared and the cropped piece left fallow. The system is practised wherever space permits.

In Torres Strait each family has its patch of garden land marked out within the tribal area by definite boundaries. The limit may be marked by standing trees but more commonly the boundary is a ridge of earth, formed by the weeds and refuse thrown on the edge in the process of clearing the land. Every year a man clears a new piece of land and lets another portion lie fallow. The men cut down the larger trees, formerly with shell axes, while the women attack the undergrowth. There is no regular rotation of crops; usually the same plants (yams, bananas, sweet potatoes or sugar-cane) are planted in the same patch; only, as the crops deteriorate after one, two or three years, the land is allowed to lie fallow until the undergrowth is four or five years old, when it is cleared again. There are special names for gardens of successive ages. A newly cleared patch is *kerkar gedub* (new garden), next year it is *keas gedub*, and after two years *gazag gedub*. *Keas* and *gazag* gardens are not replanted, though sugar-cane and bananas continue to bear. (Torres Strait Reports, iv, 145-151.) Extensive agriculture (clearing a fresh patch every season) may go on as long as there is sufficient land, either virgin land still uncleared or overgrown fallow worth clearing; but where, owing to limitations of land or increase of population or



AN EGYPTIAN HOE FOUND AT THEBES USED IN THE NILE VALLEY ABOUT 2,000 B.C.

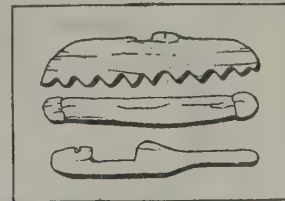
other economic influences, more crops or better crops are required and the exhausted land cannot restore itself, artificial restoration must be applied. Extensive agriculture becomes intensive.

Agriculture is everywhere associated with magic and religious ceremonies to ensure fertility, but artificial fertilization of a more practical nature is not unknown to primitive gardeners. Mariner describes it in Tonga in 1827; powdered pumice was used in the Gilbert isles; human manure was a marketable commodity in Mexico, as in China. In America artificial manuring was found from Nova Scotia to Chile. Fish was commonly planted in the maize hills with the seed and guano was carefully collected. In Peru extensive cultivation was impossible from lack of space, and crops were restricted to the pockets (*bolson*) of rich soil, formed from detritus washed down by the mountain torrents, enriched with mineral deposits from volcanic rocks. These natural plots were enlarged by irrigation streams which were also fertilizing. The guano beds of Peru were highly valued; they were the property of the different provinces, and the breeding places of the birds were protected by law.

Irrigation.—Leading an artificial stream on to a patch of land, to provide water for a crop varies from the hollowed tree-trunk which the Fijian lays down to supply his taro bed, to the imposing engineering works of the primitive agriculturalists of Peru, or the miles of aqueducts of ancient Ceylon. The sources of water may be natural rivers or lakes, artificial canals, reservoirs or underground supplies, and there are many contrivances for directing it over the land to be watered. Water from a higher level is led off in narrow mud-banked channels which can be stopped or diverted merely by blocking up or breaking down a channel wall here and there. If the water has to be raised, a man may sit by the side of a stream with a half gourd or coco-nut (nowadays often a kerosene tin) fixed to a stick, ladling out the water and pouring it on to his crop. In deep water a bucket is lowered by means of a rope and drawn up to the surface. The *shaduf*, characteristic of Egypt, and widely distributed from West Africa to the East Indies, consists of a forked pole stuck in the ground, with a long pole balancing on the fork, its heavier end on the bank, and the lighter end, with a bucket attached, over the water. The bucket is lowered into the water, and, when full, the heavy end of the pole helps to raise it. Water can thus be raised 10 or 15 ft., and a succession of *shadufs* can raise it to any height required. When there is running water, a water-wheel with buckets on an endless chain is common in the Old World, or the wheel may be turned by animals or men. Where the underground supply of water is very deep, as in parts of India or in the Sahara, a pit is dug, walled in with masonry, and a skin bag lowered over a pulley by long ropes to a depth of 100 or 200 ft. The ends of the ropes are attached to bullocks, mules, donkeys, camels, women or slaves, who walk down a slope equal to the depth of the wall. Neither the *shaduf*, the water-wheel or the pulley was used in the New World, but there are extensive irrigation works in the drier Pueblo region, especially Arizona, where 150 miles of ancient irrigation ditches may be traced. In Mexico and Peru extensive engineering works prove the care given to irrigation. Channels were carried round the sides of mountains and even tunneled through them; so that the waters of the higher valleys where the supply was abundant were made available for the cultivation of others where it was deficient; and these channels were made to irrigate not only the cultivated fields but the llama pastures on the mountain sides.

Terrace Cultivation.—In clearing sloping land for planting, trees are felled, stones are collected or undergrowth and weeds heaped up all along the edges of the space to be planted, and ridges and terraces are thus formed. The discovery of their value for preserving moisture and preventing erosion on slopes would easily lead to the artificial terracing so widely distributed throughout the Old and New Worlds. Terrace cultivation is imposed on agriculture by political, geographical, climatic or economic influences. An agricultural group is by its nature exposed to attacks which, by its nature, it is unable to resist except by retreat to a naturally fortified or easily defended position; and this is provided by the hills, where every patch must be carefully preserved and augmented. Artificial banks are therefore raised to prevent

further erosion, and, if necessary, loads of earth are retrieved from the valleys. Such is the precarious agriculture of the Man Tze, or "untameable worms," as the aboriginal inhabitants are called by their Mongol conquerors who forced them to retreat into the mountain fastnesses of the Yangtse valley, where, at a height of about 10,000 ft. above sea-level, they perch their villages on the steep cliffs. The back of the house is burrowed out of the rock face; the front is supported on a platform, resting on beams; the approach is by steps made of bolts driven into the rock, and small children are tethered to the door-posts to prevent them from falling over the edge. Here in little patches between the rocks every inch of soil is carefully tilled and crops are raised though the only



BY COURTESY OF THE METROPOLITAN MUSEUM OF ART
A PRIMITIVE EGYPTIAN RAKE OF THE XXth DYNASTY FOUND AT LISHT

access to the terrace may be by a rope (I. B. Bishop, *The Yangtse Valley and Beyond*, 1900). Both archaeology and history show evidence of early terracing round the Mediterranean and in Britain during the Bronze Age.

In hilly and mountainous districts where the rainfall is insufficient or irregular, terrace cultivation and irrigation go hand in hand. The water from a mountain stream is easily directed down the slope, and the embankments of the terraces preserve the moisture, so this method is universal on the drier slopes throughout the world. The Arabs in Yemen give the best example. Here the mountains are terraced from their base up to sometimes as high as 6,000 ft., with terrace walls from 5 ft. to 15 ft. high. Reservoirs filled in the two rainy seasons supply the streams for the irrigation channels. When, in the 10th century, the Arabs reached Spain, they converted every mountain slope into a succession of green terraces. In the mountain areas of India, in Ceylon, in Tibet and in China, terrace cultivation can be seen on a large scale. The Chinese, farmers of 40 centuries, carry terracing to a fine art. In densely populated neighbourhoods every inch of soil is of value; it is collected in baskets in the valleys, carried up the barren hill slopes, and embanked, forming astonishingly productive gardens. Examples are rare in the New World, but in Peru the same necessities were met by the same device, and hundreds of terraces one above the other rose from the valleys to the utmost cultivable limit. These were extended year by year by communal labour, and produced the finest crops of potatoes and maize, eliciting the astonished admiration of Cortes: "There was not a span that was not cultivated." Increase of population and of civilized wants, with the growing importance of food-crops or drink-crops, lead to the intensive cultivation seen in the mountain zone of Europe; in Switzerland, for example, or the Moselle and Rhine valleys, in the Vosges and Black Forest, in the Suabian Jura, in Italy, up the slopes of the Apennines or the Ligurian Alps, and in the "desperate agriculture" of Teneriffe, where camels laden with earth bring soil for the gardens almost daily into the town of Santa Cruz.

Implements.—The primitive implement is everywhere the digging stick, usually merely a strong stick, with one end pointed or flattened (a rudimentary spade) and often hardened in the fire. This is used for digging up roots by people who do not cultivate the soil, such as the Australians or the Bushmen of South Africa. The Bushmen weight their digging sticks with a heavy perforated stone whorl which acts as a lever. The digging stick or *ō* in use in Tahiti nearly a century ago was originally a stick sharpened at the point and hardened by charring at the end; but when iron was obtainable, a narrow sharp piece like a chisel was fixed at the end, and as much of the ground was stony, this was found very convenient. No use was made of the foot in thrusting the spade into the soil, but the digger assumed a crouching attitude, piercing the ground and breaking up the earth by the strength of hands and arms (Ellis, *Polynesian Researches*, p. 137-138). In Fiji the grass, reeds and undergrowth were broken down by a sharp-edged club. The digging sticks (poles with one end flattened) are used by three or four men encircling a large clod which they lever up. The women, fol-

lowing on their knees, pulverize this with their hands. A hoe, made of turtle shell or an oyster valve, was used for weeding. A knife has now replaced the club, but as a spade is painful to bare feet, the digging stick holds its place, though its power is now increased by an iron blade. In New Zealand the Maori lashed on a foot-piece at right angles to the digging stick; in Peru a foot-rest is bound on with leathern thongs, and, higher up, another rest is attached in the same way; this is for the left hand, which assists the foot in applying the weight of the body to the thrust. Similar types are found from New Mexico to Chile. The *caschrom*, still used in the stony patches of the Shetlands and the Hebrides, is a larger and more elaborate digging stick, with its end shod in iron and a foot-rest attached. The hoe is really a pick, with the digging end flattened. The simplest form is a piece of wood, with a natural angle, usually part of the trunk and a projecting branch, or two pieces of wood fastened together. The former is illustrated in Europe in the Swedish "back" and the latter was characteristic of ancient Egypt. In North America a bent piece of wood, the shoulder blade of elk or bison, or a piece of tortoise shell is fastened to a handle, but the hoe was rare in America except in the eastern maize area. African hoes are of iron, often set at an acute angle to the shaft, this and the shortness of the handle necessitating a crouching position when hoeing. The size and shape of hoes in Nigeria reflect the variation of soil, a gradation being traced from the sandy soils of the north to the heavier land of the south. There is little doubt that women were the earliest agriculturists. Even when the harder labour of clearing the ground is done by men, planting, sowing, tending and collecting are women's work. "When the women plant maize," said the Indians, "the stalk produces two or three ears. Why? Because women know how to produce children. They only know how to plant corn to ensure its germinating. Then let them plant it. They know more than we do." (Payne, *History of the New World*, ii, 7.) The fact that the cereal deities of the old and new worlds were usually female strengthens the view that the cultivation of plants is one of women's contributions to civilization.

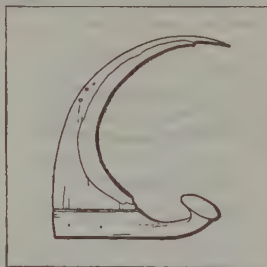
BIBLIOGRAPHY.—See E. J. Payne, *History of the New World Called America* (1892); O. T. Mason, *The Origins of Invention* (1895); Harold Peake, *The Origins of Agriculture* (1928); E. E. Edwards and W. D. Rasmussen, "A Bibliography on the Agriculture of the American Indians," U.S. Department of Agriculture, *Misc. Pub.* 447 (1942). (A. H. Q.)

AGRICULTURE, TROPICAL: see TROPICAL AGRICULTURE.

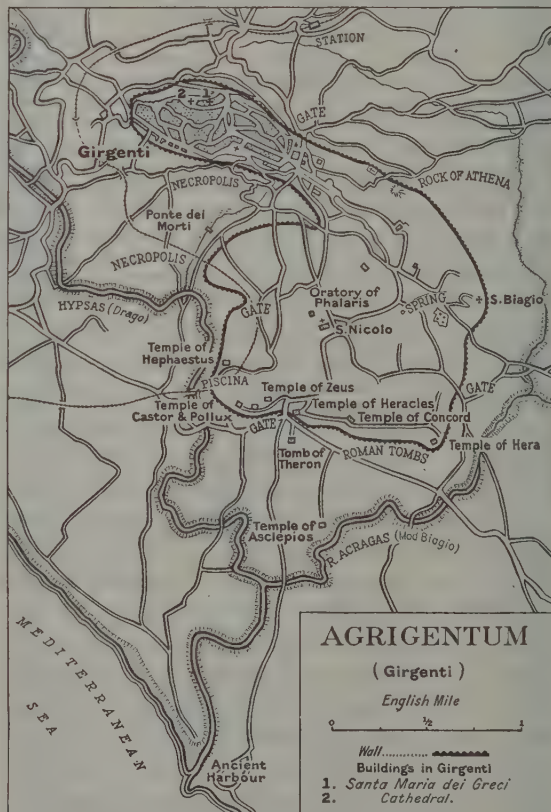
AGRI DECUMATES, "tithe lands" given by the Romans to Gallic settlers, and also to Roman veterans on the payment of a rent of a tenth (*decuma*) of the produce, on the east of the Rhine. (See LIMES GERMANICUS.)

AGRIGENTUM (Gr. Ἀκράγας, mod. AGRIGENTO), ancient city, south coast of Sicily, 2½ m. from the sea. Founded by Greek colonists from Gela as late as 582 B.C., its favourable site for cultivation and trade with Carthage made it second only to Syracuse. Pindar calls it καλλίστα βροτεῶν πόλιων (fairest of mortal cities). Ruled at first by tyrants, in 472 a democracy was established. In the struggle between Syracuse and Athens (415–413) the city remained neutral. Its prosperity continued to increase (its population is given at over 200,000) until in 405 B.C. it was captured and plundered by the Carthaginians, a blow from which it never entirely recovered. It was colonized by Timoleon in 338 B.C. with settlers from Velia in Lucania, and in the time of the tyrant Phintias (289–279) it had regained some of its power. In the first Punic War, however, it was sacked by the Romans (261) and the Carthaginians (255), and finally in the

second Punic War by the Romans (210). Still in the Roman period, it exported agricultural products, textile fabrics and sulphur. In the local museum are tiles used for stamping cakes of sulphur, which show that the mines, at any rate from the 3rd century A.D., were imperial property leased to contractors: The site is unusual and beautiful with a lofty ridge with two summits to the north. On the western summit is the modern town (985 ft.), the eastern summit slightly higher, bears the name of Rock of Athena, owing to its identification by some scholars with the acropolis of Acragas as described by Polybius, who places upon it the temple of Zeus Atabyrius (said to have been erected by the half-mythical Phalaris) and that of Athena. The available space about 70 x 20 yds. on the eastern summit is, however, too small. In the modern town, on the other hand, the remains of one temple are to be seen in the church of Sta. Maria dei Greci, while the other is generally supposed to have occupied the site of the cathedral. On the north both summits are defended by cliffs; on the south the ground slopes away somewhat abruptly from the eastern summit towards the plateau on which the town stood, while the western summit is separated from this plateau by a valley traversed by a branch of the Hypsas (mod. *Drago*), the deep ravine of which forms the western boundary and defence of the city. On the east is the valley of the Acragas (Fiume S. Biagio). The church of S. Biagio, above it, is built into the temple of Demeter which was preceded by a sanctuary in the cliffs. The Acragas defends the approach from the east and the



BY COURTESY OF THE METROPOLITAN MUSEUM OF ART
A STONE SICKLE OF THE TYPE USED IN EGYPT 4,000 YEARS AGO RECONSTRUCTED FROM FRAGMENTS DISCOVERED AT THEBES



deeper Hypsas that from the south-west. They unite south of the town and flow out in the small abandoned harbour. A row of important Doric temples crowns the southern slopes; they are built of the local porous stone, which is of a warm red brown colour, full of fossil shells and easily corroded when exposed to the air. Of all these temples the oldest is probably that of Heracles (eight columns of which have recently been re-erected)

DIMENSIONS OF TEMPLES AT AGRIGENTUM

	Demeter.	Hera Lacinia (so called).	Con- cordia (so called).	Heracles.	Zeus.	Castor and Pollux (so called).	Unnamed near Castor and Pollux.	Hephaes- tus (so called).	Asclepius.	Athena (so called).
Length excluding steps*	90	125	129 $\frac{1}{4}$	220	361	..	..	..	..	..
Breadth	43 $\frac{1}{2}$	55 $\frac{1}{2}$	55 $\frac{1}{2}$	85	173 $\frac{1}{2}$	..	67 $\frac{1}{4}$	51 $\frac{1}{2}$	30 $\frac{1}{2}$	45
Length of cella	65	93	96 $\frac{1}{4}$	156	332	91	..	..	..	..
Breadth of cella	43 $\frac{1}{2}$	32 $\frac{1}{2}$	31 $\frac{1}{2}$	45 $\frac{3}{4}$	144 $\frac{1}{2}$	33	..	..	..	..
Height of columns with capitals	..	21	22	33	62 $\frac{1}{2}$?	19 $\frac{1}{2}$	..	..	..	..
Diameter of columns at bottom	..	4 $\frac{1}{2}$	4 $\frac{1}{2}$	6 $\frac{1}{2}$	14	4	..	5	3 $\frac{1}{2}$	4 $\frac{3}{4}$
Original number of columns	..	34	34	38	38	34	..	..	..	..
Class	In antis.	Peripteros hexastylus.	Peripteros hexastylus.	Peripteros hexastylus.	Pseudo- peripteros hepta- stylus.	Peripteros hexastylus.	..	Peripteros hexastylus.	Prostylos pseudo- peripteros.	Peripteros
Approximate date	500 B.C.	460 B.C.	440 B.C.	510 B.C.	450 B.C.	338-210 B.C.	..	After 338 B.C.	Before 210 B.C.	488-472 B.C.

*Dimensions in English feet.

while the best preserved are those wrongly attributed to Hera and Concordia, which are very similar in dimensions; the latter, indeed, lacks nothing but its roof, owing its preservation to its conversion into the cathedral in 597 by Gregory II., bishop of Girgenti. These temples are among the finest in existence. In front of the former, as in front of those of Heracles and Zeus, stood a huge altar for burnt offerings, as long as the façade of the temple itself. The *cella* of the temple of Heracles was modified in Roman times, and a statue of Asclepius seems to show change of cult.

In the colossal temple of Zeus the huge Atlantes (figures of Atlas), 25ft. in height, are noticeable. They seem to have stood in the inter-columniations half-way up the outside wall and to have supported the epistyle. The collapse both of this temple and of that of Heracles must be attributed to an earthquake; many fallen blocks of the former were removed in 1756 for the construction of the harbour of Porto Empedocle. The four columns

west of the city, with drains in its sides; the bottom is now an orange garden.

The wall line can be traced, but actual remains are small except in the valley below the temple of Demeter (S. Biagio). East and west ravines gave protection, so a massive wall was unnecessary, while near the south-east angle a breastwork was formed by the excavation of the natural rock, in later times honeycombed with tombs. Close to this temple on the west is the site of the gate known in later times as the *Porta Aurea*, through which the modern road passes.

Tombs of the Greek period have been found mainly on the west of the town, outside the probable line of the walls, between the Hypsas and a small tributary, the latter having been spanned by a bridge, now called *Ponte dei Morti*, of which one massive pier, 45ft. in width, still exists. Just inside the south wall is a Christian catacomb, and outside it a tomb in two storeys, a mixture of Doric and Ionic architecture, belonging probably to the 2nd century B.C. A village of the Byzantine period has been explored at Balatizzo, immediately to the south of the modern town. The walls of the dwellings are entirely cut out of the natural rock.

The modern town, known as Girgenti till 1928 but then reverting to the older form of Agrigento, is the capital of the province of Agrigento, and an episcopal see, 58 mi. S. by E. of Palermo direct and 84 $\frac{1}{2}$ mi. by rail. Pop. (1936) 27,785 (town), 32,951 (commune). The cathedral occupies the highest point in the town; it was founded in the 13th century and there are other remains of architecture of this period. The museum contains fine vases, terra cottas, sculptures, etc. Porto Empedocle, pop. (1936), 13,834 (town), 14,764 (commune), 5 $\frac{1}{2}$ mi. S. by rail, is connected with Castelvetro, on the line from Palermo to Trapani. It is the principal port for the shipment of sulphur, the mining district beginning just north of Agrigento, and was heavily bombed by the Allies during World War II after their victory in North Africa. (T. A.; X.)

AGRIMONY, a slender perennial herb (botanical name, *Agrimonia Eupatoria*, family Rosaceae), 1 $\frac{1}{2}$ to 3 ft. high growing in hedge-banks, copses and borders of fields. The leafy stem ends in spikes of small yellow flowers. The flower-stalk becomes recurved in the fruiting stage, and the fruit bears a number of hooks which enable it to cling to rough objects, such as the coat of an animal, thus ensuring distribution of the seed. The plant is common in Britain and widely spread through the north temperate region. The underground woody stem is astringent and yields a yellow dye.

The name has been unsystematically given to several other plants; for instance: bastard, Dutch, hemp or water agrimony (*Eupatorium cannabinum*); noble or three-leaved agrimony (*Anemone Hepatica*); water agrimony (*Bidens*); and wild agrimony (*Potentilla Anserina*).



THE TEMPLE HERE SHOWN WITH ALL ITS COLUMNS STILL IN SITU, WHICH HAS BEEN WRONGLY ATTRIBUTED TO CONCORDIA, IS THE BEST PRESERVED OF THE NUMEROUS AND SPLENDID RUINS STILL TO BE FOUND ON THE SITE OF THE CITY OF AGRIGENTUM. IT OWES ITS PRESERVATION TO GREGORY II. BISHOP OF GIRGENTI

erected on the site of the temple of Castor and Pollux are a modern (and incorrect) restoration in which portions of two buildings have been used. Of that of Hephaestus only two columns remain, while that of Asclepius, a mile to the south of the town, an anta and two pillars are preserved. Other remains are unimportant. Near the picturesque church of S. Nicolo is the so-called oratory of Phalaris, a tomb of the 1st century B.C., 27 $\frac{1}{2}$ ft. by 23 $\frac{1}{2}$ ft., and not far off on the east are two private houses of the Roman period. The fishpond (circumference said by Diodorus to be 7 stadia) is an enormous excavation south-

AGRIOLOGY is the science of the prehistoric human practices and ways of living, especially those pertaining to the key-factors of existence, food, shelter and clothing.

AGRIONIA, an ancient Greek festival, celebrated annually at Orchomenus in Boeotia and elsewhere, in honour of Dionysus Agrionius ("the wild") by women and priests at night. The tradition is that the daughters of Minyas, king of Orchomenus, having despised the rites of the god, were seized with frenzy and ate the flesh of one of their children. At this festival it was originally the custom for the priest of the god to pursue a woman of the Minyan family with a drawn sword and kill her. (Plutarch, *Quaest. Rom. cii.*, *Quaest. Graecae*, xxxviii.)

AGRIPPA, a sceptical philosopher, whose date cannot be accurately determined. He must have lived later than Aenesidemus. To him are ascribed the five tropes (*πέντε τρόποι*) which, according to Sextus Empiricus, summarize the attitude of the later ancient sceptics. (1) Since some thinkers hold that nothing is known but the sensible; others that nothing is known but the intelligible, it follows that the only wise course is neither to affirm nor to deny. (2) The proof of one so-called fact depends on another fact which itself needs demonstration, and so on *ad infinitum*. (3) The data of sense are relative to the sentient being, those of reason to the intelligent mind; that in different conditions things themselves are seen or thought to be different. Where, then, is the absolute criterion? (4) All knowledge depends on certain hypotheses, or facts taken for granted. Such knowledge is hypothetical. (5) The fifth trope points out the impossibility of proving the sensible by the intelligible inasmuch as it remains to establish the intelligible in its turn by the sensible. Such a process is a vicious circle and has no logical validity. A comparison of these tropes with the ten tropes enumerated in the article **AENESIDEMUS** shows that scepticism has made an advance into the more abstruse questions of metaphysics. The first and the third include all the ideas expressed in the ten tropes, and the other three systematize the more profound difficulties which new thinkers had developed.

See Diogenes Laertius x. 88, and Zeller's *Greek Philosophy*. Also the articles **SCPTICISM**; **AENESIDEMUS**.

AGRIPPA, HEROD I. (c. 10 B.C.—A.D. 44), king of Judaea, the son of Aristobulus and Berenice, and grandson of Herod the Great, was born about 10 B.C. His original name was Marcus Iulius Agrippa. Josephus informs us that, after the murder of his father, Herod the Great sent him to Rome to the court of Tiberius, whose son Drusus became his friend. On the death of Drusus, Agrippa, who had been recklessly extravagant, was obliged to leave Rome overwhelmed with debt. After a brief seclusion, Herod the Tetrarch, his uncle, who had married Agrippa's sister Herodias, made him *Agoronomos* (Overseer of Markets) of Tiberias, and presented him with a large sum of money; but his uncle being unwilling to continue his support, Agrippa left Judaea for Antioch and soon after returned to Rome, where he was welcomed by Tiberius and became constant companion to the emperor Gaius (Caligula), then a popular favourite. Agrippa, overheard by his freedman Eutyches to express a wish for Tiberius' death and the advancement of Gaius, was betrayed to the emperor and cast into prison. In A.D. 37 Caligula, having ascended the throne, heaped wealth and favours upon Agrippa and gave him the tetrarchy of Batanaea and Trachonitis. To this he added that held by Lysanias; and Agrippa journeyed into Judaea to take possession of his new kingdom. In A.D. 39 he returned to Rome and brought about the banishment of Herod Antipas, to whose tetrarchy he succeeded. On the assassination of Caligula (A.D. 41) Agrippa supported the emperor Claudius, who gave him the government of Judaea, while the kingdom of Chalcis in Lebanon was, at his request, given to his brother Herod. Thus Agrippa became one of the greatest princes of the east, the territory he possessed equalling in extent that held by Herod the Great. He returned to Judaea and governed it to the great satisfaction of the Jews. His zeal, private and public, for Judaism is celebrated by Josephus and the rabbis; and the narrative of Acts xii, telling of his persecution of the Apostles James and Peter, gives a typical example of it. Both the Acts of the Apostles and Josephus give an account of his sudden death after an exhibition of games at Caesarea. A

third account says that Agrippa was assassinated by the Romans, who objected to his growing power. He had shown too independent a spirit in his attempt to strengthen the walls of Jerusalem and to summon a meeting of other client princes and after his death the emperor appointed no more kings of Judaea, but ruled the province by means of procurators.

See articles Josephus, J.A. 18 and 19 in *Ency. Bibl.* (W. J. Woodhouse), *Jewish Ency.* (M. Brann), with further references; N. S. Libowitz, *Herod and Agrippa* (2nd ed., 1898); Grätz, *Geschichte d. Juden*, iii. 318–361.

AGRIPPA, HEROD II. (27–100), son of Agrippa, Herod I., and like him originally Marcus Julius Agrippa, was born about A.D. 27, and received from Claudius the tetrarchy of Chalcis and the oversight of the Temple on the death of his uncle, Herod, A.D. 48. In A.D. 53 he was deprived of that kingdom and given other provinces instead. He tried to prevent the Jews from rebelling, and when war broke out sent auxiliaries to help the Romans. He died in Rome in A.D. 100. He was the seventh and last king of the family of Herod the Great. It was before him and his sister Berenice (q.v. B.2) that St. Paul pleaded his cause at Caesarea (Acts xxvi.). He supplied Josephus with information for his history.

AGRIPPA, MARCUS VIPSANIUS (63–12 B.C.), Roman statesman and general, son-in-law and minister of the emperor Augustus, was of humble origin. He was of the same age as Octavian (as the emperor was then called), and was studying with him at Apollonia when news of Julius Caesar's assassination (44 B.C.) arrived. By his advice Octavian at once set out for Rome. Agrippa played a conspicuous part in the war against Lucius, brother of Mark Antony, which ended in the capture of Perusia (40). Two years later he put down a rising of the Aquitanians in Gaul, and crossed the Rhine to punish the aggressions of the Germans. On his return he refused a triumph but accepted the consulship (37). At this time Sextus Pompeius, with whom war was imminent, had command of the sea on the coasts of Italy. Agrippa's first care was to provide a safe harbour for his ships, which he accomplished by cutting through the strips of land which separated the Lacus Lucrinus from the sea, thus forming an outer harbour; an inner one was also made by joining the lake Avernus to the Lucrinus (Dio Cassius xlviii. 49; Pliny, *Nat. Hist.* xxxvi. 24). About this time Agrippa married Pomponia, daughter of Cicero's friend Pomponius Atticus. Having been appointed naval commander-in-chief he put his crews through a course of training, until he felt in a position to meet the fleet of Pompeius. In 36 he was victorious at Mylae and Naulochus, and received the honour of a naval crown for his services. In 33 he was chosen aedile and signalized his tenure of office by effecting great improvements in the city of Rome, restoring and building aqueducts, enlarging and cleansing the sewers, and constructing baths and porticos, and laying out gardens. He also first encouraged the public exhibition of works of art. The emperor's boast that he had found the city of brick but left it of marble ("marmoream se relinquere, quan latericium accepisset," Suet. Aug. 29), might with greater propriety have been uttered by Agrippa. He was again called away to take command of the fleet when the war with Antony broke out. The victory at Actium (31), which gave the mastery of the world to Octavian, was mainly due to Agrippa. As a token of signal regard Octavian bestowed upon him the hand of his niece Marcella (28). We must suppose that his wife Pomponia was either dead or divorced. In 27 Agrippa was consul for the third time, and in the following year the senate bestowed upon Octavian the imperial title of Augustus. Probably in commemoration of the battle of Actium, Agrippa built and dedicated the Pantheon still in existence as *La Rotonda*. The inscription on the portico states that it was erected by him during his third consulship. His friendship with Augustus seems to have been clouded by the jealousy of his brother-in-law Marcellus, which was probably fomented by the intrigues of Livia, the second wife of Augustus, who feared his influence with her husband. In 23 B.C., Agrippa went as governor to the East, ruling by means of legates, while he himself remained at Lesbos. But the death of Marcellus, which took place in the same year, obliged the emperor to look

to Agrippa as his successor. He was recalled to Rome, and to strengthen the tie between him and Augustus was made to divorce Marcella and marry the emperor's daughter Julia (21), the widow of Marcellus. In 19 he was employed in putting down a rising of the Cantabrians in Spain. In 18 B.C. he received the Tribunician power for five years, and in the following year a renewal of his command in the East, where his just and prudent administration won him the goodwill of the provincials, especially the Hebrew population. His last public service was the bloodless suppression of an insurrection in Pannonia (13). He died at Campania in March of the year following his 51st year. Augustus honoured his memory by a magnificent funeral.

Agrippa was also known as a writer, especially on geography. Under his supervision Julius Caesar's design of having a complete survey of the empire made was carried out. Amongst his writings an autobiography, now lost, is referred to. Agrippa left several children; by Pomponia, a daughter Vipsania, who became the wife of the emperor Tiberius; by Julia three sons, Gaius and Lucius Caesar (adopted by Augustus as his successors) and Agrippa Postumus, and two daughters, Agrippina the elder, afterwards the wife of Germanicus, and Julia, who married Lucius Aemilius Paullus.

See Dio Cassius xlix.-liv.; Suetonius, *Augustus*; Velleius Paterculus ii.; Josephus, *Antiq. Jud.* xv. 10, xvi. 2; Turnbull, *Three Dissertations*, one of the characters of Horace, Augustus and Agrippa (1740); Frandsen, *Marcus Vipsianus Agrippa* (1836); Motte, *Étude sur Marcus Agrippa* (1872); Nispi-Landi, *Marcus Agrippa e i suoi tempi* (1901); D. Detelesen, *Ursprung, Einrichtung und Bedeutung der Erdkarte Agrippas* (1906); V. Gardthausen, *Augustus und seine Zeit*. Vol. i. 762 foll., ii. 432 foll.

AGRIPPA VON NETTESHEIM, HENRY CORNELIUS (1486-1535), German writer, soldier, physician and by common reputation a magician. Agrippa was for many years in the service of Maximilian I., the German king, who sent him in 1510 on a diplomatic mission to England, where he was the guest of Dean Colet. From 1511 to 1518 he was in Italy in the service of William VI. of Monferrato and of Charles III. of Savoy. His interest in the occult sciences had brought him into conflict with the church at Dôle in 1509 when he lectured on John Reuchlin's *De verbo mirifico*; again at Pavia in 1515 when he lectured at the university on the *Pimander* of Hermes Trismegistus; and again at Metz in 1518, where he was town orator, for his defence of a woman accused of witchcraft. He then practised medicine in Cologne, Geneva, Freiburg and Lyons for short periods until Margaret, duchess of Savoy and regent of the Netherlands, appointed him archivist and historiographer to the emperor. Margaret's death in 1530 weakened his position, but after suffering a short imprisonment for debt at Brussels he lived at Cologne and Bonn, under the protection of Hermann of Wied, archbishop of Cologne. He then went to France, where he was arrested by order of Francis I. for some disparaging words about the queen-mother; but he was soon released, and on Feb. 18 1535, died at Grenoble. He was thrice married and had a large family. Agrippa's work, *De occulta philosophia*, which brought him into antagonism with the Inquisition, was written about 1510, partly under the influence of the author's friend, John Trithemius, abbot of Würzburg, but its publication was delayed until 1531, when it appeared at Antwerp. It is a defence of magic, by means of which men may come to a knowledge of nature and of God, and contains Agrippa's idea of the universe with its three worlds or spheres. His other principal work, *De incertitudine et vanitate scientiarum et artium atque excellentia Verbi Dei declamatio*, was written about 1527 and published at Antwerp in 1531. In it Agrippa denounces the accretions which had grown up around the simple doctrines of Christianity, and wishes for a return to the primitive belief of the early Christian church. He also wrote *De nobilitate et praecellentia feminei sexus*, dedicated to Margaret of Burgundy, *De matrimonii sacramento* and other smaller works. An edition of his works was published at Leyden in 1550 and they have been republished several times.

See H. Morley, *Life of H. C. Agrippa* (London, 1856); A. Prost, *Les sciences et les arts occultes au XVI. siècle*: Cornielle Agrippa, *sa vie et ses œuvres* (Paris, 1881); A. Daquet, *Cornelius Agrippa* (Paris, 1856); J. Orsier, *H. C. Agrippa, sa Vie et son Oeuvre* (1911).

AGRIPPINA, the "elder," daughter of Marcus Vipsianus Agrippa (q.v.) by his third wife Julia, was the granddaughter of Augustus and the wife of Germanicus. She accompanied her husband to Germany, when the legions on the Rhine revolted after the death of Augustus (A.D. 14). Three years later she was in the East with Germanicus (q.v.), who died at Antioch in 19, poisoned, it was said, by order of Cn. Calpurnius Piso, governor of Syria. Eager to avenge his death, she returned to Rome and boldly accused Piso of the murder of Germanicus. To avoid public infamy Piso committed suicide. Tiberius and his favourite Sejanus feared that her ambition might lead her to attempt to secure the throne for her children, and she was banished to the island of Pandataria off the coast of Campania, where she died on Oct. 18, 33, starved to death by herself, or, according to some, by order of Tiberius. Two of her sons, Nero and Drusus, had already fallen victims to the machinations of Sejanus. Agrippina had a large family by Germanicus, several of whom died young, while only two are of importance—Agrippina the "younger" and Gaius Caesar, who succeeded Tiberius under the name of Caligula. There is a portrait of Agrippina in the Capitoline Museum at Rome and a bronze medal in the British Museum, representing the bringing back of her ashes to Rome by order of Caligula.

See Tac. *Ann.* i.-vi.; Suetonius *Tiberius*, 53; Dio Cassius lviii. 6, lviii. 22, lix. 3; Elizabeth Hamilton, *Memoirs of the Life of Agrippina* (1804); Stahr, *Römische Kaiserfrauen* (1880).

AGRIPPINA, the "younger" (A.D. 16-59), daughter of Germanicus and Agrippina the elder, sister of Caligula and mother of Nero, was born at Oppidum Ubiorum on the Rhine, afterwards named in her honour Colonia Agrippinae (mod. Cologne). By her first husband, Gnaeus Domitius Ahenobarbus, she was the mother of the emperor Nero; her second husband was Passienus Crispus, whom she was accused of poisoning, in 49. After the death of Messalina, she married the emperor Claudius, her uncle, and induced him to adopt the future Nero as heir to the throne in place of his own son (Britannicus). In 54 she poisoned Claudius and secured the throne for her son. Being alarmed at the influence of the freedwoman Acte over Nero, she threatened to support the claims of the rightful heir Britannicus. Nero thereupon murdered the young prince and decided to get rid of his mother.

Pretending a reconciliation, he invited her to Baiae, where an unsuccessful attempt was made to drown her on a vessel especially constructed to founder. Eventually he had her put to death at her country house.

Agrippina wrote memoirs of her times, referred to by Tacitus (*Ann.* iv, 53).

See Tac. *Ann.* xii, xiii, xiv; Dio Cassius lix-lxi; Suetonius, *Nero*, 34; Stahr, *Agrippina, die Mutter Neros* (1880); Rafay, *Die Memoiren der Kaiserin Agrippina* (1884); B. W. Henderson, *The Life and Principate of the Emperor Nero* (1903); J. MacCabe, *Empresses of Rome*, ch. v (1911); also article NERO.

AGRONOMY. In the middle 1890s the term agronomy, used to designate the branch of agriculture dealing with climate, soils, fertilizers and crops (plant production), was introduced into the agricultural colleges and experiment stations of the United States. The term as now generally used indicates that branch of agriculture dealing with the science and the art of field crop culture and soil management. However, in some institutions the term agronomy is limited to the culture of field crops. (A. D. T.)

AGUADILLA, the largest and most important town in the northwestern section of Puerto Rico.

The population by the 1950 census of the town itself was 18,181 (1940, 13,468), while the population of the municipal district in 1950 was 43,748.

Aguadilla is situated on the west coast of Puerto Rico, on the Mona channel which connects the Atlantic ocean with the Caribbean sea. It is a seaport, but has little shipping. It is situated on the belt-line railroad which follows the coastal plains around the island and also has connection by well-built highways with the principal cities of the island.

Aguadilla has several industries and its business houses are well established. Its schools are superior, and an old church is of

especial interest.

According to tradition, Columbus' fleet of discovery in 1493 refilled its water casks at the fountain which still flows in the centre of the town. It is certain that Columbus landed in Aguadilla near the bank of the Culebrinas river. On this spot a magnificent marble cross has been erected to commemorate this historic event. There is no place under the U.S. flag on which Columbus landed except Puerto Rico.

(H. M. T.; J. L.-Ee.; X.)

AGUASCALIENTES, an inland state of Mexico, bounded north, east and west by the state of Zacatecas, and south by Jalisco. Pop. (1930) 132,900; (1940) 161,693. Area, 2,498 sq. mi. The state occupies a part of the plateau of central Mexico about 6,000 ft. above sea level, extending from two spurs of the Sierra Madre, called the Sierra Fria and Sierra de Laurel, eastward to the rolling fertile plains of its eastern and southeastern districts. It is well watered by numerous small streams and one large river, the Aguascalientes or Rio Grande, and has a mild healthy climate with a light rainfall. The fertile valleys of the north and west are devoted to agriculture and the plains to stock raising. Indian corn, flour, cattle, horses, mules and hides are exported to the neighbouring states. Mining industries are still undeveloped, but considerable progress has been made in manufactures, especially of textile fabrics. The state has good railway communications and a prosperous trade. The capital, Aguascalientes, named from the medicinal hot springs near it, is a flourishing commercial and manufacturing city. Pop. (1910) 45,198, (1940) 82,234. It has cotton factories, smelting works, railway shops, potteries, tanneries, distilleries and wagon and tobacco factories. It is a station on the Mexican National railway, 364 mi. N.W. of the city of Mexico, and is connected by rail with Tampico on the Gulf of Mexico. The city is well built, has many fine churches and good public buildings, street cars and electric lights. Other towns of the State are Rincón de Romos (4,460), Asientos de Ibarra (1,847) and Calvillo (3,486).



CATHEDRAL AT AGUASCALIENTES
Aguascalientes, capital of the Inland Mexican state of the same name, is an industrial centre for the agricultural plateau surrounding it

AGUE, the common name given to a form or stage of malarial disease; the ague fit is the cold, shivering stage, and hence the word is also loosely used for any such paroxysm. (See **MALARIA**.) For "brow-ague" see **NEURALGIA**.

AGUESSEAU, HENRI FRANÇOIS D' (1668-1751), chancellor of France, was born at Limoges Nov. 27, 1668, the son of Henri d'Aguesseau, who held many important posts in the government. He studied law under Jean Domat and was one of the first masters of forensic eloquence in France. He was procurator general from 1700 to 1717, and defended the rights of the Gallican church against Rome in the controversy which led to the promulgation of the bull *Unigenitus*.

In 1717 he was made chancellor by the regent Orleans, but was dismissed next year because of his steady opposition to the financial projects of John Law which had been adopted by the regent. He was recalled in 1720. He then assented to the truce which Dubois made with Rome because he feared the outbreak of civil war. Popular opinion unjustly ascribed his attitude to base compliance with Dubois; but he opposed other measures of Dubois and was dismissed when the favourite became chief minister. After five years of retirement spent in study, he was recalled by Cardinal Fleury, and again became chancellor. He attempted, in vain, the codification of French law, but he executed a body of reform which placed him in the same rank with L'Hôpital and Lamoignon.

His grandson, **HENRI CARDIN JEAN BAPTISTE, MARQUIS D' AGUESSEAU** (1746-1826), was advocate general in the parlement of Paris and deputy in the estates-general. Under the consulate he became president of the court of appeal and later minister at Copenhagen. He was elected to the French academy in 1787.

Of H. F. d'Aguesseau's works the most complete edition is that of Jean Marie Pardessus, published in 16 vol. (1818-20); his letters were edited separately by Rives (1823); a selection of his works, *Oeuvres choisies*, was issued, with a biographical notice, by E. Falconnet in 2 vol. (Paris, 1865). His works include a treatise on money; a life of his father, which is interesting from the account which it gives of his own education; and *Metaphysical Meditations*.

See Charles Butler, *Mem. of Life of H. F. d'Aguesseau*, etc. (1830); Boullée, *Histoire de la vie et des ouvrages du chancelier d'Aguesseau* (Paris, 1835); Fr. Monnier, *Le Chancelier d'Aguesseau* (Paris, 1860; 2nd ed., 1863).

AGUILAR, GRACE (1816-47), English writer, the daughter of a Jewish merchant in London, was born in June 1816. Her works consist chiefly of religious fiction, such as *The Vale of Cedars* (1850) and *Home Influence* (1847). She also wrote, in defence of her faith and its professors, *The Spirit of Judaism* (1842) and other works. She died at Frankfurt-on-Main on Sept. 16, 1847.

AGUILAR, or **AGUILAR DE LA FRONTERA**, a town of southern Spain, in the province of Córdoba. Pop. of town (1940) 15,144; mun., 16,091. Aguilar "of the Frontier" was so named in the middle ages from its position on the border of the Moorish territories. Situated in the south of the fertile *Campaña de Córdoba*, its olives and white wine are celebrated; the wine is known as Amontillado, from the adjacent town of Montilla.

AGUILAS, seaport and railway terminus, southeast Spain, province of Murcia. Pop., town (1940) 11,636; mun., 15,166. Aguilas is built on the landward side of a small peninsula, between two bays and has a good harbour. It is the chief outlet for the Spanish trade in esparto grass, and exports also iron ore and other mineral products of the neighbourhood.

AGUINALDO, EMILIO (c. 1869-), Filipino insurrectionary leader, was born near Cavite, Luzon, of Chinese and Tagalog parentage. He was educated in his native town and in the University of St. Thomas, Manila. At the outbreak of the insurrection in Aug. 1896, he was mayor of Cavite Viejo. During this uprising Aguinaldo took a prominent part. But in Jan. 1898 he left the Philippines for Hong Kong, agreeing to remain permanently in exile on condition of a substantial financial reward from Spain coupled with the promise of liberal reforms. Immediately after the battle of Manila, May 1, 1898, he returned to the Philippines with the express purpose, it is said, of assisting the U.S. in the war with Spain. Obtaining the consent of the U.S. authorities, he established a native government and proclaimed a Philippine republic, of which he became the head, and reorganized the army. Because the U.S. did not recognize Philippine independence, he began hostilities against the United States on Feb. 4, 1899, by making an unsuccessful attack on Manila. During 1899 there were several severe engagements, but in the end the native troops became so hard pressed that Aguinaldo was forced to take refuge in the mountains. On March 23, 1901, he was captured by Gen. Frederick Funston at Palawan, Luzon. On April 19, 1901, Aguinaldo took the oath of allegiance to the United States and retired to private life. In 1950, Pres. Elpidio Quirino appointed him a member of the council of state.

AGUIRRE, LOPE DE (1508-1561), Spanish adventurer. In 1559 he joined Pedro de Ursua's expedition to the Upper Amazon, in search of El Dorado, and took part in the murder of Ursua and his lieutenant in 1561, after which Guzman was elected captain by the crew, with Aguirre as his master of the camp. The murderers declared themselves rebels, and sailed down the Amazon, plundering and putting to the sword whole villages of Indians. Aguirre established a reign of terror on board ship, which culminated in the murder of Guzman, and his own self-appointment to the position of captain. In July of 1561 the party reached Margarita Island, where they murdered the governor, robbed the royal treasury and proceeded to make incursions into the mainland of Venezuela. About this time Aguirre wrote and despatched an amazing letter to the king of Spain, accusing him of ingratitude toward himself, Aguirre, and his followers, and giving a full account of his own villainous exploits on the voyage.

Soon after, his men began to desert him and just when an attack was expected from Spanish troops, he was shot by his own fellow-rebels, in Oct. 1561.

See R. Southey, *Expedition of Orsua, and the Crimes of Aguirre* (1821); and P. Simon, *The Expedition of Pedro de Ursua and Lope de Aguirre in search of El Dorado and Omagua* (1861).

AGUJARI, LUCREZIA (1743–1783), an Italian operatic singer, possessed of one of the most extraordinary voices, in respect of its almost incredible compass, ever known. Mozart, who heard her at Parma in 1770, noted down some of the passages which she sang, showing her range to have extended from middle C to C in altissimo, or more than an octave above the B flat which is about the limit of the average soprano. At the same time she was a brilliant executant. Known (and advertised) as *La Bastardella*, on account of the circumstances of her birth, as the natural daughter of a man of rank, she paid many visits to London where she received as much as £100 a night.

AHA, of Shabha, an 8th-century Talmudist. He was author of *Quaestiones* (*Sheiltoth*), a collection of homilies (at once learned and popular) on Jewish law and ethics. This is recorded as the first work written by a Jewish scholar after the completion of the Talmud.

AHAB, son of Omri, king of Israel from c. 875 to c. 852 B.C. (I Kings xvi. 29–xxii. 40). The more important aspects of his reign, which in some respects marks the high water mark of the success of the northern kingdom, may be summarized as follows: (1) *Foreign relations*.—In the reigns of Omri and Ahab the northern kingdom for the first time took an important part in international politics. Omri left to his son an empire which comprised not only territory to the east of Jordan, in Gilead and probably Bashan, but also the land of Moab, whose king was tributary, while Judah (and probably Edom also) if not actually subject to Omri, was certainly a subordinate ally. Ahab's marriage with Jezebel, daughter of Ethbaal of Sidon, revived an alliance which had been in abeyance since the time of Solomon. But throughout the reign of Ahab a fierce border war was waged with Damascus, in which Israel, in spite of occasional victory, proved the weaker, while Mesha, king of Moab, successfully revolted and occupied the southern portions of the territory of Gad. Yet the forces of Israel retained strength enough to contribute the second largest contingent of soldiers (the largest force of chariots) to the combined armies which, under the leadership of Benhadad of Damascus, checked the westward movement of Shalmaneser III. of Assyria at Karkar in 853 B.C. After the Assyrian repulse, however, the alliance broke up, and Ahab met his death fighting the Syrians in a vain attempt to recover Ramoth Gilead. (2) *Domestic affairs*.—Contact with a wider world, and especially the alliance with Phoenicia, had far-reaching results for the kingdom of Israel itself. Jezebel attempted to introduce into religion and government elements which were common enough elsewhere in the ancient world but strange in Israel. She endeavoured to set up the worship of the Tyrian Baal in Samaria, and to maintain the familiar oriental principle of the absolute despotic power and authority of the sovereign. This roused the bitter hostility of that conservative party which clung to the sole worship of the national God, Yahweh, and at the same time held to those democratic conceptions of society which the Hebrews had brought with them from the wilderness and had consistently maintained through their history. The spirit of this party found expression in the prophet Elijah (*q.v.*), who protested alike against the establishment of the Baal priests and the judicial murder of Naboth. He and those who came after him seem to have been successful in eliminating the foreign worship, though in the end their purpose was only achieved by a bloody revolution; but they were powerless to stem the tide of social and moral deterioration. (See Amos.) It is to the reign of Ahab that we may trace the beginning of that sapping of the national life which led to the condemnations of the 8th century prophets and to the downfall of Samaria. (T. H. R.)

AHAGGAR, general name for a large plateau region of the north centre of the Sahara, culminating about 900m. due S. of Algiers and 1,200m. due N. of the mouth of the Niger. The

highest peaks do not greatly exceed 8,000ft. above sea-level. (See also SAHARA.)

AHASUERUS, a royal Persian name occurring in Ezra iv. 6, Dan. ix. 1, and throughout the book of Esther, but its occurrence in Tobit xiv. 15, in some Greek mss., is due to a copyist's blunder. It is the Latinized form of the Hebrew *Aḥašwērōš* (LXX. Ἀχασούρος). In Ezra iv. 6 Ahasuerus is mentioned as a king of Persia, to whom the enemies of the Jews sent representations opposing the rebuilding of the temple at Jerusalem. He here occupies a place in a chronological series of those Persian rulers who were directly concerned with events of Jewish history. (See EZRA and NEHEMIAH, BOOKS OF.) Immediately preceding Artaxerxes I. Longimanus, he is evidently to be identified with Xerxes. This conclusion is supported by the resemblance of the Hebrew form of the name to the Babylonian *Aḥšiyarš(u)*, the Egyptian-Aramaic transliterations, etc. The old Persian form, found in inscriptions, is *Khšayārša*.

In the book of Esther the king, at whose court the scene is laid, bears the same Hebrew name, rendered *Assuerus* in the Latin version and Ahasuerus in the English Bible (but in LXX. "Artaxerxes" throughout). Most modern scholars are agreed that here also Xerxes is the king intended. (See ESTHER.)

In Dan. ix. 1 "Ahasuerus" (*Aḥašwērōš*) is the father of "Darius the Mede," who is said to have become king over Babylonia upon the death of Belshazzar. (See also v. 30, vi. 1, 29.) The name seems impossible here, however, and is probably due to some accident in the literary transmission (Josephus, *Ant.* x. 11, 4, has "Astyages"). It was perhaps originally a Hebrew form of *Huw-ahšatara* (Cyaxares). No other name resembling Ahasuerus, nor any name like Darius, is to be found in the list of Median kings. We know, moreover, from the Cyrus cylinder, as well as from the Greek historians, that the immediate successor of Nabonidus and Belshazzar as ruler of Babylonia was Cyrus (he is represented in Dan. x. 1, xi. 1, as successor of this Darius). Comparison with the list of Persian kings in the book of Ezra (see above) seems to show that in the Jewish tradition Darius I. Hystaspis was placed before Cyrus as "Darius the Mede."

See articles "Ahasuerus" in the *Encyclopaedia Biblica*, Hastings' Dictionary, the *Jewish Encyclopaedia*; Driver, *Introd. to the Lit. of the Old Test.*; Torrey, *Ezra Studies*, pp. 38 seq., 135 seq., 141.

(C. C. T.)

AHAZ, king of Judah. After the death of Menahem, Pekah, king of Israel, and Rezin (rather Rasun), king of Syria, allied against Assyria and invaded Judah. At the same time the Edomites recovered Elath on the Gulf of Akabah and Judah was isolated. Notwithstanding the counsel of Isaiah, Ahaz called in the aid of Tiglath-pileser I., who, after attacking the Philistines, destroyed the power of Syria, and exacted heavy tribute from Judah. It was as a vassal that Ahaz presented himself to the Assyrian king at Damascus, and brought back religious innovations, on the nature of which see W. R. Smith, *Relig. of Semites*, pp. 485 sqq. and commentaries on II. Kings xvi. 17.

AHAZIAH, the name of two kings in the Bible. (1) Ahaziah, 8th king of Israel, was the son and successor of Ahab, and reigned for less than two years. On his accession the Moabites refused any longer to pay tribute. Ahaziah lost his life through a fall from the lattice of an upper room in his palace (2 Kings i. 2–17). (2) Ahaziah, 6th king of Judah, son of Jehoram and Ahab's daughter Athaliah, reigned one year. He, together with Joram, king of Israel, was slain by Jehu, son of Nimshi. He is variously called Jehoahaz and Azariah (2 Kings viii. 25–ix. 28).

AHENOBARBUS [Lat. "brazen-bearded"], the name of a very extensive plebeian Roman family of the gens *Domitia*. The name was derived from the red beard and hair by which many of the family were distinguished. Amongst its members the following may be mentioned:—

GNAEUS DOMITIUS AHENOBARBUS, tribune of the people 104 B.C., brought forward a law (*lex Domitia de Sacerdotiis*) by which the priests of the superior colleges were to be elected by the people in the *comitia tributa* instead of by co-optation; the law was repealed by Sulla, revived by Julius Caesar and (perhaps) again repealed by Marcus Antonius, the triumvir (Cicero *De*

Lege Agraria, ii. 7; Suetonius, *Nero*, 2). Ahenobarbus was elected pontifex maximus in 103, consul in 96 and censor in 92 with Lucius Licinius Crassus the orator, with whom he was frequently at variance. They took joint action, however, in suppressing the recently established Latin rhetorical schools, which they regarded as injurious to public morals (Aulus Gellius xv. 11).

LUCIUS DOMITIUS AHENOBARBUS, son of the above, and husband of Porcia the sister of Cato Uticensis. Being a convinced aristocrat he opposed Pompey and Caesar while they were united, and when their friendship cooled, attached himself to Pompey. He was consul in 54 B.C., and in 49 B.C. he was appointed by the senate to succeed Caesar as governor of Gaul. After the outbreak of the civil war he commanded the Pompeian troops at Corfinium, but was obliged to surrender. Although treated with great generosity by Caesar, he stirred up Massilia (Marseille) to an unsuccessful resistance against him. After its surrender, he joined Pompey in Greece and was slain in the flight after the battle of Pharsalus (Caesar, *Bellum Civile*, i, ii, iii.; Dio Cassius xxxix., xli.; Appian, B.C. ii. 82).

GAEUS DOMITIUS AHENOBARBUS, son of the above, accompanied by his father at Corfinium and Pharsalus, and, having been pardoned by Caesar, returned to Rome in 46 B.C. After Caesar's assassination he attached himself to Brutus and Cassius, and in 43 B.C. was condemned by the *lex Pedia* as having been implicated in the plot. He obtained considerable naval successes in the Ionian sea against the triumvirate, both before and after Philippi, but in 40 B.C. became reconciled to Antony, who made him governor of Bithynia. He took part in Antony's Parthian campaigns, and was consul in 32 B.C. When war broke out between Antony and Octavian, he at first supported Antony, but, disgusted with his intrigue with Cleopatra, went over to Octavian shortly before the battle of Actium (31 B.C.). He died soon afterwards (Dio Cassius xlviii. 1.; Appian, *Bell. Civ.*, iv., v.). His son was married to Antonia, daughter of Antony, and became the grandfather of the emperor Nero.

See Drumann, *Geschichte Rom.*, 2nd ed. by Groebe, vol. iii. pp. 14 ff.

AHITHOPHEL, one of David's most trusted advisers, whose counsel was "as though one inquired of the word of God." He took a leading part in Absalom's revolt, and his defection was a severe blow to the king, who prayed that God would bring his counsel to "foolishness." At Ahithophel's advice Absalom first took the precaution of asserting his claim to the throne by seizing his father's concubines. The immediate pursuit of David was then suggested but Hushai recommended waiting till the levies of all Israel could be called up. This advice was adopted, and David had time to escape across the Jordan. Finding that his policy was neglected, and foreseeing the disaster which actually occurred, Ahithophel went home and hanged himself. (2 Sam. xv. 31-37; xvi. 20-xvii. 14, 23.)

AHLEN, a town in the southeast of the district of Münster, in the Prussian province of Westphalia. Pop. (1939) 25,461. It produces metalwork, enamelling, die stamping, galvanizing, etc.

AHMAD IBN HANBAL (780-855), the founder, involuntarily and after his death, of the Hanbalite school of canon law, was born at Baghdad in A.H. 164 (A.D. 780) of parents from Merv, but of Arab stock. He studied the Koran and its traditions (*hadith, sunna*) there and on a student journey through Mesopotamia, Arabia and Syria. After his return to Baghdad he studied under ash-Shāfi' between A.H. 195 and 198, and became, for his life, a devoted Shāfi'ite. But his position in both theology and law was more narrowly traditional than that of ash-Shāfi'; he rejected all reasoning, whether orthodox or heretical in its conclusions, and stood for acceptance on tradition (*naql*) only from the Fathers. In consequence, when al-Ma'mūn and, after him, al-Mu'tasim and al-Wāthiq tried to force upon the people the rationalistic Mu'tazilite doctrine that the Koran was created, ibn Hanbal, the most prominent and popular theologian who stood for the old view, was imprisoned and scourged. In A.H. 234, under al-Motawakkil, the Koran was finally decreed uncreated, and ibn Hanbal, who had come through this trial better than any of the other theologians, enjoyed an immense popularity with the mass of the people as a saint, confessor and ascetic. He

died at Baghdad in A.H. 241 (A.D. 855) and was buried there.

BIBLIOGRAPHY.—On his great work, the *Musnad*, a collection of some 30,000 selected traditions, see Goldziher in *ZDMG*, l. 465 ff. For his life and works generally, see W. M. Patten, *Ahmed ibn Hanbal and the Mihna*; C. Brockelmann, *Geschichte der Arab. Lit.* i. 181 ff.; F. Wüstenfeld, *Schäffröten*, 55 ff.; M'G. de Slane's transl. of *Ibn Khallikan*, i. 44 ff.; Macdonald, *Development of Muslim Theology*, 110, 157, index.

AHMADIYYAH: see ISLAM.

AHMAD SHAH (1724-73), founder of the Durani dynasty in Afghanistan, was the son of Sammaun-Khan, hereditary chief of the Abdali tribe. While still a boy, Ahmad fell into the hands of the hostile tribe of Ghilzais, by whom he was kept prisoner at Kandahar. In March 1738 he was rescued by Nadir Shah, who soon afterwards gave him the command of a body of cavalry composed chiefly of Abdalis. On the assassination of Nadir in 1747, Ahmad, having failed in an attempt to seize the Persian treasures, retreated to Afghanistan, where he persuaded the tribes to assert their independence and accept him as their sovereign. He was crowned at Kandahar in Oct. 1747, and about the same time he changed the name of his tribe to Durani. He first crossed the Indus in 1748, when he took Lahore; and in 1751, after a feeble resistance on the part of the Mohammedan viceroy, he became master of the entire Punjab. In 1750 he took Nishapur, and in 1752 subdued Kashmir. His great expedition to Delhi was undertaken in 1756 in order to avenge himself on the Great Mogul for the recapture of Lahore. Ahmad entered Delhi with his army in triumph, and for more than a month the city was given over to pillage. The shah himself added to his wives a princess of the imperial family, and bestowed another upon his son Timur Shah, whom he made governor of the Punjab and Sirhind. As his viceroy in Delhi he left a Rohilla chief in whom he had all confidence, but scarcely had he crossed the Indus when the Mohammedan wazir drove the Afghan chief from the city, killed the Great Mogul and set another prince of the family, a tool of his own, upon the throne. The Mahratta chiefs availed themselves of these circumstances to endeavour to possess themselves of the whole country, and Ahmad was compelled more than once to cross the Indus in order to protect his territory from them and the Sikhs, who were constantly attacking his garrisons. In 1758 the Mahrattas obtained possession of the Punjab, but on Jan. 6, 1761, they were totally routed by Ahmad in the great battle of Panipat. In a later expedition he inflicted a severe defeat upon the Sikhs, but had to hasten westwards immediately afterwards in order to quell an insurrection in Afghanistan. Meanwhile the Sikhs again rose, and Ahmad was forced to abandon all hope of retaining the command of the Punjab. He died in 1773, leaving to his son Timur the kingdom he had founded.

AHMED I. (1589-1617), sultan of Turkey, was the son of Mohammed III., whom he succeeded in 1603, being the first Ottoman sultan who reached the throne before attaining his majority. He was of kindly and humane disposition, as he showed by refusing to put to death his brother Mustafa, who eventually succeeded him. In the earlier part of his reign he gave proof of decision and vigour, which were belied by his subsequent conduct. The wars which attended his accession both in Hungary and in Persia terminated unfavourably for Turkey, and her prestige received its first check in the peace of Sitvatörök, signed in 1606, whereby the annual tribute paid by Austria was abolished. Ahmed gave himself up to pleasure during the remainder of his reign—which ended in 1617—and demoralization and corruption had become as general throughout the public service as indiscipline in the ranks of the army. The use of tobacco is said to have been introduced into Turkey during Ahmed I.'s reign.

AHMED II. (1643-95), sultan of Turkey, son of Sultan Ibrahim, succeeded his brother Suleiman II. in 1691. His chief merit was to confirm Mustafa Kuprili as grand vizier. But a few weeks after his accession Turkey sustained a crushing defeat at Slankamen (1691) from the Austrians under Prince Louis of Baden and was driven from Hungary; during the four years of his reign disaster followed on disaster, and on Feb. 6, 1695, Ahmed died, worn out by disease and sorrow.

AHMED III. (1673-1736), sultan of Turkey, son of Moham-

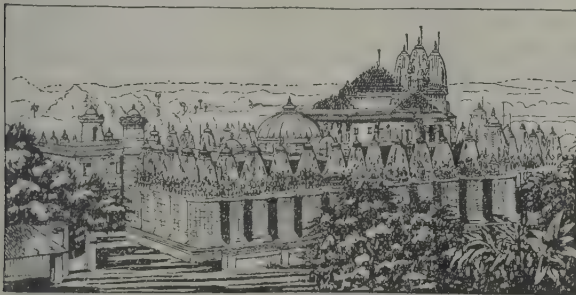
med IV., succeeded to the throne in 1703 on the abdication of his brother Mustafa II. He cultivated good relations with England, and he afforded a refuge in Turkey to Charles XII. of Sweden, after his defeat at Poltava (1709). Forced into war with Russia, he came nearer than any Turkish sovereign before or since to breaking the power of his northern rival, whom his grand vizier, Baltaji Mohammed Pasha succeeded in completely surrounding near the Pruth (1711). In the treaty which Russia was compelled to sign, Turkey obtained the restitution of Azov, the destruction of the forts built by Russia, and the understanding that the tsar should abstain from future interference in the affairs of the Poles or the Cossacks. Discontent at the leniency of these terms was so strong at Constantinople that it nearly brought on a renewal of the war. In 1715 the Morea was taken from the Venetians. This led to hostilities with Austria, in which Turkey was unsuccessful, and Belgrade fell into the hands of Austria (1717). Through the mediation of England and Holland the peace of Passarowitz was concluded (1718), by which Turkey retained her conquests from the Venetians, but lost Hungary. A war with Persia terminated in disaster, leading to a revolt of the janissaries, who deposed Ahmed in Sept. 1730.

He died in captivity.

AHMEDABAD, a city and district of British India in the Northern division of Bombay. Pop. (1941) 591,267. The city was once the handsomest and most flourishing in western India, and it still ranks next to Agra and Delhi for the beauty and extent of its architectural remains. It was founded by Ahmad Shah in A.D. 1411 on a site used for earlier Hindu towns, and embellished with fine buildings of marble brought from a distance. The Portuguese Barbosa described it as "very rich and well embellished, with good streets and squares supplied with houses of stone and cement." In Sir Thomas Roe's time, A.D. 1615, "it was a goodly city as large as London." From 1411 to 1511 it grew in size and wealth; from 1512 to 1572 it declined with the decay of the dynasty of Gujarat; from 1572 to 1709 it renewed its greatness under the Moghul emperors; from 1709 to 1809 it dwindled with their decline; and from 1818 onwards it again increased under British rule.

In consequence of these changes of dynasty, Ahmedabad became the meeting place of Hindu, Mohammedan and Jain architecture. Ahmad Shah pulled down Hindu temples in order to build his mosques with the material. The Jama Masjid itself, with its 300 pillars fantastically carved, is a Hindu temple converted into a mosque.

Many of the houses are most beautifully carved and there are numerous fine mosques, tombs, etc. One of the finest is the modern Jain temple of Hathi Singh outside the Delhi gate, which was built only in 1848. Two of the windows in Sidi Said's mosque



FROM "ARCHITECTURE OF AHMEDABAD," BY COURTESY OF JOHN MURRAY

THE TEMPLE OF HATHI SINGH AT AHMEDABAD, BUILT IN 1848 AS THE LOCAL SHRINE OF JAINISM

of filigree marble work are marvels of delicacy and grace, and finer than anything of the kind to be found in Agra or Delhi.

The modern city of Ahmedabad is situated on the left bank of the river Sabarmati; Sabarmati, on the opposite bank of the river, is practically part of Ahmedabad. It has a station on the Bombay and Baroda railway, 309 mi. from Bombay, whence branch lines diverge to Delhi, Khed, Brahma and Dolka, and is the largest centre for trade and manufacture in the province

after Bombay. Its native bankers, shopkeepers and workers are all strongly organized in guilds. It has numerous cotton mills, about one-third of the population being dependent on the cotton industry, and factories for ginning and pressing cotton. Other industries include oil, flour and silk mills, manufactures of soap, matches, glass, tobacco and hosiery, carpet works and tanneries. Ahmedabad is famous for its handicrafts, including brocades and tinsel lace, copper and brass working, jewellery and wood carving. Filtered water is obtained from wells in the river bed and the main streets are lighted by electricity. The military cantonment, 3 mi. N. of the native town, is the headquarters of the northern division of the Bombay command, with an arsenal.

The district of Ahmedabad lies at the head of the gulf of Cambay, between Baroda and Kathiawar. Area 3,879 sq. mi. Pop. (1941) 1,372,171. The river Sabarmati and its tributaries, flowing from northeast to southwest into the gulf of Cambay, are the principal streams that water the district. The northeastern portion is dotted with low hills, which gradually sink into a vast plain, subject to inundation on its western extremity. With the exception of this latter portion, the soil is very fertile, and some parts are wooded. The principal crops are millets, cotton, wheat and pulse. The district is traversed by the Bombay and Baroda railway, and has two seaports, Dholera and Gogo, the former of which has given its name to a mark of raw cotton in the Liverpool market.

AHMEDNAGAR, a city and district of British India in the Central division of Bombay on the left bank of the river Sina. Pop. (1941) 54,193. The town was founded in 1494 on the site of a more ancient city, Bhingar, by Ahmad Nizam Shah, who established a new monarchy, which lasted till its overthrow by Shah Jahan in 1636. In 1759 the Peshwa obtained possession of the place by bribery, and in 1797 it was ceded to the Mahratta chief, Daulat Rao Sindhia. During the war with the Mahrattas in 1803, Ahmednagar was invested by Gen. Wellesley and captured. Restored to the Mahrattas, it again became a British possession in 1817, under the treaty of Poona. There is a large trade in cotton and silk goods, while turbans and copper and brass pots are made. There are also factories for ginning and pressing cotton, indigo works and a tannery. Ahmednagar is a station on the loop line of the Great Indian Peninsula railway, 218 mi. from Bombay, a military station of the Poona district and an important mission station.

The district of Ahmednagar is a comparatively barren tract with a small rainfall. The area is 6,646 sq. mi. The population in 1941 was 1,142,229, showing a slight increase in the decade. On the north the district is watered by the Godavari and its tributaries, the Prawara and the Mula; on the northeast by the Dor, another tributary of the Godavari; on the east by the Sephani, which flows through the valley below the Balaghat range; and in the extreme south by the Bhima and its tributary the Gor. The Sina river, another tributary of the Bhima, flows through the Nagar and Karjat talukas.

The principal crops are cotton, millet, pulse and wheat and dyes are produced.

AHMED VEFIK, PASHA (1819-1891), Turkish statesman and man of letters, was born in Stambul and educated in Paris. He was appointed to a post in the *bureau de traduction* of the ministry for foreign affairs, and devoted his leisure to the translation of Molière's plays into Turkish and to the compilation of educational books (dictionaries, historical and geographical manuals, etc.) for use in Turkish schools. In 1847 he brought out the first edition of the *Salnameh*, the official annual of the Ottoman empire. Two years later he was appointed imperial commissioner in the Danubian principalities, and in 1851 ambassador to Persia. After his return he was appointed a member of the Grand Council of Justice, and was entrusted with the revision of the penal code and the code of procedure.

In 1860 he was sent as ambassador to Paris, to avert the intervention of France in the affairs of Syria. Ahmed Vefik held various important posts in the Turkish government during the next two decades, and was twice minister of public instruction, but the position in which he rendered his most distinguished

service was as vali of Brusa (1879-82). The drainage of the pestilent marshes, the water-supply from the mountains, the numerous roads, the suppression of brigandage, the multiplication of schools, the vast development of the silk industry through the substitution of mulberry plantations for rice-fields, the opening out of the mineral springs of Chitli, the introduction of rose trees and the production of attar of roses—all these were Ahmed Vefik's work. A few days after his return he was again appointed prime minister (Dec. 1, 1882), but he made conditions which were unacceptable to the sultan, and Said Pasha was appointed in his place. For the rest of his life Ahmed Vefik, by the sultan's orders, was practically a prisoner in his own house.

Ahmed Vefik was a great linguist. He spoke and wrote French perfectly, and thoroughly understood English, German, Italian, Greek, Arabic and Persian. From all these languages he translated many books into Turkish, but wrote no original work. His splendid library of 15,000 volumes contained priceless manuscripts in many languages. In his lifetime he appreciably aided the progress of education; but, as he had no following, the effects of his labour and influence in a great measure faded away after his death.

AHOM, the branch of the Tai race settled in and giving its name to Assam (*q.v.*). This people came into Assam in the 13th century under a leader named Sukupha and gradually extended their rule westward down the Brahmaputra valley, which they dominated till its invasion by the Burmese early in the 19th century. They instituted and retained in Assam a form of government in which taxes were paid by personal service and the population was organized in *paiks* of three householders, one of whom had always to be on duty. Religion was animistic until Hinduized; society was organized in clans (*khel*), originally exogamous, but tending to become under Hinduism endogamous occupational groups. There was a written language in script derived ultimately from Devanagari, but now, like the spoken tongue, extinct, though palm-leaf books written in it are still extant. (See also *SHAN*.)

See Hastings' *Encyclopaedia of Religion and Ethics* (*s.v.*) "Ahom"; E. A. Gait, *History of Assam* (1926).

AHRENS, FRANZ HEINRICH LUDOLF (1809-81), German philologist, was born at Helmsedt, June 6, 1809, and died Sept. 25, 1881. His most important work is *De Graecae Linguae Dialectis* (1839-43, new ed. by Meister, 1882-89), which, although unfortunately incomplete, dealing only with Aeolic and Doric, and in some respects superseded by modern research, remains a standard treatise. A volume of his minor works (ed. Haeblerin, 1891) contains a complete list of his writings.

AHRIMAN, the name of the principle of evil in the dualistic doctrine of Zoroaster (Gr. *Ἀρειμάνιος* in Aristotle, or *Ἀρειμάνης* in Agathias; in the *Avesta*, *Angrō Mainyush*)—"the Destructive Spirit". In the *Avesta* he is called the twin-brother of the Holy Spirits, and contrasted either with the Holy Spirit of Ormazd or with Ormazd himself. He is the all-destroying Satan, the source of all evil in the world. Eventually, in the great world catastrophe, he will be defeated by Ormazd and disappear. (See *ZOROASTER*.)

AHRWEILER, a town in Rhenish Prussia, Germany, on the river Ahr. Pop. (1933) 7,002. The town is surrounded by mediæval walls and gates. The Gothic church dates from 1245. There is trade in the red wine of the district.

AHT, a confederacy of 22 tribes of North American Indians of the Wakashan stock. They are settled on the west coast of Vancouver, British Columbia. The chief tribes included are the Nitinaht, Tlaasht or Makah, Tlaokiwaht or Clahoquaht, Ahanasht and Ehatishah. In the year 1928 the confederacy numbered some 3,500.

AHTENA ("ice people"), the name of an Athabaskan tribe of North American Indians, in the basin of Copper river, Alaska.

See *Handbook of American Indians*, ed. F. W. Hodge (Washington, 1907).

AHURA MAZDA, the Good Spirit in the dual system of Zoroaster, opposed to Ahriman, Angra Mainyu or Druj, the Spiritual Enemy. The name is sometimes translated as the "Wise Lord" and it is the origin of the modern Persian *Ormazd* or *Ormuzd*.

AHWAZ, a town of south-west Iran, in the province of Khuzistan, on the left bank of the River Karun, 85 mi. by road and 105 m. by river from Mohammerah (*q.v.*), 31° 20' N., 48° 48' E. It has been identified with the Aginis of Nearchus, and occupies the site of what was once an extensive and important city, of which, however, very few vestiges remain, the present town having been built in the last 50 years from the ruins of the old. Close by are to be seen the ruins of a stone dam of great strength, constructed across the Karun for the purposes of irrigation. Dependent on it was a system of great canals on both banks which served in the 12th and 13th centuries, if not before, to irrigate an area which was estimated by Major W. R. Morton, R. E., in 1907, at approximately half a million acres. Arab historians of the 12th and 13th centuries describe Ahwaz as the centre of a great sugar, rice and silk growing area, exporting its products all over Persia and as far west as Syria. Since the opening of the Karun to foreign commerce in Oct. 1888 another settlement, called Bandar Nāsiri, in compliment to the Shah Nāsir ed Din (d. 1896), has arisen, 1 m. below Ahwaz, at the point below the rapids where steamers come to anchor. Here are situated the Government post and telegraph offices, the British consulate and the Soviet consular agency. Bandar Nāsiri is an official port of entry under the Anglo-Persian Commercial Convention of 1903, and a custom-house is established there. The climate is dry and healthy and the town, which was well laid out between 1903 and 1925, has a mixed Persian and Arab population of about 32,000. The Anglo-Iranian Oil company's European staff at Ahwaz, where some 70,000 tons of cargo are transhipped annually and where their workshops and stores are situated, number about 70, together with some 2,000 Persians, for most of whom special quarters have been built north of the old town. Motor routes run from Ahwaz along the right bank of the Karun and Diz to Dizful (85 mi.), to Shushtar (64 mi.), crossing the Karun at Band-i-Qir (28 mi.), and to Ram Hormuz (60 mi.) and Behbahan (126 mi.) (*q.v.*) and Masjid Suleiman (70 mi.). Ahwaz is the last important station on the Trans-Iranian railway before the terminus at Bandar Shapur.

AI (ah'ē), a three-toed sloth (*Bradypus tridactylus*), a tree-dwelling mammal native to dense forests in tropical America, so called because of its plaintive cry which somewhat resembles the sound indicated by its name. For descriptive details and illustration see *EDENTATA: Pilosa; SLOTH*.

AI, in Hebrew always with the definite article, *Haai*, "the heap of ruins." Other forms of the name are 'Ayya (Neh. ii. 31), 'Ayyath (Isa. x. 28). Some mss. read, probably correctly, 'Ayya for Gaza in I Chron. vii. 28. It was a royal city of the Canaanites and is best known for its complete destruction by Joshua (viii. 28), from which time, indeed, the name may date. Abraham pitched his tent between Ai and Bethel (Gen. xii. 8, xiii. 3). It lay somewhere east of Bethel (Beitin) near Beth-Aven with valleys to the north and west (Josh. vii. 11, 12). Identifications have fluctuated. Et-Tell (*Tell el-Hajar*), Khirbet el-Qudeira, Khirbet el-Haya and Khirbet Hayyan, all of which are mounds or ruined sites in the neighbourhood, have had their advocates. The weight of authority now favours Khirbet Hayyan with visible evidence of extensive habitation in rock-hewn reservoirs and débris of stone buildings. This site is rather more than 2 m. south-east of Beitin on the road leading to the Jordan valley.

See *Pal. Expl. Fund Quart. Statement* (1869), p. 123; (1874), p. 62-4; (1878), pp. 10, 132, 195; (1881), p. 254; E. Robinson, *Bib. Researches*, i. 143, ii. 312 ff.; Sellin, *Mitt. des Deutsch. Palästina Vereins* (1900), p. 1 ff.; W. F. Albright, *Annual Amer. Schools of Orient. Research* (1924), appendix v. (E. Ro.)

AICARD, JEAN FRANÇOIS VICTOR (1848-92), French poet and dramatist, was born at Toulon. He went to Paris to study law, and his first visit was to Victor Hugo, who returned the young man's admiration in kind, and is reported to have said in the Académie Française, "Je promets ce poète à la France." Aicard won the Vitet prize, and soon became known in literary circles in Paris for the charm and luminous simplicity of his verse. His poetry includes: *Les Rébellions et les apaisements* (1871); *Poèmes de Provence* (1874), and *La Chanson de l'enfant* (1876), both of which were crowned by the Academy; *Miette et Noré*

(1880), a Provençal idyll; *Le Livre d'heures de l'amour* (1887); *Jésus* (1896), etc. Of his plays the most successful was *Le Père Lebonnard* (1890), which was originally produced at the Théâtre Libre. Among his other works are the novels, *Le Roi de Camargue* (1890), *L'Âme d'un enfant* (1898) and *Tatas* (1901), *Benjamine* (1906) and *La Vénus de Milo* (1874), an account of the discovery of the statue from unpublished documents.

AICHINGER, GREGOR (c. 1565–1628), a distinguished composer. He was organist to the Fugger family at Augsburg in 1584. Proske, in the preface to vol. ii. of his *Musica Divina*, calls him a priest of Regensburg, and is inclined to give him the palm for the devout and ingenuous mastery of his style.

AIDAN (or AEDAN), a monk of Iona, and first bishop of Lindisfarne (A.D. 635–651). In 635 Oswald, who had succeeded to the kingdom of Bernicia in the previous year, re-united the whole of Northumbria under himself. Northumbria had been converted to Christianity by Paulinus (625–633), but had relapsed under the heathen successors of Edwin, and in 635 Oswald, who was an earnest Christian, sent for a new bishop. Paulinus had been a member of the Roman Church, but his successor was summoned from the headquarters of the Celtic church, the monastery of Iona, which Oswald had visited during his exile. The first monk sent was unsuccessful; when he reported at Iona that he could do nothing with the uncouth Northumbrians, Aidan suggested that "he had not first given them the milk of mild doctrine . . . until they were able to understand the more perfect mysteries . . . of God." Thereupon it was decided to send Aidan as bishop to Northumbria.

True to the traditions of the Celtic church, he fixed his abode on the island of Lindisfarne. Under his influence, and that of the Irish monks who joined him, churches were built, and monasteries established, and a school founded where 12 boys were trained as preachers.

Christianity spread apace through Northumbria, partly because Aidan was building on the foundations laid by Paulinus, and partly because of the active support given by Oswald. There was a close friendship between king and bishop, and Bede tells us that when Aidan was preaching, Oswald, who understood Scottish, would often act as his interpreter. But the main cause of Aidan's success was his own character; Bede, though disapproving of his observance of the Celtic Easter, gives him the highest praise for his learning, simplicity of life, and open-handed generosity. "What chiefly commended his teaching to all men was that it agreed with the life he and his followers led."

The defeat and death of Oswald at Maserfield (Aug. 5, 642) did not destroy the Northumbrian Church; though the kingdom was divided, Aidan retained his see, and legend tells that his prayers saved Bamburgh from destruction by Mercian invaders. He died at Bamburgh, Aug. 31, 651, eleven days after the murder of his friend, King Oswin of Deira.

Aidan by his energy and saintly character had established in Northumbria Christianity in its Celtic form. But the phase was not lasting; in 664, at the Synod of Whitby, Oswy adopted the Roman Easter, and, abandoning the Celtic church with its monastic ideal, brought Northumbria again into touch with the Christianity of Southern England and the Continent.

See Bede, *Hist. Eccl.* iii. 3, 5, 14–17, 25—Plummer's edition, with excursus on the Paschal Controversy; Oman, *England before the Conquest* (1921), ch. xiv.; W. Bright, *Chapters of Early English Church History* (1897) chaps iv., v. See article EASTER.

AIDAN (d. 606), king of the Scottish kingdom of Dalriada, was the son of Gabran, king of Dalriada, and became king after the death of his kinsman, King Conall, when he was crowned at Iona by St. Columba. He refused to allow his kingdom to remain in dependence on the Irish Dalriada, but coming into collision with his southern neighbours he led a large force against Aethelfrith, king of the Northumbrians, and was defeated at a place called Daegsanstane, probably in Liddesdale.

See Bede, *Historiae Ecclesiasticae gentis Anglorum*, ed. by C. Plummer (1896); Adamnan, *Vita S. Columbae*, ed. by J. T. Fowler (1894).

AIDE-DE-CAMP (Fr. for camp-assistant or, perhaps, field-assistant), an officer of the personal staff of a general, who acts

as his confidential secretary in routine matters. On Napoleon's staff such officers were frequently of high military qualifications, and acted both as his "eyes" and as the interpreters of his mind to subordinate commanders, even on occasion exercising a delegated authority. But in modern times, particularly in the British army, they have usually been of very junior rank and their duties largely social. In Great Britain the office of aide-de-camp to the king is given to senior officers as a reward or an honorary distinction. In many foreign armies the word *adjutant* is used for an aide-de-camp, and *adjutant-general* for a royal aide-de-camp. The common abbreviation for aide-de-camp in the British service is "A.D.C.," and in the United States "aid." Civil governors, such as the lord lieutenant of Ireland, have also, as a rule, officers on their staffs with the title and functions of aides-de-camp. The aide-de-camp of the governor of a State in the United States has the title of colonel.

AIDIN or **AYDIN**. (1) A vilayet in S.W. Turkey, including the lower part of the Maeander valley; area 2,926.6 sq.mi., pop. 281,784. (2) The principal town of the vilayet about 70 mi. E.S.E. of Smyrna. It was taken by the Seljuks, Aidin and Mentesh, late in the 13th century, and about 1390, when ruled by Isa Bey, a descendant of the first-named, acknowledged Ottoman suzerainty. In the Seljuk period it was only a secondary city under the provincial capital, Tireh. In the 17th century it came under the power of the Karasmons of Manisa and remained so till about 1820. Aidin is on the Smyrna-Dineir railway. On a neighbouring height are still to be seen the ruins of the ancient *Tralles* (q.v.). Aidin itself suffered severely in the Graeco-Turkish conflict of 1919–1922. Pop. 17,732.

AIDONE, a town of Sicily, in the province of Enna, about 22 mi. E.S.E. of the town of Caltanissetta. Pop. (1936), 8,178 (town), 8,694 (commune). There are ruins of an ancient city on Mte. Serra Orlando near by. Aidone has some interesting 14th-century churches. (See E. Mauceri in *L'Arte*, 1906–17.)

AIDS, a term of mediaeval finance, were part of the service due to a lord from his men, and appear to have been based upon the principle that they ought to assist him in special emergency or need. The occasions for demanding them and the amount to be demanded would thus be matters of dispute, while the loose use of the term to denote many different payments increases the difficulty of the subject.

Both in Normandy and in England in the 12th century the two recognized occasions on which, by custom, the lord could demand "aid" were (1) the knighting of his eldest son, (2) the marriage of his eldest daughter; but while in England the third occasion was, according to Glanvill, as in Normandy, his payment of "relief" on his succession, it was, according to the Great Charter (1215), the lord's ransom from captivity. By its provisions, the king covenanted to exact an "aid" from his barons on these three occasions alone—and then only a "reasonable" one—except by "the common counsel" of his realm. Enormous importance has been attached to this provision, as establishing the principle of taxation by consent, but its scope was limited to the barons and the City of London, and the word "aids" was omitted from subsequent issues of the charter. The barons, on their part, covenanted to claim from their feudal tenants only the above three customary aids. The last levy by the Crown was that of James I. on the knighting of his eldest son (1609) and the marriage of his daughter (1613).

From at least the days of Henry I. the term "aid" was also applied (1) to the special contributions of boroughs to the king's revenue, (2) to a payment in lieu of the military service due from the Crown's knights. Both these occur on the pipe roll of 1130, the military payment as *auxilium militum* (and possibly as *auxilium comitatus*). The borough "aids" were alternatively known as "gifts" (*dona*), resembling in this the "benevolences" of later days. When first met with, under Henry I., they are fixed round sums, but under Henry II., as the *Dialogue on the Exchequer* explains, they were either assessed on a population basis by Crown officers or were sums offered by the towns and accepted by them as sufficient. In this case the townsfolk were collectively responsible for the amount.

Aids and the Great Charter.—The Great Charter, as before stated, extended specially to London the limitation on baronial "aids," but left untouched its liability to tallage, a lower and more arbitrary form of taxation, which the towns shared with the crown's demesne manors, and which London resisted in vain. The two exactions, although distinct, have to be studied together, and when in 1296-97 Edward I was forced to his great surrender, he was formerly supposed by historians to have pledged himself, under *De tallagio non concedendo*, to levy no tallage or aid except by common consent of his people. It is now held, however, that he limited this concession to *aides*, *mises* and *prises*, retaining the right to tallage. Eventually, by a statute of 1340, it was provided that the nation should not be called upon "to make any common aid or sustain charge" except by consent of parliament. The aids spoken of at this period are of yet another character, namely, the grant of a certain proportion of all "movables" (i.e., personal property), a form of taxation introduced about 1188 and of rapidly increasing importance. These subsidies were conveniently classed under the vague term "aids," as were also the grants made by the clergy in convocation, the term covering both feudal and non-feudal levies from the higher clergy and proportions not only of "movables" but of ecclesiastical revenues as well.

The "knight's aid" of 1130 spoken of above is probably identical with *auxilium exercitus* mentioned in the oldest customs of Normandy, where the phrase appears to represent what was known in England as "scutage." Even in England the phrase "*quando Rex accipit auxilium de militibus*" occurs in 1166 and appears to be loosely used for scutage.

The same loose use enabled the early barons to demand "aid" from their tenants on various grounds, such as their indebtedness to the Jews, as is well seen in the Norfolk fragments of returns to the Inquest of Sheriffs (1170).

Sheriff's aid was a local payment of a fixed nature paid in early days to the sheriff for his service. It was the subject of a hot dispute between Henry II and Becket in 1163.

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AIGRETTE, the long back plumes which the egret (*q.v.*) assumes in the breeding season, the use of which as ornaments in women's headdresses has become rare, owing to the protests of humanitarians because of the cruelty involved in slaughtering the birds and leaving their young to starve. The name is also given to any similar ornament, in gems, etc., to the insignia of rank of colonels in the French army and, in science, to feathery excrescences such as the *pappus* of the dandelion and the luminous rays seen diverging from the moon's edges in solar eclipses.

AIGUESMORTES, a town of southeast France, department of Gard, 25 mi. S.S.W. of Nîmes on a branch line of the P.L.M. railway. Population (1936) 3,458. It occupies an isolated position in the marshy plain at the western extremity of the Rhône delta, 2½ mi. from the Gulf of Lions. Louis IX embarked from Aiguesmortes in 1248 and 1270 for the 7th and 8th crusades, and developed the town. The mediaeval fortifications which surround it are of great interest. They form a parallelogram 596

yd. long by 149 yd. broad and consist of crenellated walls from 25 to 36 ft. in height, dominated by towers, of which the Tour de Constance (N.W.), built by Louis IX, was used as a prison for Protestants after the revocation of the Edict of Nantes. The fortifications were completed under Philip III. To further the prosperity of the town a most liberal charter was granted to it, and in addition the trade of the port was artificially fostered by a decree requiring that every vessel navigating within sight of the lights should put in there. This ordinance remained in force till the reign of Louis XIV. The town, although steadily decreasing in population, remains important historically as an outstanding example of mediaeval city planning. Aiguesmortes is the meeting-place of several canals connecting with Beaucaire, Cette, the Petit Rhône and the Mediterranean. Fishing and the manufacture of soda are industries, with trade in coal, fruits and wine. In the surrounding country there are important vineyards, which are preserved from disease by periodical submersion.

AIGUILLE (Fr. for needle), the sharp jagged point above the snow-line formed by a part of a mountain which has been split by frost action along joints or planes of cleavage with sides too steep for snow to rest upon them. Aiguilles are thus the forms left from the splitting up of the high ridges with "house-roof" structure into detached pinnacles. (See *ARÊTE*.)

AIGUILLON, EMMANUEL ARMAND DE WIGNEROD DU PLESSIS DE RICHELIEU, DUC D' (1720-1782), French statesman, nephew of the maréchal de Richelieu, was born on July 31, 1720. He was a member of the so-called *parti dévot*, the faction opposed to Madame de Pompadour, to the Jansenists, and to the parlement. In 1753 he was appointed commandant (governor) of Brittany and was engaged in constant disputes with the Breton parlement, in 1768 returning to court, where he resumed his intrigue with the *parti dévot* and finally obtained the dismissal of the minister Choiseul (Dec. 24, 1770). When Louis XV, acting on the advice of Madame du Barry, reorganized the government with a view to suppressing the resistance of the parlements, d'Aiguillon was made minister of foreign affairs, Maupeou and the Abbé Terray (1715-1778) also obtaining places in the ministry. D'Aiguillon was blamed for having provoked the *coup d'état* of Gustavus III, king of Sweden, in 1772, although the instructions of the comte de Vergennes, the French ambassador in Sweden, had been written by the minister, the duc de la Vrillière. D'Aiguillon, however, could do nothing to rehabilitate French diplomacy; he acquiesced in the first division of Poland, renewed the Family compact, and, although a supporter of the Jesuits, sanctioned the suppression of the society. After the death of Louis XV he quarrelled with Maupeou and with the young queen, Marie Antoinette, who demanded his dismissal from the ministry (1774). He died, forgotten, in 1782.

See *Mémoires du Ministère du Duc d'Aiguillon* (3rd ed., 1792), probably written by J. L. Soulaie. On d'Aiguillon's governorship of Brittany see Carré, *La Chalotais et le duc d'Aiguillon* (1893); Marion, *La Bretagne et le duc d'Aiguillon* (1898); and Barthélemy Pocquet, *Le Duc d'Aiguillon et La Chalotais* (1901-02). The three last have full bibliographies. See also Flammermont, *Le Chancelier Maupeou et les parlements* (1883); Frédéric Masson, *Le Cardinal de Bernis* (1884).

AIGUILLON, MARIE MADELEINE DE WIGNEROD DU PONT DE COURLAY, DUCHESSE D' (1604-75), daughter of Cardinal Richelieu's sister. In 1620 she married a nephew of the Constable de Luynes, Antoine de Beauvoir du Roure, Sieur de Combalet, who died in 1622. In 1625, through her uncle's influence, she was made a lady-in-waiting (*dame d'atour*) to the queen-mother, and in 1638 was created duchess of Aiguillon. After the death of the cardinal (1642) she withdrew from the court, and devoted herself entirely to works of charity. She helped St. Vincent de Paul to establish the hospital for foundlings, and also took part in organizing the General hospital and several others in the provinces. She died on April 17, 1675. Corneille dedicated to her his tragedy of *Le Cid*.

See E. Fléchier, *Oraison funèbre de Mme. Marie de Wignerod, duchesse d'Aiguillon*; Bonneau-Avenant, *La duchesse d'Aiguillon* (1879); *Mémoires de Saint-Simon*, ed. by A. de Boislisle (1879 et seq.).

AIGUN, 49° 58' N. 127° 35' E., a treaty port on the south bank of the Amur in northern Manchuria on the extreme north-



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eastern frontier of China. Population 38,112. It lies on the opposite bank to, but about 20 mi. below, the Russian city of Blagoveshchensk. The treaty of Aigun (1858) was one of a series of treaties which attempted to define the boundaries between the Chinese and Russian empires. With political and strategic developments along the Siberia-Manchuria frontier and with the diversion of river trade to the north Manchurian (former Chinese Eastern) railway, it has lost its former importance as an entrepôt for the shipment of cattle, meat and grains across the Amur to Blagoveshchensk.

AIKEN, a city of South Carolina, U.S., 17 mi. E.N.E. of Augusta, Ga., 565 ft. above sea level; the county seat of Aiken county. It is on federal highways 1 and 78 and is served by the Southern railway. Population (1950) 7,067; (1940) 6,168. The climate is unusually dry and equable. Fox hunting, pigeon shooting, riding, polo, tennis, steeplechase and flat racing and golf are popular sports. With its seven polo fields, Aiken is a winter training ground for this game. Aiken was settled early in the 19th century and was incorporated in 1835. It was on the line of one of the earliest railways, and was named after the first president of that road, William Aiken (1806-37), who was governor of the State (1844-47).

AIKIN, JOHN (1747-1822), English physician and author, was born at Kibworth-Harcourt on Jan. 15, 1747, and died at Stoke Newington, London, on Dec. 7, 1822. He practised as a consulting physician in London from 1792 onwards, but gradually became absorbed in literary pursuits. Aikin and his sister, Anna Letitia Barbauld, wrote popular books which had a great vogue. Their admirable miscellany, *Evenings at Home* (1792-95) was translated into many European languages. Aikin's voluminous works include *General Biography* (1799-1815), and *Lives of John Selden and Archbishop Usher* (1812).

His daughter, **LUCY AIKIN** (1781-1864), born at Warrington on Nov. 6, 1781, wrote several books for children, including versions of classical stories written in monosyllables. She also wrote: a novel, *Lorimer* (1814); *Memoirs of the Court of Queen Elizabeth* (1818); *Memoirs of the Court of James I.* (1822); *Memoirs of the Court of Charles I.* (1833) and a *Life of Addison* (1843). Miss Aikin died at Hampstead on Jan. 29, 1864.

See a *Memoir of John Aikin, with selections of his miscellaneous pieces* (1823), by his daughter; and the *Memoirs, Miscellanies and Letters of Lucy Aikin* (1864), including her correspondence (1826-42) with William Ellery Channing, edited by P. H. Le Breton.

AILANTHUS (more correctly *ailantus*, from *ailanto*, an Amboyna word probably meaning "Tree of the Gods," or "Tree of Heaven"), a genus of trees belonging to the quassia family (Simarubaceae). The best known species, tree of heaven or Chinese sumac (*Ailanthus altissima*), is a handsome, rapidly growing tree with spreading branches and large pinnately compound leaves bearing many lance-shaped leaflets with conspicuous glandular bases. The small greenish flowers are borne in branched panicles; the staminate (male), upon opening, exhale a most disagreeable odour. The fruit is a samara with a single centrally disposed seed in the elliptical, twisted, fibrous wing. This tree, which is a native of China and Japan, was introduced into England in 1751 and is a favourite in parks and gardens. It has been planted extensively in the eastern United States and is one of a few trees capable of thriving in smoky atmospheres adjoining industrial centres. Two other species, *A. imberbiflora* and *A. punctata*, are Australian trees of secondary importance; *A. excelsa* is a common tree in India. (E. S. HR.)

AILANTHUS, CYNTHIA or ERIA SILK MOTH (*Philosamia cynthia*), a member of the so-called "wild" silk moths, ranging in many races and strains from China to Timor. It is olive or brown with a translucent white crescent on each wing. The caterpillar (the eria silkworm) is green with blue knobs; and the chief commercial strain (*P. c. ricini*) feeds on the castor oil plant. One of the races feeding on *Ailanthus* (*P. c. advena*) was introduced from China to France and thence to the U.S., and is established in France, Germany and along the Atlantic coast. Other races feed on *Ilex*, *Zanthoxylum* and other trees. (See **SILK** and **SERICULTURE**: *Wild Silks*.)

See H. Rebel, "Revision des Formenkreises von *Philosamia cynthia*

Dru." *Annalen des naturhistorischen Museums in Wien*, xxxix: 154-176, 1925 (races); Schüssler, "Saturniidae," *Lepidopterorum Catalogus*, lv, 24-41, lxx, 517-564, 733, biblig. (1934). (W. T. M. F.)

AILERON, a hinged or movable portion of an aeroplane wing, the function of which is to impress a motion on the aeroplane about its longitudinal axis. Situated generally at the rear edge of the wing and at or near the wing tip, the ailerons are connected to the control column by wires or push-pull rods in such a way that a movement of it, e.g., to the right, raises the aileron on the right wing and lowers that on the left wing, causing the aeroplane to bank for a turn to the right.

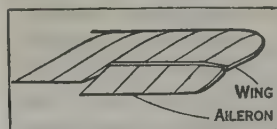


FIG. 1.—NORMAL TYPE OF AILERON
The banking of an aeroplane in turning is brought about by two ailerons, one on the rear edge of each wing. One goes up as the other goes down

Ailerons of the type shown in fig. 1 are effective in normal flight but when the aeroplane is stalled (as in the last few seconds before a normal landing) they become less effective. Great attention has therefore been devoted to aileron design in aerodynamic research laboratories throughout

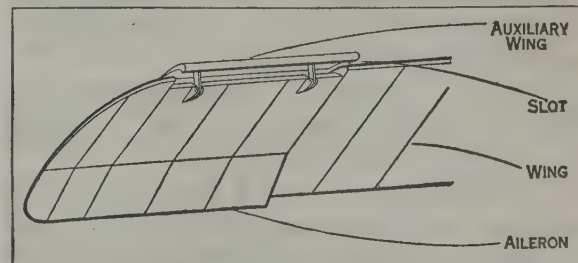


FIG. 2.—AILERON COMBINED WITH HANDLEY-PAGE SLOTTED WING
The purpose of this auxiliary wing is to remove one of the most serious risks of flying. In stalling the ailerons become ineffective. By this device the "slot" opens automatically when the wing stalls and this renders the aileron effective. The illustration shows a right wing seen from below

the world. The mounting of automatic slots of the Handley-Page type (see **AEROPLANE**) along the leading edge of the wing is one of several effective methods which have been developed to retain aileron action beyond the usual stalling point. (D. SE.)

AILLY, PIERRE D' or **PETRUS D'ALLIACO** (1350-1420), French churchman and schoolman, was born at Compiègne and studied at the College of Navarre of the University of Paris. He became master of the college in 1384 and later obtained the highest dignity in the university, the chancellorship of Notre Dame. John Gerson was one of Ailly's pupils and his lifelong friend. The two men played an important part in the later history of the papal schism. Pierre d'Ailly acted as spokesman of the university before the king's council (May 20, 1381) with the proposal that the best way of ending the scandal of the existence of two popes, Urban VI. at Rome and Clement VII. at Avignon, was the summoning of a general council. The suggestion was unacceptable and Ailly retired from Paris for some time. As master of the College of Navarre he was twice sent by the university on missions to Clement VII., and on the death of that pope, he was sent by the king to congratulate Clement's successor, Benedict XIII. His acceptance of that mission displeased the university, which was already beginning to demand the resignation of both popes as a preliminary to the re-unification of the church. Suspicion of his attitude was deepened by his nomination by Benedict XIII. as bishop of Le Puy (1395) and then bishop of Cambrai (1397). At the ecclesiastical council, held in Paris in 1406, Ailly, by the king's order, defended Benedict XIII., and it was not until the convocation of the general Council of Pisa (1409) that he forsook Benedict's cause and returned to the point of view of the University of Paris, of which he had been the champion before his preferment. He and Gerson urged that the unity of the church could only be restored by a general council which, in case of schism, would be supreme and legitimate even though it were not convoked by the pope. The nominee of the Council of Pisa died within a year. His successor, John

XXIII., gave Ailly the bishopric of Orange and made him a cardinal. Nevertheless Ailly was one of the most formidable adversaries of John XXIII. at the Council of Constance (Nov. 1414–April 1418). He maintained that, as the decisions of the Council of Pisa had not been accepted and there were now three “popes,” it was necessary to begin *de novo* and treat the claims of all three alike, and he made serious depositions against John. The theory put forward by Ailly and Gerson that the general council had jurisdiction over the pope himself was a dangerous one, and, according to later decisions, even heretical; but both men were seeking an outlet from an impossible situation. Ailly found in the end an ingenious compromise on the rights of the Sacred College and the council and the schism was healed by the appointment of Martin V.

During the Council of Constance, Ailly had earned the hatred of the Anglo-Burgundians by trying to reduce the power of the English by contesting their right to form one of the four separate nations. He was compelled to retire to Avignon, where he died on Aug. 9 1420.

Pierre d'Ailly's written works are numerous. Many of them were published with the works of Gerson (by Ellies du Pin, Antwerp, 1706); others appeared in the 15th century, probably at Brussels; and there are many treatises and sermons still unpublished. In philosophy he was a nominalist.

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AILSA CRAIG, an island rock at the mouth of the Firth of Clyde, rom. W. of Girvan, Ayrshire, Scotland. It is of conoidal form, with an irregular elliptic base, and rises abruptly to a height of 1,097ft. The only side from which the rock can be ascended is the east, the other sides being for the most part perpendicular, and generally presenting lofty columnar forms, though not so regular as those of Staffa. The island is composed of micro-granite with riebeckite, of great interest on account of the rare occurrence of this type in Britain. It is fine-grained and of a greyish colour, and may be of Tertiary age. Pebbles of this rock were carried far south (e.g. to Welsh shores) by glaciers of the Ice age. The rock is a favourite material for curling-stones. Hence curling-stones are popularly known as “Ailsas” or “Ailsa Craigs.” The rock is also used for paving stones. A columnar cave exists towards the north side of the island, and on the east are remains of a tower. Two springs occur and some scanty grass affords subsistence to rabbits, and, on the higher levels, to goats. The precipices have large breeding colonies of gannets and other sea birds which spend the winter months at sea. A lighthouse on the south side flashes a light visible for 13 miles. Pop. (1931) 11.

AIMAK, the name of nomadic or semi-nomadic Mongolian tribes inhabiting the north and north-west Afghan highlands north of Herat. *Aimak* is a Mongolian word meaning “clan” or “section of a tribe.” They were originally known as “chahar (the four) eimaks,” because there were four principal tribes: the Taimani, the Ferozkhoi, the Jamshidi and the Hazara. They number about 250,000, and speak a dialect akin to Kalmuck. They are Sunnite Mohammedans.

AIMARD, GUSTAVE, the pen-name of OLIVIER GLOUX (1818–83), French novelist, who was born in Paris Sept. 13, 1818, and died there June 20, 1883. He made use of the materials collected in a roving and adventurous youth and early manhood in numerous romances in the style of J. Fenimore Cooper. Among the best of them are: *Les Trappeurs de l'Arkansas* (1858); *La grande fièvre* (1860); *Nuits mexicaines* (1863); *La Forêt vierge* (1870).

AIMOIN (c. 960–c.1010), French chronicler, spent the greater part of his life in the monastery of Fleury. His chief works are: *Historia Francorum* or *Libri V. de gestis Francorum*, a history of the Franks from the earliest times to 633, which was continued by other writers and brought down to the middle of the 12th century; a life of Abbo, abbot of Fleury; and books ii. and iii. of the *Miracula S. Benedicti*.

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AIN, a department of eastern France, formed from Bresse, the Pays de Dombes on the lowland and the Pays de Gex, Valromey and Bugey among the high parallel scarps of the Jura reaching south to the Rhône between Geneva and Lyons. Area 2,249 sq.mi. Pop. (1936) 316,710. The name is that of the river which roughly separates the two first from the other districts, running north to south at first between outer hill ranks and then along the foot of the highland to join the Rhône. The western boundary is the Saône, the southern the Rhône, the eastern Switzerland and the northern the departments of Saône-et-Loire and Jura, the boundary over against the latter being closely linked with that of old between Burgundy and Franche Comté. The Pays de Gex includes some of the highest Jura scarps (Crêt de la Neige 5,653-ft.), the Pays de Valromey flanks on the west the deep Rhône gorge below Bellegarde, the Pays de Bugey is the south-pointing triangle of the Rhône focussing on Belley. West of the hills, Bresse occupies the fertile north part of the department and is effectively drained to the Saône, thus contrasting with the Pays de Dombes, mantled in boulder clay and possessing endless pools and marshes with, still, a good deal of consequent malarial trouble. The summers are warm in the lowland but the winters, generally, are sharp, the rainfall rises well above 1 metre per annum in the highland. The farms of Bresse are famous for pigs and poultry and the latter (especially geese) are also bred, in Dombes, which also raises horses. In the Jura hill country, pastures feed sheep and cattle from which cheese is produced, while many slopes are well forested. Bresse produces considerable cereal and other crops but the rest of the department is thus concerned mainly with stock-raising or with activities connected with its forests (of fir and oak) or with extensions of the silk industry from Lyons just beyond the south-west corner of the department, thanks to the water power available from the rivers among the gorges of the limestone country. Bourg is the capital of the department; the four arrondissements of which take their names from Bourg, Belley (the seat of a bishop in the archiepiscopal province of Besançon) and Nantua. The departmental appeals are heard at the court of Lyons and the department is also under Lyons educationally. Bourg (*q.v.*) is a market town specially known in connection with the famous church of Brou, wrongly described in Arnold's well known poem as being in Savoy. Among silk towns one may mention Jujurieux, Tenay, St. Rambert, St. Bernard en Bugey; Bellegarde and St. Rambert make wood pulp; and Oyonnax, a rather larger town than several of the others, north of Nantua, makes articles in wood and horn and is specially well known for its combs. Seyssel, on the far east, yields asphalt and many parts of the department give building stones, cement or potter's clay. There is a good tourist industry for winter sports, angling, etc., and some of the gorges and ridges are very striking; near Bellegarde, at the Perte du Rhône, that great river formerly disappeared down a fissure. Though the main P.L.M. railway from Dijon to Lyons lies west of the Saône, and so outside the department, the main line from Paris to Geneva runs through Bourg and Ambérieu to Bellegarde; both the Saône and the Rhône are navigable for considerable lengths along the confines of the department.

AINGER, ALFRED (1837–1904), English divine and man of letters, was born in London on Feb. 9, 1837, the son of an architect. He was educated at King's College, London, and at Trinity College, Cambridge, and was ordained in 1860 to a curacy at Alrewas, near Rugeley. His connection with the Temple Church, in London, began in 1866, when he was appointed reader; and in 1894 he succeeded Dr. Vaughan as master. In 1887 he was presented to a canonry in Bristol cathedral, and he was chaplain-in-ordinary to Queen Victoria and King Edward VII. He died on Feb. 8, 1904. Canon Ainger's gentle wit and humour, his generosity and lovable disposition, endeared him to a wide circle. In literature his name is chiefly associated with his sympathetic appreciation of Charles Lamb and Thomas Hood.

His works include: *Charles Lamb* (1882) and *Crabbe* (1903) in the "English Men of Letters" series; editions of Lamb's *Essays of Elia* (1883) and of his *Letters* (1888; 2nd ed., 1904), of the *Poems* (1897) of Thomas Hood, with a biographical introduction; *The Life and Works of Charles Lamb* (1899-1900); articles on Tennyson and Du Maurier in the *Dictionary of National Biography*; *The Gospel and Human Life* (1904), sermons; *Lectures and Essays* (1905), edited by the Rev. H. C. Beeching.

See Edith Sichel, *The Life and Letters of Canon Ainger* (1906).

AINHARDUS: see EINHARD.

AINMÜLLER, MAXIMILIAN EMMANUEL (1807-1870), German artist and glass-painter, was born at Munich on Feb. 14, 1807. In 1828 he was appointed director of the newly-founded royal painted-glass manufactory at Munich. The method which he gradually perfected there was a development of the enamel process adopted in the Renaissance, and consisted in actually painting the design upon the glass, which was subjected, as each colour was laid on, to carefully-adjusted heating. The earliest specimens of Airmüller's work are to be found in the cathedral of Ratisbon. With a few exceptions, all the windows in Glasgow cathedral are from his hand. Specimens may also be seen in St. Paul's cathedral, and Peterhouse, Cambridge, and Cologne cathedral contains some of his finest productions. Airmüller had considerable skill as an oil-painter, especially in interiors. He died on Dec. 9, 1870.

AINSWORTH, HENRY (1571-c. 1622), English Nonconformist divine and rabbinical scholar, was born at Swanton Morley, Norfolk. He was a scholar of Caius College, Cambridge, joined the Puritan party in the church, and eventually the Separatist. Driven abroad in the persecution of 1593, he found a home in "a blind lane at Amsterdam." He acted as "porter" to a scholarly bookseller in that city, who, on discovering his skill in Hebrew, enabled him to continue his Hebrew studies. When part of the London church, of which Francis Johnson (then in prison) was pastor, reassembled in Amsterdam, Ainsworth was chosen as their doctor or teacher.

In 1596 he drew up a confession of their faith, which he reissued in Latin in 1598. Johnson joined his flock in 1597, and in 1604 he and Ainsworth composed *An Apology or Defence of such true Christians as are commonly but unjustly called Brownists*. In 1610 he was forced reluctantly to withdraw, with a large part of their church, from Johnson and his adherents on a question of church government, Ainsworth taking the more congregational view. (See CONGREGATIONALISM.) But in spirit he remained a man of peace. The fruit of his rabbinical learning appeared in his *Annotations*—on *Genesis* (1616); *Exodus* (1617); *Leviticus* (1618); *Numbers* (1619); *Deuteronomy* (1619); *Psalms* (including a metrical version, 1612); *Song of Solomon* (1623). These were collected in folio in 1627, and again in 1639. From the outset the *Annotations* took a commanding place, especially among Continental scholars.

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AINSWORTH, ROBERT (1660-1743), English schoolmaster and author, was born at Eccles, near Manchester, in Sept. 1660. Ainsworth's name is associated with his Latin-English dictionary, begun in 1714 and published in 1736 as *Thesaurus linguae Latinae compendarius*. He died in London, April 4, 1743.

AINSWORTH, WILLIAM HARRISON (1805-1882), English novelist, was born at Manchester, Feb. 4, 1805. He was educated for the law, but at the age of 21 he married a daughter of John Ebers, the publisher, and followed his father-in-law's profession for a short time. A novel called *Sir John Chiverton*, in which he had a share, won the praise of Sir Walter Scott, and he turned to novel-writing. *Rookwood* (1834), with its description of the ride of Dick Turpin to York, had an immediate success. He published about 40 "historical" novels, of which the

best known are *Jack Sheppard* (1839), *The Tower of London* (1840), *Old St. Paul's* (1841) and *Windsor Castle* (1843). He edited *Bentley's Miscellany*, in which *Jack Sheppard* was published as a serial, and in 1842 he became proprietor of *Ainsworth's Magazine*. In 1853 it ceased to appear, and Ainsworth bought the *New Monthly Magazine*. He died at Reigate, Jan. 3, 1882.

See S. M. Ellis, *William Harrison Ainsworth and his Friends* (London, New York, 1911).

AINTAB or **GAZIANTEP** (anc. **DOLICHE**), a city of Anatolia, Turkey, just outside Syria, pop. (1940) 57,132 (two-thirds are Muslim, mainly of Turkoman origin and there are 15,000 Armenians). In ancient times (2nd Mil. B.C.) Aintab was in the Hittite area and is probably of Hittite origin. Duluk, the site of *Doliche*, famous for the worship of Zeus Dolichenus (Baal), is marked by a mound two hours distant to the northwest. In Crusading times its strong castle (*Hamtab*) was a strategic point of importance and was captured by Saladin in 1183. It served as the last base of Ibrahim Pasha before his victory over the Turks at Nezib, 25 mi. to the northeast (1839). In the winter of 1920-21 the armed opposition of the Turkish nationalists to the French occupation of north Syria centred in Aintab, which became the "Verdun of Anatolia." After an investment lasting six months, despite determined Turkish efforts to relieve it, the city surrendered to the French troops. France returned it to Turkey under the Angora treaty of Oct. 30, 1921.

The modern city stands high (3,500 ft.) in the open, treeless valley of the Sajur, a tributary of the Euphrates, some 65 mi. N.E. of Aleppo. Important educational and medical work is carried on by the American Mission Board in their college (founded 1874) and girls' seminary. There is also a Franciscan mission. Manufactures include striped dress materials (the chief of which is a mixture of silk and cotton), black goats' hair cloth for tents, morocco leather (*sakhtiyani*) made from goats' skins (it is estimated that nearly 400,000 are tanned here annually), "Aleppo soap" made from olive oil, *Pekmez*, a sweet paste made from grapes, and the dyeing of yarns. The exports include pistachio nuts, tobacco, cotton and cereals.

AINU, who are racially closely akin to, if not identical with, the Neolithic inhabitants of Japan (see *JAPAN: History*)



AN AINU VILLAGE CHIEF
The Ainu are now under Japanese rule, but in former times their affairs were administered by hereditary chiefs, three in each village

are now very reduced in numbers and live in Hokkaido, the northern island of Japan, in part of Saghalien, and have kinsfolk in the Ryukyu archipelago (*q.v.*). They are dwindling fast and are unable to compete with the advance of Japanese civilization. Physically they are probably the remains of an old Proto-Nordic population once widely spread over Northern Asia, and are certainly the relics of a very old human stock. Their culture recalls in many ways stone age man and they have preserved the very earliest stage of agriculture, when the men are still hunters but the women have developed beyond the mere collecting stage and are beginning actually to plant crops.

The Ainu religion is closely akin to the animistic religion practised by various primitive peoples of northern Asia, and they are particularly liable to that peculiar kind of religious ecstasy known as Arctic hysteria. One of their special cults is that of the bear. This animal is caught as a cub, and is carefully tended by the women who will even suckle it. At about three years old the bear is sacrificed with elaborate ceremony. In most of the Ainu villages, the special wooden cages in which the bears are kept can be seen. Prominent also in the villages are sticks which have been whittled (*inao*) and the shavings left on. The sticks are stuck in the ground and have a religious significance.

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AIR, a region lying between 15° and 19° N. and 6° and 10° E., and included in the province of Agades in Niger colony, French West Africa. It is one of several upland regions of the Sahara. It consists basically of broadly rounded, ancient granitic hills rising to an average elevation of 2,500 ft. These are overlaid by scattered lava flows and are crossed from east to west by wide, shallow valleys which are usually dry. Several volcanic ranges, reaching to 5,000-ft. elevation, rise with startling abruptness above the general level of the land. Because of elevation, Air is considerably more moist than most of the Sahara. Rainfall at Agades in the lower, southern part of the region averages seven inches per year and is concentrated from May through September. Higher elevations receive more rain, but seasonal distribution is the same. Though there are no permanent rivers in Air, the valleys become broad, rapidly flowing streams several times during each rainy season. Most of the water runs off westward to the broad, lower plain of Talak where the soil moisture thus derived provides plentiful grass cover. A small amount drains eastward to disappear beneath the desert sands of Ténéré.

In contrast to the barren hill and mountain slopes, many of the valleys of Air are densely covered with brush and tree vegetation or grasses through which are scattered a few small trees.

In 1944, Air's population totalled about 20,000; that of Agades was about 3,200. The inhabitants are Tuareg, or Berbers, with a strong admixture of Negroid blood. These people are dominantly nomadic; yet they maintain permanent settlements which serve as market centres and caravan relay stations. Agriculture is unimportant, but camels, sheep and a few cattle are pastured.

Agades is the capital and is on the trans-Saharan bus route from Algiers to Zinder. Caravan routes, of which that eastward to the Bilma salt oasis is the most important, pass through the town. Its population was greatest, more than 30,000, in 1591, but decline of caravan trade and treatment accorded the Tuareg by the French after the revolt of 1917 caused its modern decline.

AIR, the atmosphere that surrounds the earth. With the development of analytical and especially of pneumatic chemistry, the air was recognized not to be one homogeneous substance, as was long supposed, and different "airs," or gases, came to be distinguished. At the end of the 18th century oxygen gas was known as *dephlogisticated air*, nitrogen or azote as *phlogisticated air*, hydrogen as *inflammable air*, carbonic acid gas as *fixed air*. The name is now ordinarily restricted to atmospheric air (see **ATMOSPHERE**).

The sense of atmosphere or environment may have led to the further use of the word "air" to mean "manner" or "appearance"; and so to its employment (cf. Lat. *modus*) in music for "melody." (See **ARIA**.)

AIRAY, HENRY (1560?-1616), English Puritan theologian, was born at Kentmere, Westmorland, but no record remains of the date of either birth or baptism.

According to Anthony Wood's *Athenae*, Airay "was sent to St. Edmund's hall in 1579, aged nineteen or thereabouts. Soon after he was translated to Queen's College, where he became *pauper puer serviens*; that is, a poor serving child that waits on the fellows in the common hall at meals, and in their chambers, and does other servile work about the college." He was graduated from Queen's College as B.A. on June 19, 1583; and, after receiving M.A. and B.D. degrees, he became D.D. at his college on June 17, 1600. "About the time he was master" (1586) "he entered holy orders, and became a frequent and zealous preacher in the university."

His *Commentary on the Epistle to the Philippians* (1618, reprinted 1864) is a specimen of his preaching before the college and his enunciation of Calvinism. In 1598 he was chosen college provost, and in 1606 he was vice-chancellor of the university. He was also rector of Otmore (or Otmoor) near Oxford.

He died on Oct. 6, 1616. His character as a man, preacher, theologian, and as an important ruler in the university, will be found portrayed in the Epistle by John Potter, prefixed to his *Commentary*. He must have been a fine specimen of the more cultured Puritans—possessed of a robust common sense in admirable contrast with some of his contemporaries.

AIR BLADDER, the name given to a structure present in

all bony fishes (teleosts) and somewhat homologous with the lungs of land vertebrates. The functions of this organ, which contains gas having a high percentage of oxygen, are obscure; hydrostatic uses are attributed to it, but its function doubtless varies. In some fishes (especially Siluroidea), it is connected with the internal ear by a chain of bones, the Weberian ossicles, and in these forms it is possibly concerned with hearing. It usually retains a connection with the alimentary canal (except in most Acanthopterygii, *q.v.*), but is normally dorsal to it. (See **FISHES**.)

AIRBRUSH, a machine used for applying liquid colouring powders, flock, latex and glazes to a surface by means of compressed air. The use of compressed air for the atomization of liquids has been known for many years, but it is only in the last 35 years that the principle has been successfully applied to the application of all types of coating materials in commercial and industrial enterprises, and today there is hardly an institution anywhere whose product requires finishing that does not employ this method of application. The early successful use of airbrushes was in the field of art for retouching, etc.

The airbrush shown in fig. 1 (p. 447) is used in drawing the most delicate hairline work, as well as photographic retouching. It is a common implement in all large newspaper art departments. Fig. 2 illustrates the next step toward a commercial airbrush, this style being used for decorative and show-card work.

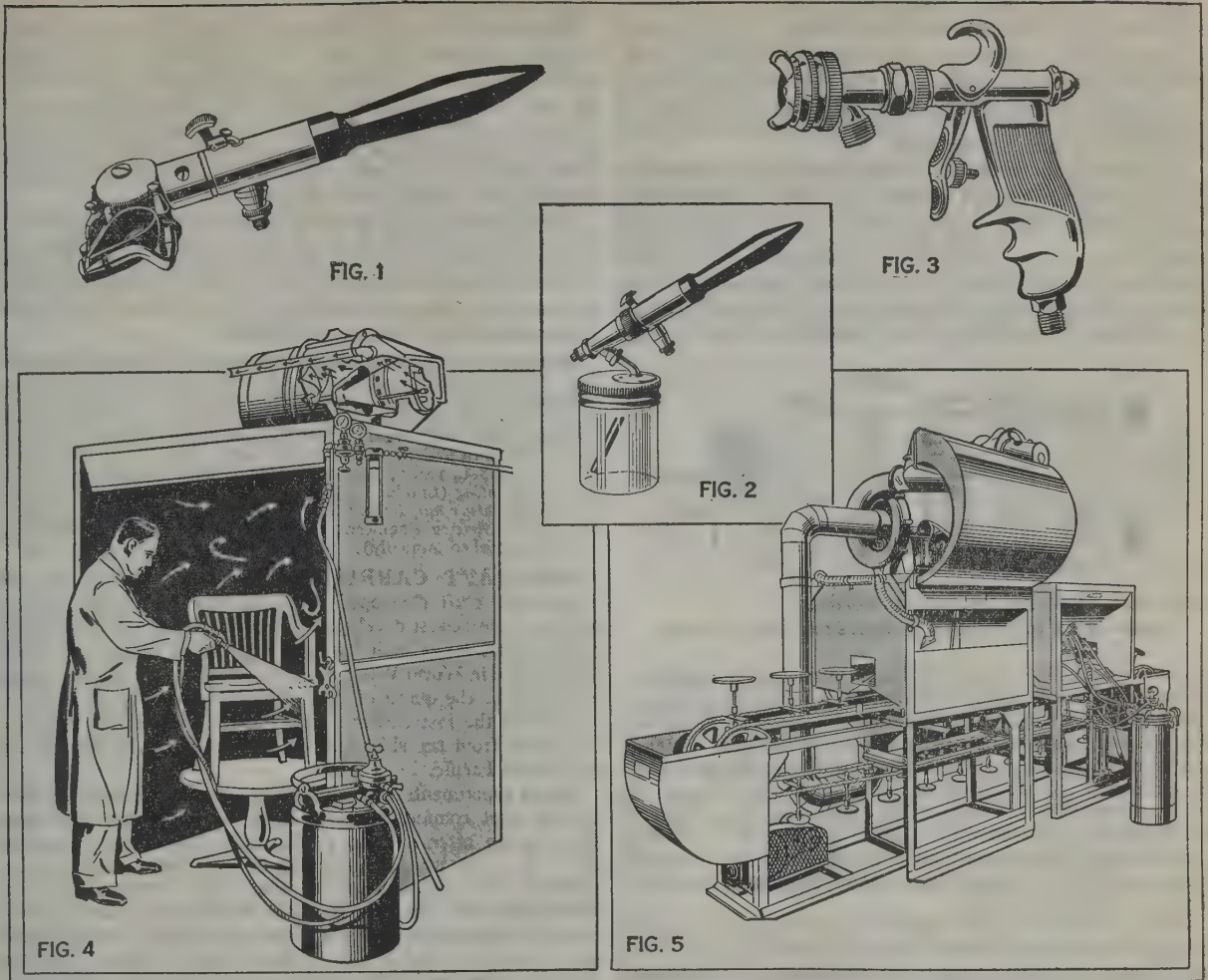
The natural evolution of the airbrush that was used by the artist brought about the present industrial type (fig. 3) which is used in practically every automobile and furniture factory, or any industry applying liquid finishes to their product. This is a universal airbrush, inasmuch as it may be used with any style of fluid supply, gravity (overhead bucket), pressure tank and cup (either syphon or gravity), thus making the airbrush applicable to all purposes. The heads for this type are made in 12 sizes, all interchangeable, thus adapting the airbrush to all consistencies of material. The production of as many as 5,000 automobiles per day could never have been reached were it not for the airbrush, which makes it possible to coat a body in less than one minute. Fig. 4 shows an industrial installation as used for the finishing of furniture, the booth and ventilating equipment being very necessary to carry off the fumes and excess spray.

Fig. 5 illustrates an automatic adhesive and flocking unit such as used by largest industrial organizations for high-speed daily production. In this unit, the airbrushes are operated automatically. In the section to the right the automatic airbrush applies the adhesive or binder and in the second station at the left the specially designed airbrush applies the flock, the unit reclaiming all unused material. Daily production in eight hours is 11,000 disks. Contract painters and large railroad companies also use the airbrush for general painting on buildings and bridges, effecting large savings, in addition to the fact that they are able to do the work in season.

Portable air-painting units for both electric and gasoline (petrol) engine operation are universally selected for outside air-painting jobs. Airbrushes are now made to function in every capacity from that of a cement mixture to the most delicate art work.

AIR CONDITIONING. The term is derived from the word conditioning which was applied to the determination of the moisture content of textiles, and covers the treating of air in an enclosure to regulate its moisture content, temperature, purity and usually its circulation. For increasing human comfort and for the manufacturing or processing of certain materials, an accurate control of the moisture content of the air is most important. It is sometimes roughly effected by adding water vapour or mist directly to the enclosed air, but more precisely by using an air-conditioning apparatus by which the air is purified and its temperature and moisture definitely controlled before it is introduced into the space to be conditioned.

Originally only places where equable and moist climatic conditions prevail, such as Lancashire, Eng., and the Fall River district in Massachusetts, could be chosen for the building of cotton mills. Then moisture was added to the air by evaporating water in steam pots. This method sufficed for small mills but was inadequate in the larger mills because of the heat generated by the



BY COURTESY OF PAASCHE AIRBRUSH COMPANY

FIG. 1.—AIRBRUSH USED EXTENSIVELY BY COMMERCIAL ARTISTS. FIG. 2.—LARGER THAN THE AIRBRUSH IN FIGURE 1 AND DIFFERING CHIEFLY IN HAVING A LARGER COLOUR RESERVOIR. FIG. 3.—ONE TYPE OF INDUSTRIAL AIRBRUSH. FIG. 4.—MODERN INDUSTRIAL INSTALLATION USED FOR PAINTING FURNITURE. FIG. 5.—AUTOMATIC ADHESIVE AND FLOCKING UNIT

great concentration of machinery. In the latter half of the 19th century the direct introduction into the room of an atomized spray of water both cooled and moistened the air, thus making it practicable to spin fine cotton yarns in all climates. At about the same time moist air was supplied to malting floors by passing the air through coke filters over which water trickled, or through a large series of wetted baffle plates. In 1897 Joseph McCreary of Toledo, O., patented an air washer intended primarily for purifying the air, but incidentally it cooled it and increased the moisture content. In 1906 Stuart W. Cramer of Charlotte, N.C., and Willis H. Carrier of Buffalo, N.Y., working independently, made two important contributions to the art. Cramer automatically controlled humidity by a system which depended upon the relation between the wet- and dry-bulb temperatures. This was applied to the humidifying spray heads located in the room. Carrier devised the "dew point control," an improved form of air washer which not only brought the air to saturation, but also controlled automatically the temperature of such saturation, thus determining the moisture content of the air supplied.

Types of Apparatus.—Of the two main types of humidifiers, the direct spray type, which provides for the atomization of the water and its introduction directly into the room, is made in relatively small sizes. The nozzles or distributors are placed just below the ceiling, and provide for humidifying only. The saturated air type, on the other hand, introduces large volumes of

saturated air at the required temperature.

In the conditioning chamber this air is brought into intimate contact with water finely divided by spraying through special nozzles under moderate pressure. All of the free particles of water are then removed by an eliminator, which usually consists of a series of specially formed baffle plates on which all free particles of moisture are caught, leaving the air saturated but free of all suspended water particles. The spray water may be heated or cooled, and the temperature of the saturated air may be modified before passing it into the room at the theoretic dew point.

When it is desirable to remove dust, soot and pollen from air, several types of filters may be employed. The most general types are composed of frames packed with fibrous glass, steel wool or similar materials. These may be covered with a viscous oil to hold the particles of dust more firmly. Special filter paper, arranged in V's for greater surface, is also employed. Electrostatic precipitators are installed in many large air-conditioning systems. Where dust particles of the smallest sizes must be removed, a special filtering medium of asbestos-bearing paper, closely pleated and completely sealed at the edges to a frame, is used.

Thermostats usually control the temperature automatically, either by admission of steam or hot water to the air heaters or by regulating the supply of cold, dehumidified air. Hygrostats control the humidity by regulating the air dew point, by varying the air volume or by on-and-off operation of the direct sprays.

After air conditioning of small shops, restaurants and other plants had become general by mid-20th century, air-conditioning units assembled at the factory were developed. These are complete with fans, heaters, cooling coils and filters enclosed in a cabinet. The development of safe refrigerants also made it possible to include the compressor and condenser within the cabinet or to install them in some near-by place.

The quantity of moisture which may remain in the vapour state in a unit volume of space is dependent only upon its temperature. The saturation pressure of water vapour is approximately doubled for each 20° F. rise in temperature; i.e., the maximum vapour pressure increases approximately in a geometric ratio for equal increments of temperature. The relation of the weight of water vapour in the atmosphere to the weight of air varies approximately in accordance with Dalton's law of partial pressures. When

since humidity is important.

Residences.—During the heating season, the humidity within residences becomes very low. This is especially true in homes with open fireplaces. With low humidity, dust particles float in the air and are augmented by brittle fibres from clothing, carpets, books, etc. Approximately three-fourths to one gallon of water per 24 hr. evaporated per room is necessary to raise the humidity from 15% to 35% or 40%. Excessive humidity may cause condensation and dripping from the windows.

Humidifiers are built into many hot air central heating systems. Complete year-around air conditioning units with heating and mechanical cooling have been installed in many homes. Factory-assembled, single-room cooling units as well as humidifying units are available, and with steam or hot water heating systems an evaporating pan can be set in the floor.

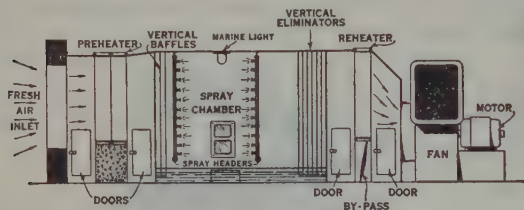
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AIRCRAFT CARRIERS. With the exception of the amphibious craft developed in World War II, aircraft carriers represent the newest development in naval design. From the first experimental types built by both the United States and Great Britain late in World War I or soon thereafter, the carrier rapidly evolved into the queen of the battle line around which the U.S. navy built the fast carrier striking forces which swept Japanese air power from the skies and was a vital factor in winning the war in the Pacific.

Naval experiments with aircraft as a means of providing eyes for the fleet commenced early in the 20th century. The first flight of an aircraft from a U.S. naval vessel took place on Nov. 14, 1910, when Eugene Ely flew a Curtiss plane from a platform built on the bow of the cruiser "Birmingham," in Chesapeake bay. In January of the following year, in San Francisco, the same pilot landed a plane on a landing platform built on the stern of the U.S.S. "Pennsylvania." Ropes, stretched laterally across the landing platform, every three feet, had a 50-lb. sand bag secured to each end, and were supported at a sufficient height from the deck to permit a hook on the plane to engage them. As the landing plane moved over the deck, it picked up an additional 100-lb. drag every three feet, thus being brought to a stop after travelling only a little more than half the length of the 120-ft. platform.

Experiments with shipboard aircraft were being carried out by Great Britain at approximately the same time, and in 1912 Commander C. R. Swanson flew a plane off H.M.S. "Hibernia." The following year the British flew seaplanes off the cruiser "Hermes," although the launching arrangement of small wheeled trucks supporting the plane resembled a catapult more than a flight deck. Three years later, the British completed a 250-ft. flight deck on the Cunard ship, "Campania," from which seaplanes were hoisted over the side into the water. While only one plane was flown off this model, the "Campania" introduced one feature common to all carriers since that time—an elevator which moved planes from the flight deck to a hangar space below, and brought them up again when flight operations were planned.

During the same period, tests were conducted with catapult launching of planes. A plane piloted by Theodore G. Ellyson was catapulted from an experimental model built at Annapolis, Md., in Nov. 1912, and in 1915 Comdr. Henry C. Mustin became the first person to make a catapult flight from a U.S. naval vessel when he was catapulted from the "North Carolina" in a Curtiss AB-2 flying boat. The U.S. cruisers "Seattle" and "Huntington" were fitted with catapults in 1916, and in 1917 these devices were capable of launching twin-float R-6 torpedo planes weighing 5,500 lb. The fact that such planes carried two 50-lb. bombs



BY COURTESY OF COOLING AND AIR CONDITIONING CORPORATION
DESIGN OF AIR CONDITIONING APPARATUS FOR LARGE BUILDING

water is brought into contact with unsaturated air it evaporates. If the air is the sole source of heat necessary to produce evaporation, an eventual equilibrium saturation temperature is established depending on the initial air temperature and its initial degree of saturation. The reduction in the sensible heat of the atmosphere is equalled by the latent heat of the acquired water vapour; the total heat remains constant. The equilibrium temperature of evaporation is observed with practical accuracy by a wet-bulb thermometer. The general formula based upon this heat balance was stated in W. H. Carrier, "Rational Psychrometric Formulae," *Trans. A.S.M.E.*, vol. xxxiii.

When unsaturated air is passed through an air washer and brought to saturation without changing the temperature of the spray water, it will be cooled to the temperature of evaporation (substantially, to the wet-bulb temperature of the entering air). For example, when the outside air is at 95° F., the average wet-bulb temperature will be approximately 75° F. and the air passing through a spray humidifier will be cooled to substantially 75° F. This method of cooling is especially valuable in textile mills and tobacco factories where the increased humidity as well as the lower temperature is desirable.

The temperature of evaporation is independent of the actual rate of evaporation. The rate of evaporation of water into air is dependent upon the air velocity over the water surface and upon the difference in vapour pressure existing between the water and the air. The determinations of these relationships have important applications in the drying of materials in air.

Regain.—The ratio of moisture content to the weight of dry material is technically termed regain and is characteristic of most organic materials. The regain for various materials varies widely, each having its own moisture of equilibrium, depending principally on the relative humidity of the surrounding air and to a slight extent on the temperature. The amount of regain varies with the relative humidity. Materials such as natural silk, wool, cotton and synthetic yarns are sold on the basis of standard regain. These materials are finally processed in an atmosphere having a relative humidity corresponding to the standard regain.

Comfort.—The relation of moisture, heat and air motion to human comfort and physiological reactions was determined by research. These data were plotted as effective temperature lines of equal comfort sensation for different combinations of temperature, humidity and air motion. Complete air conditioning is necessary for comfort. Temperature control alone is not sufficient

indicated that naval minds, early alert to the possibilities of aerial reconnaissance, had also seized on the offensive uses of ship-borne planes. It is this feature of supplying wings to carry bombs and torpedoes to targets hundreds of miles away which eventually made the carrier the potent weapon it has become.

Actual operations of ship-borne planes during World War I were of slight importance. The U.S. cruiser "Huntington" carried catapult planes as submarine protection on convoy duty to Europe but the planes were not tried. The British employed as many as four seaplane tenders during World War I; one was sunk, and one accompanied the British fleet when it met the German high seas fleet in the battle of Jutland, but was unable to provide the aerial observation of German fleet movements which could have given the British a decisive victory.

Profiting by this experience, the British completed, in 1918, a 300-ft. flight deck on the "Furious," with no obstructions to hamper flight operations. In July of that year this ship made the first carrier raid in naval history by approaching to within 80 mi. of the German Zeppelin base at Tondern, from which point six Camels were launched in a foray which resulted in the destruction of the Zeppelins L54 and L60. With the Armistice, Britain announced the first flush deck carrier, "Argus," which featured a temporary "island" from which ship control and flight operations were directed, and the aircraft carrier as a type was established.

The first United States carrier, which began operations in 1922 was the "Langley," converted from the collier "Jupiter." (Long known as the "Covered Wagon," this ship was later converted to a seaplane tender which the Japanese sank off Java in 1942.) Five years later, the 33,000-ton giants "Lexington" and "Saratoga," built on battle cruiser hulls scrapped by the Washington naval treaty, joined the fleet, and in 1934, with the commissioning of the "Ranger," the U.S. navy had its first carrier built as such from the keel up. In the next 15 years more than 150 carriers of all types were built, either for use by the U.S. navy or for transfer to other nations.

Carrier Aviation.—Fleet employment of aircraft carriers covers two uses: as a fast striking force, and as an escort force. As the two terms imply, the functions are widely different and are usually performed by different classes of carriers.

The fast carriers, used both for offensive and defensive operations, observations of enemy fleet movements and shipping, and strikes against beach head targets, are primarily an offensive weapon. Built to provide mobility and flexibility of operation combined with strong aerial power and heavy defensive armament, the fast carriers are able to take aerial control of great sea areas and to harass and destroy enemy forces which may threaten friendly combatant fleets, merchant shipping or amphibious operations.

Fast carriers in 1950 were of two types, one carrying about 100 planes and the smaller, but equally fast, 33-plane ship. Fighter, dive bomber and torpedo bomber squadrons were organized in carrier air groups, whose operations were highly co-ordinated. Specialized groups consisting of night fighters and high-speed photo reconnaissance planes were also carried by fast carriers.

War-time operation of such ships involved the task group of three to five carriers, supported by several battleships and cruisers and several divisions of destroyers, under one command. The fast carrier task force, such as task force 58 was composed of from two to five task groups. The striking power of such a force is illustrated by the fact that the first air assault on the Philippines in Sept. 1944 included 730 carrier planes, the task force which supported the Leyte landings a month later carried 1,060 planes and when task force 58 raided the Japanese home islands in Feb. 1945 the component carriers were able to put 1,220 planes in the air.

Escort carriers are slower, smaller ships, carrying about 30 planes, including fighters and torpedo bombers. The escort carriers, when organized as a force, provided air and anti-submarine defense for invasion convoys and beach head areas, and furnished aerial support for invasion troops until such time as conditions permitted the employment of land-based planes. Usually four to seven such carriers, with about twice as many escorting destroyers

were assigned to support amphibious operations, but these carriers did operate individually in certain phases of anti-submarine warfare and escort duties.

Tactical Effectiveness of Carriers.—Any discussion of the value of the carrier in fleet operations must be based on the assumption that the term carrier includes such a ship with her aircraft embarked in fighting readiness. The first step in winning control of the sea is to take control of the air above it, and the carrier's high mobility permits it to be quickly placed in the area where air control is desired, while its offensive power, figured in aircraft, enables it to take control of the air in the face of the most persistent and continued resistance.

An early example of the value of air control was the German loss of the "Bismarck" in 1941, when the presence of H.M.S. "Victorious" and "Ark Royal" allowed the British to put up sufficient planes to slow her to the point where battleships could close in for the kill. Later, in Dec. 1941, through lack of aerial control, Britain lost the "Prince of Wales" and "Repulse" to Japanese aircraft in the South China sea in an engagement lasting only two hours. Again, although this action took place in the straits of Dover within range of hundreds of R.A.F. land-based planes, Britain lost an opportunity to sink the German "Gneisenau," "Scharnhorst" and "Prinz Eugen" because the Germans maintained aerial control of the immediate area with a heavy cover of fighters.

A special factor in control of the air is the ability to exercise control at all times, as was learned by the United States in 1943

Aircraft Carrier Losses in World War II—All Nations

Name	Tonnage	Date	Place	Cause
UNITED STATES				
Lexington . . .	33,000	May 8, 1942	Coral sea	Fire—sunk by U.S.
Yorktown . . .	10,900	June 7, 1942	Midway	Submarine torpedoes
Wasp . . .	14,700	Sept. 15, 1942	Solomons	Submarine torpedoes
Hornet . . .	19,800	Oct. 26, 1942	Santa Cruz I.	Fire—sunk by U.S.
Liscome Bay	6,730	Nov. 24, 1943	Tarawa I.	Submarine torpedoes
Block Island	6,730	May 29, 1944	Atlantic O.	Submarine torpedoes
Princeton . . .	11,000	Oct. 24, 1944	Leyte gulf	Damaged by Japanese shore-based aircraft—sunk by U.S.
Saint Lo . . .	6,730	Oct. 25, 1944	Leyte gulf	Japanese aircraft
Gambier Bay	6,730	Oct. 25, 1944	Leyte gulf	Gunfire by enemy surface ships
Ommaney Bay . . .	6,730	Jan. 4, 1945	Lingayen gulf	Japanese aircraft
Bismarck Sea . . .	6,730	Feb. 21, 1945	Iwo Jima	Japanese aircraft
GREAT BRITAIN				
Courageous . . .	22,500	Sept. 17, 1939	Atlantic O.	Submarine torpedoes
Glorious . . .	22,500	June 8, 1940	Off Norway	Surface action
Ark Royal . . .	22,000	Nov. 14, 1941	Mediterranean	Submarine torpedoes
Audacity . . .	5,537	Dec. 21, 1941	N. Atlantic	Submarine torpedoes
Hermes . . .	10,850	April 9, 1942	Off Ceylon	Japanese aircraft
Eagle . . .	22,600	Aug. 11, 1942	Mediterranean	Submarine torpedoes
Avenger . . .	12,000	Nov. 15, 1942	Gibraltar	Submarine torpedoes
Dasher . . .	12,000	March 27, 1943	Firth of Clyde	Internal explosion
Nabob . . .	13,785	Aug. 22, 1944	North Cape	Submarine torpedoes
Thane . . .	13,785	Jan. 15, 1945	The Clyde	Submarine torpedoes
JAPAN				
Shoho . . .	12,000	May 7, 1942	Coral sea	U.S. carrier planes
Hiryu . . .	17,500	June 4, 1942	Midway	U.S. carrier planes
Agaki . . .	36,000	June 4, 1942	Midway	U.S. carrier planes
Kaga . . .	35,000	June 4, 1942	Midway	U.S. carrier planes
Ryujo . . .	17,500	June 4, 1942	Midway	U.S. carrier planes and submarines
Soryu . . .	8,500	Aug. 24, 1942	Solomons	U.S. carrier planes
Chuyo . . .	20,000	Dec. 4, 1943	Off Honshu	U.S. submarine torpedoes
Shokaku . . .	30,000	June 19, 1944	Off Yap I.	U.S. submarine torpedoes
Taiho . . .	37,000	June 19, 1944	Off Yap I.	U.S. submarine torpedoes
Hitaka . . .	28,000	June 20, 1944	Philippine sea	U.S. carrier planes
Otake . . .	20,000	Aug. 18, 1944	Luzon	U.S. submarine torpedoes
Unyo . . .	20,000	Sept. 16, 1944	China sea	U.S. submarine torpedoes
Zuiho . . .	12,000	Oct. 25, 1944	Luzon	U.S. carrier planes
Zuikaku . . .	30,000	Oct. 25, 1944	Luzon	U.S. carrier planes
Chitose . . .	11,000	Oct. 25, 1944	Luzon	U.S. carrier planes and surface craft
Chiyoda . . .	11,000	Oct. 25, 1944	Luzon	U.S. carrier planes
Jinyo . . .	27,000	Nov. 17, 1944	Yellow sea	U.S. submarine torpedoes
Shinano . . .	50,000	Nov. 29, 1944	Off Honshu	U.S. submarine torpedoes
Unryu . . .	18,500	Dec. 19, 1944	China sea	U.S. submarine torpedoes
Kaiyo . . .	17,000	July 24, 1945	Japan	U.S. carrier planes and army aircraft and mine
Amagi . . .	18,500	July 24, 1945	Japan	U.S. carrier planes

Note: All U.S. carriers sunk by Japan with exception of "Block Island"; all British carriers sunk by Germany and Italy with exception of "Hermes"; all Japanese carriers sunk by U.S. Figures on U.S. losses from various official U.S. navy reports; figures on British losses from *Jane's Fighting Ships, 1944-45*, Sampson Low, Marston & Co. Ltd. (London, 1946); figures on Japanese losses from U.S. Joint Army-Navy Assessment Committee, *Japanese Naval and Merchant Shipping Losses During World War II By All Causes* (Feb. 1947).

when the Japanese began to stress night torpedo attacks. The U.S. navy equipped carrier-type Hellcats and Corsairs with instruments for night fighting, and was conducting effective night-fighting operations from all carriers before the army land-based Black Widow night fighter reached the theatre. Night-fighting Hellcats alone accounted for 163 enemy planes with only three losses.

Possibly the best indication of the tactical effectiveness of carriers lies in the figures on Japanese shipping losses prepared by the Joint Army-Navy Assessment committee, on the basis of official Japanese documents. These figures, covering the entire period of hostilities, and compiled for all Japanese naval vessels and merchant ships of more than 500 tons, reveal that U.S. forces sank a total of 2,728 ships with a tonnage of 9,736,068. More than half the total was accounted for by U.S. submarines, but of the remainder, 520 ships displacing 2,101,477 tons were sunk by carrier aircraft. In addition, carrier aircraft in combination with other planes or vessels sank another 35 ships totalling 210,085 tons.

Carrier War in the Pacific.—Hostilities between the United States and Japan commenced with a well-planned and -executed Japanese carrier raid on Pearl Harbor the morning of Dec. 7, 1941, resulting in the complete loss of two U.S. battleships and immobilization of others for many months. Emphasis on carrier warfare was indicated by the fact that attacking Japanese pilots expected to find two U.S. aircraft carriers in the harbour and consequently pressed home a fierce attack on other ships which were in the usual carrier berths.

The next phase of the carrier war was the February to April series of diversionary raids by fast U.S. carriers in the Gilbert and Marshall Islands, Wake Island, Marcus Island and New Guinea, plus the famous Tokyo raid by Gen. James Doolittle leading a group of planes flown off the "Hornet." This phase was followed by the Coral sea battle which occupies a unique place in naval history in that it was the world's first major naval engagement in which opposing ships did not exchange a single shot.

In June 1942, U.S. and Japanese forces again met in the battle of Midway. While the United States lost one carrier, Japan lost four; this marked the first Japanese naval defeat in 350 years, ended its offensive action in the Pacific, and so reduced Japanese aerial power that its carriers were not again encountered in numbers for almost a year. During that time, U.S. carriers, in increasing numbers, continued strikes against enemy island bases, ending the year of 1943 with an 11-ship strike against the Gilbert and Marshall Islands.

Increased carrier warfare in 1944 resulted in 4 U.S. carriers being lost against 12 Japanese carriers sunk, and reached a culmination in the October battle of Leyte gulf, when U.S. carrier planes alone sank 4 Japanese carriers, 1 battleship, 2 light cruisers and 5 destroyers, besides assisting in the destruction of many others. At this point, the Japanese navy ceased to exist as a fighting force and control of the air passed to the United States.

Until the war ended, fast carrier striking forces ranged the western Pacific at will; in January they raided Formosa, Luzon, French Indo-China, Hong Kong, Canton, Okinawa and the Ryukyus; Tokyo was hit in February, the Inland sea in March and the China sea in April. Raids on the empire continued until the war was officially ended. In 44 months of carrier warfare, the United States lost 138,000 tons of carriers against 483,000 tons for Japan; for 451 carrier planes lost in air-to-air combat there were destroyed 6,444 Japanese planes in air combat plus 5,824 more destroyed on the ground.

Postwar Carrier Disposition and Employment.—With the cessation of hostilities in 1945, the immense carrier fleet of the U.S. navy was no longer required, and approximately 75 carriers were placed in reserve in the "mothball fleets." This involved maintaining the ships in a state of preservation such that they might be quickly placed in operation again when needed. Others, particularly those converted to naval use from merchant ship hulls, were sold as being in excess of naval needs, and some of these again were converted for various commercial purposes.

Of the carriers in active service with the fleet, some were undergoing extensive modifications to fit them for use with heavier and

larger planes in use, such as the Douglas Skyraider, with a wingspread of 50 ft. and weight of more than 10 tons, and the Martin Mauler, of similar size but weighing more than 12 tons loaded.

While continuing the tactical development of carrier aviation, carriers in commission also served as a testing ground for evaluation of new types of planes, and as a means of keeping in training the thousands of naval reserve flight personnel.

Postwar carrier operations also stressed the employment of carriers in "hunter-killer teams," an exclusive development of anti-submarine warfare, in which several destroyers act as the hunter of a submarine while the carrier planes perform the actual kill.

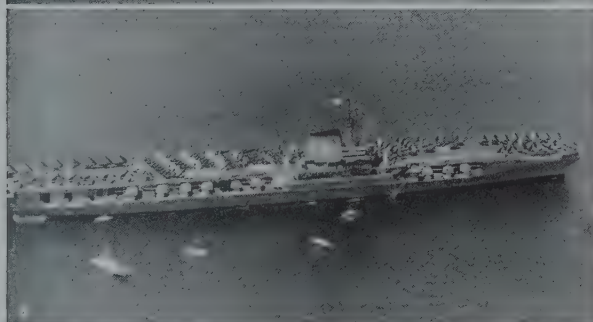
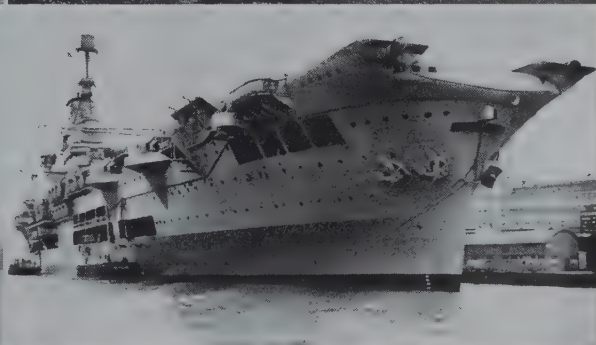
Carrier Description.—Since an aircraft carrier's one purpose is to carry planes, the landing platform, or flight deck, is the most outstanding feature of the ship. Varying in width from more than 60 to more than 100 ft., and in length from 500 ft. to almost 900 ft., it provides a miniature airport on which planes land, are fueled and armed, and take off. A series of steel cables extend athwartships over the after portion; these are lifted mechanically when a plane lands, and as a hook dropped from the plane's tail engages one of the arresting cables, hydraulic brake drums on either end decelerate the plane to a stop. In take-off, planes taxi off the forward end of the deck until airborne, although catapults built flush in the deck can be used when necessary, and jet-assisted take-offs were used for particularly heavy planes, such as the Martin Mariners flown off a carrier in Operation "Highjump" in Antarctica in 1947.

One or more elevators carry planes to and from the hangar deck, an open space almost as wide and long as the flight deck, where planes are parked when not immediately needed. As many as 200 planes can be carried in hangar and flight deck stowage by large carriers in "ferry" service. In the great hangar deck space, crews load bombs, torpedoes and ammunition, and gasoline into the planes, and perform overhaul and repair work as required. The hangar deck is, essentially, the true upper deck surface of the ship; beneath it are the living quarters, shops, storerooms, and engineering spaces common to all ships. Many carriers are, under the skin, sisters to various other types of ships; the "Independence" class carriers were built on the hulls of "Cleveland" class cruisers; the "Sangamon" class carriers were converted from oil tankers, and the "Bogue" class carriers were converted from maritime commission C3 hulls.

In order to attain their high speed, carriers are built with little or no armour, sacrificing such equivalent weight for the flight deck and an immense load of gasoline, bombs, torpedoes, fuel oil, spare parts and the stores and provisions with which to maintain as many as 3,000 men for an extended period. Some protection is offered by 5-in. guns and the many smaller automatic guns, but the carrier's chief defense is her speed and the firepower of such of her own planes as can be employed in defensive operations.

The vital nerve centres of a carrier are centred in the island, the only part of the superstructure extending above the flight deck. Here the ship is controlled and operated, and here all flight operations are handled. The island is located on the right-hand side of the flight deck in all aircraft carriers, except for the Japanese "Kaiyo" and "Hosyo," which were built without islands. Due to the din of dozens of motors connected with any flight operation, spoken conversation is practically impossible, and various hand signals are used by plane crews and plane handlers, although orders from the island can be given to the flight deck with a "bull horn," an electrical amplifier capable of magnifying the voice hundreds of times. To eliminate confusion among the many men working on the flight deck during operations, the men in each "gang" performing a specific task wear jerseys of a distinctive colour.

The actual landing of the planes aboard the carrier is under the control of one officer stationed at the after end of the flight deck. Highly experienced in the operation of carrier aircraft, he watches the approach of each plane, indicating to the pilot through a series of hand signals the proper moves to make in bringing the plane in to a landing. At any time the landing officer judges the approach unsafe, he waves the plane off and the pilot withdraws



PHOTOGRAPHS, (1, 2, 5-7) DEPARTMENT OF DEFENSE, (3) MARIUS BAR, (4) INTERNATIONAL

BRITISH, FRENCH AND UNITED STATES AIRCRAFT CARRIERS

1. The U.S.S. "Card," early escort carrier built on a merchant ship hull
2. The U.S.S. "Essex"
3. French carrier "Béarn," showing parasol-type aeroplane taking off
4. H.M.S. "Ark Royal," which carried 60 aircraft; sunk Nov. 14, 1941
5. U.S.S. "Franklin D. Roosevelt," a "Midway"-class carrier, showing planes parked with wings folded to conserve space, twin 40-mm. guns mounted aft on the hangar deck level, dual-purpose 5-in. guns housed in mounts on the starboard side, and radar installations forward of stack
6. U.S.S. "Saratoga," the navy's largest carrier in World War II, showing plane elevator lowered to hangar level
7. U.S.S. "Shangri La," a later "Essex"-class carrier

AIRCRAFT CARRIERS



DEPARTMENT OF DEFENSE

1. Planes being jockeyed into position by flight deck crews as carrier made a turn into the wind before launching the aircraft
2. Landing officer (right) guiding first plane in, with flight deck crew standing by and other planes circling above, waiting. Cables are

stretched across the deck as landing brakes, and a plane guard destroyer (extreme left) is on hand for rescue operations in event of crashes

into the landing circle of other planes to await his turn to come in for another landing.

Types of Carrier Planes.—Carrier planes in 1950 were of three major types: fighters, dive bombers, and torpedo planes. Fighter planes, designed for combat with enemy aircraft, were armed with machine guns and rockets; these with bombs, were also used against ships and land targets. Wartime carrier fighters were either Corsairs, Wildcats or Hellcats; types employed later included the jet-engined Cutlass and Sky Knight.

Dive bombers, as the name implies, dropped their bombs at the end of a dive, from extremely low levels, thus obtaining great accuracy. Such attacks were usually made in co-ordination with fighters and torpedo bombers as a triple threat offense. The early World War II dive bomber was the Douglas Dauntless, followed by the Curtis Helldivers. Torpedo bombers were Douglas Devastators and later, Grumman Avengers, carrying either a torpedo, a ton of bombs, depth charges or mines. Postwar planes of this class, classified as "attack planes," included the Douglas Skyraider and Martin Mauler. The twin-engined Lockheed Neptune patrol plane was also being modified for carrier operations.

(A. S. L.)

AIRD, SIR JOHN, 1ST BART. (1833–1911), British engineer, was born in London Dec. 3, 1833, the only child of John Aird, contractor for gas and water plants. He joined his father's business at 18, and was entrusted with the removal of the Crystal Palace buildings from Hyde Park and their re-erection at Sydenham.

He took part in many enterprises, such as the Hampton and Staines reservoirs, the waterworks of Amsterdam, Copenhagen, Moscow, Bahia, Pará, Calcutta, Simla and Berlin, and later (in the joint firm of Lucas and Aird, afterward John Aird and Co.) St. John's Wood railway, Hull and Barnsley railway and docks, the W. Highland railway and the great Aswan dam across the Nile. He represented N. Paddington in parliament as a Unionist from 1887 to 1905, and was its first mayor in 1900. In 1901 he was created a baronet. He made a fine collection of pictures by British painters, the illustrated catalogue to which was printed in 1884. He died at Beaconsfield, Bucks., Jan. 6, 1911.

AIRD, THOMAS (1802–76), Scottish poet, and journalist, was born at Bowden, Roxburghshire, on Aug. 28, 1802, and died at Dumfries on April 25, 1876. He was educated at Edinburgh university, where he made the acquaintance of Thomas Carlyle and James Hogg, and he decided to devote himself to literary work. He published *Martouffe, a Tragedy, with other Poems* (1826), a volume of essays and a long narrative poem in several cantos, *The Captive of Fez* (1830).

For a year he edited the *Edinburgh Weekly Journal*, and for 28 years the *Dumfriesshire and Galloway Herald*. In 1848 he published a collected edition of his poems, which met with much favour. Carlyle said that he found in them "a healthy breath as of mountain breezes." Among Aird's other friends were Thomas de Quincey, John Gibson Lockhart, Arthur Penrhyn Stanley (afterwards dean of Westminster) and William Motherwell.

See a "Life" by J. Wallace prefixed to the 5th edition (1848) of his *Poems*.

AIRDRIE, a large burgh of Lanarkshire, Scotland. Pop. (est. 1938) 28,134. Area, 3.23 sq.mi. It is 11 mi. E. of Glasgow by the Scottish region railway, and connects with Glasgow by the Monkland canal, as well as by the Scottish region railway via Coatbridge and Whifflet. The canal (constructed 1761–90) connects with the Forth and Clyde canal near Maryhill. Airdrie was a market town in 1695; its later prosperity was due to coal and iron beds. Industries are boilermaking, sanitary engineering, iron and brass founding, general engineering, railway carmaking and cotton manufacturing.

The burgh was the first town in Scotland to adopt the Free Library act. Airdrie unites with Coatbridge in sending one member to parliament. The parish of New Monkland, in which Airdrie lies, was formed (with Old Monkland) in 1640 out of the barony of Monkland, land granted by Malcolm IV to the monks of Newbattle.

AIRE, a town of north France, on the Lys, in the department

of Pas-de-Calais, 12 mi. S.S.E. of St. Omer by rail. Pop. (1946) 5,194. The town lies in a low and marshy situation at the junction of three canals. In the middle ages Aire belonged to the counts of Flanders, and a charter (1188) is still extant. It was given to France by the Peace of Utrecht (1713).

The church of St. Pierre (15th and 16th centuries) shows three stages of Gothic architecture. The hôtel-de-ville is 18th century. Aire has considerable trade in agricultural produce. In World War I it was one of the headquarters of the British army (1917–18).

AIRE, a town of southwest France, in the department of Landes, on the Adour, 22 mi. S.E. of Mont-de-Marsan on the railway between Morcenx and Tarbes. Pop. (1946) 2,974. Aire (*Atura*, *Vicus Julii*) was the residence of the kings of the Visigoths, one of whom, Alaric II (*q.v.*), there drew up his famous code.

It is the seat of a bishopric dating from the 5th century, and has a cathedral of the 12th century and an episcopal palace of the 11th, 17th and 18th centuries. Both have undergone frequent restoration. They are surpassed in interest by the church of St. Quiterie in Mas d'Aire, the suburb southwest of the town. The latter is a brick building of the 13th and 14th centuries, with a choir in the Romanesque style, and a fine western portal which became much disfigured. The crypt contains several Gallo-Roman tombs and the sarcophagus (5th century) of St. Quiterie.

AIR ENGINE. The practical drawbacks to employing air as the expanding substance of a heat engine are so great that its use has been very limited. Such attempts as have been made to

design air engines on a large scale have been practical failures, and are now interesting only as steps in the historical development of applied thermodynamics. In the form of domestic motors, air engines had some application, prior to the development of the internal combustion engine and the extended use of electricity. The type survives in a few motors of very small power. One of the chief practical objections to air engines is the great bulk of the working substance in relation to the amount of heat that is utilized in the working of the engine. Another is the difficulty of getting heat into the working air through the walls of the containing vessel.

Air takes up heat from such a surface with much less readiness than does water. The waste of heat in the chimney gases is accordingly greater; and further, the metallic shell is liable to be quickly burned away as a result of its contact at a high temperature with free oxygen. The temperature of the shell is much higher than that of a steam boiler, for in order to secure that the working air take up a fair amount of heat, the upper limit to which its temperature is raised greatly exceeds that of even high-pressure steam.

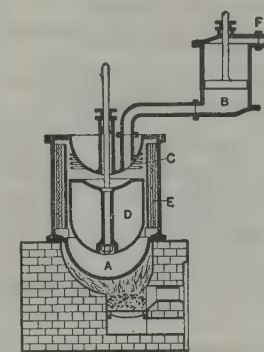


FIG. 1.—STIRLING'S AIR ENGINE

The working parts shown are:

- | | |
|------------------------------------|--|
| A. Externally fired heating vessel | D. Displacer |
| B. Working cylinder | E. Regenerator |
| C. Cooling pipes | F. Connecting flange to another heating vessel |

A form of air engine invented in 1827 by the Rev. R. Stirling is of special interest as embodying the earliest application of what is known as the "regenerative" principle, namely, the principle that heat may be deposited by a substance at one stage of its action and taken up again at another stage with but little loss, and with a great resulting change in the temperature of the substance at each of the two stages in the operation.

The principle has since found wide application in metallurgical and other operations. In any heat engine it is essential that the working substance should be at a high temperature while it is taking in heat, and at a relatively low temperature while it is rejecting heat.

An attempt to develop a powerful air engine was made in the

U.S. about 1833 by John Ericsson, who applied it to marine propulsion in the ship "Caloric," but without permanent success. Like Stirling, Ericsson used a regenerator, but with this difference,

tial principle by practically all countries, it was not so recognized by many until the experiences of World War II drove home the lessons which had been first learned in 1917.

Two Theories of Control.—Not unnaturally, the commanders of the surface forces have always wished to keep in their own hands the control of the air forces which they regard as auxiliary weapons to be used in the manner best fitted to the achievement of their plans for the prosecution of the war. The exponents of air power, on the other hand, have regarded this as a completely unjustifiable cramping of the possibilities of the air weapon, which they see as a means of acting directly upon aspects of the enemy's economy and will-to-war quite outside the reach of the other two services. In extreme cases, they urge, even final victory can be brought about by means of air action alone. Although not denying to the surface forces the services of specialized air units which can act in direct support of them, they hold that such services form only a small part of the activities which the air arm is qualified to carry out.

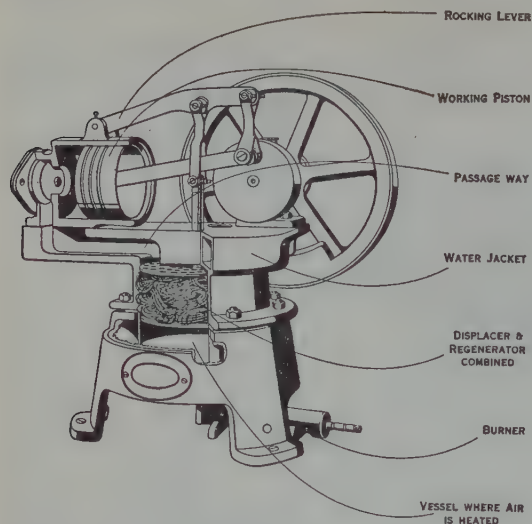
EUROPE

Evolution of Separate Air Forces.—In Great Britain, it was the difficulties in the matter of the supply of aircraft arising from the competing needs of the army and royal navy and the ill effect of such competition upon the country's air effort that forced upon the government a thorough investigation of the question of the control of the air forces. In June 1917 a cabinet committee was set up under Lieut. Gen. (afterward Field Marshal) J. C. Smuts, to consider the question of air defense and organization. As a result of its report, the Air Force (Constitution) act was passed and the royal air force was formed as a merger between the royal naval air service and the royal flying corps on April 1, 1918.

During the next 20 years the royal air force had to withstand a number of attacks upon its independence. Both the admiralty and the war office sought to regain control of their own air arms, urging not only greater economy, but the essential dependence of the air forces upon the commanders on the surface. Whereas, in the case of the army, these claims were not very seriously pressed, the royal navy held strongly the view that naval problems were so specialized that the fleet at sea could receive the kind of air support it needed only from aviators who had received naval training and that the great development in the role of aircraft carriers in naval warfare had enormously complicated the problems of naval aviation. After protracted argument it was decided by the government of the day that the admiralty's claim was justified, and a separate fleet air arm, manned by naval personnel, was formed, though the supply of aircraft to the royal navy remained a responsibility of the royal air force. With this modification, the pattern of 1918 remained virtually unchanged, and co-operation between the services was excellent and satisfactorily withstood the strain of World War II. The British example was followed simultaneously by the other commonwealth countries, and their common training and equipment ensured that they could all fit into a unified defense pattern immediately upon the outbreak of war in 1939.

Though no other country immediately followed Great Britain's lead in forming a separate air force in 1918, several had come around to its point of view before the next war occurred. Italy was the first to do so. The Italians had been early impressed by the possibilities of the use of air power, and the Italian Gen. G. Douhet had written a highly imaginative book in which he foreshadowed the decisive role which air power might play. Benito Mussolini clearly recognized the uses to which he might put a powerful air force in the prosecution of his plans of empire and set up a separate service in 1923. It attracted some of the most dynamic men in fascist Italy and, after being blooded in Ethiopia and Spain, entered World War II in high spirits. Though it was roughly handled by the Allies while Italy remained an enemy, it was resuscitated as a separate defense force at the end of the war.

France followed suit in 1928, and after the armistice of June 1940, while part of the French air force continued to serve the



BY COURTESY OF SCIENCE MUSEUM, LONDON

FIG. 2.—ROBINSON'S FORM OF STIRLING'S AIR ENGINE
In this domestic motor, the displacer and regenerator were combined thus simplifying the machine. A gas burner took the place of the furnace

that the pressure instead of the volume of the air remained constant while it passed in each direction through the regenerator.

(J. A. E.)

AIREY, RICHARD AIREY, BARON (1803-1881), British general, served in the Crimean War as quartermaster-general to Lord Raglan. He was recognized in the army as one of the best men on the staff, but public opinion held him responsible for the failures of the commissariat. Airey demanded an inquiry in which he completely cleared himself. He was governor of Gibraltar (1805-70), was promoted full general in 1871, received a peerage in 1876, and in 1878-80 presided over the commission on army reform.

AIR FORCES. Fighting men at first welcomed the balloon and the aeroplane merely as means of extending the range of their vision. They valued them for their relatively passive role of spying out the enemy's dispositions and not as in themselves actively aggressive weapons. Still less was it realized that the advent of the aeroplane introduced a fundamental change into the whole theory and practice of warfare. Naval and military staffs, therefore, interested themselves first in the development of scouting aircraft suited to their own special reconnaissance needs. The greater potential range of lighter-than-air craft recommended them particularly to the sailors, while the soldiers were attracted by the easier handling problems and greater manoeuvrability of the aeroplane.

Had World War I not occurred when it did, the potentialities of aircraft in war might well not have been recognized until much later than they were, and the aeroplane might have first developed as a transport vehicle rather than as a weapon. But the four years of war speeded aerial development enormously, and the aeroplane (followed temporarily and at a distance by the dirigible balloon) passed rapidly through the phases of offensive participation in the battle on the ground or sea to attacks upon the sources of enemy strength far removed from the battle area. Once the ability of air formations to act as a self-contained force at a distance from the immediate control of the ground or sea commanders had been recognized, the question of the desirability of their subordination to those commanders began, almost inevitably, to become a subject of debate. Though, by mid-20th century, the independence of the air forces had been accepted as an essen-

Vichy government in North Africa, units of the Free French air force were formed in Great Britain and fought side by side with the royal air force. After the war, a separate air ministry and air force were again set up in Paris.

In common with his fellow dictator, Adolf Hitler saw in a powerful air weapon the most decisive instrument of his policy, and, therefore, as soon as the arms limitation of the Versailles treaty had been repudiated, Germany embarked upon the creation of a great *Luftwaffe*, under the direction of Hermann Goering, a fighter pilot of World War I. By 1939 Germany was in possession of an air arm very much greater in size than that of any other power. In spite of this, and largely because of the failure to realize, even under the severe trials of the war, the correct use of air power, the German air force was beaten out of the air and virtually pinned to the ground during the last months of fighting in 1944 and 1945.

Of the other great powers, the U.S. and the U.S.S.R. did not follow the lead of Great Britain between the wars. The former, after practical experience in Europe and the Pacific, finally decided to make the air force independent of the other services in 1947 (see below), but the U.S.S.R. retained two air arms as integral parts of the army and navy, though there also existed an independent striking force at the disposal of the supreme command.

Co-ordination of Defense.—Although in the period before the advent of the flying machine it was usual for a country to wage war through the agency of two separate ministries and staffs, each responsible for operations in its own element, under a fairly loose political control of the nation's general war policy, it became generally realized that this was no longer practically possible. The air is indivisible over land and sea and takes no account of battle fronts and frontiers. As a result, the use of the air weapon raises problems of far wider scope than the defeat of the enemy's armed forces; inevitably war becomes total, an affair involving every activity of the warring nations; not only must the air force give its immediate support to the other services, but its activities must be fitted into a wider national strategy involving the highest political considerations. A defense organization correlating the activities of all three services therefore becomes a necessity, to ensure the adequate provision of resources and training to the separate services in peace and to direct their operations toward the achievement of the national aim in war. Such an organization must be presided over by a senior responsible minister; in war it is almost inevitable that the national chief executive should be at its head, for the decisions to be taken may well affect the very existence of the country.

The Aircraft Industry.—Aircraft are more rapidly and lavishly expendable than any other of the weapons of war, and this is true not only of the actual period of hostilities. Aircraft and their crews have a high wastage rate in peacetime, because of accident and the comparatively short life of aircraft before being worn out. Moreover, they become quickly obsolescent, and the introduction of some new technique, whether by designers of one's own or other countries, may suddenly make all aircraft out-of-date and involve a major re-equipment at urgent speed.

An active and well-equipped aircraft industry is thus an essential concomitant to the air force of a country which aims at air power. Not only must its factories be able to produce the most modern types of aircraft at a peacetime rhythm, but they must be so designed that they can be expanded to infinitely greater production in war and be able to throw off replicas of themselves as shadow factories with the necessary cadres of trained executives and technicians to get the new teams of workers into productive work at the earliest possible moment.

Because experimental work to introduce improvements is constantly necessary and costly beyond the means of individual manufacturers, the government must possess a technical agency charged with the control of constant research work to ensure that the equipment is kept always in the forefront of progress.

Composition of Air Forces.—As soon as the possibilities of using aircraft for purposes other than reconnaissance were recognized, early in World War I, specialization into types designed

for particular functions began. Aircraft for air-to-air combat, mostly light manoeuvrable single-seaters; weight-carrying aircraft, generally two-seaters, but occasionally bigger, for bombing; reconnaissance and artillery-spotting aircraft; seaplanes to co-operate with naval forces; all formed part of the air arms of the belligerents by the end of World War I.

During the following years of peace and preparation, the composition of air forces crystallized on these lines, the types for the various functions tending to be grouped together under separate subordinate commands, with specialized training to fit each for its role.

World War II, with its intensified air operations and greater speed of movement, naturally led to considerable modifications. While the main differentiated types continued to carry out their major strategic functions of defense and offense, there was a great extension of air activity over the narrow seas for the protection and the attack of shipping, and in the various main theatres of land operations it was found necessary to provide self-contained tactical air forces to meet the needs of the surface commanders.

Air Transport.—During World War II, the employment of aircraft for the transport of troops, not only from point to point behind the respective battle fronts, but also into the heart of the enemy's country, was also greatly developed. Each of the main belligerents formed special transport commands equipped with troop-carrying aircraft, and these were largely used for reinforcement and for the dropping of ammunition and supplies to distant garrisons and to isolated bodies of troops. For special operations, troops were parachuted to carry out sabotage or to hold bridgeheads until the main body had broken the enemy resistance and effected a junction with them; such occasions were the German seizure of Crete and the British operation at Arnhem. An extension of this technique took the form of towing gliders filled with troops behind transport aircraft and dropping them in the neighbourhood of the intended operation; during the Normandy operations and later at the Rhine crossing, this method was largely used by the British and U.S. forces.

In such operations as these, the tendency was for the land forces to take to the air, the parachutists and glider pilots being generally soldiers; artillery spotting also became generally a job for artillery officers flying their own light aircraft.

Reserves.—The vast increases in the air forces in war naturally place a great strain upon the industry and the training resources of an air power. Not only have great numbers of training aircraft to be made available, but buildings for housing and ground instruction must be provided at short notice and, most difficult of all to improvise, many additional flying instructors are required. The belligerent nations solved these difficulties in various ways during World War II. Under heavy bombing attack, Great Britain had perforce to arrange for most of its training to take place across the Atlantic; Germany found the problem more and more difficult as the war went on, and the falling off in the quality of its air crews was apparent. In the years after World War II, the soundest preparation appeared to be to build in peacetime a healthy civil aviation, both commercial and recreational. By this means it could be ensured that spare constructional capacity would be available in the aircraft industry and that a certain reserve of efficient flying personnel would be available to be called upon for transport and training purposes, though clearly the needs of war would be likely to make demands infinitely greater than any system economically suitable to peace conditions could supply.

Jet Planes and Atomic Warfare.—Just as the invention of the internal combustion engine with its characteristics of lightness and compactness in relation to power made inevitable the evolution of the aeroplane and conditioned the development of air forces and their characteristics, so the invention of the jet engine and the discovery of a means of using atomic power were likely to change profoundly their form and future use.

The coming of the jet engine would inevitably tend to push air operations to a greater altitude, since it could give its best performance only at great height, incidentally making the problems of interception of hostile aircraft more difficult, while the develop-

ment of the atomic bomb, with its infinitely great destructive power as compared with ordinary high explosive, was likely to have the effect of cutting down both the number and size of bombers employed.

It might well be that the air forces which had been developed from the flimsy reconnaissance machines of 1914 to the jet fighters and superheavy bombers were already obsolescent a few years after World War II, and that the next air weapons might be pilotless craft controlled from the ground and carrying destructive loads more powerful than anything yet envisaged. In that event, the whole theory and practice of warfare might change once again.

(D. Cr.)

UNITED STATES

When the United States entered World War I, little had been done toward giving the aviation section of the army's signal corps either adequate equipment or trained personnel, and its record of participation in the punitive expedition into Mexico (in its only previous combat operation) was one of dismal failure. In 1917 congress authorized an increase in personnel and appropriated \$640,000,000 for procurement of aircraft and for the support of the augmented aviation section, which now expanded rapidly from a personnel strength of 131 officers (of whom 78 were pilots) and 1,120 enlisted men in 7 squadrons (in April 1917) to 20,000 officers, 600 cadets and 164,000 men in 7 squadrons (in Nov. 1918). Aviation served successfully as the "eyes of the armies" as hostilities deteriorated into the long stalemate of trench warfare. A force of 1,481 planes—U.S., British and French—under the command of Col. William L. ("Billy") Mitchell took part in the St. Mihiel offensive of Sept. 1918, without producing decisive action. But World War I gave early training to future air leaders, revealed the potentialities of aviation for strategic as well as tactical reconnaissance, hastened the technical developments of aeronautics and pointed the way to the future use of air power in strategic bombardment.

The Army Reorganization act of 1920 established the renamed air service as a separate and co-ordinate arm of the army with an authorized strength of 1,516 officers and 16,000 enlisted men. The air service now concentrated on the progressive development and improvement of planes and motors built according to new and better designs. Experiments were made with the use of dirigibles, but they did not prove successful. Notable early records for distance, speed and endurance were achieved.

The Air Corps act of 1926 gave the air service a new name, and by provisions affecting personnel and procurement sought "to provide more effectively for the national defense by increasing the efficiency of the Air Corps." On June 20, 1941, the army air forces was established and—particularly as a result of reorganization announced March 2, 1942—achieved *de facto* autonomy, absorbing for all practical purposes the army air corps.

World War II saw the development of the use and the maturing of the strategic concept of air power. Tactical air power co-operated with the army and the navy to win victories in the invasion of North Africa in Nov. 1942, as it was to do later in the invasion of Normandy in the summer of 1944. But independent action of the A.A.F. (in co-operation with the R.A.F.) in long-range, strategic bombardment (chiefly by B-17s) did much to destroy and dislocate the German military, industrial and economic system and to undermine the morale of the German people to the point where their capacity for armed resistance was fatally weakened. Particularly notable was the destruction of the German fighter defense, beginning in July 1943 and culminating in the "Big Week" of Feb. 20, 1944, when six days of perfect flying weather permitted a continuous assault on the widely-dispersed German air-frame factories and assembly plants. The German aircraft industry never fully recovered from the blow, and the Allies controlled the air over Europe during the remaining 14 months of the war.

In the Pacific the A.A.F. won its initial victories in the China-Burma-India theatre, giving substantial protection against Japanese air power and disrupting the Japanese shipping and railways. It transported men and supplies for all U.S. forces, and in its

flight from bases in India over the "Hump" of the Himalaya to China performed a logistic air feat previously unparalleled, that kept China in the war. Co-operating with navy and marine air forces, it assured air superiority in the push toward Okinawa, and finally, when B-29s dropped single atomic bombs on Hiroshima and Nagasaki on Aug. 6 and 9, 1945, it deepened the conviction of the Japanese people that surrender was inevitable.

After the surrender of Japan the A.A.F. shrank rapidly from its wartime peak of 2,400,000 men and officers and 80,000 planes to a low point of 303,614 military personnel in May 1947. Hasty demobilization weakened the training facilities of the air force and reduced the force to such a low state in operational efficiency that there was deep concern for its capabilities. Anticipating the eventual enactment of legislation to establish an autonomous air force within a unified defense establishment and taking heed of lessons learned during the war, the air force reorganized its structure into functional commands to replace the previous organization based on geographical or area responsibility, or on the type of aircraft employed, and reorganized its headquarters functionally as well. The command structure that became effective June 11, 1946, was retained when autonomy was achieved, and the United States air force came into existence Sept. 18, 1947.

Of the three military services, the air force at mid-century had primary interest in operations in the air and had the responsibility, assigned by the joint chiefs of staff, of being organized, trained and equipped for prompt and sustained combat operations. There were two combat commands, eight supporting commands (which for the most part performed functions implicit in their names) and five commands overseas. The continental air command combined the former air defense command and tactical air command into a continental defense command, while the strategic air command trained primarily for long-range operations in any part of the world at any time, either independently or in co-operation with land and naval forces. The air materiel command, the air proving ground and the air training command lent direct support, while the Air university provided the training of staff and command officers. The military air transport service, a joint operation with the navy for which the air force had responsibility, provided air transportation for personnel and cargo of all agencies of the department of defense. The air force special weapons command was responsible for the service and development testing, within the field of air force interest and responsibility, of equipment and techniques relating to atomic energy. The research and development command (established Jan. 1950) had supervision of all U.S.A.F. field activities supporting research and development. The headquarters command supported the air staff.

The Alaskan air command and the Caribbean air command remained essential to hemispheric defense. The United States air forces in Europe and the far east air forces had occupational duties. The 3rd air division, raised to command status in Jan. 1949 with headquarters in England, supported air force activities overseas.

The necessity of performing the air lift supply of about 2,250,000 people in Berlin from June 26, 1948, to Sept. 30, 1949, proved a diversion from the air force's main task of rebuilding operational effectiveness, but provided opportunities that in the end contributed notably to the development of techniques and to the refinement of the total operational activity. In the "Good Friday" lift of mid-April 1949, 12,941 tons of food, clothing, fuel and other supplies were flown in to the beleaguered city in 24 hr. Almost 2,500,000 tons of supplies were carried in the 15 months of air lift in an unexcelled air logistics feat.

The attention to research and development which had characterized U.S. military aviation from its inception in 1907 was considerably increased after World War II and led to the rapid development of jet and rocket air power; to development of the long-range intercontinental bomber, the B-36; to establishment of records for long-range, high altitude and speed flights; and to notable experiments with guided missiles, which had been only slightly developed at the close of World War II. Particularly significant as pointing the way to future experiments and developments, and use of air power, were the many flights of the X-1

research aircraft after Oct. 1947 at a speed hundreds of miles in excess of the speed of sound (760 mi. per hour at sea level) and the flights of a C-54 transport aircraft across the Atlantic, under the control of a mechanical automatic "pilot," in the fall of 1947.

AIR GAS: see GASOLINE PRESSURE APPLIANCES.

AIR GUN, a gun in which the force employed to propel the bullet is the elasticity of compressed atmospheric air. It has attached to it, or constructed in it, a reservoir of compressed air, a portion of which, liberated into the space behind the bullet when the trigger is pulled, propels the bullet from the barrel by its expansion. The common forms of air gun, which are merely toys, are charged by compressing a spiral spring, one end of which forms a piston working in a cylinder; when released by a pull on the trigger, this spring expands, and the air forces out the bullet.

AIR HOIST. In factories and other places where a supply of compressed air is available, its use for operating lifting tackle is much favoured, because of the cleanliness, absence of noise and ease of connection with flexible hose.

The direct hoist, raising a load 4 or 5 ft., and dealing with from 100 to 7,000 lb. in different sizes, is the simplest. It comprises a cylinder, a piston, a rod attached thereto and carrying the lifting hook at the bottom and an operating valve, controlled by pendant chains. An eyebolt at the top affords means of suspension to a fixed beam, or a swinging jib, or to a trolley running on a girder, either stationary or forming part of a jib or travelling crane.

The hoist shown in the diagram is controlled by balanced pressure. The full air pressure of 100 lb. per square inch is maintained at the underside of the piston throughout all the operations of lifting, lowering and remaining stationary. For lifting, the attendant manipulates the valve so that air leaks off the top piston.

Another way of applying air power is to use a special pulley block to which is attached a small pneumatic motor, the cylinders of which actuate connecting rods and so drive a crankshaft, this being geared to the rope drum in order to gain power. Loads up to ten tons can be lifted in this way.

For colliery service, another class of air hoist is built, a winch or haulage engine, the rope drum being driven through gears from a pneumatic motor. This is essential in circumstances where compressed air is the power supply in use. Some of the engines can be run either with air or steam.

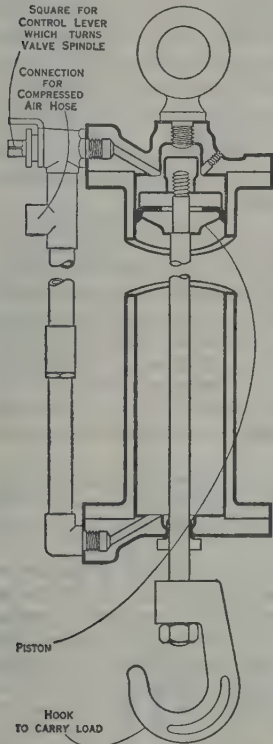
AIR LAW: see AERIAL LAW.

AIR LIFT, a system of lifting liquids by compressed air without a pump. For artesian wells the method consists in carrying down a smaller air pipe either within the water delivery pipe or alongside it and connecting an air compressor. The compressed air forms with the water a mixture of lower specific gravity than the surrounding water in the well or bore hole, with the result that the mixture of air and water in the tube is forced by the weight of the surrounding water to the point of discharge (see figure). When the supply flowing into a well is not enough to give constant delivery, waste of energy may be avoided by a

governor. Some air lifts yield as many as 285,000 gal. per hour per well. The Shone ejector, another form of air lift, is used for raising sewage and other liquids automatically from one or any number of points, and forcing to any spot desired. The difference between this and the well lift just described is that the liquid gravitates into a bell-shaped casting through an inlet pipe and rises until the vessel is nearly full. Then the air trapped at the top becomes slightly compressed and acts on a metal cup that lifts a valve and admits a supply of compressed air into the vessel. This drives the sewage out through an outlet pipe to reach a higher level or any distance away; a fresh supply enters through the inlet pipe, which has been automatically closed during the discharge, and the cycle commences again.

AIR LIFT (BERLIN). On June 26, 1948, an intensive air cargo operation was launched by the United States and Great Britain to offset a soviet land blockade of Berlin from western Europe. The blockade was aimed at wresting the western (U.S., British, French) sectors of Berlin from the control of the three western powers. It lasted 10½ months, to May 12, 1949, with a tapering off period ended Sept. 30. During the total period, the 2,500,000 inhabitants of the western sectors were supplied with 2,323,738 tons of food, coal, machinery and other necessities (1,783,826 tons by U.S. planes, 538,416 by British), at a cost, to May 12, of \$170,000,000. The air lift was discontinued after the U.S.S.R. agreed to reopen land and rail communications to the city.

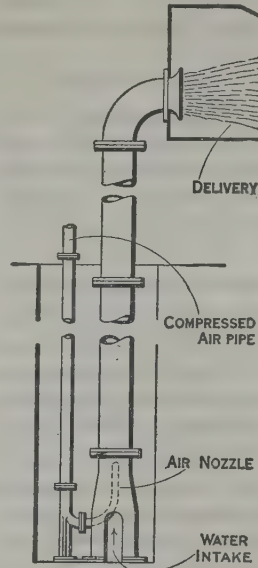
AIR LOCK, a steel-plated chamber provided in a tunnelling shield or a caisson (*q.v.*), to prevent the escape of compressed air during the passage of workers. The pressure in the caisson may be 25 to 30 lb. per square inch, though higher pressures have been used. A steel door at each exit of the lock provides for the



WORKING PARTS OF AN AIR HOIST

The hoist is suspended from the eye at the top and the load is slung on the hook. The piston is shown at the top of the chamber, it having been forced upward to the full length of its stroke by the pressure of the air from below

or haulage engine, the rope drum being driven through gears from a pneumatic motor. This is essential in circumstances where compressed air is the power supply in use. Some of the engines can be run either with air or steam.

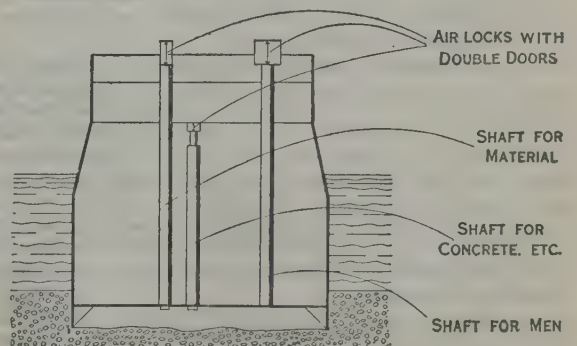


THE OPERATION OF AN AIR LIFT

The diagram shows water being forced up from a well by compressed air. Although chiefly supplied to wells and for lifting sewage, the method can be also used for moving acids, sludges, slimes and heavier liquids

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THE USE OF AIR LOCKS IN CONNECTION WITH A BRIDGE CAISSON

The usual air pressure in caissons is 25 to 30 lb. per square inch, and steel locks are provided for each shaft. Excavated material is raised by power and, at great depths, cages are used to bring workers to the surface. Under the high pressure, work becomes laborious, and every effort is made to minimize the worker's fatigue

safe passage of men or material, one being opened while the other is shut. There will be several locks in a tunnel shield and in some big caissons. The diagram indicates the shape of a caisson, sunk to make the foundation for a bridge pier, two shafts for material and one for men being fitted. The shaft down which concrete is shot has its airtlock placed lower than those of the other shafts, because the concrete mixer happens to be located on the lower platform.

Air lock also means the trapping of air in a bend; e.g., of a water or gasoline supply, stopping the flow.

AIR LOG or **AIR DISTANCE RECORDER**, an instrument which measures the distance flown by an aeroplane relative to the air. It consists of two units: a transmitter, which is installed on a wing strut or in some other position on the aircraft where it receives undisturbed air, and an indicator, which is mounted on the instrument board. The transmission may be either pneumatic or electric.

The transmitter comprises an impellor or windmill, which revolves as the aircraft moves through the air, the number of revolutions being proportional to the air distance travelled. The motion of the impellor is reduced by gearing to actuate a valve or contact at a predetermined unit of distance, the resulting impulse of air or electric current operating a ratchet in the indicator. The latter unit is simply a counter. By properly relating the pitch of the impellor blades and the gearing, the instrument will record any unit of distance, such as geographic miles, nautical miles or kilometres. The instrument is rendered inoperative below a predetermined minimum speed, in the pneumatic type by relating the air pressure to the speed in such a way that operating pressure is not available below the minimum speed, and in the electric type by using a centrifugally controlled switch. This protection is necessary to prevent the operation of the air log by the wind, while the aircraft is on the ground.

(C. H. C.)

AIR MASS, (a) in physical meteorology, the term for unit of mass of the atmosphere passed through by the sun's rays in reaching from outside the atmosphere to the earth's surface. Air mass of value 1 is defined as the amount of air passed through by the vertical rays when the sun is in the zenith. Then for lesser elevations of the sun above the horizon, the air mass m is nearly proportional to the secant of the sun's zenith distance, and may be described as the equivalent number of atmospheres of air mass 1 which the rays would pass through at any given solar elevation.

Tables of m values for various zenith distances are required for convenience in calculating the absorption of solar energy by the atmosphere. In order to avoid confusion with the expression *air mass* (see below) as used in synoptic meteorology, E. W. Woolard and I. F. Hand suggested the word *air path* for m .

(b) In synoptic meteorology, *air mass* is the designation for a vast body of air in which certain physical properties—mainly those of special value in analysis for weather forecasting purposes—vary but slightly in the horizontal.

The basic properties of air masses which determine characteristics of the weather are the vertical distribution of temperature and moisture content. These properties determine the actual or potential development of clouds and precipitation. Two air masses of similar horizontal homogeneity and similar average temperature and moisture at the ground, may have very different vertical distribution of these properties. The practice of air mass analysis for weather forecasting therefore requires upper-air soundings to determine the vertical distributions, although it is possible to infer to some extent the latter from the conditions measured at or seen from the ground.

The origin and persistence of distinctive air masses are explained by the facts: (1) that there are certain large *source regions* of the earth's surface where conditions are sufficiently uniform so that the overlying air can acquire similar characteristics; i.e., horizontal homogeneity, throughout the region; and (2) that the general circulation of the world's atmosphere has large-scale streams that are more or less steady and permit the travel of the air masses over long distances without being dispersed into small eddy branches.

The primary source regions are the polar areas and the subtropical belts (around 10° – 30° latitude). The middle latitudes are the scene of interactions between the polar and tropical air masses, which intertwine and over- or under-run one another in great spiral trajectories that constitute the travelling cyclones and anticyclones (*q.v.*).

Such interactions produce the major weather variations in these latitudes (see METEOROLOGY). There is a subsidiary class of source regions in middle latitudes where the effects of the prevailing difference in temperature between ocean and continent surfaces tend to transform originally polar or tropical air masses passing over them into subtypes with distinctive and important characteristics.

Thus polar (or tropical) maritime and polar (or tropical) continental air masses are created, which also may interact in cyclones and anticyclones as a result of the large-scale air circulation bringing them together. Near the coasts very rapid and striking transformations in air mass properties often take place, when for example, warm continental air moves onto cold ocean waters (in summer) or (in winter) cold continental air moves onto warm ocean waters; although such effects do not reach to very high levels in the atmosphere and are usually limited in area, locally they may play a dominant role in the weather.

Small-scale phenomena, such as sea and land breezes, mountain and valley breezes, may be considered as the result of contrasting local or pseudo air mass source regions.

Although the air mass concept was recognized in a general way by H. W. Dove and others before the middle of the 19th century, its practical significance in weather forecasting was first realized in 1917 by Norwegian meteorologists hard-pressed for a new technique to compensate for their lack of foreign weather reports withheld by the neighbouring warring nations. By 1923 it had been adopted by the weather services in Belgium and Germany; by 1930 in most advanced countries. It greatly improved accuracy of forecasting, but only for periods up to 24 or 36 hr. in advance, and clarified the understanding of many familiar weather phenomena.

The classification and detailed description of air masses are found in many modern standard treatises on meteorology (see especially H. C. Willett, *Descriptive Meteorology* [1944], pp. 183–224).

The classifications in use, however, are all based on properties important for forecasting temperature, clouds, rain, etc. It would be possible to make other classifications based on properties more important for other problems. This may not be entirely necessary, in as much as many phenomena (optical, electrical, biological, etc.) are more or less strongly influenced directly or indirectly by the same properties on which the existing forecasters' classification scheme is based.

The development of an air mass climatology has been proposed. It would entail first a description of the climate which is peculiar to each air mass type and then a description of the climates of places or regions in terms of the occurrence of the various air masses.

It had not been demonstrated by 1947 whether such a method would contribute much new understanding of the climate. In general, the usefulness of the air mass concept is limited by the lack of absolute homogeneity within and the diffuseness of the transitions between the air masses as observed in nature. The identification of air masses can not be made rigorously and only a qualitative unanimity of opinion about it can be obtained among meteorologists.

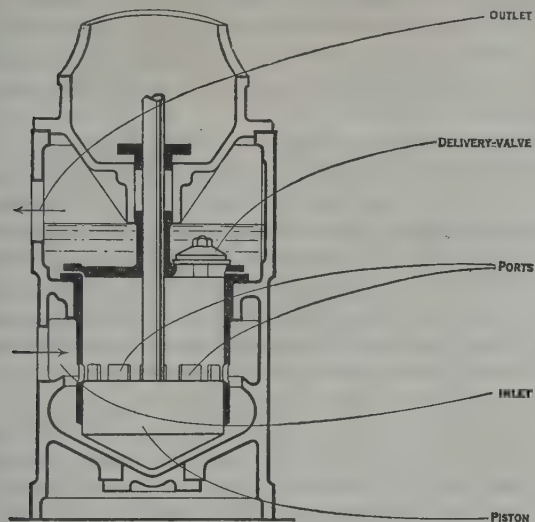
The analysis of air masses is to a large degree a matter of judgment based on a knowledge of the conservatism of the properties with time, season and region of the globe, and of the accuracy and representativity with which the properties can be measured in practice.

The occurrence of contrasting air masses with relatively sharp separations is a phenomenon mainly of the lower layers of the atmosphere, for the distinctions between the air masses readily identified near the ground are seldom traceable above 15,000 ft.

(R. G. SE.)

AIRPORT: see AERODROME.

AIR PUMP. This appliance was introduced by James Watt in 1765, when he invented the separate condenser for steam



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FIG. 1.—THE WORKING PRINCIPLES OF EDWARD'S AIR PUMP

The function of the pump is to extract the water and air from a condenser. As the piston descends at high speed the water collected below it is driven with force up the curved walls and through the ports. On the rise of the piston the air is forced out through the delivery-valve with a portion of the water

engines, in order to extract a mixture of air, water and vapour from the condenser, so providing the maximum practical vacuum. The air pump may be built as a part of the engine with its piston moved to and fro by a rocking lever, or sometimes by an extension of the engine piston rod through the back head of the cylinder. A separate drive by engine or motor makes the air pump an independent unit. An arrangement of valves allows the inrush of air and vapour on the suction stroke, and expulsion through other valves on the return stroke.

A simplified pump has a conical-shaped piston or bucket (fig. 1) which dashes at high speed down on to the water collected below which it drives upward into the pump barrel above the bucket, which has just uncovered the ring of ports. The water, vapour and air shoot up the barrel and out through the top valve.

Modern pumps move the air independently of the water. The ejector type of air pump is the most popular. A steam jet extracts the air and vapour from the condenser, which it discharges to the second jet, which finally ejects the air against atmospheric pressure. The ejector may incorporate a small condenser, an arrangement seen in the drawing (fig. 2), consisting of a series of small tubes through which water from the condenser (termed the "condensate") is pumped. The primary steam jet sucks in air in the direction of the arrow at A, and discharges it along with the operating steam into the first condensing compartment. The secondary jet withdraws the aerated vapour from the first compartment and sends it with its operating steam into the second condensing compartment. The heat remaining in the steam after it has done its work is thus transferred to the condensate, so acting as a feed-water heater to the latter on its way to the boiler. The tire pump is a familiar example of simple reciprocating class, though strictly it should be termed an air compressor. (See also VACUUM-PUMP.)

AIR RAIDS. Air raids are efforts to destroy objectives on the surface of the earth by means of missiles released from aircraft in flight. They are the means of expressing the offensive in air warfare. As their name implies, they were initially looked upon as a means of harassing an enemy, and no great or decisive effect was expected from them. However, as bombing aircraft became larger and more efficient, the destructive potentiality of air raids increased, until great towns were devastated, industry and transportation brought to a virtual standstill and the war-making capacity of nations fatally undermined by means of bombing from the air.

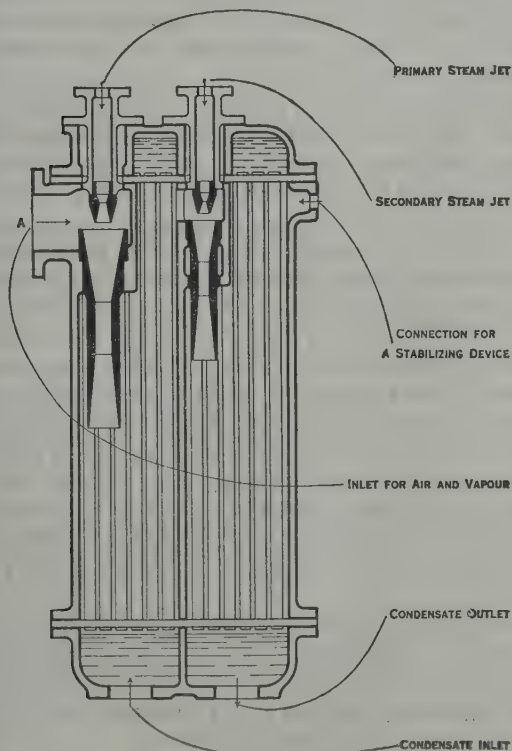
In World War I, London was the principal objective of the German air raids. On their side, the Allied air forces repeatedly attacked the industrial centres of the Rhine. The number of aircraft employed and the weight of bombs dropped in these operations were negligible by the standards of 1944-45.

In World War II, air raids worked up in a crescendo from the minor affairs of the early months of the static war (though the bomb attacks on Poland in Sept. 1939 were an indication for the future), through the relatively intense bombing of England by the Germans, to the massive Allied attacks on the axis. The end came with the V-1 and V-2 raids on England and Belgium in 1944 and 1945 and the two atomic bombs on Japan in the summer of 1945, which heralded, but were not the reason for, the Japanese surrender.

In the course of these developments, the whole technique of bombing underwent several complete transformations because of the ever increasing weight of explosive dropped from larger and larger fleets of more and more powerful aircraft, and the introduction of mechanized and radar aids to navigation, interception and bomb aiming such as had hardly been dreamed of when the war began. Finally, the perfection of the atomic bomb and its experimental use against Hiroshima and Nagasaki opened up the possibility of a new era in bombing in which not the size of the bomber fleet but the destructiveness of the individual bomb would be the determining factor in the effectiveness of the raid.

AIR RAIDS IN WORLD WAR I

From a historical, though no longer from a military point of view, the raids on Great Britain, France and Germany in World



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FIG. 2.—DIAGRAM SHOWING OPERATION OF AN EJECTOR AIR PUMP

The type shown is operated by steam jets. The primary steam jet withdraws air and vapour from the main condenser and discharges to the secondary jet which finally ejects the aerated vapour at about atmospheric pressure. The tubes constitute a small condenser which helps to warm the condensate ready to go back into the boilers

War I are worthy of study. In the exercise of its characteristic ability to overpass the enemy's armed forces and attack the heart of the country and its war industries, the air arm had shown that an end once and for all had been put to the possibility of limited conflicts. Henceforward, war meant total war.

Raids in 1914-15.—In Dec. 1914 a couple of bombs were dropped in the sea off Dover, and three days later, on Dec. 24, the first German air projectile hit English soil. A few half-hearted attacks by aeroplanes during 1915 were ineffective, and it was left to the lighter-than-air machines to cause the first damage. On Jan. 19, 1915, naval Zeppelins dropped bombs on Yarmouth and Cromer and killed four people. The first raid on London occurred on the night of May 31, 1915, when a single military airship caused 41 fires and 5 deaths. On June 6, Hull was bombed, with 24 fatal casualties and the destruction of 40 houses. On this night an airship, the L237, was destroyed near Ghent on its homeward journey by Lieut. R. A. J. Warneford, R.N., who received the Victoria cross for his exploit.

During the latter months of 1915, London was bombed four times. Damage amounting to £500,000 was caused, and in a raid on Woolwich 33 people were killed and 77 wounded.

Raids in 1916.—In the early part of the year, the British defenses had little success against the Zeppelins. On Jan. 31, 1916, nine Zeppelins had their own way over the midland counties, and bombs dropped on Shrewsbury killed 59 people. Of 16 British aircraft which took off to intercept, 8 crashed on landing. By the spring, however, the British defense measures improved. The L15, one of the five Zeppelins that attacked on March 31, was hit by gunfire, fell in the air by Lieut. A. de B. Brandon of the royal flying corps and crashed into the sea off the coast of Essex. However, 15 raids on England and Scotland during April caused 84 deaths.

On Sept. 2 London suffered a raid by 14 Zeppelins, of which one, the SL11, was destroyed in flames near Cuffley, Middlesex.

On Sept. 23, 1916, three of the newest super-Zeppelins attacked London. Of these, the L33 dropped 20 bombs, but the city was no longer helpless. Lit by searchlights, the airship was riddled by fire from guns and aircraft and landed near Colchester, its crew being made prisoners. A second aircraft, the L32, was brought down in flames at Billericay. Meanwhile, the third ship, piloted by Mathy, the boldest of the Zeppelin commanders, reached London and dropped a number of bombs on the outskirts and returned safely to Germany. The British casualties on this night were 40 killed.

Mathy's career was brought to an end on Oct. 1. Eleven Zeppelins crossed the coast at Lowestoft and steered toward London. Under heavy gunfire, Mathy in the L31 was brought down in flames at Potters Bar. During the whole raid by 11 aircraft, the British loss was only one killed. The defense of London had now definitely mastered the lighter-than-air attacks, and no German airship thereafter flew intentionally over the metropolis.

The last attack with airships on England in 1916 was made on Nov. 27, when eight Zeppelins reached the coast, one being brought down over Hartlepool and another at Yarmouth, after a remarkable flight across England to Cheshire and back to the east coast. Before the end of the year, the first aeroplane attack on London was made by a single aircraft which dropped six small bombs in daylight with slight result.

Raids in 1917.—By the end of 1916, the German command had come to the conclusion that it must try new methods. Early in 1917, therefore, they began to equip a squadron of aeroplanes for the systematic bombing of England.

The squadron began to operate about the end of May, but its first two attempts to reach London were unsuccessful, though in one of them a Canadian camp at Shorncliffe and a street in Folkestone were bombed, causing 133 fatal casualties. One of the aircraft was hit by anti-aircraft fire and fell into the Thames. The third attempt on London was more successful. A bomber squadron attacked the city just before noon on June 13, 1917; 72 bombs were dropped in the neighbourhood of Liverpool street station, and casualties were caused amounting to 104 killed and 423 injured.

London was again successfully raided by 22 aircraft on July 7. Seventy-six bombs destroyed a number of buildings, damaged the general post office, killed 46 people and injured 123. The anti-aircraft fire was unsuccessful in hitting any of the raiders. The failure of the defense measures caused a public outcry, and the government ordered a complete reorganization. The London air defenses were formed into a separate command and, under Gen. E. B. Ashmore, included all means of defense, both ground and air.

The new arrangements were soon tested. On Aug. 12, nine Gothas, heavy bombing machines, made landfall at Harwich and turned inland for London. The communication system of the defense control worked well, and the squadrons immediately defending London were at the required height in time to meet the enemy formation. The attack was beaten off, and the bombs were unloaded at Southend, where 32 people were killed.

An abortive attack by eight Zeppelins was made on the midlands on Aug. 21, and the next day the last daylight attack was made on England, when 13 Gothas started out to bomb Sheerness and Dover. British seaplanes turned them back from their objective, and three of them were destroyed by gunfire.

Night Attacks Begin.—The first group of night attacks by aeroplanes came in the beginning of September. On the night of Sept. 3-4 hostile aircraft came in over the North Foreland and, though they did not reach London, one of them dropped a bomb on a building at Chatham where a number of naval ratings were asleep, killing 107 and wounding 86. The following night, the German squadron reached London, though a number of the aircraft were turned back by gunfire. This time damage caused was small and the total casualties amounted to only 14 killed and 48 injured.

The defenses had profited from their experience of these early night raids, the pilots in the handling of their aircraft at night and in finding their objectives, and the anti-aircraft guns in the evolution of a barrage system of fire which disconcerted the raiders.

On the night of Sept. 24, the Germans launched a double raid with an aeroplane attack on London and a simultaneous Zeppelin raid on Hull. In London, barrage fire turned back most of the raiders and brought 1 down, but 27 British aircraft which took the air failed to find the enemy. The airship raid on Hull had slight success.

During this period, barrage fire scored a considerable success in turning a large proportion of the attackers back before they had reached their target, but it was expensive in ammunition; and the defending squadrons of aircraft were still far from an efficient instrument because the central control could give no information to pilots once they had left the ground.

An airship raid on the night of Oct. 19-20 had points of special interest. Eleven airships met off the Yorkshire coast to attack industrial centres in the midlands. They flew at more than 16,000 ft., where they suffered greatly from cold and also encountered a strong northerly gale before which they drifted south helplessly. One airship crossed London and dropped a bomb on Piccadilly circus, though without realizing its whereabouts. The raid ended in disaster for the attackers. One flew back to Germany in the normal way, six got back by flying over the Netherlands or across the Allied lines, but the remaining four were destroyed on French territory.

At the end of October, the Gothas renewed their raids on London, but the defenses of the capital were showing steady improvement. Two Gothas were brought down by anti-aircraft fire on Dec. 6. In a raid on Dec. 18, the Germans first used a giant aircraft which dropped a 300 kg. bomb near Eaton square, making a large hole but doing little damage.

Raids of 1918.—During the first quarter of the year, five aeroplane raids took place, the Germans showing a tendency to employ more and more of the giants in place of the smaller Gothas. One Gotha was destroyed by a fighter on Jan. 28, on which night a bomb dropped by a giant aeroplane fell on a building which was being used as an air-raid shelter, and 41 people were killed. The use of the 300 kg. bomb was now becoming

general, and the damage caused by it was considerable. On March 7, the only aeroplane raid on London in a nonmoon period took place.

Meanwhile the Zeppelins began their last series of raids on England on the night of March 12. They now tended to bomb from a considerable altitude, and the damage caused was generally slight. Their last appearance was on the night of Aug. 5-6, when five Zeppelins came up the coast of Norfolk. No bombs were dropped on land and the L70, the latest word in airship construction, was destroyed.

In the great aircraft raid of May 19, 1918, the Germans made their maximum and final effort of the war with this form of attack. Between 30 and 40 Gothas and at least 2 giants took part. Thirteen raiders managed to reach London, and the damage was considerable; 34 people were killed and 98 injured. By this time, however, the defense was really something to reckon with. The Germans lost seven aircraft: three were shot down in air combat; three were destroyed by gunfire; and one was compelled to make a forced landing because of engine failure. This defensive success was final, and the German air force made no further attempt to bomb London.

In the raids during World War I on England, the Germans employed 435 aircraft and 208 airships, which dropped 2,869 and 5,907 bombs respectively. In these raids 1,316 people were killed and 3,000 injured, and the material damage caused was considerable. Over and above this, the holdup of work in factories because of the presence of enemy raiders and the slowness of the personnel in returning to work in vulnerable areas after a raid had taken place had a far from negligible effect on production.

AIR RAIDS IN WORLD WAR II

The possibility of raids of overwhelming severity had been impressed upon the people of Europe with great clarity during the period before the outbreak of war in 1939. The raids that had been carried out by the Italians in Ethiopia, admittedly against a primitive people entirely unprovided with defense against air attack, and the air attacks by both sides on troops and centres of population during the Spanish Civil War had made the world very bomb conscious. Moreover, most of the European countries had given much attention to measures of civil defense, in the course of which the dangers of neglect to comply with the precautions recommended had been painted in the most sombre colours. The likelihood of bombardment with poison gas had been stressed, and it was widely expected that this form of attack would be employed by a ruthless enemy from the first, as it had in fact been used by the Italian air force in Ethiopia, though not by either side in Spain.

Though most of the ideas held by the general public about air bombardment were in the highest degree fanciful and were later falsified by events, World War II began with an exhibition of air bombing which showed how important a part this form of offensive would play in modern war.

The Continental Campaign, 1939-40.—On the morning of Sept. 1, 1939, when the German campaign against Poland was launched, the German air force struck heavily against the Polish air force. In less than three days the air raids directed against its aerodromes caused the complete destruction of Polish air power as an effective means of resistance. Then the attacks were switched on to railway bridges, locomotives and rolling stock, to break up the lines of communication of the Polish armies. As resistance crumbled, the air raids were directed against columns of moving men and vehicles on the roads and, finally, they were centred on Warsaw, the last seat of resistance. The city suffered heavy damage.

On the western front, the first eight months of the war saw few large-scale air raids by either side. Extensive reconnaissance flights were made and data collected for the real struggle to come. In the spring of 1940 it came with great violence.

In the attack on France and the Low Countries, the German air raids were designed to assist their ground forces. In the Netherlands, parachute troops and air-borne infantry were used

with striking success. Just as the Netherlands capitulated, a three-hour air raid was directed against Rotterdam. A high degree of damage resulted, and the heart of the city was wrecked.

In France and Flanders, air attacks were made upon key fortresses in the great systems of French and Belgian ground defenses as well as against the French air force and railway system. The concentration of air power was so intense that the German ground forces had little difficulty in breaking through.

Under the shield of air attack the German army drove relentlessly forward to trap the British expeditionary force at Dunkirk. There the royal air force established a local fighter defense that largely nullified the strength of the German air attack, and the Germans were unable to destroy the forces being evacuated across the channel.

The Battle of Britain.—After the fall of France there was a comparative lull in air activity for about six weeks. Then, in August, the Germans launched a heavy air offensive against England as a preliminary to their projected invasion. Though the possibility of invading the British Isles rapidly faded in face of the defensive strength of the British air forces, the bombing offensive, mainly directed against London, was sustained for many months.

Initially, the German air staff concentrated its efforts upon the elimination of the British fighter force by attacks upon aerodromes, aircraft factories and radio-location (radar) stations, while at the same time attempting to lure the fighters into the air by attacks upon shipping. Although it inflicted much damage in these attacks, the *Luftwaffe* lost heavily (76 aircraft on Aug. 15), and by the end of August the first phase of the battle of Britain was over, leaving the German air staff with many lessons to digest.

During the second phase, the attacks were concentrated mainly

TABLE I.—Air Raids on Great Britain in World War II

Cities and towns most heavily raided			
Place	Tonnage of aircraft bombs dropped (metric tons)	Casualties	
		Killed	Seriously injured
London	12,238.05	29,800	50,507
Bristol	988.01	1,223	1,140
Liverpool (and Birkenhead)	882.88	3,219	3,073
Coventry	854.62	1,250	1,858
Birmingham	823.84	2,337	2,024
Hull	744.80	1,212	1,051
Manchester	496.42	577	583
Plymouth	489.56	1,100	1,102
Southampton	452.47	508	880
Sheffield	342.48	624	568
Glasgow	311.72	776	597
Portsmouth	259.60	847	1,113
Swansea	243.87	380	401
Belfast	182.20	667	678
Canterbury	179.00	114	127
Norwich	154.31	346	362
Bath	132.07	415	371
Cardiff	118.08	263	353
Folkestone	103.60	123	124
Exeter	95.02	272	241
Dover	81.91	232	371
York	59.53	85	118
Total for the whole of Great Britain	70,905.00	60,595	86,182
Enemy aircraft destroyed (claims only)			
Destroyed by fighter aircraft in defense of Great Britain			3,743*
Destroyed by anti-aircraft command			833
Destroyed by balloon command			24
Pilotless aircraft or flying bombs (V-1)			
Target: Principally London area and Manchester			
Estimated number launched (from ground)			0,230
(from air)			1,287
Number that fell in target area			2,420
Number brought down by guns			1,878*
Number brought down by fighter aircraft			1,846*
Number brought down by balloons			231*
Total brought down by all arms			3,957
Casualties			
Killed			6,184
Severely injured			17,681
Slightly injured			24,493
Rockets (V-2)			
Target: Principally London area and Norwich			
Number launched			not known
Number reported by the defenses			1,115
Number that fell in London area			518
Casualties			
Killed			2,754
Severely injured			6,523
Slightly injured			15,438

*Fractions relate to claims shared between different arms of the defense
Source: Compiled from data given by the Home Office and by the Air Ministry, London.

upon London and were made both by day and by night. With the exception of the attack of Sept. 7, 1940, with about 400 aircraft, the *Luftwaffe* was unable to break through to the heart of London by day, and though the casualties and damage inflicted on that occasion were heavy, its own casualties during these weeks, which reached a figure of more than 50 on some days, convinced it that daylight raids in face of the defenses of the metropolis did not pay. A week later, in the course of raids on the outskirts of London and the south coast, the German air force suffered heavily, losing 56 aircraft in one day.

In the final, long drawn out phase of the battle, heavy and sustained night attacks were made against London and other British cities, but there was little real military purpose behind them. Almost nightly for three months, up to the end of 1940, German bomber attacks averaged 200 sorties a night. The casualties they inflicted during this period were heavy, but they failed to break the spirit of the people or vitally to damage industry. The general accuracy of the bombing was poor, with a high proportion of bombs falling in open country or on unremunerative targets. Later, although attacks continued to be made for a time and damage resulted to London and a number of other towns of industrial or cultural importance, the German bombing policy lost its objectivity, and with the *Luftwaffe's* preoccupation elsewhere and the greater strength of the British defenses, heavy aircraft raiding of England virtually came to an end by the early summer of 1941.

Malta and the Mediterranean.—The Germans next switched their attention to the Mediterranean, where their Italian allies were in need of support in their African campaign. It was first necessary to eliminate Malta as a platform for British aircraft capable of harassing the sea routes; and therefore 1941 and early 1942 saw a heavy air offensive carried out against the island. The German bomber force consisted of about 150 Junkers 87s and 88s, protected by Italian fighters, and Malta, with the slenderest of fighter defenses, suffered heavily, not only from attacks on the island itself, but through the losses incurred by convoys attempting to bring in fuel, food and reinforcements. The bomb attacks on Malta, however, always just failed to be sufficiently sustained to achieve their object, and the need to divide the *Luftwaffe* to deal with the needs of the desert campaign in Africa and of the successive attacks upon the Balkan countries and Russia meant that the bomber forces were too weak to deal a knockout blow anywhere. During 18 months fighting in the Mediterranean, the Germans were generally trying to do too many things at the same time, with the result that they were weak and comparatively ineffective everywhere. By June 1942 their Mediterranean air offensive was over, and thereafter the initiative swung to the side of the Allies. British bombers cooperated with ground forces in beating Field Marshal Erwin Rommel's armies in Africa; they helped the Allied forces to sweep forward to Italy; captured aerodromes gave the bombers bases from which to operate over the Alps into southern Germany; and the main Allied bombing policy now began to exhibit the rudiments of the plan that led on to an unbroken succession of attacks of increasing intensity and the staggering blows that were to paralyze German and Japanese resistance three years later.

The *Luftwaffe* in the Russian Campaign.—In the U.S.S.R., the *Luftwaffe* commanders proved that they had really learned little by the experience which they had by now received in the handling of air forces in modern war. For them, air power was still a weapon to be used for the tactical benefit of the armies in the prosecution of the blitzkrieg, the one form of warfare upon which the German high command relied for the achievement of victory. For this reason, there is little to be learned by the student of war from a consideration of the bomber operations which took place on either side during the Russian campaign. The heavy bomber raids on Moscow and other soviet cities were for the most part badly planned affairs in which heavy losses were suffered from fighters and anti-aircraft defenses, whereas relatively little serious damage was done to the objectives. On the soviet side, bombing took rather a haphazard form and had little effect

upon the progress of operations.

The Strategic Plan.—Despite the failure of the Germans to achieve their objective in the battle of Britain, there were those on the Allied side who were unshaken in their belief that a bomber offensive properly directed, unfalteringly sustained and of sufficient weight would prove decisive in the winning of the war. The errors made by Germany in directing air offensives against the British Isles, in the Mediterranean and in the course of the Russian campaign were evident, and by 1942 the inability of the *Luftwaffe* to play a decisive role was obvious. Since the beginning of the Russian campaign, the *Luftwaffe* had been fighting on three fronts at once, and already the German aircraft industry was swinging away from the construction of strategic bombers to concentrate on tactically offensive or purely defensive types. The British royal air force early initiated a policy of night attack upon German industry and had continued these attacks to the limit of its strength in unbroken and increasing intensity.

Soon after the entry of the U.S. into the war, U.S. bombers began to arrive in Great Britain to take their part in this offensive. Within six months more than 400 heavy bombers were based on British aerodromes, and on Aug. 17, 1942, 12 Flying Fortresses made a day attack on the railway marshalling yards at Rouen, France, and returned without loss. The day and night partnership of the U.S. and British bomber forces had begun.

In Jan. 1943 the Allied leaders at Casablanca authorized an increased bomber offensive and defined its object as "the destruction and dislocation of the German military, industrial and economic system and the undermining of the morale of the German people to the point where their capacity for armed resistance is fatally weakened." It was clear that the ability of the bomber forces to implement this directive largely depended on the possibility of checking the activities of the German defensive fighter forces. A first call upon the activities of the bombers was, therefore, to destroy the factories where the fighter aircraft were constructed, together with the engine, ball-bearing and accessory plants associated with them. Once a sufficient degree of immunity from interference had been won for the bombers, they could turn their destructive activities to other and more direct sources of the enemy's power of resistance.

The new offensive began forthwith and, despite heavy losses to both the Allied air forces, considerable results were achieved: the rate of delivery of fighter aircraft to German air force units was sensibly reduced. Though the effect of this slowing up of production was not felt immediately, the shortages that were ultimately imposed on the fighter units had a significant effect upon their ability to interfere with the Allied attack at a most critical stage of the war early in 1944.

Although right up to the end of World War II Germany continued to concentrate the main portion of its aircraft productive capacity on the output of fighter aircraft to defend its cities and industries against the increasing weight of bomber attack and though the Allied bombers continued to suffer severely from German fighter attack, sufficient freedom of action was won for them to attack with increasing force every phase of German life and war-waging activity and especially its cities, transportation systems, fuel and heavy industries. The Allied air staffs devoted much energy and ingenuity to the collection and interpretation of information concerning German industry and in assessing its vulnerability to raids and the speed at which it would recover from such attacks. As time went on, valuable information was accumulated and many earlier estimates of the effect of bombing upon industrial targets had to be reconsidered. For instance, intelligence sources indicated, and postwar investigation afterward confirmed, that even the most destructive raids often had a much smaller effect than was expected upon the productive potential of a plant. Generally speaking, it may be said that the most rewarding strategic targets were oil and nitrogen plants and attacks upon transportation targets. Later, when the royal air force turned to area bombing of towns, one of the most important effects upon the enemy war-making capacity was the number of workers who had to be diverted from productive work to such activities as debris clearance, reconstruction and the

replacement of household goods destroyed in raids. It was estimated that by the end of 1944, 20% of the German labour force, excluding agricultural workers, was engaged in this type of work.

Invasion of the European Citadel.—In the preparation for the invasion of the German fortress of Europe, the air had a many-sided offensive role to play. In the long period of preparation, when attacks upon the centres of production and the means of transportation were most important in order to prevent the enemy from reinforcing and supplying his defensive forces, the ability of the bombing forces to make deep penetrations into Germany depended largely upon their freedom from interference. During the early part of 1944, therefore, the long-range fighters which could accompany the bombers to their objectives—notably the U.S. P-51 Mustang fighter—had a vitally important part to play. By tempting the German fighters, whose production was already suffering from the offensive against the aircraft factories, into the air and destroying them there, the Mustangs not only enabled their bombers to attack their objectives with success but also ensured that, when the invasion came, the ground forces could proceed from the United Kingdom virtually immune from attack from the German air force.

In the invasion itself, the air forces played manifold roles in conjunction with the surface forces. Saturation bombing (as at St. Lô, where 2,500 bombers operated against an area 3,000 yd. by 7,000 yd. for two-and-one-half hours on end) was used to facilitate local attacks. Raids upon bridges, railway and road junctions, supply dumps and communications centres were practically continuous as called for by the land commanders to soften enemy resistance and enable the program of advance to be maintained: and, as a background to all these tactical interventions, the steady bombing of fuel and manufacturing targets went on in order to starve the enemy of the means to move and fight. Against these activities the enemy air forces were able to do little, since the great preinvasion offensives had had the effect of draining them of their lifeblood.

The Pilotless Aircraft and Rocket Campaign.—For more than a year before and during much of the invasion period, a considerable proportion of the Allied bomber force had had to be diverted from an offensive to what was, in reality, a defensive role. The preparations which the Germans were making to open a heavy attack with pilotless aircraft and rockets against England became known to the Allies in 1943, and from then on heavy and frequent attacks were made upon the factories where these weapons were being produced and upon the hydrogen and liquid oxygen plants that produced their characteristic fuels. Moreover, as soon as the construction of launching sites on the northern coasts of the continent opposite southern England was observed, these sites were subjected to a high intensity of attack. The beginning of the actual attack by the V-1 pilotless aircraft on England was practically simultaneous with that of the invasion of Normandy, and it is clear that, had the launching sites and manufacturing centres not been attacked as they were, the V-1 offensive would have begun earlier and in greater intensity and might have seriously interfered with the invasion preparations. As it was, more than 8,000 V-1's were launched against England and nearly 8,000 against continental targets, chiefly Antwerp, after the Allied forces were in occupation of the continental channel coast. The rocket attacks came mainly from the Netherlands and western Germany; a total of 1,100 exploded in England and 1,675 on the continent, again chiefly on Antwerp, which was in use as an Allied invasion port. London was the usual objective of the attacks upon England, though inevitably the southern counties on the route of the V-1s and V-2s to London were sprinkled with those that fell short or were intercepted and shot down on the way. In the course of countermeasures against these missiles, a campaign which lasted for 13 months in all, a total of 100,000 tons of bombs was dropped, representing 9% of the total tonnage dropped by the Allied air forces from the United Kingdom during the period. Quite apart from the damage actually caused by the weapons themselves, the threat which they represented had thus a considerable value for the Germans in diverting Allied bomb tonnage away from industrial targets and centres of population.

Statistics of Air Raids in the European Theatre.—During the course of the war in Europe, the Allied air forces flew nearly 1,500,000 bomber sorties from the United Kingdom against the axis. In these, nearly 2,750,000 tons of bombs were dropped, with a loss of more than 20,000 bomber aircraft and nearly 160,000 men, divided almost equally between the U.S. and British air forces.

TABLE II.—Allied Bomb Tonnage Dropped at Principal European Target Systems of the Axis Powers, 1939-45

Type of target	Tonnage dropped (to nearest 1,000 tons)	Percentage of total
Aircraft factories	48,000	1.8
Miscellaneous manufactures	70,000	2.6
Water transport	113,000	4.2
V-weapon launching sites	54,000	2.0
Airfields	186,000	6.9
Oil, chemicals, rubber	251,000	9.3
Military targets	300,000	11.1
Industrial areas	640,000	23.7
Land transports	867,000	32.1
All other targets	170,000	6.3

Table II gives the distribution by percentages of the bomb tonnage dropped on Germany and countries in association with or occupied by it; while German statistics show that, as an incidental concomitant to the Allied raids, more than 3,500,000 dwelling houses or flats, about 20% of the total, in Germany were destroyed or heavily damaged; 250,000 civilians were killed and more than 300,000 seriously wounded. A comparison of these figures with those for casualties in the raids on England in World War I offers a grim commentary on the progress of air bombing between 1914 and 1945.

The Pacific Area.—On Dec. 7, 1941, Japan opened its campaign against the U.S. in the Pacific with a temporarily overwhelming display of air power, employed without warning at a time of international tension but when the two countries were still officially at peace. For negligible losses, the Japanese air force at Pearl Harbor practically eliminated U.S. naval power in the Pacific for the time being. On Dec. 10 the sinking of two major British naval units off Malaya for the loss of only four medium bombers lent further point to the lesson that naval forces were an easy prey to air attack unless provided with air cover. Within a few months, under an air umbrella and helped forward by air bombing against weak ground forces, the Japanese had overrun Malaya, the Philippines and Burma, as well as having gained control of vast areas of the Pacific, all at very minor expense in men and equipment.

On the Allied side, the really significant air event of this period was an air raid led by Gen. James Doolittle on Tokyo on April 18, 1942. Though the material damage caused was slight, the proof of vulnerability to attack in the heart of its empire which this raid gave to the governing junta in Tokyo persuaded it to expand its perimeter beyond the limits which it could possibly defend and supply and thus sowed the seeds of its ultimate collapse. Thus, though Gen. Doolittle's exploit was looked upon at the time rather as a superb gesture of defiance than as a serious contribution to the winning of the war, a retrospective view puts it into a very different perspective.

For the next two years, the main air problem for both sides was to bring aircraft within range of the enemy. Over the great distances of the Pacific, it was possible often to strike at the enemy only with carrier-based forces. The target was sometimes the enemy fleet, sometimes the garrisons and installations on islands on the perimeter of the Japanese sphere of domination. At all times, Japanese merchant shipping, vital to the supply of their armies, received a full measure of attention from the U.S. bombers. Within a year of Pearl Harbor, 4% of the whole of the Japanese merchant fleet had been sunk by aircraft action alone, and it continued to be a high priority target until the end, by which time, of a total of 9,000,000 tons sunk, nearly 3,000,000 tons had been destroyed by air attack. At the same time, concentrated bombing of the Japanese navy took a heavy toll. Of a total of 2,250,000 tons of warships possessed by Japan, nearly 700,000 tons were sunk by air attack in the course of World War II.

In areas where it was possible for air forces to operate from land bases against Japanese-held outposts, it was necessary to provide such bases at short notice and to strike from the air against the long lines of communication, whether by sea to the Pacific islands or by land, as in Indo-China and Burma. While, on the ground, the Japanese were largely on the defensive, their air forces often struck back hard and it was not until early 1943 that the initiative in the Pacific had definitely passed to the Allies.

But, just as in Europe the main objective of the air raids of both sides was the heart of the enemy's home territory, so in the Pacific war, the U.S. looked to the attack on Japan's industry and home population as an essential feature of its defeat. The U.S. was fortunate in that at no period of the war was it in serious danger of air raiding of its home country by the Japanese bomber force, except for the possibility of tip-and-run raids from carrier-based forces against the Pacific coast, which in fact never took place. The nearest the enemy got to bomb attacks on the United States homeland was the random release of some explosive-loaded balloons, designed to fall in the western states. The nuisance value of this primitive form of attack was, however, slight.

To attack the Japanese home islands, air bases had to be secured within 1,500 mi. of them to enable the long-range bombers to operate. This dictated a large-scale advance from the perimeter: on the south to the Philippines; in the central Pacific to the Marianas and on to Okinawa. In the course of these preparatory operations, air power was exploited to the utmost, air forces being used from carriers and from specially constructed air bases within range to smother enemy resistance and neutralize air forces. To hold this air offensive in check, the Japanese committed all their available aircraft and suffered losses which they were never afterward able to make good, although production of aircraft had increased greatly, reaching more than 2,000 a month in 1944. In spite of losses in aeroplanes amounting to 9,000 in the Philippines campaign, the output from Japanese factories should have been sufficient to maintain first-line strength had air crew training and ground services matched production; but in these particulars, the Japanese air staff failed signally, and the air force fell lower and lower in the scale of efficiency.

Suicide Bombers.—It was the recognition of their inability to equal the Allied air forces in efficiency that led the Japanese commanders to exploit the willingness of their pilots to engage in suicide attacks, the so-called Kamikaze technique, in which the pilot deliberately crashed his explosive-laden aircraft into his objective. In all, the Japanese flew 2,500 suicide sorties, of which 475 secured hits, sinking 45 ships and doing serious damage, among others, to 15 battleships and 16 aircraft carriers. In addition to this direct effect, the U.S. air force was constrained to divert 2,000 heavy bomber sorties from industrial targets to Kamikaze bases.

Attacks upon the Japanese Homeland.—A chain of islands with relatively small quantities of basic raw materials available at home, the Japanese empire was ill equipped to fight a major war unless it could be sure of adequate supplies from overseas. Though its adventures on the Asiatic mainland in the years before 1941 improved the position, Japan remained almost completely dependent upon its sea communications for its war-making capacity. By the virtual destruction of its merchant fleet, it was reduced to such a condition by 1944 that its ultimate defeat by exhaustion of supplies was inevitable. Nevertheless, the Allied strategy contemplated an invasion of Japan, for which a bombing offensive against its industries and cities was a normal preliminary.

The offensive opened from the Marianas in Nov. 1944. At first the targets selected were mainly air frame and aero-engine factories; but in March 1945 a decision was taken to act directly against Japanese centres of population, with the object of destroying the will to continue the struggle.

Within a period of ten days, more than 9,000 tons of bombs were dropped, causing the total destruction of 31 sq.mi. in the

four towns of Tokyo, Nagoya, Osaka and Kobe. Thereafter, bombing attacks alternated against towns, factories, oil refineries and airfields. In all, 160,000 tons of bombs were dropped against Japan itself, as against nearly 1,500,000 tons dropped on Germany. Nevertheless, the physical destruction in Germany and Japan resulting from air raids was comparable. The attack on Japan was more concentrated in time, and the target areas were more vulnerable. Forty-four per cent of the built-up area of 66 cities was destroyed and 30% of the urban population of the whole country lost their homes. After five months of bombing, the Japanese economy was very close to the breaking point, even without other factors.

The Atomic Bombs.—Early in Aug. 1945, the first two atomic bombs ever used in war were dropped by a U.S. aircraft on Hiroshima and Nagasaki respectively. In the two attacks, 100,000 people were killed and six square miles of built-up area completely devastated. It was calculated that the damage caused by these two bombs was equal to that which would have been done by 345 B-29 bombers carrying more than 3,000 tons of conventional bombs.

Though, indeed, the Japanese government had been casting about since early May to find a way to end the war, the effect caused by the explosion of the two atomic bombs and the fear of similar attacks was used by them as a reason for an immediate surrender.

Conclusion.—In the course of two world-wide conflicts within the space of 40 yr., the technique and potentiality of raiding from the air had progressed from the dropping of a 20 lb. bomb from a single aircraft to the unloading of millions of tons of explosive and two atomic bombs by many thousands of aircraft. The effect of air bombing had, in the same period, passed from being a mere irritant to playing a main role in deciding the issue of wars.

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AIRSCREW, the designation of all those devices which, when rotated, tend to screw their way forward, sucking the air from in front and throwing it away behind, or which, when placed in a moving stream of air, are themselves rotated. The term covers: (1) fans of a certain type; (2) screw propellers working in air; (3) helicopters; (4) windmills; (5) gyroplanes.

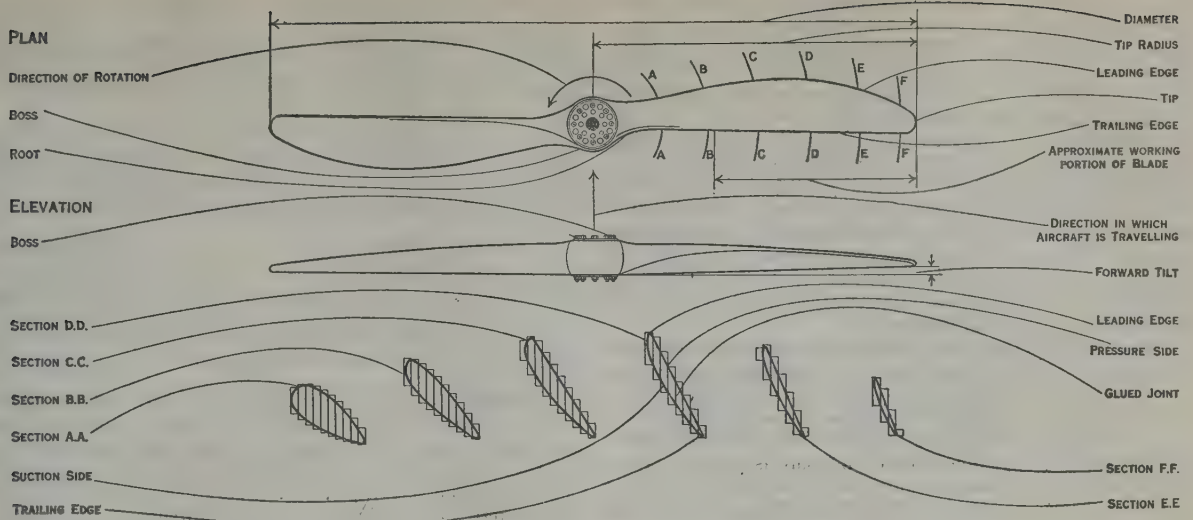
(1) If the airscrew is rotated but restrained from forward movement, air is drawn in from the front and thrown back behind, and the airscrew acts purely as a fan.

(2) If the airscrew is not so restrained, the thrust caused by moving the air backward drives forward the airscrew and the aircraft, or body, to which it is attached. The airscrew is then acting as a propeller. The thrust exerted, and the volume of air moved, have their maximum value when the airscrew is acting purely as a fan. As the airscrew moves forward, the volume of air delivered and the thrust exerted decrease, and at a certain speed become nothing. At this forward speed the distance moved in one complete revolution is known as the experimental pitch of the airscrew. The thrust acts approximately in a horizontal direction.

(3) If, however, the airscrew is placed so that it exerts its thrust upward in an approximately vertical direction, it is then acting as a helicopter.

(4) In the above conditions the airscrew is driven by some engine or motor, but if it is placed freely on a shaft in a wind, or if it is moved forward through the air, it will rotate and some of the energy in the moving air will be transformed into useful work and transmitted to whatever mechanism is attached to the airscrew. The airscrew is then acting as a windmill. The wind blows approximately in the direction of the airscrew shaft; i.e., at right angles to the plane of rotation.

(5) If the wind blows at a small angle to the plane of rotation, the airscrew will not only be caused to rotate, but in doing so will exert a thrust. It is then acting as a gyroplane. The best known



FROM WATTS, "SCREW PROPELLERS FOR AIRCRAFT," BY PERMISSION OF LONGMANS GREEN & CO., LTD.

FIG. 1.—PLAN, ELEVATION AND CROSS SECTIONS OF A TWO-BLADED PROPELLER. THE CROSS SECTIONS IN LOWER HALF OF ILLUSTRATION WERE MADE AT THE POINTS A, B, C, D, E, F, ON THE TOP FIGURE; THEY SHOW THE TWISTED SHAPE OF THE AIRSCREW BLADE

example of this use of the airscrew is the autogiro, invented in Spain by Don Juan de la Cierva. In this case the plane of rotation is approximately horizontal and the thrust approximately vertical.

General Description.—An airscrew consists of a boss or hub with spokes radiating therefrom—like a wheel without a rim. The number of spokes or blades, as they are technically termed, is usually two or three, though four are sometimes used, particularly on the larger British transport craft. They have seen little use in the United States, however.

In fig. 1 is shown the plan and elevation of a two-bladed airscrew intended for use as an aircraft propeller. Below them are shown the sections which would appear if the blade were cut through at points A, B, C, etc. The terms used in connection with airscrews are also shown. Note the term "diameter," the distance from the tip of one to the tip of the opposite blade. For aircraft propellers the diameter varies from as little as 4 ft. to as much as 19 ft. Note also the characteristic shape of the cross sections of the blade. Sections of this shape are called aerofoil sections; their properties will be found described in any standard work on aerodynamics. The shape of these cross sections has an important influence on the efficiency of the airscrew. It will be noticed that the blades are twisted; the angle is greater at the root than at the tip. This twist is necessitated by the fact that in order to work most efficiently, an aerofoil section must move at a small angle to the relative air flow.

Now any point in the blade has two simple motions: (1) in the direction of rotation; (2) the forward motion at right angles to (1). In fig. 2 these two simple motions are illustrated to scale as AB and AC for a point near the tip of the blade, and in fig. 3 for a point near the root of the blade; AD is the resultant direction and speed of movement. The speed AC of the forward movement is the same for both points, but the speed AB in the direction of rotation is proportional to the distance of the point from the centre. Its value is zero at the centre and a maximum at the tip.

Thus as will be seen from figs. 2 and 3, the resultant direction of movement of the point near the tip is at a smaller angle to the plane of rotation than that of the point near the centre. Since the aerofoil section must be placed at a small angle to its direction of movement, the blade has a smaller angle at the tip than near the centre. The distance travelled in one complete revolution, when the direction of the resultant motion is along the line joining the leading and trailing edge of the section (see fig. 1, section D.D.), is the geometrical pitch. It has approximately the same value for

all parts of the blade and is usually referred to by the word "pitch."

Problems of Design.—The main difference between various airscrews is in the diameter and pitch, and it is the designer's object to choose these for the attainment of certain specified results. He has three aims: (1) To ensure that the airscrew runs at a certain rate of rotation when driven by a certain power, when the aircraft to which it is attached is travelling at a certain speed at a certain height above sea level. (2) To ensure that under these conditions the airscrew will give its maximum efficiency (The efficiency is the ratio of the useful work done by the airscrew to the work done by the engine in turning it. Efficiencies of from 75 to 87% are commonly attained.). (3) To ensure that the airscrew is reliable and safe. Airscrews rotate at a high speed. Their tips travel at speeds varying from 700 to as much as 1,100 ft per second—a velocity exceeding that of sound. This sets up a centrifugal pull in the blade of as much as from 10 to 25 tons, in addition to which the blade must withstand the bending caused by its own thrust.

To satisfy these various requirements, the designer will specify an airscrew of a certain diameter and pitch, with blades of a certain width and thickness. If any one of these conditions alters—the rate of rotation, the power or the aircraft speed—a different airscrew will be required. Hence the infinite number of designs involved.

Controllable Pitch Airscrews.—From the very start of aircraft development it has been plain to engineers and inventors that it would be very desirable to alter the pitch angles of the propeller blades during flight. If the blades are set at the proper angle for level flight at relatively high forward speed, the angles are too high at the time of take-off and climb when the forward speed of the aeroplane is low, so that the propeller is operating inefficiently under these conditions. When the internal-combustion engine was adopted universally as an aircraft power plant, there was an additional need for a variable or controllable pitch airscrew, since a propeller which was set for the proper engine rotation at level flight would not allow the engine to turn at its full rated speed at the time of take-off, so that there was a material loss in engine power under these conditions. The effect of the controllable pitch propeller on the engine is analogous to that of the gear shift for the automobile, and the controllable pitch propeller has sometimes been referred to as the "gear shift of the air."

A large part of the early pioneering development on the controllable pitch propeller was carried out at the aeronautical

laboratory of the U.S. army at McCook Field, Dayton, O. These experiments led to the adoption of the detachable aluminum alloy blades for the propellers. While the pitch of these early propellers could not be changed in flight, the development of the aluminum alloy blade paved the way to a large degree for the later development of the controllable pitch propeller.

A large number of types of controllable pitch propellers were built experimentally. The Hamilton standard is one of the leading successful controllable pitch propellers, and may be taken to indicate the development of this adjunct to flying. The original of this type was built in late 1929, and improvement was rapid after that time. During 1933, the Hamilton standard came into universal use on the air transport lines of the United States, and the propeller was awarded the Collier trophy for the greatest advancement in aviation during that year.

This propeller is made with semihollow aluminum alloy blades journaled at the end on plain bearings. Centrifugal load on the blades is taken up by means of roller bearings encircling the inner ends of the blades. The actual operation of changing the pitch is carried out by means of an oil cylinder which forces the blades into the low pitch position when oil pressure is applied. When the oil pressure is released, the propeller is forced into high pitch by means of counterweights which are acted on by centrifugal force.



FIG. 2



FIG. 3

FIGS. 2 AND 3.—DIAGRAM SHOWING THE MOVEMENT OF A POINT NEAR THE TIP OF THE BLADE AND NEAR THE BOSS OF THE AIRSCREW

AB=Velocity of rotation. AC=Velocity of forward motion. AD=Resultant velocity

The device is very simple in design and in operation. In the initial form, it utilized two pitch settings, one being suitable for take-off and climb, and the other for level flight and cruising. The latest development of the device incorporates an automatic governor which serves to change the pitch automatically so as to maintain the engine operation at any constant number of revolutions per minute which may be selected by the pilot in flight. This device is known as the constant speed propeller.

Materials of Construction.—At first airscrews were invariably constructed of hardwoods, such as walnut or mahogany. The airscrew is built up of a number of superimposed planks or laminae about one inch thick, suitably cut to shape. In fig. 1 the cut planks for a two-bladed airscrew are illustrated. The planks are glued together to form the rough block from which the airscrew is shaped. This and the finished airscrew are also shown.

Wooden airscrews are affected by the humidity and temperature of the atmosphere, and have been found unsuitable for tropical climates. Hence there has arisen a need for metal airscrews. Of such there are two distinct types: airscrews with hollow blades, and those with solid blades. The former are constructed of steel and the latter of a light metal, usually an aluminum or magnesium alloy. Both types have met with a considerable degree of success, but both are heavier and more costly than the wooden airscrew. Despite the added expense, however, metal propellers have come into very common use, particularly on engines of higher horsepower. In large sizes the weight of the solid type appears likely to be excessive, while that of the hollow steel type approaches very closely to that of a wooden airscrew.

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AIRSHIP, a self-propelled dirigible aircraft, inflated with a gas lighter than air and sustained aloft chiefly by buoyancy from aerostatic forces. To distinguish it from the free balloon or balloon, which has similar lighter-than-air flight characteristics but no propelling or steering system, the airship is sometimes popularly referred to as a dirigible balloon or dirigible.

Consisting of an elongated gas-filled streamlined hull, mounting one or more cars or gondolas, power plants and stabilizing fins with attached rudder and elevator control surfaces, airships are classified according to three structural types: nonrigid, semirigid and rigid.

The hull of a nonrigid airship, the so-called blimp type, consists of a gas-tight fabric envelope which maintains its form by the pressure of the lifting gas and air ballonets (which inflate and deflate to compensate for changes in gas volume) contained therein. The semirigid airship similarly depends upon internal gas and air pressure to sustain the form of its envelope but has in addition a supporting metal keel extending longitudinally along the bottom of the ship. Because of their reliance upon a pressure differential for the maintenance of envelope rigidity, nonrigids and semirigids are also known as pressure airships. This distinguishes them from the rigid airship, the hull of which, consisting of a rigid structural frame, maintains its shape irrespective of internal gas pressure. Around this framework of girders, an outer cloth covering is secured, and, inside, individual gas cells are arranged throughout the ship's length.

EVOLUTION OF THE AIRSHIP

Human flight was first made possible in 1783 by the invention of the free balloon, and there immediately followed a period of intensive balloon development (see BALLOON). The airship was the inevitable result of this development and of man's desire to construct an aircraft which could be propelled and steered. Accordingly, from 1783 to 1852, when the first airship was flown, numerous unsuccessful attempts were made to propel and steer balloons. These efforts failed primarily because of lack of a suitable mechanical means of propulsion and the consequent dependence upon oars and other primitive types of manual power.

Finally in 1851, Henri Giffard, the French inventor of the steam injector, overcame the airship power plant problem by developing a 350 lb. steam engine of 3 h.p. which could drive a propeller 11 ft. in diameter at 110 r.p.m. The following year, he constructed an 88,000 cu.ft. airship, 144 ft. long and 40 ft. in diameter, and mounted his engine thereon. Giffard ascended in this hydrogen-filled craft on Sept. 24, 1852, from the Hippodrome in Paris and, at an estimated speed of 6 m.p.h., demonstrated in a light wind the first appreciable control ever exerted on a lighter-than-air craft.

Initial application of the internal-combustion engine to airship flight was made by the German engineer, Paul Haeuflin, when in 1872 he completed and flew an airship propelled by a gas engine drawing its fuel from the envelope. The French brothers Albert and Gaston Tissandier were the first to build an electrically powered airship; their 37,500 cu.ft. craft, powered by a

1.5 h.p. electric motor, made a successful initial flight on Oct. 8, 1883.

The first airship to possess sufficient control enabling it to return to the point of ascent was the electrically powered 66,000 cu.ft. "La France," constructed of an envelope of Chinese silk and a car of bamboo trelliswork. Powered by an 8 h.p. electric motor and piloted by its constructors, Charles Renard and A. C. Krebs, this French airship made its first trial on Aug. 9, 1884, at Chalais-Meudon and completed a circular flight of about five miles. By this and subsequent similarly successful flights, the "La France" demonstrated to the world the practicability of airship navigation.

The 130,000 cu.ft. David Schwarz aluminum-hulled airship, built and tested in Germany in 1897, was the first airship of the rigid type. Consisting of an aluminum framework covered by aluminum sheeting, it was also the first airship powered by a gasoline engine. Although the craft failed on its initial flight because of gas leakage and faulty power transmission, it was noteworthy for having introduced the rigid and metal-clad principles to airship construction.

Meanwhile, Albert Santos-Dumont, a Brazilian living in Paris, had become interested in lighter-than-air flight, and in 1898 completed his first in a series of 14 nonrigid, gasoline-powered airships. These small Santos-Dumont ships performed a number of record-making and unusual flights which won world-wide fame for their constructor. In 1905, Santos-Dumont abandoned airship development to turn his inventive genius to heavier-than-air craft.

An event of great importance was the construction of the first Zeppelin airship (LZ-1) which made its initial flight from a floating hangar on Lake Constance, Germany, on July 2, 1900. Designed by Count Ferdinand von Zeppelin, a German army officer who had retired to devote his full-time efforts to the development of a radically different airship of rigid structural design, the 388,470 cu.ft. LZ-1 was 420 ft. long and 38 ft. in diameter. Its cigar-shaped aluminum frame consisted of 24 longitudinal girders extending from nose to tail, spaced by 16 transverse rings, and braced by diagonal wiring. The entire frame was covered by a cotton cloth to protect the inner structure and to present a smooth outer surface. Inside the framework, between the transverse rings, were separate hydrogen-filled gas cells of rubberized cloth, while, under the craft, was a keel-like structure connecting two external cars. In each of the cars was a 16 h.p. engine geared to two propellers. A sliding weight secured to the keel was designed to afford vertical control by raising or lowering the nose; rudders were provided for horizontal control. Despite structural weaknesses, the LZ-1 proved the practicability of the Zeppelin design and attained speeds approaching 20 m.p.h. In constructing subsequent airships, Zeppelin experienced numerous financial reverses and accidents which threatened to end his aeronautical activities; popular subscription and later governmental support, however, enabled the development of the Zeppelin airship to continue uninterrupted until the end of World War I.

During the first decade of the 20th century, airship construction was carried on in most of the major countries of the world. Such development was at first generally limited to private enterprise and to the efforts of aeronautical sportsmen and inventors. However, as these pioneering efforts began to meet with success, governmental interest arose, and the employment of the airship as a war machine soon followed.

During World War I, airships saw considerable use by the major belligerents. Germany's Zeppelins, developed by that time to a point of great strength, large load carrying ability and high performance characteristics, operated with the Imperial German army and navy. Military and naval missions were flown by French pressure airships, while similar war duties were performed by Italian semirigids. Great Britain and the U.S. looked to their nonrigids for a solution to the U-boat problem. Given the impetus of war, the airship underwent unprecedented development from 1914 to 1918. Zeppelins were produced at the rate of one every two weeks; nonrigids were built which could make routine flights of 30 hr. and more; all phases of airship construc-

tion, operation, maintenance and ground handling were improved.

The treaty of Versailles prohibited the Zeppelin company from undertaking further airship construction and directed the delivery of existing Zeppelins and hangars to the victorious Allied powers. With these Zeppelins and with other rigid airships of their own design and construction, France, Great Britain and the U.S. undertook rigid airship programs which during the 1920s and early 1930s constituted an important part of their national aeronautical activity. The loss, however, of France's "Dixmude" (1923), Britain's R-101 (1930) and the United States' "Macon" (1935) led to the abandonment of rigid construction and operation by these countries. French and U.S. airship activity was thereafter limited to the operation on a reduced scale of small nonrigids or semirigids, while Great Britain terminated its airship program in its entirety. The abandonment of rigid airships by these three nations left Germany, whose Zeppelin company had re-entered the airship field by constructing the U.S. navy's reparations dirigible "Los Angeles" (1924) and the commercial ships "Graf Zeppelin" (1928) and "Hindenburg" (1936), as the sole constructor and operator of the rigid type of craft.

The period immediately preceding World War II witnessed the destruction by hydrogen fire in 1937 of the Zeppelin company's "Hindenburg" and the completion in 1938 of its sister ship, the new "Graf Zeppelin." At the outbreak of World War II in 1939, only two nations were positively known to possess airships. The U.S. was operating nonrigids for coastal patrol; Germany possessed the old and new "Graf Zeppelin." France had discontinued its airship service in 1937, and nothing had been heard after 1938 of Russian activity, about which previously little had definitely been known.

As the war progressed, nazi directives ordered the dismantlement of Germany's two airships, and Allied bombings in 1944 destroyed the Zeppelin company's hangars and production facilities. While the war ended Germany's airship activity, it provided a great stimulus to that of the U.S. The U.S. navy, realizing the antisubmarine value of the blimp (popular term for nonrigid airship), embarked upon a lighter-than-air expansion program which resulted in the operation of almost 200 blimps from bases in North and South America, Europe and Africa.

The post-World War II period of aeronautical development began with only two nations, the U.S. and the U.S.S.R., engaged in airship activity. Soviet lighter-than-air operations were disclosed in late 1945 by press releases reporting flights by the airship "Victory," while the completion of another ship, the "Patriot," was announced in Nov. 1946. The U.S. navy's airship service, meanwhile, was continued on a reduced peacetime scale with an emphasis upon training and experimentation and with antisubmarine or utility services to the U.S. fleet being provided by operational blimp squadrons.

United States civil airship activity was resumed with the operation of blimps by three concerns for commercial or advertising purposes.

DEVELOPMENT OF AIRSHIPS BY NATIONS

The development of the airship was international and primarily reflected the lighter-than-air efforts of Germany, Great Britain, France, the U.S. and, in the 1930s, of the U.S.S.R. Other nations, however, including Italy, Spain, Poland, Switzerland and Japan, engaged in airship operations at one time or another, but their activity and therefore their accomplishments in this field were limited.

Germany.—Although the success of the rigid airships of Count Zeppelin's Luftschiffbau-Zeppelin company dominated the German lighter-than-air picture, there were nevertheless other German dirigible constructors. Maj. August von Parseval in 1906 constructed for the German army the first in a series of some 28 Parseval pressure type airships which were built from that date until 1929. In 1907, a semirigid airship was constructed for the imperial German government by Maj. von Gross and Nikolaus Basenach. Some four additional Gross-Basenach ships were built; the last, completed in 1913, had a speed of 51 m.p.h. and saw service with the German navy in the Baltic sea.

Count Zeppelin's competitors in German rigid airship development were Johann Schütte and Heinrich Lanz who in collaboration evolved a rigid design, using a spirally disposed wooden girder type of construction. Their first ship, a 700,000 cu.ft. capacity, 430-ft.-long, 60-ft.-wide craft, was completed in 1911 and attained a speed approaching 50 m.p.h. The last Schütte-Lanz airship (22nd in the series) was completed in June 1918.

Meanwhile, the success of the Zeppelin type had led to the foundation in 1910 of the Deutsche Luftschiffahrts-Aktien-Gesellschaft, commonly known as Delag, which was a transportation company organizing commercial and pleasure flights in airships until the outbreak of World War I in 1914. During these five years, Delag's five Zeppelins made about 1,600 flights, carrying 37,250 passengers without injury.

During World War I, 88 Zeppelins were built at four Zeppelin fabrication plants. These ships operated under the German army and navy for North sea patrol, scouting and for bombing of strategic areas, although they were gradually rendered ineffective in the latter mission by improvement of Allied defense means. Under the pressure for greater range and larger bomb loads and in order that they might fly higher and faster, the Zeppelins underwent remarkable improvement during this period. By 1918, size had increased to 2,400,000 cu.ft., speed to 80 m.p.h., useful lift to 50 tons, and ceiling to more than 20,000 ft. The Zeppelins were armed with machine guns mounted in the cars and atop the hull; they also had a subcloud car which could be lowered beneath the clouds. An observer in this car could navigate or direct bombing while the airship remained hidden above. (See AIR RAIDS.)

Zeppelin activity temporarily ceased with the capitulation of Germany in 1918. Existing Zeppelins were sabotaged by their crews, dismantled or delivered to France, Italy, England, Belgium and Japan. Two small commercial Zeppelins, the "Boden-see" and "Nordstern," were built immediately following the Armistice, but were surrendered to Italy and France respectively in 1921.

The next Zeppelin airship was the 2,470,000 cu.ft. LZ-126 which was constructed as a war reparations payment to the U.S.; this airship, later christened the "Los Angeles," was delivered to the U.S. by a transatlantic flight in Oct. 1924. The "Graf Zeppelin" (LZ-127), a 3,708,600 cu.ft. ship, was completed in Sept. 1928; this airship saw nine years of successful continuous service. When decommissioned in 1937, the "Graf Zeppelin" had made 590 flights (including 144 ocean crossings) and had flown 1,053,391 mi., carrying 13,110 passengers and 235,300 lb. of mail and freight. Hugo Eckener, successor to Count Zeppelin who died in 1917, commanded the ship on a 21,700 mi. world flight, completed in an elapsed time of 20 days and 4 hours in 1929. (See also TRANS-OCEANIC and TRANS-CONTINENTAL FLIGHTS.)

The LZ-128 did not progress far beyond the blueprint stage and was followed by the 7,063,000 cu.ft. "Hindenburg" (LZ-129), completed in 1936. This 803-ft.-long airship, of conventional Zeppelin design with 36 longitudinal girders and 15 wire-braced main transverse frames, was powered by four 1,100 h.p. Mercedes-Benz diesel engines which gave the ship a maximum speed of 84 m.p.h. At a cruising speed of 78 m.p.h., the "Hindenburg," which contained accommodations for 50 passengers within its hull, had an 8,750 mi. range. In 1936, this airship operated the first commercial air service across the North Atlantic by carrying 1,002 passengers on 10 scheduled round trips between Germany and the U.S.; eastbound crossings averaged 65 hr., westbound, 52 hr. On May 6, 1937, while landing at Lakehurst, N.J., on the first of its 1937 season of North Atlantic crossings, the hydrogen inflated "Hindenburg" burst into flames and was completely destroyed with a loss of 36 lives—including the first passenger fatalities in the history of commercial airship operation. The fire was generally attributed to a discharge of atmospheric electricity in the vicinity of a hydrogen leak.

The LZ-130, bearing again the name "Graf Zeppelin" was completed and tested in Sept. 1938. Designed for helium operation, this slightly modified sister ship of the "Hindenburg" was built for transatlantic commercial service, but the tense international

situation at that time and the refusal of the U.S. to export helium prevented the use of the ship for such a purpose. Inflated with hydrogen, the LZ-130 made a limited number of exhibition and test flights over Germany but saw no commercial or war service.

With the completion of the LZ-130 in 1938, work was begun on the LZ-131 but, as the outbreak of World War II approached, the German government in July 1939 directed the Zeppelin company to discontinue all lighter-than-air manufacture. Finally, in April 1940, another Nazi directive ordered the dismantlement of the LZ-130, the old decommissioned "Graf Zeppelin" (LZ-127) and the main Zeppelin operating terminal at Frankfurt-on-Main; the reason given was the war need for duralumin and steel. Later, in July 1944, Allied bombings of Friedrichshafen resulted in the destruction of the hangars, shops and production facilities of the Zeppelin company, then engaged in the production of miscellaneous war materials.

Great Britain.—Prior to World War I, the British made little contribution to airship development, although a few private experimenters, notably Henry Spencer, Dr. Barton and E. T. Willows, aroused sufficient interest to cause the government to begin airship construction in 1907. From that date to the outbreak of hostilities in 1914, about eight British pressure airships, varying in volume from 21,000 to 180,000 cu.ft., were constructed, while an additional five were purchased from France and Germany. A rigid, the 660,000 cu.ft. "Mayfly," designed along Zeppelin lines, was completed in 1911; this ship never flew because it broke in two the same year while being brought out of its shed at Barrow. The failure of the "Mayfly" temporarily halted British rigid airship construction until 1914.

During the war period of 1914-18, seven nonrigid types were evolved for antisubmarine, antimine and coastal patrol duties. Ranging in size from the 60,000 cu.ft. S.S. type to the 360,000 cu.ft. North Sea class, these airships attained speeds as high as 58 m.p.h. and one, the NS-11, made a flight of 101 hr. endurance in 1919. A total of 207 nonrigid airships was built or used by Great Britain from 1914-18; of this number, 56 were in active service from June 1917 to Oct. 1918, during which time they flew 59,704 hr. and sighted 49 submarines. More than 9,000 patrol and 2,200 escort missions were carried out from 17 airship stations and 12 mooring-out sites. Nonrigid activity ceased shortly after the termination of the war, but one commercial blimp, the 60,000 cu.ft. AD-1, was constructed in 1929.

Rigid construction was resumed in 1914 when work was begun on the R-9; this second British rigid was completed three years later. Six rigids (two modified to abolish external keels) of the R-23 class were next laid down, followed by the R-31 and R-32, which were of wooden construction. None of these airships, however, equalled the products of the experienced Zeppelin designers and constructors. When the German Zeppelin LZ-33 was shot down in good condition over Essex in 1916, it served as a model for the next British rigids, the R-33 and R-34 which were completed in 1919 and were marked in their improvement in construction and performance; in fact, the R-34 had sufficient range to complete a transatlantic flight to Mineola, N.Y., the same year—the first transoceanic airship flight. Two additional rigids, the R-80 and R-36, were launched in 1920 and 1921. They were followed by the 2,700,000 cu.ft. R-38, which was to be purchased by the U.S. navy. Delivery by air was planned, but on its fourth trial flight, on Aug. 24, 1921, the craft broke in two and fell into the Humber river, killing 44 British and U.S. airship officers and men. The R-38 disaster brought British service airship activity to a halt, but in 1924 there was undertaken an empire communications scheme which provided for the construction of two commercial 5,000,000 cu.ft. rigid airships, the R-100 and R-101. Both were completed in 1929, the former by the Airship Guarantee company at Howden, the latter by the Royal Airship works at Cardington. The R-100, with accommodations for 100 passengers, was built on a modified Zeppelin design with six gasoline engines. Its two-year life was uneventful, although in July 1930 it flew to Montreal, Quebec, in 78 hr., returning the following month in 58 hr. The R-101, which was lengthened subsequent to completion to increase its lifting capacity, accommodated about 50 passengers,

and deviated substantially from Zeppelin practice by using steel girders and five diesel engines. On an attempted flight, Oct. 5, 1930, to India, the R-101 crashed into a hill during a storm near Beauvais, France, and burst into flames, killing 46 persons. Following this disaster, the government scrapped the R-100 in 1931 and abandoned airship activity indefinitely.

France.—In spite of the broad French background in early lighter-than-air development, French interest lapsed appreciably after A. Santos-Dumont demonstrated his series of airships. The first significant modern airship of native French design was the Lebaudy brothers' "Jaune" (1902), which resulted in an order from the ministry of war for a slightly larger version. The success of the Lebaudys encouraged others to undertake lighter-than-air manufacture. From 1904 until the outbreak of World War I, pressure airships for the French government, for private use and for export were constructed in appreciable numbers by the Astra, Clément-Bayard, and Zodiac firms and by the government's airship factory and development centre at Chalais-Meudon.

During World War I, about 30 airship types were produced, with capacities ranging from 70,600 cu.ft. to 501,100 cu.ft. The French army, which had possessed about 16 airships during the war period, abandoned its airship activity in 1917, transferring 8 ships to the navy for operation. With an additional 52 airships, the French navy in 1917-18 performed more than 3,300 flights totalling 16,000 hr.; these airships were said to have attacked 60 U-boats and sighted 100 mines.

After the Armistice, considerable governmental interest was shown in rigid airships, of which type only one had previously been constructed in France. This had been the none too successful "Spiess," a privately owned wooden rigid built by the Zodiac society in 1912. Three Zeppelins, the L-72, LZ-113 and the small commercial "Nordstern," were turned over to France by Germany in 1920-21. The latter two saw little active service prior to dismantlement, but the 2,470,000 cu.ft. L-72 (renamed the "Dixmude" by the French) established an endurance record of 118 hr. 41 min. in Sept. 1923. In December of the same year, the "Dixmude" was lost over the Mediterranean with its entire complement; this disaster brought about the termination of rigid activity in France.

Despite the loss of the "Dixmude," French naval nonrigid and semirigid airship activity continued. From the end of World War I to its disestablishment in 1937, the French naval airship service operated an average minimum of two ships without a serious accident or fatality; the main operating base was Rochefort. All airships built during this period were constructed by the sole remaining French airship manufacturer, the Zodiac society, which from 1924-37 produced ten airships (six nonrigid, four semirigid) for the navy; the smallest was a 130,000 cu.ft. Vedette, the largest a 350,000 cu.ft. Escorteur.

In 1936, Zodiac developed for the French army a 35,000 cu.ft. motorized observation balloon with an attachable power and control gondola, so that it could be flown as an airship to alternative positions. This balloon went into mass production in May 1940, during which month 21 were completed. Additional motorized balloons were not produced because of the defeat of France the following month, but several were subsequently seized by the Germans for use against the U.S.S.R. The termination of navy airship activity by government decree in 1937 and of similar army activity by German conquest in 1940 was made all the more complete by Allied bombings of airship hangars and by other war destruction. French post-World War II aviation plans therefore included no provisions for lighter-than-air development; no governmental or private airship construction was planned although the sport of free ballooning was revived in 1945-46 to such an extent that the manufacture of balloons was recommenced by Zodiac.

Italy.—Most Italian airship construction concerned itself with the development of the semirigid type, in which Italy was soon acknowledged to be the leader. Several P- and M-type airships, 166,000 cu.ft. and 424,000 cu.ft. respectively, were designed and built by Gen. A. Crocco and Ricaldoni prior to World War I; several Forlanini type semirigids had similarly been completed by

the beginning of hostilities. During the World War I period of 1914-18, additional types were developed, primarily to increase altitude performance for bombing missions.

Although receiving three Zeppelins from defeated Germany in 1920-21, the Italians made little or no effort to explore the possibilities of the rigid airship; indeed, improper handling resulted in wrecking two of these Zeppelins before they had been in Italian possession one year. In 1921, a 1,240,000 cu.ft. semirigid, the "Roma," was sold to the U.S. army; this 410-ft.-long airship was shipped disassembled to the U.S. where it was re-erected. During a test flight on Feb. 21, 1922, the "Roma" became unmanageable, crashed into a high tension wire and burned, killing 34 persons. The well-known N-type Italian semirigid was developed by Gen. Umberto Nobile and was the last airship type undertaken under government cognizance when Italy officially terminated its airship program in 1927. On May 11, 1926, the 654,000 cu.ft. "Norge" (N-1), carrying an expedition headed by Roald Amundsen, Lincoln Ellsworth and Nobile, left Spitzbergen for the north pole. The "Norge" passed over the pole on May 12 and, continuing its 3,000-mi. flight, landed 2 days later at Teller, Alaska, where it was dismantled. The N-3, third of the Nobile N-series, was sold to Japan where it was destroyed during naval manoeuvres in Oct. 1927. Using the "Italia" (N-4), Nobile attempted another polar flight in May 1928, but after reaching the north pole, the ship crashed on its homeward journey with a loss of seven lives. The "Italia" affair and its unpleasant repercussions signalled the end of airship development in Italy, and Nobile later went to Russia to practise his art of semirigid airship design.

Russia.—Although Russia had shown a pre-World War I interest in airships by purchasing semirigids from France, there was little concerted activity until about 1931 when a public subscription of 15,000,000 rubles toward an airship program was announced. The second five-year plan provided for the operation of airships on civil air routes within the Soviet Union, and to assist this program the services of Gen. Umberto Nobile, Italian designer of semirigid airships, were secured. A number of small pressure airships were subsequently constructed, and in 1933 plans were announced to lay down a 1,304,620 cu.ft. commercial ship at Dolgo Prutnaja, 19 km. from Moscow, and one of 705,200 cu.ft. at Leningrad. The former, like the 2,820,000 cu.ft. metal-clad also announced as planned, was presumably never built. The Dirigiblestroï or Dirigible Construction trust in 1936 began the 353-ft.-long 882,829 cu.ft. semirigid DP-9. In 1937 a Russian airship commission visited the U.S. to study American airship efforts. In September of the same year, the 650,000 cu.ft. semirigid V-6 established an endurance record of 130 hr. 27 min. (This record stood until Nov. 1946 when it was broken by 40 hr. by the U.S. navy blimp XM-1.) The V-6 was destroyed with the loss of 13 lives in 1938 when it crashed into a mountain while participating in rescue operations to assist soviet scientists marooned on a drifting polar ice flow. In May 1938, the V-10 began its trials at Moscow, and the V-8 was reportedly still under construction for a proposed commercial route between Moscow and Leningrad.

Nothing was heard of Russian lighter-than-air activity during World War II. In late 1945 it was disclosed that a small civil airship, the "Victory," had made an 80 hr. demonstration flight over the Black sea. In Nov. 1946, the existence of another soviet airship, the "Patriot," was announced; this 150-ft.-long craft was reported to be dual engined and capable of carrying 12 passengers with a 1-man crew. Helium resources exist in the U.S.S.R. and it was probable that this noninflammable gas was being used as an inflation medium for soviet airships.

United States.—A number of small privately-owned pressure airships were built and flown by Capt. Thomas S. Baldwin, Lincoln Beachey and Roy Knabenshue immediately following the beginning of the 20th century. The first practical U.S. airship was Baldwin's "California Arrow" (1903), while the first U.S. government airship was a 19,500 cu.ft. craft bought from Baldwin by the U.S. army in 1908. Two unsuccessful attempts to fly to the north pole were made in 1907 and 1909 by the explorer Walter Wellman in his airship "America"; using the same craft, Wellman in 1910 attempted a transatlantic flight which similarly failed. In

1912, Melville Vaniman took off from Atlantic City, N.J., for a transatlantic flight in the "Akron," but within 15 min. after departure, the airship caught fire and was destroyed with the loss of its entire crew of 5.

Naval airship activity began when the 175-ft.-long, 114,800 cu.ft. capacity, DN-1 was contracted for in 1915. Erected in a floating hangar at Pensacola, Fla., the DN-1 (later redesignated the A-1) was completed in April 1917; the craft proved unsatisfactory because of excessive gas leakage and was abandoned after three flights.

In 1917, with war clouds on the horizon and serious attention being given to the development of nonrigids for antisubmarine and coast patrol duties, the navy ordered 15 B-type airships (77,000 to 84,000 cu.ft.), which were completed in 1917-18 by the Goodyear Tire and Rubber company, Goodrich Tire and Rubber company and Connecticut Aircraft company. The B-class was followed by the 182,000 cu.ft. C-type, for which 30 (reduced to 10 after the Armistice) were contracted with Goodyear and Goodrich; the first C-ship was completed in Sept. 1918. During U.S. participation in World War I, U.S. navy blimps were based at seven Atlantic coast air stations from Chatham, Mass., to Key West, Fla., while other airships, acquired from the French, were operated from Paimboeuf, France. In May 1919, the C-5 attempted a transatlantic crossing; after flying from Montauk, Long Island, N.Y., to Newfoundland in 23 hr., the blimp was lost when strong winds tore it away crewless from its mast and blew it to sea.

Five D-type airships (189,000 cu.ft.) were next built by Goodyear and Goodrich. A considerably modified D-ship, the D-6, was later produced by the navy. In 1918 and 1919, Goodyear built three small, single engine, nonrigid airships, of which two, designated the E-1 and F-1, were purchased by the navy. A 400,000 cu.ft. G-ship design was completed in 1919, but no ships of this type were constructed. The designation G was later applied to a class of utility and training ships (183,000 to 196,700 cu.ft.) which began with the G-1 (ex-Goodyear "Defender") acquired in 1935. The first and only navy semirigid airship was the O-1, erected at Cape May, N.J., in Sept. 1919; imported from Italy, this craft saw only three months' service. In 1921, Goodyear completed for the navy the 43,000 cu.ft. H-1, a single engine airship which could be towed or used as a kite balloon. The next naval airship type was the J-ship, of which the first unit was completed in 1922.

Meanwhile, the U.S. army, which had no World War I airship program, undertook such development in 1919, with a joint services agreement that its program would concern itself with nonrigid and semirigid development, while the navy would concentrate on rigid airship activity. The army acquired several blimps from the navy and constructed main airship bases at Langley Field, Va., and Scott Field, Ill. A number of nonrigids, particularly of the TC-class, were constructed for the army which, in addition, to investigate the semirigid design, purchased the "Roma" from Italy in 1921 and the 719,000 cu.ft. RS-1 from Goodyear four years later. The 1,240,000 cu.ft. Italian-built ship was destroyed with the loss of 34 lives on Feb. 21, 1922, when it burned after striking a high tension wire at Langley Field, Va. The RS-1, after several years of intermittent service, was dismantled, and the army concentrated thereafter on nonrigids and motorized balloons. Finally, in 1937, the army terminated its airship program and turned over its nonrigids to the navy.

Entrusted with rigid airship development, the navy began construction of the 2,115,174 cu.ft. ZR-1 in 1919. Fabricated at the Naval Aircraft factory, Philadelphia, Pa., and assembled at the Naval Air station, Lakehurst, N.J., this ship, christened the "Shenandoah," was largely a copy of the German Zeppelin L-49 design, modified for mooring mast and helium operation. Her maiden flight on Sept. 4, 1923, was followed by a number of noteworthy flights including a 9,000 mi. transcontinental trip. On Sept. 3, 1925, the "Shenandoah" broke into three parts in a line storm over Ohio, killing 14 members of her crew of 43.

That no fire accompanied the "Shenandoah's" destruction, thereby enabling 29 crew members to free balloon the hull sec-

tions to earth, was undoubtedly due to the noninflammable helium with which the ship was inflated. Helium had been adopted as the sole inflation medium of army and navy airships following the burning of the former's hydrogen filled "Roma" in 1922. The first U.S. airship inflated with helium had been the army's C-7 in Dec. 1921.

The purchase of the British rigid R-38 (U.S. navy designation, ZR-2) was authorized in 1920 with accompanying arrangements for the instruction of U.S. personnel in British rigid airship technique. This 2,700,000 cu.ft. ship was destroyed on Aug. 24, 1921, with the loss of 16 U.S. airship officers and men when it broke in two during its fourth trial flight in England.

On Oct. 15, 1924, the German Zeppelin company delivered the 2,470,000 cu.ft. ZR-3, later christened the "Los Angeles," to Lakehurst, N.J., after a 5,000 mi. flight from Friedrichshafen where the ship had been constructed as a war reparations payment to the U.S. This 658-ft.-long dirigible was used extensively for experimental work on flight and mooring problems and developed a means for hooking-on and releasing aeroplanes in flight. After 331 flights for a total of 4,320 hr., the "Los Angeles" was decommissioned at Lakehurst in 1932 and dismantled 7 years later.

The German Zeppelin patents and processes together with the services of key Zeppelin personnel were acquired in 1924 by the Goodyear Tire and Rubber company, which formed a subsidiary, the Goodyear-Zeppelin corporation, in Akron, O. In 1928, Goodyear-Zeppelin began the construction of two 6,500,000 cu.ft. rigid airships for the navy. Both ships were 785 ft. long and 133 ft. in diameter, with a cruising range of 6,500 mi. and a maximum speed of 72 knots. The power plant installation was novel, with each ship having eight 560 h.p. Maybach engines mounted in separate engine rooms within the hull and driving propellers so mounted on outriggers that they could be swivelled to produce a vertical lifting component. To compensate for weight lost through fuel consumption, water recovery apparatus was installed with exhaust condensers mounted on the hull above the engine rooms. Each ship also carried a trapeze for the landing and launching of aeroplanes and possessed an internal hangar for five planes. The "Akron" (ZRS-4) was completed in 1931 but, after about 1,200 hr. of service, crashed with the loss of 73 lives on April 4, 1933, in a storm off the New Jersey coast. Her sister ship, the "Macon" (ZRS-5), was launched the same month and operated primarily from the new airship base at Sunnyvale, Calif.; previous rigids had all been based at Lakehurst. On Feb. 12, 1935, while returning from fleet manoeuvres, the "Macon" suffered failure of her upper fin structure, resulting in loss of control. With severe gas leakage and accompanying structural collapse, the "Macon" settled to the sea and slowly sank off the California coast; all but two crew members were rescued.

The loss of the "Macon" left the navy without an operational rigid airship and led to numerous naval, governmental and civil investigations to determine the safety and practicability of rigid airships. Since the results of these investigations endorsed further dirigible construction, a 3,000,000 cu.ft. navy rigid was authorized in 1938. However, money appropriated by congress to begin its construction reverted to the treasury after delays in selecting the design and size; subsequent funds were not voted, and the ship never progressed beyond the drawing board stage.

In the period between World Wars I and II, United States civil airship activity was primarily limited to the operation of commercial and advertising blimps by the Goodyear company, constructor of virtually every significant U.S. airship after 1911. After experimenting with a small "pony blimp," Goodyear in 1925 began the operation of from one to six of its own nonrigid helium inflated airships, which pioneered many airship flight and ground handling improvements. The capacity of these Goodyear blimps varied from 51,000 cu.ft. to 183,000 cu.ft. but was later standardized at 123,000 cu.ft., a size which carried 6 passengers. From the beginning of these commercial operations in 1925 until the transfer of the Goodyear blimp fleet to the navy in 1942 for war duty, Goodyear airships made 152,441 flights and carried 407,171 passengers without a single passenger injury or fatality.

In 1935, with rigid airship activity ended by the crash of the "Macon," naval lighter-than-air efforts again centred about non-rigid development. At that time, the navy was operating the 210,000 cu.ft. J-4, the 320,000 cu.ft. K-1, and the 202,000 cu.ft. ZMC-2. The J-4 was an open gondola ship completed in 1924, while the K-1, completed in 1931, used Blau gas as well as gasoline for fuel. The ZMC-2, first successful all metal airship, was constructed in 1929 by the Metalclad Airship corporation of Detroit, Mich. Its hull consisted of 24 longitudinals and 12 circular frames to which an .0095 in. thick outer cover of alclad sheet was riveted. Although possessing certain rigid construction characteristics, the ZMC-2 was nevertheless a pressure airship depending upon internal pressure to maintain hull rigidity in flight. While the craft had a long successful life prior to dismantlement, no other metal-clads were built. The 183,000 cu.ft. Goodyear-owned "Defender" was acquired by the navy in 1935 and designated the G-1. Two years later, upon abandonment of the army airship program, the navy received the former army TC-13 and TC-14, nonrigids of about 350,000 cu.ft. capacity.

Increased airship strength was authorized as the entry of the United States into World War II drew near, and at the time of Pearl Harbor the navy was operating 4 new K-type patrol airships (built 1938-41), 3 small L-type trainers (built 1938-41), the G-1 and the TC-13 and 14. The airship building program was speeded up and an improved G-type and new M-type ship evolved. During the war period, the navy operated a total of 134 K-type (425,000 cu.ft.) and 4 M-type (647,500 cu.ft.) patrol airships, 22 L-type training ships of 123,000 cu.ft. capacity and 8 G-type (196,700 cu.ft.) training and utility blimps.

Except for those used primarily for training and experimentation, U.S. navy airships of World War II were grouped into 14 U.S. fleet blimp squadrons which, operating from more than 50 main and auxiliary bases, performed antisubmarine patrol and escort operations in a 3,000,000 sq.mi. area along the U.S. Atlantic, Gulf and Pacific coasts, in the Caribbean, along the South American coast from Panamá to Rio de Janeiro and in the Mediterranean. A U.S. fleet blimp utility squadron similarly operated from five bases along the Atlantic seaboard. These 15 squadrons flew a total of 55,900 flights for 550,000 hr. and escorted 89,000 ships without the loss of a single vessel to enemy action. Of the blimps assigned to fleet units, 87% were in operational readiness at all times, thereby establishing a record availability for military aircraft.

The year 1944 marked the peak of World War II airship operation; at that time, naval lighter-than-air flight personnel numbered 1,500 officer pilots and 3,000 enlisted air crewmen; ground administrative and maintenance personnel amounted to 706 officers and 7,200 enlisted men.

The first nonrigid airship transoceanic flight was made in 1944 when blimp squadron 14 was ordered based with six K-ships at Port Lyautey, French Morocco, for patrol of the Straits of Gibraltar. The blimps were ferried across the Atlantic in pairs from South Weymouth, Mass., via Newfoundland and the Azores. The first flight (3,145 mi.) was made on May 29-June 1, 1944, by the K-123 and K-130 in a total flight time of 58 hr. In 1945, two additional K-ships were flown to Port Lyautey from Weeksville, N.C., via Bermuda and the Azores; the 3,532 mi. flight was completed in a flight time of 62 hr. Another transatlantic airship movement was planned in May 1945 when the navy, recognizing the value of the airship in visual and instrumental detection of U-boats, ordered a blimp squadron based in southwest England. This move was cancelled just prior to execution because of the capitulation of Germany.

Although antisubmarine operations were the main duties of U.S. navy airships during the war, it was found that their unusual flight characteristics were valuable in the fulfilment of general utility missions. Torpedo recovery, aerial photography, observation, special equipment calibration, search operations, rescue work and other services requiring slow speed, low altitude operations for extended periods of time were performed in great numbers and variety for fleet and shore units. In the Mediterranean, the airships of squadron 14 assumed an unprecedented importance in

mine sweeping operations through spotting and marking otherwise undetected mine fields and through saving a number of sweeping vessels by diverting them from collision courses with mines they could not see.

With the end of hostilities in 1945, the active naval airship organization was reduced to two operational U.S. fleet blimp squadrons plus an extensive training and experimental program at Lakehurst, war and postwar headquarters of naval lighter-than-air activity. The activation of a naval reserve airship training program was also planned. As part of Lakehurst experimentation to determine the sea-keeping and habitability features of airships, the 725,000 cu.ft. XM-1 (formerly the 647,500 cu.ft. M-1) on Nov. 2, 1946, established a 170 hr. 17 min. world's aircraft endurance record for continuous unrefuelled flight.

Civil airship activity was resumed in 1946 with the purchase and operation of surplus navy K- and L-type blimps for advertising purposes by the Goodyear company, Douglas Leigh Sky Advertising corporation and Hughes Aircraft corporation.

AIRSHIP OPERATION AND CONSTRUCTION CONSIDERATIONS

This discussion is limited to the nonrigid airship and omits consideration of rigid activity because of its world-wide termination in 1940 with the dismantlement of the German Zeppelin LZ-130.

Flight Principles.—An airship or balloon floats in the air whenever the sum of the weight of the gas container (and any structural weights or other loads hanging therefrom) plus the weight of the very light lifting gas is the same as or less than the weight of the air which the airship or balloon displaces. This Archimedean precept is the fundamental principle of airship flight. Airships lighter than the air they displace experience a buoyant force tending to make them ascend; those which are heavier will tend to descend. The lift acquired by an airship from the buoyancy of its gas is known as static lift.

When a lighter-than-air craft is buoyant, it is in a "light" condition. When its weight and static lift are equal, it is "in equilibrium"; it is "heavy" when its weight exceeds its static lift. An airship is also subject to dynamic lift derived from its motion through the air. While its hull is by no means an efficient airfoil, its size produces an appreciable lifting effect when driven through the air at an inclination. The "heavy" airship utilizes this dynamic lift of the hull and fins as well as static lift and, like an aeroplane, becomes airborne by means of a take-off run on its landing gear. U.S. navy blimps have taken off as much as 6,000 lb. "heavy." "Light" airships are sufficiently buoyant to become airborne without a take-off run. While blimps which are "heavy" fly at a slight inclination to make use of the lifting effect of the air flow, "light" airships conversely fly slightly nose down, so that the air flow against the top side of the envelope will counteract the lightness and the constant static tendency to gain altitude. The static condition of airships varies in flight, depending upon such factors as the amount of fuel consumed (each gallon of gasoline weighs six pounds) and changes in weather conditions. Extreme heaviness can be remedied by ballast expenditure while excessive lightness can be overcome by picking up sea water or other ballast and valving lifting gas.

Normal control of altitude is maintained neither by the expending of ballast nor by the valving of helium. To ascend, "up elevator" is given, raising the airship's elevators which are flippers attached to the horizontal fins. The air flow about the moving airship strikes these raised surfaces and depresses the tail, thus lifting the nose; the engines drive the ship upward. To descend, "down elevator" raises the tail and lowers the nose, enabling the motors to drive the ship earthward. Rudder control is similarly exerted; the air flow, striking the rudder surfaces (attached to the upper and lower vertical fins), turns the tail, hence the nose, in the desired horizontal direction. The control of an airship in many respects resembles that of a submarine, the blimp's elevators and rudders corresponding to the undersea craft's diving planes and rudder.

Lifting Gases and Pressure Control.—At sea level and at standard conditions, air weighs about 81 lb. per 1,000 cu.ft. There

are only a few gases which give any practical lift in air, the most commonly used being hydrogen, helium and coal gas. Because of the weight of coal gas, its use is restricted to free balloons of limited performance. Pure hydrogen and helium weigh 5 and 11 lb. per 1,000 cu.ft. respectively, and their corresponding lifts are 76 and 70 lb. However, impurities generally present reduce these values to working figures of 68 lb. for hydrogen and 62 lb. for helium. The disadvantage of the lesser lift of the helium is offset by the noninflammable nature of the gas, an advantage which caused the U.S. to adopt a "helium only" policy in airship operation. The higher cost of helium (approximately \$15 per 1,000 cu.ft. as against about \$6 for hydrogen) plus the fact that its shipment and storage are complicated and expensive make it necessary that helium valving practice be much more conservative than that used with hydrogen inflation. (See HELIUM.)

In nonrigid airships, internal gas pressure and its maintenance between maximum and minimum safety levels are vital. A blimp flying with low pressure reduces the firmness of its envelope and is endangered by the possibility that the air flow might cause the bag to fold or buckle. On the other hand, excessively high pressure places undue strain on the envelope, perhaps causing it to rip were it not for helium valves which automatically operate when the pressure exceeds the safety limit. This problem of maintaining proper pressure is aggravated by the eccentricities of gases which continually expand and contract because of temperature and altitude changes. To compensate for these changes in helium or hydrogen volume, nonrigid airship envelopes contain air compartments known as ballonets.

The 425,000 cu.ft. envelope of a K-ship (representative of standard airship design) consisted of one helium chamber and two ballonets. When the envelope was inflated with helium to its maximum capacity, the gas chamber contained 425,000 cu.ft. of helium and the air ballonets were empty. If during flight a decrease in temperature or altitude caused the 425,000 cu.ft. of helium to contract to 400,000 cu.ft., the operation of the ballonets ensured the maintenance of constant and adequate pressure. As the 25,000 cu.ft. of helium disappeared through contraction, an electric blower or the propeller slip stream blew an equivalent volume of air into the ballonets which inflated within the envelope, thereby replacing the missing helium and keeping the pressure constant. If the gas later expanded to a volume of 470,000 cu.ft., 10,000 cu.ft. of air were then released from the ballonets by automatic valves. The total capacity of the K-ship's two ballonets was 114,000 cu.ft.—slightly more than one-quarter of the total bag volume. By means of these air ballonets, K-ship helium pressure was maintained at a point equivalent to the weight of 1.5 in. of water. Ballonets, because of their fore and aft locations, may also be utilized for trimming purposes.

Construction Details.—A modern nonrigid airship envelope ordinarily consists of three layers of long staple cotton fabric impregnated with rubber. The envelope is divided into a system of gores and panels, the seams of which are lapped, cemented, sewed and taped to reduce gas leakage which is still further discouraged by coating the envelope's inner side with paraffin. An aluminum paint on the outer side reflects the sun and reduces the amount of heat absorption by the envelope, thereby helping to minimize the degree of helium expansion. Battens, which are fabric covered strips of wood laced to the envelope, reinforce and stiffen the blimp's nose to avert its buckling at high speeds.

The car or gondola in modern nonrigid airship practice is suspended against the bottom of the envelope by a system of internal and external catenary curtains. The internal catenaries, consisting of strong fabric mounted in parallel rows running fore and aft, hang down from the top inside the envelope. From these curtains suspension cables extend to the framework of the car. Another catenary curtain is located outside and at the bottom of the envelope; to this external suspension system, the top of the car is affixed.

Personnel, armament, power plants and virtually all the equipment of a nonrigid airship are carried by its car, which rests upon a wheel (sometimes retractable) to make possible wheel ("heavy") take-offs and landings. The power plants, usually

aeroplane type gasoline engines, are mounted on outriggers extending from either side of the car; access to the engines is possible in flight. Because of their large size (42 ft. in length for the K-ship, 115 ft. for the M-ship), airship cars possess good habitability characteristics and are fitted with the finest communications and navigational equipment.

Each blimp is equipped with a number of ropes and lines used in ground handling operations to steady and hold the ship in position or to pull a "light" craft to earth.

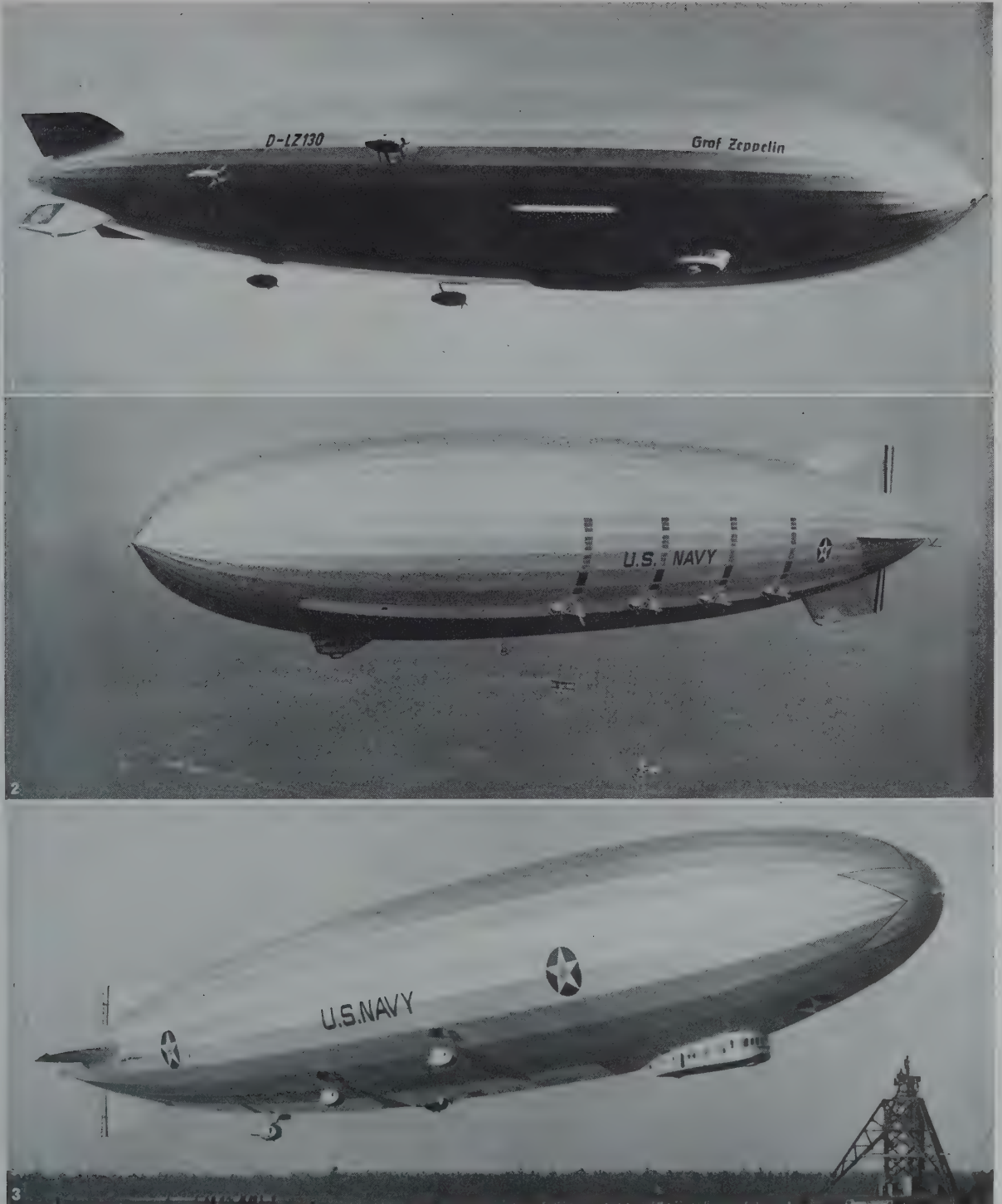
At the extreme bow of the airship is a round disk mounting a horizontal spindle to which a cone is attached. The mooring of an airship is normally accomplished by fitting this cone into a cuplike device at the top of the mooring mast. With its nose held in this manner, an airship is docked, undocked or "walked" across the field by means of a mobile, tractor-towed, triangular-shaped, steel mast, in the case of a K-ship about 43 ft. high.

Future Development.—Although the U.S. navy's 725,000 cu.ft. XM-1 was at its time of building the largest successful nonrigid airship ever constructed, it by no means represented the maximum volume permissible with the nonrigid type of construction. Progress in the development of stronger and lighter envelope fabrics makes nonrigids exceeding 1,000,000 cu.ft. capacity entirely practicable. However, increased gas volume makes possible greater car loading; this increased weight, when concentrated in a short car, imposes considerable strain on the catenary curtains and envelope. Accordingly, modern airship practice calls for a proportionately longer car to provide a more equitable weight distribution on the bag. In the case of the XM-1, its 115-ft.-long car was built of three sections integrated by universal joints to provide a degree of flexibility.

With the development of improved power plants, it was considered in 1947 that a maximum air speed of about 90 to 100 m.p.h. was obtainable with standard established hull designs and propulsion methods. This figure, although low compared with aeroplane speeds, offers no great disadvantage to lighter-than-air development because the utility of the airship is derived not from its maximum speed but from its ability to conduct hovering or low speed, long endurance operations. One aspect of power plant improvement during World War II was the incorporation of electric reversible propellers to facilitate landing operations by slowing or stopping the forward motion of the ship so that it could be more readily taken in hand by the ground crew.

Under war demands, U.S. navy airships from 1942-45 operated daily under severe weather and climatic conditions, leading to the development of new operational techniques. For example, the landing of blimps in winds of 35 knots was in peacetime an emergency measure; in wartime operations, routine landings were made in these and in winds approaching 50 knots. The prewar notion that successful blimp operations necessitated expensive hangars and supporting bases was refuted in 1943 when K-ships began day and night operations from wooden stick masts at primitive isolated jungle bases with a minimum of equipment and personnel. During these South American operations, which were conducted a thousand miles or so from airship hangars, blimps were exposed to the rigours of the equatorial sun and the tropical rains. In so doing, they demonstrated their ability to operate in such fabric deteriorating conditions for months without other hangar availability than that necessary for routine overhaul or repair purposes. Of the 50-odd airship bases utilized by U.S. navy blimps during World War II, only 13 possessed hangar facilities. It was thought as experience was gained by continued operations, additional progress in operating and maintenance technique would follow. New developments in ground handling operations could additionally be expected as improved mechanical means were evolved for the landing, mooring, docking or undocking of airships with consequent reduction in ground crew personnel requirements.

The post-World War II employment of U.S. navy airships began with emphasis upon experimentation. Because of the large carrying capacity and the size of airship cars, the installation of heavy or bulky equipment is possible in airships which additionally are unusually stable airborne platforms. For this reason, air-



BY COURTESY OF (2, 3) U.S. NAVY; PHOTO (1) FROM PRESS ASSOCIATION, INC.

THE "GRAF ZEPPELIN," THE "MACON" AND THE "LOS ANGELES"

1. The German Zeppelin, the LZ-130, named the "Graf Zeppelin" to replace the retired world-girdling airship of the same name, shown undergoing its trials in Sept. 1938. The LZ-130 was designed for commercial transatlantic service and represented the most advanced rigid airship yet constructed. It was dismantled in 1940 for war reasons.
2. Rigid airship "Macon" about to land two of its complement of five

aeroplanes. Each plane mounted a hook atop its wing and effected landings on the dirigible by hooking on to the retractable trapeze shown protruding beneath the "Macon's" hull; take-offs were made by unhooking and dropping away from the airship.

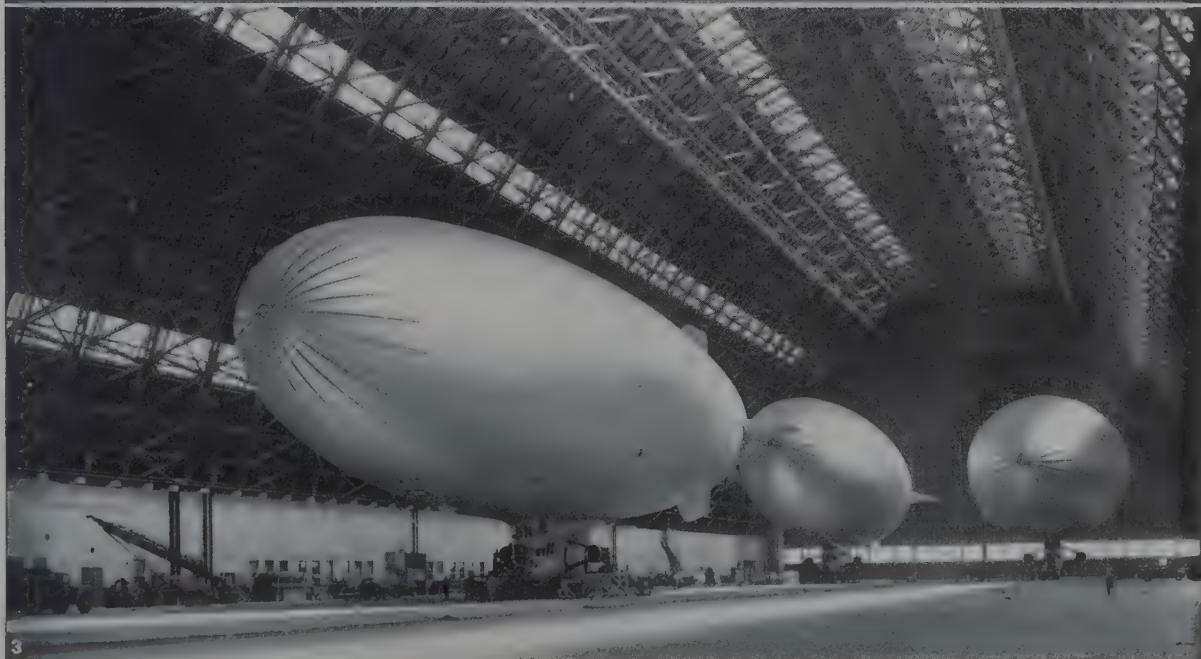
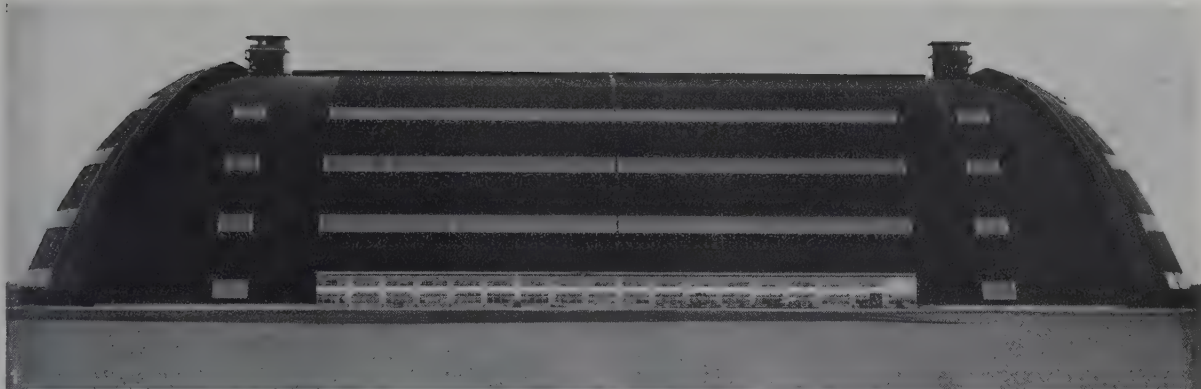
3. The German-built "Los Angeles," most successful U.S.-owned rigid airship, takes off from the mobile stub mast, a ground-handling development which it pioneered.



BY COURTESY OF U.S. NAVY

A composite photograph illustrating the four nonrigid airship (blimp) types operated by the United States during and following World War II. The airships shown are proportionally in scale

	L	G	K	M
Volume, cu.ft.	123,000	196,700	425,000	647,500
Length, ft.	148	192	252	293
Height, ft.	54	62	79	89
Width, ft.	47	53	62	71
Maximum speed, knots.....	53	53	67	69
Cruising speed, knots.....	40	40	50	50



BY COURTESY OF U.S. NAVY

SHEDS BUILT TO HOUSE MODERN AIRSHIPS

1. U.S. navy airship shed of steel construction and orange-peel door design. The doors of this 960-ft.-long building divide into two sections which slide around the ends of the shed to permit a complete opening of the arch of the structure
2. Two of the seventeen 1,000-ft.-long wooden hangars erected by the

- U.S. navy during World War II. The sectional doors, when opened, slide into the centre of the concrete pylons on either side of the sill
3. Interior view of standard U.S. navy wooden shed showing details of its timber construction. Three K-type blimps are docked inside

ships before and during World War II were used to pioneer, test and prove many aeronautical, scientific and technical advancements. Continuation of this activity in peacetime under the cognizance of the Lakehurst-based Naval Airship Training and Experimental command was authorized with promising prospects of improvements in airship antisubmarine, utility, mine spotting, and rescue devices and operating procedures.

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AIRSHIP SHEDS. The term airship shed is used synonymously with airship hangar or airship dock to denote a building or other structure in which airships are housed for construction, storage, repair or overhaul purposes.

Sheds are not normally essential for operations since both rigid and pressure airships can be "moored out" and operate from masts for extended periods of time. Airships can be serviced and given minor repairs at masts, and being capable of operating from aircraft carriers and specially fitted airship tenders, require hangar availability only for major repairs and overhaul or for protection from severe weather conditions.

When airships were small, their sheds were of simple barnlike construction with wooden or fabric walls and with swinging doors. Earliest hangars were built on the water or sometimes mounted on turntables, so that they could be turned into the wind. The advent of larger airships, however, seriously complicated shed design. It became necessary to develop mammoth structures devoid of interior supports, yet so designed that neither the shed nor its doors would seriously disturb the normal air flow over the airport, thereby complicating the landing and manoeuvring of airships.

The world's largest airship shed, completed by the Goodyear Tire and Rubber company at Akron, O., in 1929, is an arch-shaped structure with orange-peel doors—a design inaugurated by Germany prior to World War I. The Akron dock required about 7,500 tons of structural steel and has a floor area of 364,000 sq. ft. and a cubical content of 45,000,000 cu. ft. At each end there are two spherical-calotte doors which can be opened electrically in five minutes; each door weighs 600 tons, the weight being taken by 40 wheels running on circular railroad tracks. These orange-peel doors rotate about hinge pins in the roof, so that in the fully opened position they nestle along the arched sides of the shed. A similar type hangar with slight modifications and smaller dimensions was constructed about 1933 by the U.S. navy at Sunnyvale (later renamed Moffett field), Calif.

The extensive U.S. navy nonrigid airship (blimp) program of World War II brought about the construction of numerous airship bases and sheds along the U.S. Atlantic, Gulf and Pacific coasts. Two 960-ft.-long, 330-ft.-wide, 200-ft.-high steel hangars of orange-peel door design were erected at South Weymouth, Mass., and Weeksville, N.C. Other hangars were needed, and to conserve steel a new type shed of wooden construction with concrete foundations was designed and erected at South Weymouth (1); Weeksville (1); Lakehurst, N.J. (2); Glyncro, Ga. (2); Richmond, Fla. (3); Houma, La. (1); Hitchcock, Tex. (1); Santa Ana, Calif. (2); Moffett Field, Calif. (2); and Tillamook, Ore. (2). These 17 hangars were, with slight modifications, identical in size and design. The dimensions of the 2 Lakehurst wooden

Interior length, hangar deck	1,026 ft.
Interior width, hangar deck	235 "
Interior door opening, max. height	120 "
Interior door opening, max. width	220 "
Exterior hangar length, max.	1,076 "
Exterior hangar width, max.	207 "
Exterior hangar height, max.	173 "

sheds shown in the table in column one can therefore be taken as representative of the 15 others.

The wood which went into the construction of these sheds was chemically treated to make it fire resistant. Much of the structure was prefabricated; the truss joints of the wooden beams were bolted together. With the exception of the hangar at Houma, each shed mounts folding leaflike sectional doors which are 120 ft. high supported on railroad rails at the top and bottom of the door sill. These doors fold away in recesses between twin reinforced concrete pylons on either side of the shed. The pylons support a box beam girder carrying the upper rail on which the electrically operated doors slide. The doors of the Houma structure are detachable and, when opened, move on railroad tracks off to one side completely apart from the shed. The three hangars at Richmond were totally destroyed by a hurricane and fire in Sept. 1945. Many of the world's most famous airship sheds, including those of the German Zeppelin company, were destroyed during World War II. The location and dimensions (in feet) of the larger sheds still remaining after the war, excluding the war-

	Length	Width	Height
Brazil: Rio de Janeiro	886 ft.	164 ft.	161 ft.
England: Cardington (2 sheds)	850 "	180 "	115 "
France: Cuers (Toulon) (2 sheds)	770 "	107 "	150 "
India: Karachi	850 "	180 "	155 "
U.S.A.: Akron, Ohio	1,175 "	325 "	200 "
Moffett Field, California	1,138 "	310 "	198 "
Lakehurst, New Jersey	807 "	264 "	188 "

time U.S. navy steel and wooden hangars already described, are listed in the table. (See AIRSHIP.) (J. G. V.)

AIR SICKNESS: see ANOXAEMIA.

AIR WARFARE. Military aviation came into being when Louis Bleriot flew across the English channel from Calais, France, to Dover, England, on July 25, 1909. Many military men never realized the significance of that flight. Some more farsighted experts, however, began to readjust their ideas as to the warfare of the future. Napoleon had looked longingly across the channel but could not take his army across. Engineers had talked for years about putting a tunnel under the channel but the British objected that it would remove their isolation. Then Bleriot in a few minutes completely removed the bars to British isolation from the continent of Europe. What one aeroplane could do, certainly hundreds and thousands could do.

There was little done to make the aeroplane a practical, effective military weapon between 1903 and 1914. Isolated tests and experiments indicated that the device was capable of doing more in warfare than merely carrying messages and observing for the ground troops. As early as the fall of 1911, the United States air corps had tried out Riley Scott's aerial bomb release. It was many years ahead of its time as it mathematically figured out the proper point from which to drop the bomb to hit a target. The war department was not interested so Scott took his device to France, entered the Michelin contests for accurate bombing and easily won first prize. He had no competition and his hitting a

target 375 x 124 ft. with 8 out of 15 bombs dropped from an altitude of 2,624 ft. was far beyond the conception of accuracy for any of the airmen or military men in Europe. As a result they bought the device.

In the spring of 1912 Col. I. N. Lewis, of the U.S. army, introduced a new type of machine gun. The type which was then in use was impractical in that it had a long feed slide which made the operation of the aeroplane controls impossible. However, the decision made in the war department was that the old Benet Mercier machine gun was standard for the army and would be standard for the aeroplanes. Lewis, following the precedent established by Scott, went to Europe for the sale of his gun.

These were two very important events in the history of military aviation. Two years later in 1914 World War I broke out in Europe. The Scott ideas had been incorporated into bombsight developments by that time, and the Lewis guns were installed as permanent equipment on some types of planes in European flying units. The small air corps of the world powers, however, went into World War I in Aug. 1914 still untried.

WORLD WAR I

At the beginning of World War I, aircraft production had not as yet become a technique of jigs, dies, fixtures and special fittings. Each and every aeroplane was a handmade task. No country, not even France, supposed to be far more air-minded than any other nation, had available 400 combat planes in Aug. 1914.

The ideas of the general staffs were clear with regard to how they were going to employ their cavalry, artillery, infantry and their navies, but the aeroplane was still an unknown quantity. All agreed that it had great possibilities as a reconnaissance vehicle. It could go behind the enemy lines and locate troops, concentrations of reserves moving along the roads, and it might even find them in bivouac, even in woods. What else could the aeroplane be used for?

The air enthusiasts were sure that it could be used in combat against other planes, that it could be used to carry bombs and destroy predesignated targets, but how? So it was that World War I became one of the best proving grounds to develop the aeroplane as a combat weapon.

Armament.—The Lewis gun had been used on military aircraft but only for rear-seat firing. A fighter plane must have fire power from the front. The normal technique of air operations indicated that most aerial attacks should be made in that way. There was one major problem to be solved: how could a machine gun be fired through the propeller without hitting and destroying it?

There were numerous solutions suggested for this problem. At first the airmen flew past each other shooting such weapons as they might have in their hands—pistols, shotguns, rifles or machine guns. All those methods of solving the problem were far from satisfactory, as they seldom made hits. The next step was to mount a machine gun on top of the upper wing of a biplane so that it fired over the propeller. A sight mounted along the top of the fuselage made it possible for the gunner to get accurate aim, but the mounting was very unwieldy. It was hard to fix jams in the air and it was difficult to change drums of ammunition.

Next came the razor sharp steel pieces mounted at the rear of the propeller in the line of fire of a gun located in the fuselage. The bullets either went through the blades as they rotated or they hit the steel knife blades. If they hit the knife blades, no harm was done. The big step forward came when Anthony H. G. Fokker, a Dutch aeroplane designer working for the Germans in the fall of 1915, brought out the first synchronizing gear. This gear made it possible for the gun to be fired at will by the pilot through the propeller with no ill effects; the gun was so synchronized with the moving propeller that no bullet could hit the propeller blades. That device put Germany well ahead of the Allies insofar as fighter planes were concerned.

Bombing.—The bombing efforts went through the same cut-and-try procedure before a satisfactory bombsight, type of bomb or technique of operation was secured. The first bombs dropped

were round hollow shells. The bombardier ignited the fuse by scratching a prepared plug in the bomb against a prepared surface along the sides of the aeroplane. If the fuse caught and he judged his timing right, the round shell might explode somewhere near the target.

The next step was to put fins on artillery shells and use them. About the same time some French airmen conceived the idea of employing fluted darts, pointed at one end. It was figured that if enough of the darts were dropped, some of them might hit marching enemy soldiers on the head and penetrate in spite of the steel helmets. Such bombing technique was, to say the least, ineffective and inefficient.

The first bombsights were of simple construction and operation. All of the World War I planes had open cockpits, and the bombsight was mounted on the side of the fuselage. The bombardier bent his head over the side of the cockpit, made his adjustments and then pulled the trigger. The bomb release apparatus was created to eliminate the human error of dropping the bombs by hand and to prevent complicating the planes with attachment gear when large sized bombs were used. As the war progressed bomb release gear became standardized and could be attached to any type of plane.

Formation Flying.—The mission alone could not determine the trend in aeroplane design. Both the Germans and the Allies were out to shoot down as many hostile aircraft as they could either from the air or from the ground. So it became necessary to bring out formations which gave the most protection against hostile air attacks and provided the least vulnerable target against hostile anti-aircraft gunfire. Strange as it may seem, it was the synchronizing gear of Fokker's that caused the Allied flying units to seek better protection. They were unable to get it through fire power on one plane, hence they brought several planes together so that a heavy volume of fire could be secured from the mass. Thus in the fall of 1915 the Allied airmen used the first "V" formations for mutual protection. While the formations at first were small in size, the numbers involved in a single formation grew until at the end of the war it was not unusual to see as many as 50 or 60 planes employed in a single formation by both the Germans and the Allies.

Types of Planes.—Combat brought out standardized types of planes although there were almost as many models as there were manufacturers.

Fighter.—The fighter was a sturdy, compact and rugged plane with the highest horsepower possible and the best possible speed and climb. Through all the years which followed, the characteristics of that type of plane, jet or orthodox, did not change. High-speed races with their large prizes provided incentive each year for better racing planes and provided the testing ground of future fighter planes.

Observation Plane.—As most of the higher ranking officers in the war saw observation work as the primary mission of the aeroplane, a large percentage of the total planes available was assigned to such tasks. Ground troops needed to know the location of the enemy in front of them and whether or not there were fieldworks, trenches or barbed wire. Early in the war the aerial observers demonstrated that they could perform such observation duties well. In addition they took photographs which showed exact details of the terrain, even paths made by new troops moving into concealed positions.

The observation plane flew unescorted. It went through the stages of a two-seater, three-seater, heavily armed with machine guns, lightly armed. It was fixed with bomb racks and soon became a general purpose plane which could be used for observation, light bombing or as a two-seater fighter. It was seldom that the pilot of an observation plane was able to rely on support from fighting planes. Normally he went in to enemy territory to get information by himself and fought his way out against enemy fighter planes and anti-aircraft artillery.

Bomber.—When the United States entered the war in April 1917, the status of the various types of planes was about as outlined above. Large bombs indicated the necessity for large bombing planes. However, when it was decided to start

quantity production of aeroplanes, it was indeed a problem to determine which planes should be built. There were numerous models. Even the British, French, Belgians and the Italians could not agree among themselves as to which they should recommend. The problem of engine design was equally complex. The United States decided to build its own engine, the Liberty, which could be used as a general purpose engine in observation planes, day bombers and the two-seater fighters.

At that time the Germans were far ahead in the field of bomber development. They were using night bombing against targets in England and in western France. Their heavy bombers were comparatively slow, about 90 m.p.h. as compared with the fighter's 120 m.p.h., but they could carry bomb loads of about 1,000 lb. for several hundred miles.

In the bomber class England had the Handley Page, with two engines, and Italy the Caproni with three. U.S. military leaders had already selected the de Havilland as an observation general purpose plane and had decided that the U.S. would not build any fighter planes. The difficult decision lay in selecting the type of bomber to be built. It was finally agreed that both the Handley Page and the Caproni were to be produced in the United States. Production matters, however, were further complicated by the introduction of Glenn L. Martin's two-engined bomber in 1918. A number of these planes were also built in the last days of the war.

In view of the precedent set by the aircraft industry in its tremendous output of training planes for the British, Canadian and U.S. air forces, little difficulty was anticipated in producing the bomber. It became apparent, however, that there were many unforeseen problems connected with the construction of this type of plane, for when World War I ended in 1918, the United States had produced about 4,500 DH-4s of which about 1,216 had reached France. Shipments of Handley Pages were too few in number to be of any value in the course of the hostilities.

Tactics of Aerial Combat.—As the number of aeroplanes increased on the European front and as armament became more powerful, it became evident that the day of individual aerial combat was over. So came the development of aerial tactics.

The Squadron.—The smallest administrative organization practically universally accepted for air units was the squadron. There the men were fed, their planes were repaired and maintained, sleeping accommodations were provided and the records of all men were kept. The squadron varied in size from 50 to 250, depending upon whether it was a fighter, observation or bomber squadron. It was also the smallest tactical fighting unit. Although all types of manoeuvres were utilized, the time finally came when it was obvious that the squadron must receive support in combat. There was not enough flexibility in that one organization to secure the best results. Additional squadrons seemed to be the answer.

The Group.—The group, made up of two, three or four squadrons, was a natural division not only for command in the observation and bomber units but also in the combat operations of the fighters. In the fighters, it was a cardinal principle to get above the opponent. When one squadron fought independently, if a flight of three planes acted as a decoy there were but two flights of three planes left to attack. With the group formation, entire squadrons could come into the combat to swing the tide of battle as necessary.

The French and the U.S. organized squadrons into groups. The British organized them into wings.

The Wing.—In actual practice in warfare, there was not much use for the term wing, made up of two or more groups, until Gen. William Mitchell, of the U.S., assembled about 1,500 planes for the St. Mihiel offensive in 1918. This was the largest fleet of aeroplanes ever assembled up to that time, and it was not until World War II that the figure was reached again.

The U.S. ground forces had assembled more than 500,000 men for that offensive. Mitchell planned to isolate the battlefield to deny the Germans reinforcements in men or supplies. He hit the Germans on one flank and then the other with formations of 500 planes. Then he attacked them in the rear areas where

supplies and reinforcements were being brought up. It was the first employment of aeroplanes in mass.

Changing Techniques of Combat (1916-1918).—The hit-or-miss methods first employed in aerial combat did not last long. The Fokker plane at first gave Germany the advantage, and it was the Allies who sought safety in numbers. Then in the summer of 1916, the Allied offensive patrols began. Planes flying in "V" formations sought out the enemy. When fairly large numbers of these "V's" were used, the Germans were no match even with their better performing planes. For the first time the Allies had attained superiority in the air.

The Germans tried to regain air superiority early in 1917 by bringing out new planes with two guns firing through the propeller instead of one. In addition they had superior performance. The technique of operations was unchanged but the pendulum swung once more to the German side until by the spring of 1917 their superiority was practically unchallenged. By the summer of 1917, however, the British and French had brought out new types of fighters and once more air superiority went to the Allies.

Tactics of Attack.—The simplest form of air tactics in World War I was for one fighter to creep up on a slower plane from the rear, in the area of the latter's blind spot, and shoot it down. Every variation from that simple manoeuvre complicated matters. If the attack was made from an angle, the pilot had to figure his speed, the speed of his opponent, the distance between the planes and the wind direction and velocity. Under certain conditions the consideration of all these things in the sighting formula might make the pilot aim to the rear of the hostile pilot and engine in order to get a hit.

By getting above his opponent, the fighter pilot could then, by superior speed, select his own point of attack. Accordingly, fighter pilots, whether operating in flight units, in squadrons or in groups, always tried to get above their opponents. The old two-seater type of plane and the slow bomber did not present much of a problem to the fighter.

MILITARY AVIATION, 1918-1939

The period following World War I was used by practically all nations to determine the practical value of the aeroplane. The war had brought out the fact that although it was faster than any other means of travel and could be used for destroying other planes and for securing information for the ground forces, as a weapon of destruction its value was extremely limited. In the United States, Gen. William Mitchell had long contended that air power was superior to sea power. In 1921 he conducted bombing tests on captured German warships. A submarine, destroyer, cruiser and battleship were bombed and sunk with a few well-placed 1,000-lb. bombs. In later tests, held in 1923, Mitchell's bombers, flying at 10,000 ft., sank the old battleships "Virginia" and "New Jersey" with 2,000-lb. bombs. The bomber had become a part of the air team.

During the period when Mitchell directed the operations of the U.S. army air corps, a flight was made from Mineola, L.I., N.Y., to Alaska and back under command of Capt. St. Clair Street in July 1920. Other outstanding flights showed the capabilities of modern aircraft. The first refuelling flight was conducted by Lieut. L. H. Smith and Lieut. J. P. Richter at Rockwell field, Calif., in Aug. 1923. Successive transatlantic flights showed that the ocean had ceased to be a military barrier to large planes. On May 2-3, 1923, Lieut. Oakley Kelly and Lieut. John Macready flew the T-2, a plane built by Anthony Fokker, former German plane manufacturer, nonstop from New York to San Diego, Calif. Although equipped with a single Liberty engine, it could carry a useful load of 3,000 pounds in addition to about eight men.

The U.S. navy kept pace with the army improvements in military planes. In the early days of flying the navy took the normal aeroplane and equipped it with floats. Then the flying boat came into the picture in 1916. The hulls were so heavy that for a while, at least, the flying boat was not very efficient. However the impetus of World War I brought out the NC type.

Naval planes followed the course of the army planes in development and construction only with the more complicated problems

added by hulls and the equipment necessary for landings and take-offs from carriers. Insofar as performance was concerned, they were just about the same as land planes.

Introduction of Metal Construction.—The change in design and construction of military planes made it possible for the planes themselves to do things impossible before. The increased horsepower that came with new engines set a number of new records. Metal construction was not a one-step advance but it made modern aeroplanes with their superior performance possible.

The first all-metal plane was built in Germany by Junkers. Metal frames covered with fabric panels or sewed on fabric wing or fuselage coverings were the first types of metal constructed planes. The first engineering difficulty that had to be overcome was to secure a metal frame which would not deteriorate from weather, dampness or salt air. After numerous tests throughout 1923 and 1924 this problem was solved and the metal plane became standard construction. Its advantages were so many and so obvious that all manufacturers took up the new type of construction.

Bombers.—Under the direction of Mitchell, U.S. development of the bomber proceeded at an unprecedented pace. The first all-metal bomber, the Martin B-10 which came out in 1932, was the first to attain a speed of more than 200 m.p.h. The B-18 filled in with numbers until development of the first modern U.S. bomber—the B-17, which had been tested at Wright field, O., during the fall of 1935. The first test, a flight from Seattle, Wash., to Dayton, O., was impressive.

Fighting planes, however, did not measure up to the same standards as the B-17. They followed a pattern in which an average plane, using standards set by Germany, England and France, was produced periodically. The B-17 was one of those engineering triumphs that do not occur every time a new type is developed.

Spanish Civil War.—The first test of the new types of planes came in July 1936 with the outbreak of civil war in Spain. Germany, Italy and the U.S.S.R., used this war as a proving ground for their weapons of war. This was particularly valuable for their air equipment for it had been constructed in factories with no combat experience in back of it. Many of the defects which would not have been found in the equipment until World War II became manifest and were eliminated. The war in Spain also enabled the Germans to evolve a technique of aerial operation based upon modern aeroplanes rather than those several years old.

England was not so fortunate. Peacetime manoeuvres and observers in Spain were their only sources of information. The U.S. was even more unfortunate; lack of observers and isolation from the war theatre meant that much of the information which was received was outdated by the time it could be used.

WORLD WAR II

The pattern of air warfare was well established when Germany sent its armies across the Polish border on Sept. 1, 1939. The German air-ground team of dive bombers and fast-moving armed columns seemed invincible as they destroyed the Polish air force, annihilated the Polish armies, cut communications so that no reinforcement or reserve supplies could reach threatened points, and made it impossible for the Polish leaders to carry on the war. On Sept. 27, Warsaw was captured and the campaign was over. It looked as if the terrifying Stukas with their awesome, screeching dives coupled with the fast-moving armoured cars presented a new technique in warfare that was unbeatable.

EUROPEAN THEATRE

Strength of Air Forces.—The approximate strengths of the various nations in the air at the time of the Polish invasion were as follows: France, 600 serviceable combat planes; England, between 1,500 and 2,000 combat planes; Germany, 6,000 first-line combat planes and 2,000 second-line planes in reserve; Italy, 2,000 first-line and 1,000 second-line planes; the United States, 4,000 planes in the army and navy, of which probably 1,000 might have been used in combat.

From the Polish campaign through the evacuation of Dunkirk

the *Luftwaffe* had its own way. The conquest of Norway was begun by air-borne troops carried by the *Luftwaffe*, and the *Luftwaffe* scouted their routes into the interior and circled watchfully over the transports disembarking their reinforcements. When the *Wehrmacht* rolled into the Low Countries, the *Luftwaffe* again carried the first wave of ground troops and quickly disposed of opposing air forces. The break-through into France in May 1940 was prepared by the *Luftwaffe*, which protected the flanks of the racing armour. But at Dunkirk the Germans suffered their first defeat in the air when they lost 200 planes while shooting down only 100 of the R.A.F. and failing to prevent the successful evacuation of the British and French troops. With great numerical superiority and with geography on their side the *Luftwaffe's* defeat was the direct result of their poor command direction and the battle heroism and skill of the R.A.F.

Battle of Britain.—From this initial defeat the *Luftwaffe* blundered on to its second in the battle of Britain. On Aug. 8, 1940, this famous air battle began with attacks on convoys off Bournemouth and the Isle of Wight. For a month the Germans attacked aerodromes from southern and southeastern England to the gates of the capital, and for another month they pounded the heart of London. Then it was over. In the face of the heroic R.A.F. defense the *Luftwaffe*, suffering appalling losses, was halted. The raids lost momentum and finally stopped.

It is clear why the Germans lost the battle of Britain. First, they had plenty of aircraft, but their bombers lacked the bomb carrying capacity and the fire power to do the task of strategic bombing. Second, the *Luftwaffe* was not organized to provide bombs, fuel, aircraft repairs, replacement aircraft and replacement personnel for an extended and undiminishing air offensive. Third, Hermann Goering's plan was faulty. The bombing of English ports served little purpose and took aircraft from their main job of going after the R.A.F. not only in the air and on the ground but by hitting aircraft factories and engine plants, gasoline storage facilities and refineries methodically and systematically. Goering had apparently committed himself to an operational timetable from which he refused to deviate.

The battle of Britain, although a smashing defeat for the *Luftwaffe*, was by no means the end of its power. The failure of the German air force over southern England marked its first and last great independent offensive mission, but the German air leaders placed increased emphasis on fighter aircraft—the armament of a defensive air force—and a tough, determined and skilful force was developed.

Following the battle of Britain Germany still stood astride the continent of Europe. England's life line to India was in desperate danger of being cut. Crete was in Germany's hands and the British in North Africa seemed about to be sealed off and eliminated from the fight. Then Germany invaded the U.S.S.R. and drained the Mediterranean area of its air strength. A year later, in the spring of 1942, that air power was switched back to the Mediterranean from the Russian front, but by that time the U.S. had entered the war in Europe and the R.A.F. had built up its power in the middle east and in the desert. The Germans had missed their opportunity. Instead of dominating the Mediterranean and the middle east they were soon to be pushed off the African continent and pursued across Sicily and up the Italian boot by the air-ground team of the Allied forces.

Night Bombing.—In England, in the meantime, the R.A.F. was beginning to take the offensive in the air. It became apparent to the British that, with the equipment then available to them, daylight attacks against the growing German fighter strength were prohibitively costly. They turned to night bombing. Eventually their system of night bombing became complex and highly effective. But in the early days, the problem of navigating twin-engined Wellingtons and Whitleys to their targets in blacked-out Germany, and getting bombs on the aiming point was still to be solved. Radar, "Gee," and the other instruments and procedures that were to refine R.A.F. operations were still in the future. Nonetheless, in the early months of 1942 Rostock and Luebeck were attacked with impressive results, and on May 30-31, more than 1,000 planes of all types bombed Cologne. It was the beginning of "area

bombing" as distinct from the bombing of a precise industrial or military target. The crews were briefed to drop their high explosives and incendiaries on specified aiming points in the city. With the techniques then in use the effect was to gut the city between the designated points. On June 1-2 a comparable force attacked Essen. "Air Offensive Europe" was under way.

Daylight Bombing.—When the advance guard of the U.S. 8th air force arrived in England with B-17 Flying Fortresses and the Norden bombsight, they brought the doctrine of daylight bombing. On Aug. 17, 1942, the first dozen B-17s of the 8th air force took off in daylight and successfully bombed Rouen in occupied France. On Aug. 21, during their fourth mission, nine Forts were attacked by 20 Me 109s and Fw 190s off the Dutch coast. The B-17s' guns beat off the attack and the planes returned to their base successfully.

During that fall the B-17s flew back to England after bombing their targets with considerable battle damage suffered at the hands of the German fighter pilots—but they came home. If the *Luftwaffe* was to be defeated, the job was one for the Flying Fortresses because at that stage of the war they alone had the range and the fire power to penetrate deeply into Germany and put bombs on the right targets. No escort fighters had sufficient range to protect the daylight bombers over more than a small fraction of their route.

Although by Jan. 1943 the *Luftwaffe* fighters were attacking the Allies' England-based B-17s with great determination, every time they flew over the continent, Germany had not by that time begun to feel the real weight of the Allied strategic air effort. The slow build-up of United States air strength in England was largely siphoned off to support the landings in North Africa in Nov. 1942, and a considerable amount of British strength was being expended on the war in the desert. In spite of this, however, the Germans recognized the threat of the daylight bomber. In 1941 the chief of the German air staff, Gen. Hans Jeschonnek, had said that a monthly production of 360 fighters would take care of all his requirements. In April 1943 the German plan for single-engined fighter production called for 2,230 a month.

On June 10, 1943, the Allied air commanders finally received the go-ahead from their governments to concentrate their air power against the primary enemy—Germany. The Casablanca directive set into motion the "combined bomber offensive plan" which called for the "destruction and dislocation of the German military, industrial and economic system and the undermining of the morale of the German people to the point where their capacity for armed resistance is fatally weakened."

Combined Bomber Offensive Plan.—The *Luftwaffe*, of course, was the first target. On Aug. 13, 1943, heavy bombers of the 9th air force operating from the Mediterranean area, attacked the Messerschmitt factory at Wiener-Neustadt, outside Vienna. On Aug. 17, the 8th air force attacked the ball-bearing industry at Schweinfurt and the Messerschmitt factory at Regensburg, losing 60 bombers—16% of the force of 376 dispatched on the mission. That night the R.A.F. bombed the German research centre at Peenemunde.

During the next few weeks the B-17s pressed the attack against the *Luftwaffe* at Frankfurt, Stuttgart, Anklam, Gdynia, and Marienburg, culminating with the second Schweinfurt attack of Oct. 14, when 60 bombers in a force of 291 were shot down by the German defenders. Almost immediately after that attack the weather threw a veil over southeast Germany that was not to lift until Jan. 1944.

Although the Allied command had planned a replacement rate that would have permitted sustained operations while suffering losses of 25%, it is questionable if such losses as the *Luftwaffe* inflicted on unescorted daylight bombers would have been acceptable over an extended period. In Oct. 1943 the Germans had boosted their fighter production goal for Dec. 1944 to 4,150 single-engined fighters and 1,750 twin-engined fighters per month. The Allies' outlook for continued daylight operations would have been poor indeed if long-range fighters had not made their appearance. By the end of 1943 the P-38 and the P-47 were escorting bombers to all but the farthest targets and home again. When

the P-51 arrived in Jan. 1944 the *Luftwaffe* was doomed.

Destruction of German Industry.—The German aircraft industry in the spring of 1944 was no longer attacked except to set back the production of the Me 262 jet fighters, or to smash again some rebuilt facility such as the Focke-Wulf plant at Marienburg which was levelled for the second time on April 9. With minor exceptions, the main air effort was directed against a very profitable target system—the German synthetic oil plants. As early as June 12, 1942, the U.S. air force had carried out its first heavy bombardment mission against German-held Europe when 13 B-24s, based at Fayid, Egypt, attacked an extremely important target—the oil refineries at Ploesti, Rumania. The attack did little damage, and it was more than a year before Ploesti was attacked again. On Aug. 1, 1943, 177 B-24s knocked out temporarily 60% of Ploesti's production. The attack cost 54 bombers, but it was a heavy blow that undoubtedly forced the Germans to expend more and more of their resources to increase the capacity of their synthetic oil plants. Once the 15th air force, operating out of Italy, began to pound Ploesti from the air while the Russian armies advanced on the ground, the Germans discounted Ploesti's output from their plans. Synthetic oil became a highly sensitive target.

Merseburg, Misberg (Hannover), Politz, Lutzendorf and Harburg were hit. Although the *Luftwaffe* was rarely encountered by the bombers the flak from the hundreds of heavy radar-directed anti-aircraft guns with which the desperate Germans ringed these plants was intense and accurate. The campaign against synthetic oil had barely begun, however, when it was interrupted to allow the heavy bombers to be sent against targets in preparation for the great invasion of Normandy.

Allied Invasion of Western Europe.—Prior to the invasion of Normandy, the medium bombers and the fighter bombers of the 9th air force flew from their English bases, cutting bridges on the Seine and the Marne, hitting rail centres and knocking out transportation choke points. Heavy bombers of the 8th air force and the R.A.F. destroyed the bridges across the Loire, the Oise and beyond, blasting the network of rail centres and marshalling yards that were vital to the movement of German troops from the Calais coast to Normandy. For 90 days the attacks continued, some of them on targets selected to give the impression that the Allied landings were to be made on the French coast northeast of Paris. By the first week in June the only way a large part of the German army could move into Normandy was on foot, and that with difficulty.

As dawn broke on June 6, 1944, gray and cloudy, six B-17s crossed the invasion coast, parted company and flew individual routes over towns in the invasion area dropping leaflets to warn the people to head for the open fields. The Allied invasion of western Europe was at hand. The ports of southern England had been crammed with ships and equipment for weeks but they were not attacked. During the crossing, streams of aircraft roared overhead, but none of them were German. While the actual landings were being made the *Luftwaffe* still did not appear.

Allied air power sealed off the battle area by figuratively drawing a line along the Loire river and attacking anything that attempted to cross that line from the south. The Germans could not reinforce their troops, and the Allies' supply line across the channel operated in complete security.

By the middle of July, however, the situation on the ground was far from satisfactory. The British held a line along the Orne river at the eastern end of the Cotentin peninsula. The Americans had fanned out to the west and had bitten into the Cherbourg peninsula. But the ground forces working inland had come up against a type of terrain—the hedgerow country—that put them further and further behind schedule. Each hedge had become a fortress. The swollen stream of supplies and reinforcements that flowed across the channel was dammed up behind the hedgerows. The solution was clear, however—to smash a hole in the dam and let the Allied power rush out over the plains of France. The U.S. air force was called on to smash that hole with bombs.

The Normandy carpet bombing attack took place in the St. Lô-Périers area. A target 7,000 yd. long and 250 yd. wide was at-

tacked by 1,500 heavy bombers with eight groups of fighter bombers bombing and strafing the area for 15 min. before the heavies' attack that lasted for an hour, and with seven groups of fighter bombers going over the area from low level for 30 min. afterward. Immediately following that attack, all the light and medium bombers of the 9th bomber command wound up the operation with both area and pin-point attacks.

The U.S. infantry advanced and breached the enemy positions west of St. Lô, and freed Gen. George Patton's armour to push deeper into German-held territory. The enemy did not stand successfully again until France and Belgium had been liberated and the west wall reached.

Once Patton's 3rd army was out in the open his armoured divisions always had an escort of fighter bombers. When the 1st army joined the 3rd army near Argentan and trapped about 57,000 Germans, the 11th tactical air command of the 9th air force came in to hasten the surrender. In one day the 11th T.A.C. destroyed from 400 to 500 enemy vehicles.

The Italian Campaign.—In Italy the Allied air forces' efforts to assist the progress of the ground forces were successful, but not so spectacularly so as they were in France. In spite of their best efforts, the Allies were unable to stop completely the flow of essential supplies to the Germans in Italy. Nevertheless, when the ground positions in Italy stabilized following the Anzio landing in Jan. 1944, and an attempted flanking assault failed, it was thought that air attack could diminish the enemy's ability to supply, reinforce and shift his forces, and would thus so weaken him that he could neither withstand determined ground attack nor withdraw in good order.

Medium and fighter bombers attacked key bridges on the few rail lines from northern Italy to the front. From March 24 to the fall of Rome on June 4 two principal choke lines were maintained across the narrow boot. No through trains were able to run from the Po valley to the front lines, and south of Florence nearly all supplies had to be moved by truck. The enemy attempted to increase the use of shipping, but heavy bombers attacked the vessels. The Germans diverted trucks to hauling supplies around the broken bridges and, eventually, all the way from Florence to Rimini, but fighter strafing forced the trucks to operate only at night.

Germany's ability to transport supplies was reduced from an estimated 80,000 tons a day to not more than 4,000. When the Allied drive began in early May, the enemy's transport was unable to meet the demands on it. The German lines broke under the impact of the ground offensive. Retreat in good order was impossible because of the breakdown of transportation under the constant air attack.

Industrial Collapse in Germany.—Once Allied troops were securely established in France the campaign against the German chemical industry began in strength. By the end of 1944 the output of aviation gasoline was cut 90%, and from December on, German war production ran downhill rapidly. A month later railroad carloadings were off 75% and steel was being produced at only 20% of capacity. The strategic air war was practically over. In March the chief of German armament production, Albert Speer, knew that the third reich was finished. "The German economy," he reported, "is heading for inevitable collapse within 4-8 weeks." After Germany's surrender on May 8, Allied interrogators asked Speer if he believed strategic bombardment alone could have won the war. Speer replied: "Yes, the attacks on the chemical industry alone [synthetic oil] would have sufficed without the impact of purely military events."

WAR IN THE PACIFIC

In making its decisive contribution to the victory in Europe the U.S. air force alone dropped a far greater tonnage of bombs than it dropped during the war in the Pacific. The Japanese were defeated before the U.S. bombing effort reached its peak. From 1943 onward, the United States enjoyed air superiority in the Pacific, and exploited it so thoroughly that World War II ended with the unconditional surrender of Japan while its armies, which had never been defeated in large scale fighting, held nearly

3,000,000 sq.mi. of southeastern Asia and dominated the lives of 500,000,000 people.

The collapse of Japan vindicated the whole strategic concept of the offensive phase of the Pacific war. In the simplest terms, that strategy called for the advance of air power, both land based and carrier based, step by step to the point where it could bring destructive power to bear directly on the Japanese homeland. When such a point was reached it was a certainty that air power would make invasion of the Japanese home islands possible. As it turned out, air power and sea power were so effective in combination that no invasion was necessary.

Allied Air Offensive.—On Jan. 24, 1942, the 10th air force began operations from around Chungking, in Yunnan province, China. Its first combat unit, the 23rd fighter group, had been organized from the American Volunteer group—the famous Flying Tigers. The job of the 10th at that time was to knock out Japanese airports and shoot down enemy planes, dive-bombing gunboats, junks and barges. When B-25s came to the 10th in the summer of 1942 they went after enemy shipping, docks, air bases, supply depots and troop concentrations.

In New Guinea the 5th air force was carrying out much the same sort of an operation. A year after Pearl Harbor the 5th was equipped with 81 heavy bombers, 83 medium bombers and 238 fighters. With this small force the 5th performed miracles, working out solutions to the problems posed by long overwater flying, high mountains, extensive jungle and bad weather.

In the summer of 1942, following the remarkable U.S. naval victory at Midway where four Japanese carriers were sunk, three battleships were damaged, a heavy cruiser was sunk and a number of lighter vessels were sunk or damaged, U.S. troops on Guadalcanal and Tulagi were getting air support from the 13th air force based on Espiritu Santo. At the other end of the Pacific the 11th air force had more to fight than the Japanese. In Alaska and the Aleutians, where it was based, the weather was a constant and implacable enemy. Lubricating oil congealed, tires froze to the ground; rain, snow and fog followed each other in rapid succession. Instrument flying was the usual practice in an area where mountains rose to great heights, and islands rose straight from the surface of the sea like mountain peaks. Dutch Harbor, in the Aleutians, was attacked by Japanese bombers on June 3, 1942. Air force and navy flyers had found a Japanese task force less than an hour's flying to the southeast, with two carriers, two cruisers and eight destroyers. In spite of the fact that the weather reduced visibility nearly to zero U.S. aircraft sank one of the cruisers and damaged another. Less than two weeks later aerial photographs showed Japanese on Attu, Agattu and Kiska. Their installations were bombed continually by the 11th during the next 11 months, and when U.S. surface forces finally drove them off, they didn't realize they had accomplished their mission until aerial photographs, interpreted in the United States, showed that the Japanese positions had been abandoned.

By June 1943 the tide was beginning to turn in the Pacific. On Feb. 9, 1943, Guadalcanal had fallen to U.S. forces, and on March 1-4, in the Bismarck sea action, the 5th air force and the Royal Australian air force had virtually wiped out a large Japanese convoy and its supplies, as well as nearly a division of troops, proceeding from Rabaul to Lae.

The primary objective of the Allied forces in the southwest Pacific was to advance a network of air bases deep into the Japanese perimeter. On June 30, Allied land, sea and air forces moved against the Japanese in the Solomons-New Guinea area in a simultaneous, three-pointed assault, and U.S. forces occupied Rendova Island in New Georgia. On Sept. 13 Salamaua fell to the Allies, and three days later Lae, which the Japanese had held since Jan. 1942, was recaptured. Meanwhile, the 5th air force carried out heavy attacks on Wewak and prepared Salamaua for recapture by hitting it, on July 27, with one of the heaviest bomb loads ever dropped in the southwest Pacific up to that time.

On Sept. 18-20, 1943, units of the 7th air force and two navy carrier task forces attacked Tarawa, Makin, Apamama and Nauru. The following week the 5th air force returned to Wewak, and as October began, a naval task force including six aircraft carriers

bombed Wake Island, dropping 320 tons of bombs and causing serious damage. With resistance in the central Solomons ended, the 5th air force began a series of devastating attacks on the great Japanese naval base at Rabaul on Oct. 12 that were to continue on into November.

The Japanese perimeter fell inward again when U.S. troops landed on Makin Island without opposition on Nov. 20, and simultaneously more U.S. troops established themselves successfully on Tarawa in a bloody action. In preparation for both of these attacks B-24s of the 7th air force bombed defense positions.

The B-29 Superfortress.—Meanwhile the plans division of air force headquarters in Washington, D.C., was giving a great deal of thought to how a new air weapon, to be available for operational use sometime in June 1944, should be employed. The new weapon was the B-29 which had been on the drawing boards in 1939. Germany was not considered as a B-29 target because the B-17s and B-24s in England would be hitting their full stride at the time the B-29s would be ready, and had all the range they needed to finish the task even though their bomb capacity was far less. On the other hand, Japan itself would remain free from bombardment for a long time unless the B-29s got into operation against it.

China was an obvious place to base the new Superfortresses, but there were no suitable airports closer than Chengtu or Chungking. The Marianas—specifically Guam, Tinian and Saipan—were selected as bases for up to 1,000 B-29s. Unfortunately, despite excellent progress in the Pacific, the Allies were a long way from the Marianas at the beginning of 1944. Hence, it was decided to get the Superfortresses into action from Chinese bases despite the difficulties of supply and the distance to Japan—2,000 mi. from Chengtu to Tokyo as compared to 1,400 or 1,500 mi. from the Marianas.

The first B-29 bombing attack occurred on June 5, 1944. Bangkok was the target and in order to hit it, the B-29s had to carry their own gasoline and bombs 1,200 mi. from Assam to Chengtu. On June 15 they hit the steel mills at Yawata and Japan was under direct, sustained attack for the first time in the war. Sasebo, Anshan, Palembang, Nagasaki and Yawata were repeatedly attacked from Chinese bases. All this, however, gave only a hint of what was to come when the Superfortresses began to operate from the Marianas.

Invasion of the Marshalls and Marianas.—On Feb. 7, 1944, the Japanese perimeter was again dented, this time in the Marshall Islands with the occupation of Kwajalein and Majuro. By Feb. 19, Eniwetok, westernmost of the Marshalls, had also been captured after light enemy resistance. Once on Eniwetok, U.S. forces found themselves about 2,400 mi. farther west of Pearl Harbor than they had been four months before. The Japanese inner defenses were exposed.

The question was simply where to strike next. The decision was influenced by the growing availability of B-29s and the need for bases to support further advances into the Palaus, the Philippines, Formosa and China. The joint chiefs of staff decided to by-pass Truk and strike at the southern Marianas. Truk was to be on the receiving end of a long series of neutralizing air attacks. The target date for the occupation of the Marianas was set as June 15, 1944.

Right on schedule, Saipan was attacked. During the seven days preceding the attack, heavy bombers of the 7th and 13th air forces had hit Truk to neutralize its threat to the landing operation. By July 9, organized resistance on Saipan had ended, and ten days later Guam was attacked. While the troops were moving steadily forward on Guam, Tinian was attacked on July 24. By Aug. 8 Tinian and Guam were in Allied hands.

On Nov. 24, 1944, the first B-29 mission took off from the Marianas. On that date, 100 Superfortresses left Saipan and bombed Tokyo for the first time since Gen. James Doolittle, on April 18, 1942, had taken off from the deck of the carrier "Hornet" and led 16 B-25s against Tokyo, Nagoya, Kobe and Yokohama. Within a month the B-29s had hit Tokyo three more times. They followed these attacks with one on Nagoya where they virtually demolished the Mitsubishi aircraft plant.

As 1945 began the 20th air force had a total of 345 B-29s on

Guam, Tinian and Saipan and a total of 51,800 officers and men. In the five weeks of 1944 in which they had operated they had destroyed 254 Japanese aircraft and dropped 9,000 bombs.

Bombing of Japan.—In March 1945 Gen. Curtis LeMay, commanding officer of the 20th air force, made one of the important decisions of the war—to attack Tokyo with incendiaries at low level at night with his full force. Never before had the B-29s bombed from altitudes of less than 24,000 ft., but on the night of March 9, Tokyo was attacked by 279 B-29s at a mean bombing altitude of 7,050 ft. The Japanese defenses were confused, and only 14 B-29s were lost from all causes. About 15.8 sq. mi. of the heart of Tokyo were burned out in what was, prior to the use of atomic bombs on Aug. 5 and 8, the most destructive air attack in history. The Tokyo attack was followed by devastating night incendiary attacks on Nagoya, Kobe and Osaka in quick succession.

By the war's end, the incendiary attacks had dropped 100,000 tons of bombs in the course of 15,000 sorties against 66 Japanese cities. The United States strategic bombing survey, after an exhaustive on-the-spot study of industrial facilities following V-J day, found that aerial bombardment had cut the Japanese productive capacity, as compared to its preattack output, tremendously. Oil refineries suffered a cut of 83%; aircraft engine plants, 75%; airframes, 60%; electronics and communication, 70%; army ordnance plants, 30%; naval ordnance plants, 28%; merchant and naval shipyards, 15%; light metals, 35%; ingot steel, 15%; and chemicals, 10%.

Coupled with the decisive strategic bombing of Japan was the blockade of the home islands. Since early in the war the Japanese merchant fleet had been a primary target of Allied sea, air, and submarine forces. To the submarines of the U.S. navy goes the chief credit for reducing the Japanese merchant fleet to the point where, on V-J day, that fleet consisted of about 300 ships—a little more than 1,000,000 gross tons, or 20% of the shipping afloat when the war began. In addition, aircraft sank more than 1,000,000 tons of shipping in 1944, and despite the growing scarcity of targets continued this rate until the end of the war, when the sea-air blockade was, to all intents and purposes, complete.

The B-29s made a major contribution to this achievement. One wing of the 20th air force was trained in aerial mining operations, and during the four days prior to D-day on Okinawa dropped more than 1,000 tons of mines in the Shimonoseki straits, closing the Inland sea to all large vessels for ten days to two weeks.

(H. H. AR.; X.)

AIRWAY, an artery of a mine, along which the ventilation is conducted. The districts branching from the fresh air "intakes" are ventilated by "splits" taken off the main airway. The current conducted along the branch or district intakes, round the "working face," returns by the district "return airway," enters the main "return airway" and proceeds thence to the upcast shaft up which it is drawn to the surface by fans. This is the practice in coal mining in Great Britain. In France the ventilation is generally carried out by compression, that is by fans forcing the air down the "downcast" shaft and through the workings to the "upcast."

The position, number and arrangement of the airways in an ideal coal mine are shown in the figure overleaf, as well as the manner in which the air is split for district ventilation. (See also COAL AND COAL MINING.) See diagram overleaf. (R. R.)

AIRY, SIR GEORGE BIDDELL (1801-1892), British astronomer royal, was born at Alnwick on July 27, 1801. He was educated at Colchester grammar school and at Trinity college, Cambridge, where he graduated as senior wrangler in 1823. He became a fellow of his college (1824), Lucasian professor of mathematics (1826), and then (1828) Plumian professor of astronomy and director of the new Cambridge observatory. Before long a mural circle was installed, and regular observations were instituted with it in 1833. In the same year the duke of Northumberland presented the Cambridge observatory with a fine object-glass of 12 in. aperture, which was mounted according to Airy's designs and under his superintendence, although the erection was not completed until after his removal to Greenwich in 1835. Airy's writings during this time are divided between mathematical physics and astronomy. The former were for the most part concerned

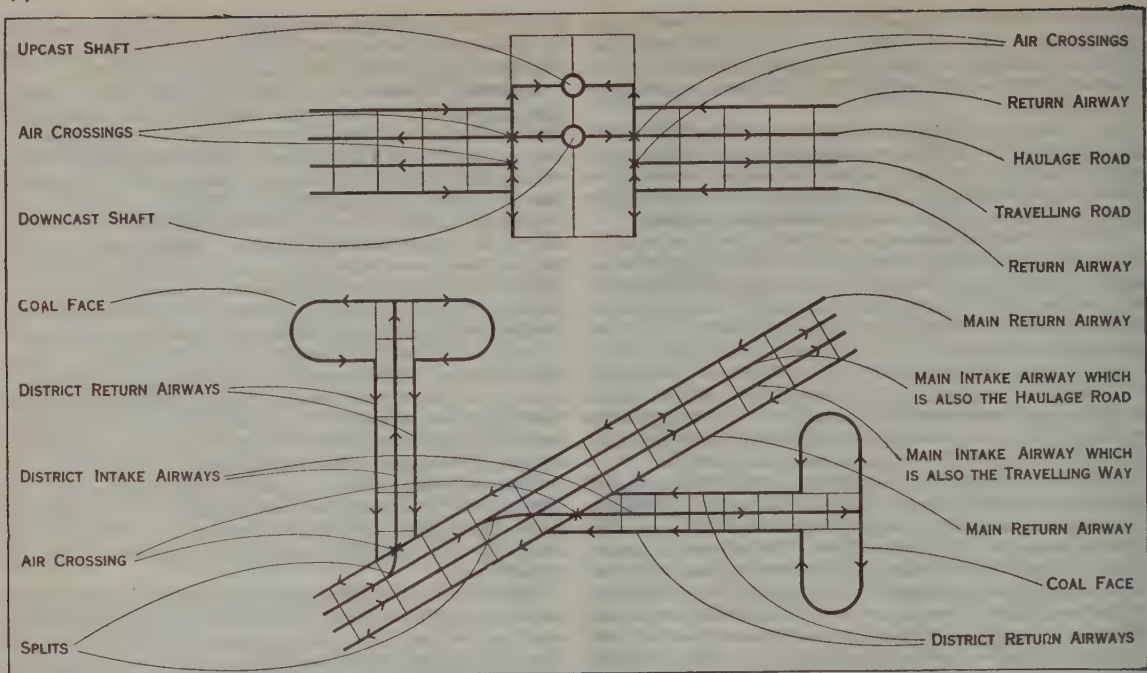


DIAGRAM ILLUSTRATING THE INSTALLATION OF AIRWAYS AND VENTILATING CURRENTS IN MINES—(SEE PAGE 477)

The upper plan shows the shaft pillars and the position of the main airways in the neighbourhood. The lower plan shows the main and district airways. The arrows in both plans indicate the direction of inward and outward air currents which make up the system of ventilation below ground

with questions relating to the theory of light, arising out of his professorial lectures, among which may be specially mentioned his paper "On the Diffraction of an Object-Glass with Circular Aperture." Of his astronomical writings during this period the most important are his investigation of the mass of Jupiter, his report to the British Association on the progress of astronomy during the 19th century, and his memoir *On an Inequality of Long Period in the Motions of the Earth and Venus*.

Airy's discovery of a new inequality in the motions of Venus and the earth was a remarkable achievement. In correcting the elements of Delambre's solar tables he discovered an inequality overlooked by their constructor. Eight times the mean motion of Venus is so nearly equal to 13 times that of the earth that the difference amounts to only the $\frac{1}{240}$ th of the earth's mean motion, and from the fact that the term depending on this difference, although very small in itself, receives in the integration of the differential equations a multiplier of about 2,200,000, Airy was led to infer the existence of a sensible inequality extending over 240 years (*Phil. Trans.*, cxxii. 67). The investigation leading to this result was probably the most laborious that had been made up to Airy's time in planetary theory, and represented the first specific improvement in the solar tables effected in England since the establishment of the theory of gravitation.

In June, 1835, Airy was appointed astronomer royal in succession to John Pond. Under Airy's administration modern apparatus was installed, and the whole organization placed on a scientific footing. No fewer than 8,000 lunar observations were rescued from oblivion, and were, in 1846, placed at the disposal of astronomers in such a form that they could be used directly for comparison with the theory and for the improvement of the tables of the moon's motion. (See HANSEN, PETER ANDREAS.)

One of the most remarkable of Airy's researches was his determination of the mean density of the earth. In 1826 the idea occurred to him of attacking this problem by means of pendulum experiments at the top and bottom of a deep mine. After some failures, successful experiments were made at the Harton pit, near South Shields, in 1854. Their immediate result was to show that gravity at the bottom of the mine exceeded that at the top by

$\frac{1}{10,386}$ th of its amount, the depth being 1,256ft.. From this Airy was led to the final value of 6.566 for the mean density of the earth as compared with that of water (*Phil. Trans.* cxlvi. 342). At the age of 71 Airy embarked on a new method of treating lunar theory. A general description of his method will be found in the *Monthly Notices of the Royal Astronomical Society*, Vol. xxxiv. No. 3. It consisted essentially in the adoption of Delaunay's final numerical expressions for longitude, latitude and parallax, with a symbolic term attached to each number, the value of which was to be determined by substitution in the equations of motion. The work was published in 1886, when its author was 85 years of age. In 1881 Sir George Airy resigned the office of astronomer royal and resided at the White house, Greenwich, not far from the Royal observatory, until his death, which took place on Jan. 2, 1892. The learned societies of his own and other countries conferred many honours on him.

BIBLIOGRAPHY.—A list of Airy's papers will be found in his *Autobiography*, edited in 1896 by his son, Wilfrid Airy, B.A., M. Inst. C.E. See also his *Mathematical Tracts* (1826) on the *Lunar Theory*, *Figure of the Earth*, *Precession and Nutation*, and *Calculus of Variations*, to which, in the second edition (of 1828), were added tracts on the *Planetary Theory* and the *Undulatory Theory of Light*; *Experiments on Iron-built Ships*, instituted for the purpose of discovering a correction for the deviation of the Compass produced by the Iron of the Ships (1839); *On the Theoretical Explanation of an apparent new Polarity in Light* (1840); *Tides and Waves* (1842).

AISLABIE, JOHN (1670-1742), English politician, born Dec. 7, 1670. He was made chancellor of the Exchequer in 1718, and supported the proposal of the South Sea Company to pay off the national debt. At the collapse of the company he was imprisoned in the Tower with other politicians accused of attempting to profit fraudulently from the scheme, but was soon released, through Walpole's intervention.

AISLE, in architecture, a term primarily meaning the wing of a house, but more commonly used to indicate any long, narrow space separated from the remainder of the building by a line of piers, columns or arches. It is specially used to designate the lateral portions of a church or other large room in which interior supports occur. The term also has come to mean a passageway,

pecially a passageway between groups of seats, as in a church or theatre. From the time of the early Christian basilica, the use of one or more side aisles flanking a central nave has been almost universal in church building, and church aisles are known as nave aisles, transept aisles or choir aisles from their position in relation to the nave, transept or choir. The choir aisle around the east end of a choir is known as an ambulatory (*q.v.*). In the normal Romanesque or Gothic church the roof of the aisles is lower than the central nave; but in certain examples in southern France (*e.g.*, St. Nazaire, Carcassonne), in Spain (*e.g.*, Barcelona), and especially in Germany, where for the smaller churches it is almost normal, the nave and aisles are of the same height. A church with nave flanked by one aisle on each side is known as a three-aisle church; one with two side aisles on each side as a five-aisle church, and so on.

AISNE, department, northern France, west of Ardennes (*q.v.*). Area 2,868 sq.mi. Pop. (1946) 453,411. It touches the western end of the Ardennes (930 ft.) in the northeast, but its surface is all of secondary or tertiary rocks. The outlying masses of the latter, often with steep flanks, form important sites such as that of Laon, the capital, and the famous Chemin des Dames. The Aisne enters the department from the east just as it leaves the chalk scarp and flows west to the Oise, the other river of the department. It has been made to stretch down to include the deep Château-Thierry portion of the Marne valley, too far west to focus on Épernay or Reims and allied to the hill country farther north rather than to Paris on the west. The department was the scene of much of World War I. It had a number of forests, but it lacks metallic ores, though quarries yield building stone, gypsum and clay. Mostly in the belt of rainfall 600–800 mm., and well watered and sheltered, it has had great farming prosperity, with specialization in dairying towards the northeast. Of the towns, Guise in the north does agricultural and other engineering and St. Quentin and numerous villages do weaving of cotton, wool and silk. St. Gobain has made mirrors since the 17th century. Sugar has been an important crop and industry. Communications are good by rail and by navigable rivers (Aisne, Oise, Marne). St. Quentin, Vervins, Laon and Soissons give their names to arrondissements and are, with Château-Thierry and Hirson (*qq.v.*), the chief towns. This department and that of Oise were rich in architectural monuments several of which were ruined in World War I, but the churches at Laon, Braine and Urcel (mainly 12th century) survived and the splendid *Basilique* of St. Quentin was largely repaired, while the castle-ruin (1400) of La Ferté-Milon did not suffer. Soissons is the seat of a bishop in the province of Reims, the court of appeal is that of Amiens (Somme), also the centre of the 2nd army corps. The department belongs to the educational province (*académie*) of Douai.

Aisne, Battle of the, 1918.—This title is one of several alternatives used to designate the third great German offensive of 1918, launched on May 27, against the Chemin des Dames ridge and rapidly carried across the Aisne and southward to the Marne. It is described under CHEMIN-DES-DAMES, BATTLE OF THE, 1918.

AÏSSÉ (a corruption of HAÏDÉE), MADEMOISELLE (*c.* 1694–1733), French letter-writer, was the daughter of a Circassian chief, and was born about 1694. Her father's palace was pillaged by the Turks, and as a child of four years old she was sold to the comte de Ferriol, the French ambassador at Constantinople. She was brought up in Paris by Ferriol's sister-in-law with her own sons, MM. D'Argental and Pont de Veyle. Her great beauty and romantic history made her the fashion, and she attracted the notice of the regent, Philip, duke of Orleans, whose offers she had the strength of mind to refuse. She formed a deep and lasting attachment to the Chevalier d'Aydie, by whom she had a daughter. She died in Paris on March 13, 1733. Her letters to her friend Madame Calandrin contain much interesting information with regard to contemporary celebrities, especially on Mme. du Deffand and Mme. de Tencin, but they are above all of interest in the picture they afford of the writer's own tenderness and fidelity.

Her *Lettres* were edited by Voltaire (1787), by J. Ravenel, with a notice by Sainte-Beuve (1846) and by Eugene Asse (1873). Mlle.

Aïssé has been the subject of three plays: by A. de Lavergne and P. Foucher (1854), by Louis Bouilhet (1872) and by Dejou (1898). See also Courteault, *Une Idylle au XVIII^e siècle, Mlle. Aïssé et le Chevalier d'Aydie* (Macon, 1900). There is an interesting essay by Sir E. Gosse in his *French Profiles* (1905).

AISTULF (d. 756), king of the Lombards (749–56). His first act as king was to drive the Greeks from the exarchate of Ravenna and to occupy the city, thus placing his army within striking distance of Rome. Pope Stephen II was forced to appeal to Pepin, king of the Franks, to defend the city, and in the campaigns of 755 and 756 Aistulf was defeated. The future of both the papacy and of the Lombard kingdom rested on Pepin's victory. The papacy was saved from becoming merely subordinate to the Lombard rule, and the Lombards were eventually (774) conquered by the Franks, who remained permanently hostile.

AITKEN, ROBERT GRANT (1864–1951), U.S. astronomer, was born in Jackson, Calif., on Dec. 31, 1864. Aitken was educated at Williams college, Williamstown, Mass., from which he graduated in 1887 and received his M.A. in 1892. In 1888–91 he was instructor of mathematics in Livermore college, and 1891–95 was professor of mathematics and astronomy in the University of the Pacific. In 1895 he was appointed astronomer at Lick observatory, Mt. Hamilton, Calif., of which he was director 1930–35. Here he specialized in the study of double stars, of which he discovered more than 3,000. For these discoveries, he was awarded in 1906 the Lalande prize by the Academy of Sciences of France and, in 1932, the gold medal of the Royal Astronomical society. He published *Binary Stars* (1918) and *New General Catalogue of Double Stars* (1932). He died Oct. 29, 1951.

AITON, WILLIAM (1731–93), Scottish botanist, was born near Hamilton in 1731, and died on Feb. 2, 1793. As director of Kew Gardens (1759–93) he effected many improvements, and in 1789 he published *Hortus Kewensis*, a catalogue of the plants there cultivated. A second and enlarged edition of the *Hortus* was brought out in 1810–13 by his eldest son, WILLIAM TOWNSEND AITON (1766–1849), who succeeded him at Kew.

AITZEMA, LIEUWE (LEO) VAN (1600–1669), Dutch historian and statesman, was born at Docum, in Friesland, Nov. 19, 1600, and died at The Hague, Feb. 23, 1669. His most important work was the *Saken van Staet in Oorlogh in ende omtrent de Vereenigt Nederlanden* (1655–71), embracing the period from 1621 to 1668. It contains a large number of state documents, and is an invaluable authority on one of the most eventful periods of Dutch history. Four continuations of the history, by the poet and historian Lambert van den Bos, were published. The *Derde Vervolg Zijnde het vierde Stuck van het Vervolg op de Historie*, etc., brought the history down to 1697.

AIVALI, Turkey; see AVVALIK.

AIX, city of southeast France, capital of an arrondissement in the department of Bouches-du-Rhône, 18 mi. N. of Marseille. Pop. (1946) 46,953. It is situated in a plain overlooking the Arc, about a mile from the right bank of the river. Aix (*Aquae Sextiae*) was founded in 123 B.C., by the Roman consul Sextius Calvinus. In 102 B.C. Marius defeated the Cimbri and Teutones there. In the 4th century it was the metropolis of Narbonensis Secunda. Occupied by Visigoths in 477, and repeatedly plundered by Franks and Lombards, it was taken by Saracens in 731. During the middle ages it was the capital of the county of Provence and reached its zenith after the 12th century, when the houses of Aragon and Anjou made it an artistic centre and seat of learning. It passed with Provence to the crown in 1487, and had the parlement of Provence (1501–1789). In the 17th and 18th centuries it was the seat of the *intendance* of Provence.

The Cours Mirabeau divides the town into the new town to the south and the old town to the north. Aix is the seat of the faculties of law and letters of the University of Aix-Marseille. The cathedral of St. Sauveur dates from the 11th, 12th and 13th centuries. It has a rich Gothic portal with elaborately carved doors. The archbishop's palace and a Romanesque cloister adjoin the cathedral on its south side. The church of St. Jean de Malte (13th century), contains valuable pictures. The *hôtel de ville* (17th century) contains fine wood-work and a large library

with valuable mss. Aix has thermal springs, remarkable for their heat and containing lime and carbonic acid; baths have been built (1705) near the site of the Roman baths. The industries include flour-milling, the making of confectionery, the manufacture of hats and the preparation of olive-oil. Trade is in olive-oil, almonds and flour.

The town, which is the seat of an archbishop and court of appeal and the centre of an *académie*, has a court of assizes, tribunal of commerce, and a chamber of arts and manufactures. It



THE SQUARE IN AIX SHOWING THE COURT HOUSE AND CLOCK TOWER

also has museums of antiquities, natural history and painting, and several learned societies.

Aix, Battle of (Aque Sextiae).—After the Roman disaster at Arausio (*q.v.*) in 105 B.C. the great migration of the Cimbri and Teutones turned aside to Spain, thus enabling Marius (*q.v.*) to gain breathing space to organize and train his "new model" army. But in 102 B.C., returning to Gaul, these tribes moved to invade Italy, the Cimbri going round the north of the Alpine barrier and the Teutones by the Mediterranean coast. On their approach Marius entrenched himself and refused to be drawn out to battle, content to repulse their assault and to acclimatize his men to the sight and ways of their strange and terrifying foe. When the host passed onwards, Marius cautiously followed until on reaching Aque Sextiae, now Aix, 20m. N. of Marseille, a partial engagement was brought on by the common desire to gain possession of the only available water supply. The Romans were successful and after a two days' pause, Marius judged the moment ripe for battle, having detached a force of 3,000 men to take up a concealed position on the enemy's flank. His cavalry and light infantry were then used to draw out the Teutones to attack, which Marius awaited on the slope of a hill. This first onslaught was stopped with difficulty, but gradually the Romans pressed their assailants downhill. Before the Teutones could reform on the level, they were struck in rear by the flank detachment, and their very numbers then intensified the press and their difficulty. The disaster was so complete that not merely the menace but the tribe itself was dispersed.

See Henry Bordeaux, *La Vallée d'Aix* (1921); M. A. E. Clerc, *Aque Sextiae* (1916).

AIX-LA-CHAPELLE: see AACHEN.

AIX-LA-CHAPELLE, CONGRESSES OF. Three congresses have met at Aix-la-Chapelle—in 1668, in 1748 and in 1818.

1. The treaty of May 2, 1668, which ended the War of Devolution, was the outcome of that of St. Germain signed on April 15 by France and the representatives of the Triple Alliance. The Treaty of Aix-la-Chapelle left to France all the conquests made in Flanders during 1667, with all their "*appartenances, dépendances et annexes*," a vague provision of which, after the peace of Nimwegen (1680), Louis XIV. took advantage to occupy villages and towns adjudged to him by his *Chambres de réunion* as dependencies of the cities and territories acquired in 1668. On the other hand, France restored to Spain Cambrai, Aire and Saint-Omer, as well as Franche Comté. The Treaty of Aix-la-Chapelle was placed under the guarantee of Great Britain, Sweden and Holland, by a

convention signed at The Hague on May 7, 1669, to which Spain acceded.

See Jean du Mont, baron de Carlsroon, *Corps universel diplomatique* (Amsterdam, 1726-31).

2. On April 24, 1748, a congress assembled at Aix-la-Chapelle to end the War of Austrian Succession. The definitive treaty was signed on Oct. 18. Its most important provisions were those stipulating for (1) a general restitution of conquests, including Cape Breton to France, Madras to England and the barrier towns to the Dutch; (2) the assignment to Don Philip of the duchies of Parma, Piacenza and Guastalla; (3) the restoration of the duke of Modena and the republic of Genoa to their former positions; (4) the renewal in favour of Great Britain of the Asiento contract of March 16, 1713, and of the right to send an annual vessel to the Spanish colonies; (5) the renewal of the article of the treaty of 1718 recognizing the Protestant succession in the English throne; (6) the recognition of the emperor Francis and the confirmation of the pragmatic sanction, *i.e.*, of the right of Maria Theresa to the Hapsburg succession; (7) the guarantee to Prussia of the duchy of Silesia and the county of Glatz.

Spain having raised objections to the Asiento clauses, the Treaty of Aix-la-Chapelle was supplemented by that of Madrid (Oct. 5, 1750), by which Great Britain surrendered her claims for a sum of £100,000.

See Comte G. de Garden, *Hist. des traités de paix*, iii. p. 373 (1848-87).

3. The congress or conference of Aix-la-Chapelle in 1818 was primarily a meeting of the four Allied Powers—Great Britain, Austria, Prussia and Russia—to decide the question of the withdrawal of the army of occupation from France and the consequent international relationships of the Powers. The congress, which opened on Oct. 1, was attended by Alexander I. of Russia, Francis I. of Austria, and Frederick William III. of Prussia, in person. Great Britain was represented by Lord Castlereagh and the duke of Wellington, Austria by Prince Metternich, Russia by Counts Capo d'Istria and Nesselrode, Prussia by Prince Hardenberg and Count Bernstorff. The duc de Richelieu, by favour of the allies, was present on behalf of France. The evacuation of France was agreed to in principle at the first session, the consequent treaty being signed on Oct. 9. The rest of the time of the congress was mainly occupied in discussing the form to be taken by the European alliance, and the precautions to be adopted against a fresh outburst on the part of France. The proposal of Alexander I., to establish a "universal union of guarantee" on the broad basis of the Holy Alliance, broke down on the opposition of Great Britain; and the main outcome of the congress was the signature, on Nov. 15, of two instruments: (1) a secret protocol confirming and renewing the Quadruple Alliance established by the treaties of Chaumont and Paris (Nov. 20, 1815) against France; (2) a public "declaration" of the intention of the Powers to maintain their intimate union, of which the object was to preserve peace on the basis of respect for treaties. The secret protocol was communicated in confidence to Richelieu; to the declaration France was invited publicly to adhere.

The congress also concerned itself with the questions of the suppression of the slave trade and the Barbary pirates. In neither case was any decision arrived at, owing (1) to the refusal of the other Powers to agree with the British proposal for a reciprocal right of search on the high seas; (2) to the objection of Great Britain to international action, which would have involved the presence of a Russian squadron in the Mediterranean. A great variety of lesser questions was considered, but an attempt to introduce the subject of the Spanish colonies was defeated by the opposition of Great Britain. The congress represents the highest point reached in the attempt to govern Europe by an international committee of the Powers.

See W. Alison Phillips, *The Confederation of Europe* (2nd. ed. 1919). (W. A. P.)

AIX-LES-BAINS, thermal spa and fashionable resort, east France, in the department of Savoie, near the Lac du Bourget, 9 mi. by rail N. of Chambéry. Pop. (1936) 8,917. The sulphur springs were known as *Aque Gratianae* by the Romans, and the



BY COURTESY OF THE ARCHAEOLOGICAL DEPARTMENT OF HYDERABAD

**FRESCO PAINTING OF THE BODHISATTVA, VAJRAPANI, A DIVINE-HUMAN
BEING ARMED WITH A THUNDERBOLT, FROM THE CAVES OF AJANTA**

The illustration was taken from Cave I. There are about 30 caves excavated in the south side of the bank of the ravine of the river Wagura, some three and a half miles from Ajanta, India, which were used as dwellings and meeting-halls by the Buddhist Order from 200 B.C. to the seventh century A.D. Many of the interior walls of these caves are covered with fresco paintings, which are very decorative. These have been preserved and form an important body of evidence of pre-Hindu art in India

neighbourhood has numerous ancient remains. Over 50,000 visitors are ordinarily attracted annually; the main season is July–September, but Aix also serves as a base for Alpine winter sports.

AIYAR, SIR SHESHADRI (1845–1901), Indian statesman, the son of a Brahman of Palghat, Malabar, rose from a humble position as translator in his native district to be prime minister of Mysore under the Maharaja Chamarajendra. To him Mysore owes many important public works and the development of the Kolar gold-fields. Aiyar retired in 1900 and died on Sept. 13, 1901.

AIYAR, SIR TIRUVARUR MUTUSWAMY (1832–1895), native Indian judge of the high court of Madras, was born of poor parents in the village of Vuchuwadi, near Tanjore, on Jan. 28, 1832. His widowed mother was forced by poverty to remove with Mutuswamy and his brother to Tiruvārur, where the former learnt Tamil, and soon set to work under the village accountant at a monthly salary of one rupee. Aiyar worked his way through a series of minor offices until he was able to take his degree in law. He then became a judge of the Madras small causes court, and in 1878 he was raised to the bench of the high court, which office he occupied with ability and distinction for over fifteen years, sometimes acting as the chief justice. He attended by invitation of the viceroy the imperial assemblage at Delhi in 1877. In 1878 he received the honour of C.I.E., and in 1893 the K.C.I.E. was conferred on him. He died suddenly in 1895. Aiyar took his full share in the affairs of the Madras university, of which he was nominated a fellow in 1872 and a syndic in 1877, and was well acquainted with English law, literature and philosophy. He was through life a staunch Brahman, devout and amiable in character, with a taste for the ancient music of India and the study of the Vedas and other departments of Sanskrit literature.

AJACCIO, capital of Corsica, on the west coast of the island. Pop. (1936) 34,393. Ajaccio occupies a sheltered position at the foot of wooded hills on the north shore of the Gulf of Ajaccio. The harbour, to the east, is protected on the south by a peninsula which carries the citadel. It is deep enough to shelter large ships. To the southwest of the peninsula lies the Place Bonaparte, frequented by winter visitors attracted by the mild climate. Apart from one or two fine thoroughfares, the streets are narrow. The present town of Ajaccio lies about 2 mi. south of its original site, from which it was transferred by the Genoese in 1492. Occupied in 1553 by the French, it again fell to the Genoese after the treaty of Cateau Cambrésis in 1559. The town finally passed to the French in 1768. Since 1810 it has been the capital of the department of Corsica. The associations of Napoleon I with the town are everywhere emphasized by street-names and statues. The town is the seat of a bishopric (7th century) and of a prefect. It has tribunals of first instance and of commerce and a museum. Ajaccio makes cigars and macaroni and carries on shipbuilding, sardine-fishing and coral-fishing. Its exports include timber, oranges, citrons and skins.

AJAIGARH, an Indian state in the Central India states. It has an area of 788 sq.mi., and a population in 1941 of 96,596. The ruler, who is a Bundela Rajput, bears the title of sawai maharaja and has a salute of eleven guns. He resides at Ajaigarh, at the foot of the hill-fortress from which the state takes its name. This fort is situated on a very steep hill, more than 800 ft. above the town, and contains the ruins of temples with elaborate sculptures.

AJANTA (more properly Ājūnthā), a village in the dominions of the Nizam of Hyderabad in India, celebrated for its cave hermitages and halls, in a wooded and rugged ravine about 3½ m. from the village. The ravine is that of the river Wāgura which falls from the east over a bluff forming several waterfalls. The caves, about 30 in number, are excavated in the south side of the precipitous bank of the ravine, and are of two kinds—dwelling-halls and meeting-halls. The former have a broad verandah, its roof supported by pillars, and giving towards the interior on to a hall averaging in size about 35 ft. by 20 ft. Dormitories are excavated opening on to this hall, and an image of the Buddha usually stands in a niche facing the entrance. In the larger caves pillars support the roof on all three sides, forming a sort of cloister run-

ning round the hall. The meeting-halls which back into the rock about twice as far as the dwelling-halls, were used as chapter-houses for the meetings of the Buddhist Order. The oldest caves date from 200 B.C. to A.D. 200, the next belong approximately to the 6th, and the youngest to the 7th century A.D. Most of the interior walls of the caves are covered with fresco paintings, of considerable merit, and somewhat in the early Italian style. When first discovered, in 1817, these frescoes were in a fair state of preservation, but they fell later into decay. The remains are now properly preserved, and form, with copies of those destroyed, important evidence as to pre-Hindu art in India. Ajanta was a kind of college monastery.

AJAX (I.) the Greater Gr. Atas, son of Telamon, king of Salamis. In Homer's *Iliad* he is described as of great stature and colossal frame, second only to Achilles in strength and bravery. He engaged Hector in single combat and, with the aid of Athene, rescued the body of Achilles from the hands of the Trojans. In the competition between him and Odysseus for the armour of Achilles, Agamemnon, at the instigation of Athene, awarded the prize to Odysseus. This so enraged Ajax that it caused his death (*Odyssey*, xi. 541). According to a later and more definite story, accepted by Sophocles as the basis of his drama, his disappointment drove him mad; he rushed out of his tent and fell upon the flocks of sheep in the camp under the impression that they were the Greeks; on coming to his senses he slew himself with the sword which he had received as a present from Hector. From his blood sprang a red flower (see *HYACINTHEUS*) which bore on its leaves the initial letters of his name AI, also expressive of lament (Pausanias i. 35. 4.). He was the tutelary hero of the island of Salamis, where he had a temple and an image, and where a festival called *Aianteia* was celebrated in his honour (Pausanias i. 35).

II., the Lesser, son of Oileus, king of Locris, called the "lesser" or Locrian Ajax, to distinguish him from the son of Telamon. In spite of his small stature, he held his own amongst the other heroes before Troy; he was brave, next to Achilles in swiftness of foot, and famous for throwing the spear. But he was boastful, arrogant, and quarrelsome. Athena wrecked his ship on his homeward voyage (*Odyssey*, iv. 499), presumably for his crime (not definitely mentioned by Homer) in dragging Cassandra from the statue of the goddess, during the sack of Troy, and violating her. This led to the thousand years' penance of his people; nevertheless, he was worshipped as a national hero by the Opuntian Locrians (on whose coins he appeared), who always left a vacant place for him in their battle line.

See articles in Roscher's *Lexikon* and Pauly-Wissowa, *Realencyklopädie*; L. R. Farnell, *Hero-Cults*, pp. 293 et seq. and 305 et seq.

AJMERE or **AJMER**, a city of India in Rajputana, which gives its name to a district and also to a petty province called Ajmere-Merwara. Pop. of the city (1941) 147,258. It is on the lower slopes of Taragarh Hill, in the Aravalli mountains. To the north of the city is a large artificial lake called the Ana Sagar, and farther up the valley is a new lake, the Foy Sagar, from which the water supply of the place is now derived.

The chief object of interest is the *darga*, or tomb of the famous Mohammedan saint Muin-ud-din Chishti. It is situated at the foot of the Taragarh hill, and consists of a block of white marble buildings without much pretension to architectural beauty. To this place the emperor Akbar, with his empress, performed a pilgrimage on foot from Agra in accordance with the terms of a vow he had made when praying for a son. An ancient Jain temple converted about A.D. 1200 into a mosque, is situated on the lower slope of the Taragarh hill. With the exception of that part used as a mosque, nearly the whole of the ancient temple has fallen into ruins, but the relics are not excelled in beauty of architecture and sculpture by any remains of Hindu art. Forty columns support the roof, but no two are alike, and great fertility of invention is manifested in the execution of the ornaments. The summit of Taragarh hill, overhanging Ajmere, is crowned by a fort, the lofty thick battlements of which run along its brow and enclose the tableland. The walls are 2 m. in circumference, and the fort can only be approached by steep and very roughly paved planes,

commanded by the fort and the outworks, and by the hill to the west. Ajmere was founded about the year A.D. 145 by Ajaipal, a Chauhan, who established the dynasty which continued to rule the country (with many vicissitudes of fortune) while the repeated waves of Mohammedan invasion swept over India, until it eventually became an appanage of the crown of Delhi in 1193. Its internal government, however, was handed over to its ancient rulers upon the payment of a heavy tribute to the conquerors. It then remained feudatory to Delhi till 1365, when it was captured by the ruler of Mewar. Akbar took it back in 1556; and it continued in the hands of the Moguls, with occasional revolts, till 1770, when it was ceded to the Mahrattas, from which time up to 1818 the unhappy district was the scene of a continual struggle, being seized at different times by the Mewar and Marwar rajas, from whom it was so often retaken by the Mahrattas. In 1818 the latter ceded it to the British in return for a payment of 50,000 rupees.

The modern city is an important administrative and railway centre. It is well laid out with wide streets and handsome houses. The city does an active trade in salt which is imported in large quantities from the Sambar lake and Ramsur. Oil making is also a profitable branch of trade. Cotton cloths are manufactured to some extent, for the dyeing of which the city has attained a high reputation. The educational institutions include the Mayo Rajkumar college, opened in 1875, for training the sons of the nobles of Rajputana, on the lines of an English public school.

Seven miles from Ajmere lies the lake of Pushkar, one of the most sacred pieces of water in India, where a pilgrim fair is held every autumn, and Brahma has the only temple dedicated to him in India.

The district of Ajmere, which forms the largest part of the province of Ajmere-Merwara, has an area of 2,125 sq.mi. Population 378,960, inclusive of Ajmere city. Besides the city of Ajmere, the district contains the military station of Nasirabad, with a population of 32,196 (1941).

AJMERE-MERWARA, a former British district of India, in Rajputana agency, consisting of the two districts of Ajmere and Merwara, separated from each other and isolated amid Indian states. Pop. (1941) 583,693. The administration was in the hands of a commissioner, subordinate to the governor general's agent for Rajputana. The capital is Ajmere city. The area is 2,400 sq.mi. The Aravalli range is the distinguishing feature of the district. The range of hills which runs between Ajmere and Nasirabad marks the watershed of the subcontinent of India. The rain which falls on one side drains into the Chambal, and so into the Bay of Bengal; that which falls on the other side, into the Luni, which discharges itself into the Runn of Cutch. The province is on the border of what may be called the arid zone; it is the debatable land between the northeastern and southwestern monsoons, and beyond the influence of either. The southwest monsoon sweeps up the Nerbudda valley from Bombay and crossing the tableland at Neemuch gives copious supplies to Malwa, Jhalawar and Kotah and the countries which lie in the course of the Chambal river; but it is only when the monsoon is in considerable force that Merwara gets a plentiful supply from it. The northeastern monsoon sweeps up the valley of the Ganges from the Bay of Bengal and waters the northern part of Rajputana, but hardly penetrates farther west than the longitude of Ajmere. The agriculturist in Ajmere-Merwara can thus rarely rely upon two good harvests in succession. A district subject to such conditions can hardly be free from famine or scarcity for any length of time, but the population, having declined in the period from 1891-1921, showed a steady increase after 1921. Among Hindus, the Rajputs are landholders, and the Jats and Gujars are cultivators. The Jains are traders and moneylenders. The aboriginal tribe of Mers are divided between Hindus and Mohammedans. The chief crops are millet, wheat, cotton and oil seeds. There are several factories for ginning and pressing cotton, the chief trading centres being Beawar and Kekri.

AJO, an unincorporated town in Pima county, southern Arizona, U.S., about 25 mi. from the Mexican border and 90 mi. southwest of Phoenix; the altitude is 1,859 ft. It is on state highway 85 and is served by the Tucson, Cornelia and Gila Bend railroad. The

population was 5,777 by the federal census of 1950. There are copper, gold, silver and lead mines in Ajo, and copper is smelted there. Spaniards were working the copper mines at Ajo as early as 1750. In 1854 the Ajo Copper company became the first incorporated mining company in the territory. After mining, the ore was hauled across the desert and shipped via the Gulf of California to Swansea, Wales, for smelting.

Originally, the town was called *Muy Vavi*, a Papago Indian term for warm water, but later it was changed to Ajo, Spanish for garlic, which grows plentifully in the nearby hills.

AJODHYA, an ancient city of India, situated on the right bank of the Gogra, in the Fyzabad district of the United Provinces. In remote antiquity Ajodhya was one of the largest and most magnificent of Indian cities. It is said to have covered an area of 96 sq.mi., and was the capital of the kingdom of Kosala, the court of the great king Dasaratha, who was the father of Rama, the hero of the *Ramayana*. The opening passages of that epic recount the magnificence of the city, the glories of the monarch and the virtues, wealth and loyalty of his people. A period of Buddhist supremacy followed the death of the last king of the Solar dynasty. On the revival of Brahmanism, Ajodhya was restored by King Vikramaditya (c. 57 B.C.). Kosala has claims to be the birthplace of the founders of both Buddhism and Jainism. The Chinese traveller, Hsüan Tsang, in the 7th century, found 20 Buddhist temples with 3,000 monks at Ajodhya, among a large Brahmanical population. The ancient city is now represented by a heap of ruins, with a few fine temples, and the modern town is only a small suburb of Fyzabad.

AKA HILLS, a tract of country on the northeast frontier of India, occupied by an independent tribe called the Akas. It lies north of the Darrang district of eastern Bengal and Assam, and is bounded on the east by the Dafia Hills and on the west by independent Bhutia tribes. The Aka country is very difficult of access, the direct road from the plains leading along the precipitous channel of the Bhareli river, which divides the Aka from the Dafia country.

The Akas are a brave people, and the men are strong and well made. They have clans graded socially, a dual organization and burial of the dead. They worship the Bhareli river annually, poison their arrows with aconite and play both varieties of nose flute.

The reputation of the Akas as raiders is sufficiently shown in the division of the tribe into two clans, the Hazari-khoas or "eaters of a thousand hearths," and the Kapah-chors or "thieves that lurk in the cotton fields." In the early years of British occupation, about 1829, they gave much trouble; and in 1883 they broke out once more into their old habits. They raided into the British district of Darrang and carried off several native forest officers as hostages. An expedition was sent against them under Gen. Sale Hill with 860 troops, which was completely successful. Living among them as a labouring but not servile class is the Niggiya or Khao tribe divided into four clans.

See Nevill, "The Akas," *Assam Census Report*, 1921, I, App. B, i.

AKALKOT, a native state of India, in the Deccan and Kolhapur agency. It forms part of the Deccan tableland, and has a cool climate. Area 473 sq.mi.; pop. (1931) 92,605; (1941) 103,903. The tribute is £1,000. The state was under British management.

The town of Akalkot is situated near the Great Indian peninsula railway, which traverses the state. Pop. (1941) 13,810.

AKAN, a Gold Coast tribe inhabiting the Koforidua district of the Accra hinterland, neighbours of the Fanti and Ashanti, with whom they probably share a common origin, their language being closely related to these two idioms, and their organization being the same.

See Sarbah, *Fanti Customary Law* (1904).

AKBAR, JALAL UD-DIN MOHAMMED (1542-1605), the greatest of the Mogul (Mughal) emperors of India, was born at Umarkot in Sind when his father Humayun, who had been driven from the throne of Delhi by an Afghan usurper named Sher Shah, was escaping to Persia. Thirteen years passed before Humayun felt strong enough to attempt the reconquest of Hindustan,

and little had been accomplished before his death in 1556: in fact there was no Mogul empire before Akbar, but only the attempt to create one. Akbar's first task on his succession to the throne was to overthrow all rival claimants, the chief of them being the usurping Hindu minister Hemu whose forces were routed at Panipat on Nov. 5, 1556. By 1562 Akbar's kingdom embraced the Punjab and Multan, the basin of the Ganges and Jumna from Panipat to Allahabad, Gwalior in central India, Ajmere in Rajputana and the province of Kabul in Afghanistan. Another 14 years of almost incessant warfare resulted in the conquest of Malwa, Chitor, Ranthambhor, Kalinjar, Gujarat and Bengal. Thus, by 1576, Akbar was master of almost the whole of northern India. Between 1586 and 1595 he added Kashmir, Sind, Baluchistan, Kandahar and parts of Orissa to his dominions. With his power firmly established in the north he crossed the Narbada into the Deccan and annexed Khandesh, Berar and parts of Ahmednagar. At his death in 1605 his empire comprised 15 *subas* (provinces) and stretched from the Hindu Kush to the Godavari and from Bengal to Gujarat.

Akbar was endowed with a genius for administration to which the structure of both his central and provincial governments bears testimony. He deliberately accepted compromise as the basis of his empire and by his policy of *sulh-i-kull* (universal toleration) sought to conciliate the subject Hindu population and secure their loyalty. Realizing that it was impossible to govern as a strictly orthodox Moslem monarch, he abolished the hated *jizya* or poll-tax on non-Moslems and the tax previously levied on Hindu pilgrims. Hindus, especially Rajputs, were given important posts in the army and in the revenue department. To relieve the pressure on the peasants he demanded no more than one-third of their gross produce as land revenue. But although his interest in religious toleration was genuine his policy appears to have been dictated rather by political and dynastic considerations: his conception of sovereignty was autocratic and his religious policy an assertion of the supremacy of the state, politically, economically and financially. For this reason he crushed the power of the *ulema*, a body of orthodox divines and doctors of the law who constituted a check upon his power, by forcing them to subscribe to a document known as the Infallibility decree which assigned to Akbar the rank of *mujtahid* (interpreter) thus making him the authority on all matters relating to Islam.

Although illiterate Akbar was extremely interested in the study of comparative religion and built an *ibadat khana* or "house of worship" where learned men of all religions discussed theological problems. As a result of these discussions he became convinced that there was good in all religions and went so far as to promulgate a new eclectic faith called the *Din Illahi*. At his request three separate Jesuit missions were sent to his court; but they failed to convert him to Christianity as he was unable to give up the pleasures of the harem or subscribe to the doctrines of the Trinity and the Incarnation. The departure of his successors from the main principles of his rule, especially their policy of religious intolerance, paved the way for the decline of the Mogul empire.

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AKCHA, a town and khanate of Afghan Turkistan, 42 mi. W. of Balkh on the road to Andkhui. It is protected by a mud wall and a citadel. Estimated population 8,000, chiefly Uzbegs. The khanate is small, but well watered and populous. The rivers which rise in the southern mountains end near Akcha in vast swamps filled in flood time with debris of hillside plants.

AKEE, the West African name of a small tree (*Blighia sapida*) of the soapberry family (Sapindaceae), native to Guinea, and also of its important food fruit. Introduced in 1778 into Jamaica, which now exports the fruit, its cultivation has spread throughout most of tropical America. The shrublike, stiff-branched tree, sometimes 20 ft. to 30 ft. high, bears handsome red or orange coloured fruits, about 3 in. long, in small clusters at the tips of slender branches. The fruit, which is a soft-walled capsule, splits when ripe into three sections, from apex to base, displaying round,

shining, black seeds, attached to the base by large whitish or yellowish fleshy arils. When cooked the arils bear a resemblance to a fine omelette both in taste and in appearance; the Latin-American name *seso vegetal* (vegetable brain) is significant of their form.

AKEN, a town of Germany on the Elbe in the south-east of the district of Magdeburg, Prussian Saxony. Pop. (1939) 12,490. Chemicals and oils are manufactured. There is considerable transit trade on the Elbe, and petrol storage.

AKENSIDE, MARK (1721-1770), English poet and physician, was born at Newcastle-on-Tyne. He was the son of a butcher, and was slightly lame all his life from a wound he received as a child from his father's cleaver. He was sent (1739) to Edinburgh to study theology with a view to becoming a minister, but in fact studied medicine, and seems to have drifted to a mild deism. His politics, says Dr. Johnson, were characterized by an "impetuous eagerness to subvert and confound, with very little care what shall be established," and he is caricatured in the republican doctor of Smollett's *Peregrine Pickle*. He was elected a member of the Medical Society of Edinburgh in 1740. His ambitions already lay outside his profession, and his gifts as a speaker made him hope one day to enter parliament. In 1740 he printed his "Ode on the Winter Solstice" in a small volume of poems. In 1741 he left Edinburgh for Newcastle and began to call himself a surgeon, though it is doubtful whether he practised, and from the next year dates his life-long friendship with Jeremiah Dyson (1722-1776). During a visit to Morpeth in 1738 he had conceived the idea of his didactic poem, *The Pleasures of the Imagination*. He had already acquired a considerable literary reputation when he came to London about the end of 1743, and offered the work to Dodsley for £120. Dodsley thought the price exorbitant, and only accepted the terms after submitting the manuscript to Pope, who assured him that this was "no everyday writer." The three books of this poem appeared in Jan. 1744. It was translated eventually into German, French and Italian, and gained a general success. His aim, Akenside tells us in the preface, was "not so much to give formal precepts, or enter into the way of direct argumentation, as, by exhibiting the most engaging prospects of nature, to enlarge and harmonize the imagination, and by that means insensibly dispose the minds of men to a similar taste and habit of thinking in religion, morals and civil life." Akenside's powers fell short of this lofty design; his imagination was not brilliant enough to surmount the difficulties inherent in a poem dealing so largely with abstractions; but the work was well received by the general public. His success was not unchallenged. Gray wrote to Thomas Wharton that it was "above the middling," but "often obscure and unintelligible and too much infected with the Hutchinson jargon." The reference was to Francis Hutcheson (1694-1746), author of an *Inquiry into the Original of our Ideas of Beauty and Virtue* (1725).

Into a note added by Akenside to the passage in the third book dealing with ridicule, William Warburton chose to read a reflection on himself. Accordingly he attacked the author of the *Pleasures of the Imagination*—which was published anonymously—in a scathing preface to his *Remarks on Several Occasional Reflections, in answer to Dr Middleton*... (1744). This was answered, nominally by Dyson, in *An Epistle to the Rev. Mr Warburton*, in which Akenside no doubt had a hand. It was in the press when he left England in 1744 to secure a medical degree at Leyden. In little more than a month he had completed the necessary dissertation, *De ortu et incremento foetus humani*, and received his diploma. Returning to England he attempted without success to establish a practice in Northampton. In 1744 he published his *Epistle to Curio*, attacking William Pulteney (afterward earl of Bath) for having abandoned his liberal principles to become a supporter of the government, and in the next year he produced a small volume of *Odes on Several Subjects*, in the preface to which he lays claim to correctness and a careful study of the best models. His friend Dyson had meanwhile left the bar, and had become, by purchase, clerk to the house of commons. Akenside had come to London and was trying to make a practice at Hampstead. Dyson took a house there, and did all he could to further his friend's interest in the neighbourhood. But Akenside's arrogance and pedantry frus-

trated these efforts, and Dyson then took a house for him in Bloomsbury Square, making him independent of his profession by an allowance stated to have been £300 a year, but probably greater, for it was asserted that his income enabled him to "keep a chariot" and to live "incomparably well." In 1746 he wrote his much-praised "Hymn to the Naiads," and he also became a contributor to *Dodsley's Museum, or Literary and Historical Register*.

He was now 25 years old, and began to devote himself almost exclusively to his profession. He was an acute and learned physician. He was admitted M.D. at Cambridge in 1753, fellow of the Royal College of Physicians in 1754, and fourth censor in 1755. In June 1755 he read the Gulstonian lectures before the college, in Sept. 1756 the Croonian lectures and in 1759 the Harveian oration. In Jan. 1759 he was appointed assistant physician, and two months later principal physician to Christ's hospital, but he was charged with harsh treatment of the poorer patients, and his unsympathetic character prevented the success to which his undeniable learning and ability entitled him. At the accession of George III, both Dyson and Akenside changed their political opinions, and Akenside's conversion to Tory principles was rewarded by the appointment of physician to the queen. Dyson became secretary to the treasury, lord of the treasury, and in 1774 privy councillor and cofferer to the household.

Akenside died on June 23, 1770, at his house in Burlington street, where the last ten years of his life had been spent. His friendship with Dyson puts his character in the most amiable light. Writing to his friend so early as 1744, Akenside said that the intimacy had "the force of an additional conscience, of a new principle of religion," and there seems to have been no break in their affection. He left all his effects and his literary remains to Dyson, who issued an edition of his poems in 1772. This included the revised version of the *Pleasures of Imagination*, on which the author was engaged at his death.

See Dyce's *Life of Akenside* prefixed to his edition of the *Poetical Works* (1835); also Johnson's *Lives of the Poets*, and C. Bucke, *Life, Writings and Genius of Akenside* (1832).

AKERMAN, JOHN YONGE (1806-1873), English antiquarian, distinguished chiefly in numismatics, was born in Wiltshire. He became early known in connection with his favourite study, having initiated the *Numismatic Journal* in 1836. In the following year he became secretary of the newly established Numismatic society. In 1848 he was elected secretary to the Society of Antiquaries, an office which he was compelled to resign in 1860 on account of failing health. Akerman published a considerable number of works on his special subject, the more important being a *Catalogue of Roman Coins* (1839); a *Numismatic Manual* (1840); *Roman Coins Relating to Britain* (1844); *Ancient Coins—Hispania, Gallia, Britannia* (1846); and *Numismatic Illustrations of the New Testament* (1846). He also wrote a *Glossary of Words Used in Wiltshire* (1842); *Wiltshire Tales, Illustrative of the Dialect* (1853); and *Remains of Pagan Saxondom* (1855).

AKHALTSIKH (Georgian *Akhalsikhe* = "New Castle"), a town in the Georgian S.S.R. It is situated in 41° 40' N. and 42° 55' E. at an altitude of 3,375 ft. on a tributary of the Kura river. The new town is on the right bank, the old on the left. Pop. about 15,000. Capital of the former province of Meschia or Samtskhe, it appears as a fief of the feudal house of Jaqeli c. 1203. By the 13th century, the Jaqelis acquired the whole principality of Meschia with the title of Atabegs (hence another name of the province: Saatabago). The separatist tendencies of Meschia first manifested in 1268 came to a break with the crown of Georgia under the Atabeg Quarquare II, who was referred to in the west as "duke of Akhaltsikhe" or "of Georgiana," in 1463. But in the 16th century the principality became tributary to the Ottoman empire. In 1625 the Atabeg Beka III turned Moslem and was created by the sultan pasha of Akhaltsikhe, which rank was borne by the rulers of Meschia until the Turkish suppression of this vassal principality in 1744. In 1828 Akhaltsikhe was taken by the Russians and the whole province incorporated in the Russian empire. There is trade in silk, honey and wax. Brown coal is found in the district. Its silver filigree work is famous. It is on the trade route to Turkey for caravans, but it has no railway communica-

tions. (See GEORGIA.)

AKHENATON; see IKHNATON.

AK-HISSAR or AKHISAR (anc. THYATEIRA, the "town of Thyra"), a Turkish town situated in a fertile plain on the Gürdük Chai (Lycus), in the Manisa vilayet, 58 mi. N.E. of Smyrna. Pop. 22,739. Thyateira was an ancient town re-peopled with Macedonians by Seleucus about 290 B.C. It became an important station on the Roman road from Pergamum to Laodicea, and one of the "Seven Churches" of Asia (Rev. ii, 18), but was never a *metropolis* or honoured with a neocorate, though made the centre of a *conventus* by Caracalla. The modern town is connected with Smyrna by railway, and exports cotton, wool, opium, cocoons and cereals. Cotton of excellent quality is grown in the neighbourhood, and the place is celebrated for its scarlet dyes.

See W. M. Ramsay, *Letters to the Seven Churches* (1904); M. Clerc, *De rebus Thyatirenorum* (1893).

AKHMIM, a town of upper Egypt, on the right bank of the Nile, 67 mi. by river south of Asyut, and 4 mi. above Suhag, on the opposite side of the river. It has several mosques and two Coptic churches, maintains a weekly market, and manufactures cotton goods, notably the blue shirts and check shawls with silk fringes worn by the poorer classes of Egypt. Outside the walls are the scanty ruins of two ancient temples. In Abulfeda's days (13th century A.D.) a very imposing temple still stood here. Akhmim was the Egyptian Apu or Khen-min, in Coptic Shmin, known to the Greeks as Chemmis or Panopolis, capital of the 9th or Chemmite nome of upper Egypt. Herodotus mentions the temple dedicated to "Perseus" and asserts that Chemmis was remarkable for the celebration of games in honour of that hero, after the manner of the Greeks, at which prizes were given; but it is possible that he confused Coptos (*q.v.*) with Chemmis. Strabo mentions linen weaving as an ancient industry of Panopolis, and it is not altogether a coincidence that the cemetery of Akhmim is one of the chief sources of the beautiful textiles of Roman and Coptic age that are brought from Egypt. Monasteries abounded in this neighbourhood from a very early date. Nonnus, the Greek poet, was born at Panopolis.

AKHTAL (ahch-tah') (GHYATH IBN HARITH) (c. 640-710), Arabian poet of the Omayyad period, belonged to the tribe of Taghlib in Mesopotamia, and was, like his fellow tribesmen, a Christian, enjoying the freedom of his religion, while not taking its duty very seriously. Akhtal, Jarir and Ferazdaq form a trio celebrated among the Arabs, but as to relative superiority there is dispute. Abu 'Ubaida placed him highest of the three on the ground that among his poems there were ten flawless *qasidas* ("elegies"), and ten more which were nearly so, and that this could not be said of the other two poets.

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A full account of the poet and his times is given in H. Lammens' *Le chantre des Omiades* (Paris, 1895) (a reprint from the journal *Asiatique* for 1894).

AKHTYRKA, a town in the Ukrainian S.S.R. It is situated in 50° 20' N. and 34° 52' E. near the Vorskla river, on the railway from Kiev to Kharkov. Its beautiful cathedral, built in 1753, was designed by Rastrelli. It is a trade centre for fruit, sugar beet, corn, cattle and domestic woollen industries. It was founded by Poles in 1642. Population (1935) 27,302.

AKKA (TIKKI-TIKKI), a race of African pygmies first seen by the traveller G. A. Schweinfurth in 1870, in the Mangbettu country, northwest of Albert Nyanza. The home of the Akka is the dense forest zone of the Aruwimi district of the Congo state. They form a branch of the primitive pygmy Negroid race, and appear to be divided into groups, each with its own chief. The average height of the race would seem to be somewhat under four feet. They are of the colour of coffee slightly roasted, with hair almost the same colour, woolly and tufted; they have very projecting jaws, flat noses and protruding lips. An abdominal protuberance makes all Akka look like potbellied children, and the spine hollows into a curve like an S. These characteristics tend to disap-

pear. There is a tendency to steatopygia among the women. They are nomads, hunt game in the forests with poisoned arrows, with pitfalls and springs set everywhere, and with traps. They collect ivory and honey, manufacture poison, and exchange these for cereals, tobacco and iron weapons. In dress, weapons and utensils they are as the surrounding Negroes. They build round huts of branches and leaves in the forest clearings.

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AKKAD, an ancient country (for the town sometimes called Akkad see under AGADE), northern Babylonia. The alluvial part of Mesopotamia was known in ancient times as Sumer and Akkad. Akkad was the narrow strip of land where the rivers approached one another most closely, and included the cities of Kish, Babylon, Sippar, Borsippa, Cutha (*qq.v.*) and Opis. For details see MESOPOTAMIA: *Ancient Geography*.

AKKADIAN: see ACCADIAN.

AKKERMAN, Rumania: see CETATEA ALBA.

AKMOLINSK, a town and province of the Kazakh Soviet S.R. The boundaries of the province are, north, northern Kazakhstan; east, Pavlodar; south, Karaganda; west, Kustanaisk province. In the north the province is dotted with salt lakes, sloping south to a plateau (1,600 ft.), to the east of which is a spur formed by the dying out of the Tarbagatai range containing gold, copper and coal.

The Spasski copper mines in the province and were restarted in 1925; near them are the Karagandinask coal beds, estimated at 6,000,000,000 tons; the two are connected by rail and are linked to the main railway.

The southeast is a wide, waterless desert the Bak-pak-dala or Hunger steppe. The climate is dry and continental, the rainfall (average 8–16 in.) is mostly in heavy thunderstorms, moistening the surface only. Dry, strong northeast winds, dusty in summer, prevail all the year, in winter as the Buran gale, sweeping the snow away and exposing the ground to five months of frost.

At Akmolinsk city (average temperature January 1.5° F., July 70° F.; yearly rainfall 9 in.), south of latitude 50°, the steppe is salty soil, with sparse wormwood, blue-gray grass, and plants with drought-resisting devices, hairs, pungent oils, thick leaves, etc., and animals such as suslik, hamster, jerboa and, rarely, saiga antelope. North of latitude 50° there is more moisture and better soil; in spring it is gay with tulips, irises, etc.; and in summer with white feather grass. The southern part of this area is inhabited by Kirghiz (in the Chu valley). The nomad Kara Kirghiz rear sheep, horses, camels, cattle and goats, following the pasture.

The city had a population in 1939 of 35,800.

Near the northern boundary of the province, wheat and barley are successfully grown, and the population consists mainly of Russian peasants. The town of Akmolinsk, on the Ishim river, is on the caravan routes from Tashkent and Bukhara to the north.

AKOLA, a town and district of India, in Berar, otherwise known as the Hyderabad Assigned Districts. The town is on the Murna tributary of the Purna river, Akola proper being on the west bank, and Tajnapeth, containing the government buildings and European residences, on the east bank. It had a pop. (1941) of 62,564. It is walled, and has a citadel built in the early years of the 19th century. Akola is one of the chief centres of the cotton trade in Berar, and has numerous ginning factories and cotton presses. Among the educational establishments are a government high school, and an industrial school supported by a Protestant mission.

The district of Akola as reconstituted in 1905 had an area of 4,093 sq.mi., the population of this area in 1941 was 907,742. The surface of the country is generally flat, the greater part being situated in the central valley of Berar. On the north it is bounded by the Melghat hills. By the addition of Basim and Mangrul taluqs in 1905, the district includes the eastern part of the Ajanta hills, with peaks rising to 2,000 ft., and the tableland of Basim.

North of the Ajanta hills the country is drained eastward by the Purna affluent of the Tapi and its tributaries. The heat from April to mid-June is very great but even during the hot season the nights are cool. The annual rainfall averages 34 in. In the Purna valley the soil is everywhere a rich black loam particularly suitable to cotton, and nearly the whole of the land is cultivated. The history of Akola is not distinguished from that of the other portions of Berar.

AKRON, a city of Ohio, U.S., 35 mi. S-by-E. of Cleveland, on the Little Cuyahoga river; the county seat of Summit county. It is about 1,200 ft. above sea level, on one of the highest spots in the state, whence its Greek name. The surrounding country is hilly and there are 20 lakes within 12 mi. of the city. On its northern boundary the Big Cuyahoga river flows through a gorge of great beauty, spanned by High Level bridge. A main approach from the north and east is by the North Hill viaduct, 135 ft. high and 2,810 ft. in length. Akron is served by the Baltimore and Ohio, the Erie, the Pennsylvania and the Akron, Canton and Youngstown railways. A belt line encircles the industrial section and the city is an important trucking centre. There are two municipal airports, one the site of Goodyear zeppelin dock, and the city is served by American, Capital, Eastern and United airlines. A naval air station is located in Akron. The Ohio canal, abandoned by commercial traffic, supplies water to some of the industries from lakes south of the city and serves as a pleasure route to the Portage lake state park near by. The city covers 55 sq.mi. Pop. (1950) 273,189; (1940) 244,791; (1930) 255,040.

The important period in Akron's history began about 1910. The town was settled about 1825 and incorporated as a village in 1836; became the county seat in 1842 and was chartered as a city in 1865. Through the 19th century it had a normal gradual development, at first because of its position on the Ohio canal, later because of the completion of the railway which is now the Erie and still later because of the manufacture of clay products and rolled oats. The pioneer rubber factory was established by B. F. Goodrich in 1870, and others came into existence with the extension of the uses of rubber for bicycle tires, heels and soles, beltings for machinery, elastic stockings, insulated wire and many other purposes. By 1900 the population had increased to 42,728, and in 1910 it was 69,067.

Then began a phenomenal growth. Between 1910 and 1920 the population of the city tripled. The aggregate value of its manufactured products rose from \$73,158,000 in 1909 to \$558,962,000 in 1919 (\$575,000,000 in 1950); the average number of wage earners in the factories increased from 15,831 to 65,054 (85,000 in 1950). Postal receipts were quadrupled. All this was due chiefly to the demand for tires and other rubber products by the automobile industry. Akron's rubber factories at mid-20th century were producing more than 50,000 articles, ranging from rubber bands to balloons and dirigibles, and including 65% of the total U.S. output of tires. Normally Akron rubber factories account for approximately 40% of the annual U.S. consumption of crude rubber.

The older industries (oatmeal, matches and sewer pipes, machine tools, etc.) are still important. The town produces also puffed grains for breakfast foods, chemical stoneware, porcelain insulators, fishing tackle, rubber factory equipment, steel automobile rims, automobile batteries, wood products, plasters and chemicals. Salt and sulphur are refined, and zinc oxide is produced.

The production of synthetic rubbers became a major industry during World War II. Parts for aeroplanes also are fabricated there.

The rapid industrial development stimulated progress in other directions. Expenditures by the city for health and sanitation increased from \$53,231 in 1910 to \$795,100 in 1950; sanitation and health from \$277,454 to \$9,970,498. A municipal water system and a sewage-treatment plant were provided at a cost of \$125,000,000 and an imposing municipal building was erected. Experts surveyed the public-school system (1917) and prepared a city plan (1919). A city planning commission created in 1920 secured the adoption of a zoning ordinance in 1922. More than 4,300 ac. of park area are in or near the city, including a fine municipal golf

course. The Portage lakes also provide excellent recreation sites. From 1920 the charitable agencies were jointly financed by a "community chest" operated by the Better Akron federation.

The University of Akron, which is a part of the free public-school system of the city, was created in 1913, when the city council accepted as a nucleus the plant and endowment of Buchtel college, which had been founded in 1870 and named after its chief benefactor, John R. Buchtel (1822-92), a businessman of Akron. Fellowships for research in the chemistry of India rubber were established by the Goodyear and the Firestone Tire and Rubber companies. At mid-20th century the annual enrolment in the university was about 4,500.

Because of the dominating industries Akron's population has tended to have a preponderance of men, a high proportion of skilled and semiskilled labour; relatively high wages; and a high proportion of men engaged in gainful occupations. The population was not congested, even after the period of rapid growth. Small detached or semidetached dwellings are the rule. At mid-20th century, approximately 70% of the homes were owned by their occupants.

A "home rule" charter went into effect Jan. 1, 1920. Under it Akron adopted the city-manager form of government; but after four years this was discarded and the executive duties were transferred to a mayor elected at large. The old Portage trail, used by the Indians in carrying their canoes from the Cuyahoga river to the Tuscarawas river in the journey from Lake Erie to the Ohio, runs through the city. It is marked at each end by commemorative tablets and bronze figures of Indians. A house once occupied by John Brown, the abolitionist, is in the western part of the city.

AKSAKOV, SERGEI TIMOFEYEVICH (1791-1859), Russian writer, grandson of Sergei Aksakov, a country squire who founded a colony in the Bashkir steppe, was born at Ufa, Orenburg, on Sept. 20, 1791, and died in Moscow on April 30, 1859. He studied at the University of Kazan, and in 1808 entered the civil service in St. Petersburg (Leningrad). In 1815 he married and returned to the Urals to cultivate his estate. He dissipated his fortune after ten years of estate management, and found, through the influence of Shishkov, a place in the censorship at Moscow. There his house became a centre of Slavophilism. In 1832 he met Gogol, in whom he recognized a genius unspoiled, as he thought, by foreign influence. His friendship with Gogol led him to write himself, and, though that friendship was clouded in later years, it is to Gogol that Aksakov owed his inspiration. Aksakov draws on the history of his pioneer grandfather, a great figure of the family autocrat in a primitive community, wonderfully depicted, with the marriage of his own father and mother, and with his own schooldays. All these books are Russian classics. They give a picture of Russian rural life before the liberation of the Serfs remarkable in itself, and beautiful because of the author's keen, sensuous appreciation of nature, but interesting from the purely literary point of view in the development of the novel. Aksakov, to quote Prince Mirsky, "came nearer than any other Russian writer, even than Tolstoy in *War and Peace*, to a modern, evolutionary, continuous presentation of human life, as distinct from the dramatic and incidental presentation customary to the older novelists."

His best known works are: *Chronicles of a Russian Family* (1856, tran. by M. C. Beverley, 1924); *Recollections* (1856), tran. by J. D. Duff under the title: *Autobiography of a Russian Schoolboy* (1917, repr. 1924); *Years of Childhood* (1858: tran. by J. D. Duff, 1916, repr. 1923). Aksakov's other important work is his *Recollections of Gogol*, which is the most important contemporary record of that great writer.

His elder son, KONSTANTIN SERGEYEVICH AKSAKOV (1817-1886), Slavophil author, was born at Moscow on April 10, 1817, and died in the Island of Zante in Greece on Dec. 19, 1886.

His younger son, IVAN SERGEYEVICH AKSAKOV (1823-1886), Russian Slavophil writer, was born at Nadezhdin in Ufa, on Sept. 26, 1823, and died at Moscow on Jan. 27, 1886. He studied law at St. Petersburg, and later entered the Moscow division of the senate. At various periods he edited or established weekly and daily papers, the Moscow *Sbornik*, the *Den* (1861-65), the *Moskva*

(1867), which was three times suppressed by the government, and later, in 1880, the *Rus*, an organ of the Slavophil party. Between 1840 and 1860 Aksakov wrote numerous radical and political poems. His realistic poem *The Tramp* (1852), depicted the life of the Russian peasant. The height of Aksakov's activity as leader of the Panslavist movement was reached in 1876-78, when he warmly supported the cause of the liberation of the Balkan Slavs. In 1878 he was exiled from Moscow for a violent attack on the treaty of Berlin in a speech delivered at the Slavic committee; but he was soon allowed to return, and continued to publish the *Rus* until his death.

AKSHAK, a city in northern Sumer (now Iraq), 34° N., 44° E. There was a prehistoric Sumerian city on this site which lay on the Tigris at the mouth of the river Adhem (Physcus). It was the most northerly of the Sumerian cities and appears in the dynasty lists between Maer and the 4th dynasty of Kish. The site is usually identified with the Opis of Xenophon, who states that it was a large and populous city and that the Physcus was here spanned by a bridge, but Rawlinson identified Opis with another ancient site south of the Diyala, near Baghdad.

AK-SHEHR or **AKSEHR** (anc. PHILOMELION), town, Konia vilayet, Turkey, at the edge of a fertile plain, on the north side of the Sultan Dag. Philomelion was probably a Pergamenean foundation on the Graeco-Roman highway from Ephesus to the east, and to its townsmen the Smyrniotes wrote the letter that describes the martyrdom of Polycarp. Cicero, on his way to Cilicia, dated some of his extant correspondence there; and the place was important in frontier wars between Byzantine emperors and the sultanate of Rum. It became an important Seljuk town, and late in the 14th century passed into Ottoman hands. There Bayezid Yilderim is said by Ali of Yezd to have died after his defeat at Angora. The place still enjoys much repute among Turks as the burial place of Nasr-ed-din Hodja. The town has a station on the Anatolian railway, about 60 mi. from Afium Qarahisar and 100 mi. from Konia. Pop. (1940) 12,502.

AKSU: see TURKISTAN.

AKSUM (previously **AXUM**), an ancient city in Tigré, Abyssinia, 14° 8' N., 38° 31' E., altitude 7,226 ft., 12 mi. W. by S. of Aduwa. The old Abyssinian Book of Aksum contains the native legend of its foundation many thousands of years ago; the first authoritative mention of it, however, is in the *Periplus Maris Erythraei* (c. A.D. 67) where it is referred to as the seat of the Axumite kingdom, the successor of the more ancient Punt and the forerunner of the modern Abyssinia. (See ETHIOPIA.)

It contains the ancient church where, according to tradition, the *Tobot* or Ark of the Covenant, brought from Jerusalem by the son of Solomon and the Queen of Sheba, was deposited and is still supposed to rest. The church was burned when Axum was sacked by Mohammed Gran the Moslem invader of Abyssinia in about 1535 and a new one was erected by the Portuguese shortly afterward. It is famous for the ancient inscriptions in Minaco Sabaeen, a Giz script of the 4th and 5th centuries and for its stone obelisks, many of which are still standing. They form a consecutive series from rude unhewn stones to highly finished obelisks, of which the tallest still erect is 60 ft. in height, with 8 ft. 7 in. extreme front width; others that are fallen may have been taller. The highly finished monoliths are all representations of a many-storied castle, with an altar at the base of each. They appear to be connected with Semitic sun-worship and are assigned by J. T. Bent to the same period as the temple at Baalbek.

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AKTUBINSK, formerly part of the Turgai region, now a region in the Kazakh Soviet Socialist Republic. Area 176,632.6 sq.mi. The boundaries are, on the north, Chkalov and Kustanaisk; west, Adaev and Uralsk; south, Adaev, the Aral sea and Syr-Darya; east, Akmolinsk. It is divided for administrative purposes into Aktubinsk, pop. 238,059 (urban 20,504); Temirsk, pop. 77,-

799, (urban 4,000); Turgai, pop. 94,304, (urban 1,836); Chelkarsk, pop. 90,376 (urban 6,716). South of the east to west stretch of the Ural river, the Ural mountains continue as a plateau, the southward termination of which (the Mugojar hills) is deeply dissected by the streams of the craggy southeastern slopes, a former shore line of the Aral sea. Beneath these slopes the streams lose themselves in the saline steppes that fringe the Aral sea and extend far northeast as part of the Turgai steppe. The climatic conditions are increasingly dry (av. rainfall four to eight inches), and the prevailing northeast winds bring sandstorms in summer and dry snow in winter, a season otherwise of cloudless skies and bitter cold, while the summer temperature averages 85° F. The numerous lakes are surrounded by reeds, the haunt of the wild boar, with grass patches in places; the stream shores are also grassy, especially in spring, and attract geese and cranes. The steppe includes black-earth areas carrying feather grass, clays bearing wormwood, salt clays with salsolaceae vegetation and bare shifting sand hills. Wild cherry and almond grow on the hillsides. The steppe fauna includes jerboa, marmot, steppe fox and saiga antelope. Famines are frequent for lack of irrigation and scientific crop rotation, though rye, wheat, oats, barley and potatoes are grown. Nomadic herding of sheep, horses, camels and cattle is the chief occupation, and there is change of ground between the spring-and-summer grazing area of the Turgai steppe and the winter shelters in the Syr-Darya area. Cattle and hides are exported to Orenburg and camels are bred for the caravan transport between Bukhara, Khiva and Russian Turkistan. Sunflower-seed oil, flour and leather are produced for local use and salt is obtained from the lakes, while *koustar* (home) industries in felt products and carpets are widespread. The Emba river naphtha area extends into the southwest of the region and has its centre at Emba. In the northwest, near the Ulek river, coal is mined. Aktubinsk, the chief town, is on the Chkalov-Tashkent railway.

AKYAB, a municipality and district in the Arakan province of Burma at the confluence of the large rivers Mayu, Kaladan and Lemro. After the cession of Arakan to the British by the treaty of Yandaboo in 1826 the old capital of Myohaung was abandoned as the seat of government, and Akyab on the sea coast selected instead. Trade restrictions were removed and Akyab rapidly grew from a small fishing village into a leading port of Burma; with a population in 1931 of 38,094 (28,724 males and 9,370 females). The population has varied but slightly after the census of 1881. Out of the total population 4,049 (3,877 males and 172 females) are "adventitious" Mohammedan and Hindu labourers. The settled civil population comprises 15,802 Buddhists (Arakanese and Burmese, 8,111 males and 7,691 females), 10,988 Hindus (10,259 males and 729 females) and 10,032 Mohammedans (9,456 males and 576 females).

It contains the usual public buildings and several large rice mills. The chief export is rice. The district lies along the northeastern shores of the Bay of Bengal, with an area of 5,176 sq.mi. and a population in 1941 of 760,705. (See BURMA.)

ALA, one of the side recesses which usually opened off the atrium (*q.v.*) of a Roman house. One was placed on each side in the corners off the back of and entirely open to the atrium. The term applies also to the wings, open their entire width in front, at each side of the cella in one of the Tuscan temple plans (Vitruvius iv, 7). In physiology, any winglike process such as one of the lateral cartilages of the nose (Lat. *ala*, a wing). In botany, one of the side petals of a papilionaceous corolla, etc.

ALABAMA, called the "Cotton state" because of its chief agricultural product, a southern state of the U.S.A., is situated between approximately 84° 51' and 88° 28' W. and 30° 13' and 35° N., and is bounded N. by Tennessee, E. by Georgia, S. by Florida and the Gulf of Mexico, and W. by Mississippi. Its total area is 51,609 sq.mi., of which 531 are water surface.

Physical Features.—Northern Alabama is a diversified region, invaded by the Appalachian highlands. In the northeast Lookout, Raccoon and Sand mountains are important physical features. The rugged Cumberland plateau, extending deeply into the state from Tennessee, is crossed from east to west by the fertile Tennessee valley. The great Appalachian valley and the Piedmont plateau in-

vade the state for a considerable distance from the Georgia line.



THE GREAT SEAL OF THE STATE OF ALABAMA, ADOPTED BY ACT OF THE LEGISLATURE AND APPROVED ON APRIL 5, 1939

The Tennessee and Coosa rivers, draining the highlands, provide an important power resource. A belt of prairie country crosses the central portion of the state from east to west, while further south lies the Gulf coastal plain, which slopes gradually down to sea level in the south, where it touches the Gulf of Mexico. The rivers of the coastal plain are the Tombigbee and Black Warrior in the west, the Alabama in the central west, and the Chattahoochee, which forms almost half of the Georgia boundary, in the east. The Tombigbee and the Alabama

unite in the southwest; their waters then part to flow into Mobile bay as the Mobile and Tensas rivers. The valleys of the coastal plain are broad and in most cases rise in three successive terraces above the streams. The bay of Mobile averages about 12 ft. in depth, though there is a deep anchorage near the entrance, some 30 mi. below the city of Mobile. In 1951 a dredged channel 33 ft. deep reached from the bay entrance to the extensive port facilities of Mobile.

Climate and Soil.—Alabama has a temperate climate. The average mean temperature for the state in winter is 46° F. and in summer 79° F. In the winter, on the average, 35 days have temperatures below the freezing point; snow falls only once or twice a year in the northern part. The prevailing winds are from the south. Rainfall is fairly evenly distributed throughout the state, the annual average being about 52 in.; thunderstorms are numerous in summer. The rainy season is in the winter, however, and the dry season in late summer and fall.

There are four different belts of soil. In the timber belt along the coast the soil is sandy and generally poor but responds to fertilization. North of this lies the black belt ("black prairie" "cotton belt"), 13,000 sq.mi. in extent which has black soil that is rich in limestone and marl formations, without sand or loam and is especially adapted to the production of cotton and grasses. Between the cotton belt and the Tennessee valley lies the mineral belt, the soils of which are of varied fertility. North of the mineral belt is the cereal belt in the Tennessee valley, containing red clays and dark loams.

History.—The first Europeans to enter the limits of the present state of Alabama were Spaniards, who claimed the region as a part of Florida. The first fully authenticated visit was that of Hernando de Soto, who journeyed along the Coosa, Alabama, and Tombigbee rivers in 1539-40. The English, too, claimed the region north of the Gulf of Mexico, and the territory of modern Alabama was included in the province of Carolina by the charters of 1663 and 1665. English traders from Carolina were frequenting the valley of the Alabama river as early as 1687. Mobile, the first permanent white settlement in Alabama, was founded by the French in 1702. Later, on account of intrigues between English traders and the Indians, the French established two military posts.

The treaty of Paris, in 1763, terminated the French occupation and England came into undisputed possession of the region between the Chattahoochee and the Mississippi. The portion of Alabama below line 32° 28' N. became a part of west Florida and the portion north of this line a part of the "Illinois country," set apart by royal proclamation for the use of the Indians. By the treaty of Versailles, on Sept. 3, 1783, England ceded West Florida to Spain; but by the treaty of Paris, signed the same day, it ceded to the United States all of this province north of 31°, and thus laid the foundation for a long controversy. By the treaty of Madrid, in 1795, Spain ceded to the United States claims to the lands east of the Mississippi between 31° and 32° 28'; and three years later (1798) this district was organized by congress as the Mississippi territory. A strip of land 12 or 14 mi. wide near the present northern boundary of Alabama and Mississippi was claimed

by South Carolina which, however, ceded this claim to the federal government in 1787.

Georgia, on the basis of its charter, claimed all the lands between the 31st and 35th parallels from its present western boundary to the Mississippi river, a claim not surrendered until 1802; two years later the boundaries of the Mississippi territory were extended to include all of the Georgia cession.

In 1813 congress annexed to the Mississippi territory the Mobile district of West Florida, claiming that it was included in the Louisiana purchase. The whole area of the present state of Alabama then for the first time became subject to the jurisdiction of the United States. In 1817 the Mississippi territory was divided; the western portion became the state of Mississippi, and the eastern the territory of Alabama, with St. Stephens, on the Tombigbee river, as the temporary seat of government. In 1819 Alabama was admitted to the union.

One of the first problems of the new commonwealth was that of finance. Since the amount of money in circulation was insufficient to meet the demands of the increasing population, a system of state banks was instituted. State bonds were issued and school land sold to secure capital. The notes of the banks, loaned on security, became a medium of exchange. Prospects of an income from the banks led the legislature of 1836 to abolish all taxation for state purposes. This was hardly done, however, before the panic of 1837 wiped out a large portion of the banks' assets; next came revelations of careless and corrupt management, and in 1843 the banks were placed in liquidation. After disposing of all their available assets, the state assumed the remaining liabilities, for which it had pledged itself.

The Indian problem was important at this time. With the encroachment of the white settlers upon their hunting grounds the Creek Indians grew restless, and the great Shawnee chief Tecumseh, who visited them in 1812, fomented their discontent. When outbreak of the War of 1812 with Britain gave the Creeks assurance of British aid, many of them rose in arms, massacred several hundred settlers who had taken refuge in Fort Mims, below the junction of the Alabama and Tombigbee rivers, and soon no white family in the Creek country was safe outside a palisade. The Chickasaw and Choctaw Indians, however, remained the faithful allies of the whites and volunteers from Georgia, South Carolina and Tennessee helped to put down the Creeks.

Gen. Andrew Jackson broke forever the power of the Creek confederacy in the battle of Horseshoe Bend. By the treaty of Fort Jackson (Aug. 9, 1814) the Creeks ceded their claims to about one-half of the present state; and further cessions by the Cherokees, Chickasaws and Choctaws left the Indians only about one-fourth of Alabama. By a series of treaties with the Indians, between 1830 and 1835, the U.S. government arranged for their removal to the west. Before the contract for the removal of the Creeks was effected, the state legislature formed their lands into counties and settlers flocked in. A disagreement ensued between Alabama and the United States authorities; although it was amicably settled, it engendered a feeling that the policy of the national government might not be in harmony with the interests of the state—a feeling which, intensified by the slavery agitation, did much to cause secession in 1861.

Political History.—The political history of Alabama may be divided into three periods—that prior to 1860, from 1860 to 1874, and from 1874 onward.

The first period was one of a healthy and virile political life. Until 1832 the Democratic party was the only party in the state, but about the same time the Whig party was formed chiefly in counties where slaves were most numerous and the freemen most aristocratic. For some time the Whigs were nearly as numerous as the Democrats, but they never controlled the state government. The states' rights men were in a minority; nevertheless, under their active and persistent leader, W. L. Yancey (1814–1863), they prevailed upon the Democrats in 1848 to adopt their most radical views.

During the agitation over the introduction of slavery into the territory acquired from Mexico, Yancey induced the Democratic state convention of 1848 to adopt the "Alabama platform," which

declared that neither congress nor the government of a territory had the right to interfere with slavery in a territory, that those who held opposite views were not Democrats and that the Democrats of Alabama would not support a candidate for the presidency if he did not agree with them on these questions. This platform was endorsed by conventions in Florida and Virginia and by the legislatures of Georgia and Alabama. Old party lines were broken by the compromise of 1850. The states' rights men founded the Southern Rights party, which demanded the repeal of the compromise, advocated resistance to future encroachments and prepared for secession, while the Whigs, joined by the remaining Democrats, formed the party known as the "Unionists," which unwillingly accepted the compromise and denied the constitutional right of secession. The Unionists were successful in the elections of 1851 and 1852, but the feeling of uncertainty engendered in the south by the passage of the Kansas-Nebraska bill and the course of the slavery agitation after 1852 led the State Democratic convention of 1856 to revive the Alabama platform; and when the Alabama platform failed to secure the formal approval of the Democratic national convention at Charleston, South Carolina, in 1860, the Alabama delegates, followed by those of the other cotton states, withdrew. Upon the election of Abraham Lincoln, Gov. Andrew B. Moore, in obedience to previous instructions of the legislature, called a state convention on Jan. 7, 1861. After long debate it adopted on Jan. 11 an ordinance of secession, and Alabama became one of the Confederate states of America, whose government was organized at Montgomery Feb. 4, 1861. Yet many prominent men opposed secession, and in northern Alabama, where there were relatively few slaves, an attempt was made to organize a neutral state, Nickajack; but with President Lincoln's call to arms opposition to secession ended.

In the early part of the Civil War, Alabama was not the scene of military operations, yet the state contributed about 120,000 men to the Confederate service, almost all its male white population capable of bearing arms; 39 of these men attained the rank of general. In 1862 the Federal forces secured a foothold in northern Alabama. The interior of the state was subjected to several raids after 1862, and in 1865 Mobile was taken by a Federal fleet and army. Several days before the fall of Mobile, Selma was sacked by the Wilson raiders.

According to the presidential plan of reconstruction, a provisional governor for Alabama was appointed in June, 1865; a state convention met in September and declared the ordinance of secession null and void and slavery abolished; a legislature and a governor were elected in November; the legislature was at once recognized by the national government, and the inauguration of the governor-elect was permitted after the legislature had, in December, ratified the 13th amendment. But the passage by the legislature of vagrancy and apprenticeship laws designed to control the Negroes flocking from the plantations to the cities intensified the congressional hostility to the presidential plan and the Alabama senators and representatives were denied their seats in congress. In 1867 the congressional plan of reconstruction was completed and Alabama was placed under military government. Negroes were now enrolled as voters and large numbers of white citizens disfranchised. "Carpet-baggers" from the north organized the Republican party on the basis of Negro votes and the support of native whites called "scalawags." A constitutional convention controlled by the carpet-baggers met in Nov., 1867, and framed a constitution which conferred suffrage rights on Negroes and disfranchised a large class of whites. The constitution was defeated by the whites, who stayed away from the polls, thus preventing the required majority of registered voters from voting. Congress, however, provided subsequently that a majority of the votes cast should be sufficient, and thus the constitution went into effect. The state was admitted to the union in June, 1868, and a new governor and legislature were elected.

The next two years are notable for legislative extravagance and corruption. The state endorsed railway bonds at the rate of \$16,000 a mile until the state debt had been increased by \$17,000,000, and similar extravagance characterized local government. The native white people united, formed a conservative



BY COURTESY OF (1) BIRMINGHAM CHAMBER OF COMMERCE; PHOTOGRAPH, (2) INTERNATIONAL NEWSREEL

BIRMINGHAM AND MONTGOMERY, LEADING INDUSTRIAL CITIES OF ALABAMA

1. Birmingham, chief industrial city of the Southern States since development of coal and iron ore mining interests of Alabama, U.S.A.
2. Aerial view of Montgomery, capital of the State of Alabama, U.S.A., showing the bend in the Alabama river

party, and elected a governor and a majority of the lower house of the legislature in 1870; but, as the new administration was largely a failure, there was in 1872 a reaction in favour of the "radicals," as the Republicans were locally known. Affairs went from bad to worse. In 1874, however, the power of the radicals was finally broken and the conservative Democrats elected all state officials. A commission appointed to examine the state debt found it to be \$32,000,000; by compromise it was reduced to \$12,413,514. A new constitution was adopted in 1875, which gave equal civil and political rights to all citizens and forbade the state, counties and towns to engage in internal improvements or to give their credit to private enterprise.

After 1874 the Democratic party controlled the state administration. The Republicans usually did not make nominations for state office. They endorsed the tickets of the Greenback party in 1880 and 1882 and of the Populists in the 1890s. Economic distress among the farming classes found expression in the Jeffersonian Democratic party, organized in 1892. After the regular Democratic ticket was elected in that year, however, the Jeffersonians and Populists joined forces in the election of 1894. When, at the same time, the Republicans united with the Populists and Jeffersonians, the combination elected three congressional representatives and secured control of many of the counties but failed to carry the state. It was less successful in the next few campaigns. Partisanship became intense and charges of corruption of the Negro electorate were made. Consequently, after division on the subject among the Democrats themselves, as well as opposition from Republicans and Populists, a new constitution with restrictions on suffrage was adopted in 1901. The new restrictions resulted in the virtual elimination of the Negro vote and, therefore, in a reduction of the Republican vote. The Republican party, which had polled 54,737 votes in the presidential election of 1896 and 55,634 votes in the election of 1900, polled only 22,472 votes in the election of 1904. Its vote remained at about that level until 1920, when the effects of economic changes began to appear in elections. In the presidential election of that year the Republican vote was 74,690, or 31.9% of the vote cast—more than enough to secure the privilege of a primary for the nomination of candidates in the next election at the expense of the state government. The gains of the Republican party were registered chiefly in the growing industrial districts and in the counties round about, such as Chilton, De Kalb, St. Clair and Winston, in which the party polled majorities, and in Blount, Clay, Cullman, Marshall and Shelby, in which it polled strong minorities. Although its vote fell off to 45,005 in 1924, the striking increase in the Republican vote in the preceding 20 years and the appearance of a Socialist vote were considered by many the normal result of industrial development and by some as a sign of a future breakup of the "solid South."

The strength of the Republican party remained in the hill counties of the state. The threatening poll of 120,724 for Hoover in 1928 was largely the result of sectarian hostility to Smith and to his opposition to prohibition. Yet he carried the state by about 7,000 votes.

Franklin D. Roosevelt won easily in 1932 by 207,910 to 34,674; in 1936 by 238,195 to 35,358; in 1940 by 250,723 to 43,493; and in 1944 by a wide margin. In 1948 the Democratic electors, having pledged themselves not to vote for the election of Harry S. Truman, cast their votes for Gov. J. Strom Thurmond of South Carolina, running on the States' Rights Democrat ticket; Thurmond received 171,443 popular votes and Thomas E. Dewey, Republican, 40,930.

Three important amendments, pertaining to education and highways, were added to the constitution of 1901: one provided for local option by counties and school districts as to increased taxation for public schools; each of the other two (one in 1922 and the other in 1927) authorized the issue of state bonds to the amount of \$35,000,000 for the construction of a complete system of highways, thus securing for the state the national appropriations in aid of that policy. The problems of the depression in the early 1930s compelled several emergency measures and permanent reforms. A special conven-

tion voted for repeal of the federal prohibition amendment; a special legislature proposed an amendment to the constitution to validate about \$17,000,000 in outstanding state warrants largely held by teachers and another to provide a state income tax; both of these measures were ratified by popular vote.

The legislature of 1939 proposed amendments for the improvement of the system of pardons and paroles and for biennial sessions of the legislature, which were ratified. This same legislature enacted a state civil service law, and passed acts for the reorganization of the state government for the purpose of eliminating duplication of work and providing better administration.

Government.—The constitution of the state was drafted in 1819 and revised in 1865, 1868, 1875 and 1901. The revision of 1901 lengthened the term of executive and legislative officials from two to four years, made that of the judiciary six years, provided for quadrennial sessions of the legislature (changed to biennial sessions by an amendment of 1939), and introduced the office of lieutenant governor. The passage of local or special bills by the legislature was generally prohibited. A provision, intended to prevent lobbying, prohibited anyone except legislators and representatives of the press from being admitted to the floor of the house except by unanimous vote. No executive official might serve two consecutive terms (sheriffs were included in this provision until exempted by an amendment of 1939), and the governor could not be elected or appointed to the U.S. senate or to any state office during his term as governor or within one year thereafter. Sheriffs whose prisoners suffered mob violence might be impeached.

The constitution of 1901 eliminated most of the Negroes from politics by a suffrage clause which went into effect in 1903, restricting the right to vote to those who could read and write any article of the constitution of the United States and who had been regularly engaged in some lawful employment, business or occupation, trade or calling for the greater part of the 12 months preceding the time they offered to register, or who had paid taxes on property assessed at \$300. But by what was called the "grandfather clause" those who had served in the army or navy of the United States or of the Confederate states in time of war, their lawful descendants in every degree, and persons of good character who understood "the duties and obligations of citizenship under a republican form of government" were relieved from the operation of this law, provided they registered prior to Dec. 20, 1902. The constitution of 1901 (like that of 1875) and special statutes enacted thereunder required separate schools for white and Negro children. A "Jim Crow" law had been enacted in 1891.

Under the constitution of 1901 no person under 45 might vote who had not by Feb. 1 preceding an election paid all poll taxes due from him to the state (constitutional amendments of 1923, 1924 and 1944 exempted veterans of World Wars I and II). The penalty for buying, selling, or offering to buy or sell a vote was disfranchisement; in 1891 the Australian ballot system was adopted.

The constitution of 1901 exempted a homestead of 80 ac. of farmland or of a house and lot not exceeding \$2,000 in value from liability for any debt contracted since July 30, 1868, except for a mortgage on it to which the wife consented; personal property to the value of \$1,000 was also exempted. All amendments to the constitution had to be approved by a three-fifths vote of each house of the legislature and then ratified by the people.

Under the civil code of 1897 the earnings of a wife were made her separate property, and it was provided that "no woman, nor any boy under the age of 12 years, shall be employed to work or labor in any mine in this state." By acts of 1915 and 1919 restrictions were placed upon the employment of children under 14. An amendment of 1947 provided that no child under 16 might be employed in any gainful occupation except agriculture and domestic service; no child under 16 might be employed during school hours, and no child under 16 might be employed on or near dangerous machinery or more than 40 hours per week, except in agriculture.

Any person or firm violating these provisions was subject to

finances, and the child welfare department with a local board of child welfare in each county was available to see to the enforcement of the law.

Population.—The population of Alabama in 1820 was 127,901; in 1860 it was 964,201; in 1900, 1,828,697; in 1940, 2,832,961; and in 1950, 3,061,743. This last figure represents an increase of 8.1% over the population in 1940. The population per square mile in 1950 was 59.9, as compared with 55.5 in 1940, and with 50.6 for the U.S. in 1950.

Of the 1950 population, 1,228,209, or 40.1%, lived in incorporated places of 2,500 or more, as compared with 30.2% in 1940, when these places constituted the urban area. The entire urban population, under a new definition set up for 1950, which included also the thickly settled suburban area, or "urban fringe," adjacent to Birmingham, Mobile and Montgomery, and nine unincorporated places of 2,500 or more outside this fringe, amounted to 1,340,937, or 43.8% of the state total.

TABLE I.—Population of Alabama and Its Principal Cities, 1930-50

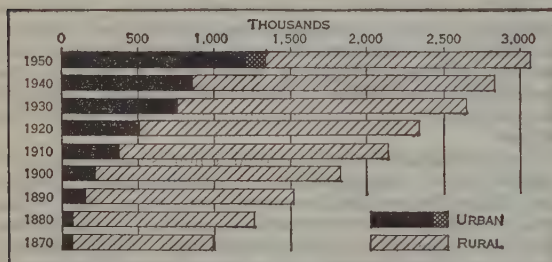
Area	Population			Per cent of increase	
	1950	1940	1930	1940-50	1930-40
The state	3,061,743	2,832,961	2,646,248	8.1	7.1
Urban	1,340,937*	855,047	744,273	56.7	15.0
Rural	1,720,806*	1,977,914	1,901,975	-13.0	-3.9
Per cent urban	43.8	30.2	28.1		
Principal cities					
Birmingham	320,037	267,585	206,678	51.8	30.0
Mobile	129,099	78,720	68,002	61.9	15.4
Montgomery	106,525	78,084	66,079	30.4	18.2
Gadsden	55,725	36,075	24,042	50.7	53.8
Tuscaloosa	46,399	27,493	20,650	68.8	33.1
Anniston	31,066	25,523	22,345	21.7	14.2
Bessemer	28,445	22,820	20,721	24.6	10.2

*Final figures based on new definition. See comment in text.

The number of households in 1950 was 786,467, as compared with 673,815 in 1940. The average population per household had declined from 4.2 in 1940 to 3.9 in 1950.

The population of the state was distributed by colour and nativity in 1950 as follows: 67.5% native white; 0.5% foreign-born white; and 32.0% nonwhite, practically all Negro. There were 98.6 males per 100 females in the native white population, and 91.7 in the Negro population; 6.5% of the population was 65 years old or over; and 51.2% of the population 14 years old and over was in the labour force.

Of the total number of employed males, 29.4% was engaged in agriculture, 24.2% in manufacturing and 18.5% in transportation and trade.



BY COURTESY OF THE U.S. BUREAU OF THE CENSUS

URBAN AND RURAL POPULATION OF ALABAMA: 1870 TO 1950

The crosshatched part of the 1950 bar represents the population of the additional areas counted as urban under the new 1950 definition

Finance and Taxation.—Formerly a large part of the state's revenue came from a general property tax, but as a result of a gradual change this source provided only 4.1% of the state government's revenue in 1949. Other principal sources in 1949 were the sales tax (18.8%), gasoline tax (17.0%), income tax (8.2%), tobacco tax (4.1%), motor vehicle licence tax (3.4%), profits from state liquor stores (6.9%) and federal grants for roads, health, schools, conservation, welfare, etc. (20.6%), the total receipts being \$174,391,524.64.

TABLE II.—State Expenditures, 1949

	Disbursement	Per cent of total
General government	\$6,103,026.68	3.5
Protection to person and property	6,123,605.19	3.5
Highways	25,963,998.24	14.9
Development and conservation of natural resources	3,737,978.83	2.2
Health and sanitation	4,202,918.74	2.4
Hospitals and institutions for the handicapped	4,219,444.22	2.4
Public welfare	25,836,676.79	14.8
Correction	4,459,381.20	2.6
Education	63,853,743.13	36.6
Libraries	92,950.02	0.05
Recreation	71,400.06	0.04
Liquor stores	2,138,939.71	1.2
Debt service	3,133,686.25	2.1
Payments to counties	29,231,247.87	11.1
Payments to cities	4,529,310.80	2.6
Total	\$174,393,904.88	100.0

Figures given do not cover city and county receipts and disbursements except as indicated.

The framers of the constitution of 1901, thinking to avoid a repetition of the reckless borrowing of the reconstruction period, prohibited an increase of the state's debt for any other purpose than the suppression of rebellion or resistance to invasion; but amendments later provided for the floating of special loans for certain internal improvements.

Education.—Public education, authorized for Mobile alone in 1826 and inaugurated there in 1852, was extended to the whole state in 1854. Previously there had been a township system,

which received support from special taxes fixed by each township and from the sale of public lands given to the state by the federal government.

The constitution of 1875 made the support of the schools dependent upon the land grant of 1819, the poll tax and state appropriations; it established separate schools for Negroes and whites. The constitution of 1901 made obligatory a state tax of from 30 to 65 cents on each \$100 worth



BY COURTESY OF THE U.S. BUREAU OF RECLAMATION

HOME OF A NEGRO FARM TENANT

of property to be expended on education. The legislature of 1907 voted an increase of \$300,000 for the common school fund, granted state aid for rural school buildings and established a system of county high schools. A constitutional amendment in 1915 allowed the counties to levy a special school tax. In 1948-49 the state board of education disbursed \$56,917,948 for elementary and secondary education and the state teachers' colleges.

Illiteracy decreased from 50% in 1880 to 34% in 1900 and 4.9% in 1949 among those between 7 and 20 years of age. In 1949 illiteracy among persons between 16 and 20 had been reduced to about 1% (white, 0.5%; Negro, 2.0%).

A school code for Alabama was framed in 1919 as a result of a report of the results of an investigation made by the U.S. bureau of education at the request of a state educational commission. Extensive revisions of the code were made by the legislature in 1927. Further extensive studies of and reports on the state's educational system were made by the Brookings institution of Washington in 1932 and by a state commission in 1945.

In 1951 education was free between the ages of 6 and 20 and compulsory between the ages of 7 and 16. The school census of 1946 counted 784,922 children between the ages of 6 and 20. In 1948-49 the public schools enrolled 657,359, of whom 436,618 were in elementary grades and 220,741 in junior and senior high schools; 18,315 were enrolled in private and parochial schools. In 1948-49 there were 29,290 teachers in public elementary and secondary schools, of whom 20,064 were white and 9,226 Negro.

At mid-20th century the chief institutions of higher learning were: the University of Alabama, at Tuscaloosa; Alabama Polytechnic institute, at Auburn; Alabama college, at Montealeo; the state teachers' colleges at Florence, Jacksonville, Livingston and Troy; Athens college (Methodist, for women), at Athens; Birmingham-Southern college (Methodist), at Birmingham;

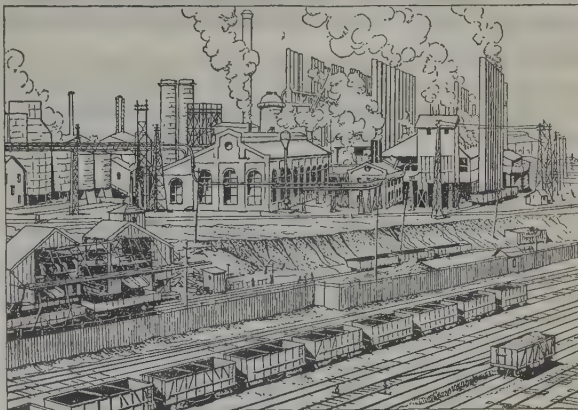
Howard college (Baptist), at Birmingham; Judson college (Baptist, for women), at Marion; Spring Hill college (Roman Catholic, for men), at Mobile; Huntingdon college (Methodist), at Montgomery; Talladega college (Congregationalist, for Negroes), at Talladega; Tuskegee institute (for Negroes), at Tuskegee; the Agricultural and Mechanical institute (for Negroes), at Normal; the State Teachers' college (for Negroes), at Montgomery; and Stillman college (for Negroes), at Tuscaloosa. Of junior college grade were St. Bernard college, Marion institute, and Snead junior college.

Charities and Correction.—Alabama's various philanthropic and penal institutions at mid-20th century included an institution for white deaf and blind and a school for Negro deaf and blind at Talladega; a hospital for insane whites and Negroes at Tuscaloosa and one for Negroes at Mount Vernon; a penitentiary; a state industrial school for white boys and a state training school for white girls, both near Birmingham; a reform school for juvenile Negroes at Mt. Meigs; and a school for mental defectives at Tuscaloosa, all these institutions being under the management of trustees appointed by the governor. The convict-lease system was abolished by the state legislature in 1927, after which convicts were largely employed by the state in highway construction and maintenance and in prison industries at Montgomery, Wetumpka, Speigner and Atmore. In 1901, a system of peonage that had grown up in the state attracted wide attention, and a federal grand jury at a single term of court indicted a number of men for holding persons as peons. Many similar cases were found later in other southern states, but those in Alabama, being the first discovered, attracted the most attention. The federal authorities took active measures to stamp out peonage and were supported by the press and by leading citizens of the state.

Agriculture.—Alabama is generally regarded as an agricultural state, but the rural farm population in 1940 was only 47.5% of the population. The number of farms in the state decreased from 262,901 in 1910 to 237,631 in 1925. After rising to 273,455 in 1935, the number declined again to 223,369 in 1945. The value of all crops, which was \$56,872,944 in 1879, amounted to \$304,348,638 in 1919, after which date it fell off steadily and stood at only \$106,100,000 in 1935; it had risen again in 1945 to \$298,295,633. In 1945 approximately 45% of the farms were managed by their owners, 6% by part owners, 17% by cash tenants and the remaining 32% by other tenants. Cotton has regularly been the chief agricultural product, though in some years the value of the corn (maize) crop has exceeded it. During the period 1911-15 the average annual cotton yield was 1,463,000 bales. From 1915-25 it was far below the 1,000,000 level, but it jumped for the period 1926-30 to 1,319,000. In 1935 the crop was 1,059,000 bales, but it had fallen in 1940 to 790,000 bales. The next time it exceeded 1,000,000 was in 1948, with 1,167,187 bales. In 1945 the corn harvest totalled 41,875,549 bu. with an approximate value of \$65,000,000. The 1945 peanut crop of 328,470,099 lb. was valued at \$24,627,328; the sweet potato crop, 5,900,148 bu. at \$11,471,988; the hay crop, 486,981 tons at \$9,414,368; the white potato crop, 2,896,264 bu. at \$3,939,063.

Minerals.—An important feature of the industrial life of Alabama since 1880 has been the exploitation of its iron and coal resources. Bituminous coal, first mined near Tuscaloosa about 1827, was produced intensively after 1881; the output grew from 946 tons in 1840 and 13,200 tons in 1870 to 420,000 tons in 1881 and 1,568,000 tons in 1883. In 1923 the output reached 20,457,649 tons, with a value of \$51,624,000 and then declined steadily until 1932, when the tonnage was 7,856,939 and the value \$12,138,000. The output then rose to 18,800,954 tons, worth \$116,626,000, in 1948. Most of this came from Jefferson and Walker counties, although coal underlies about 40% of the northern half of the state. It has been estimated that the total available coal resources of Alabama amount to almost 67,000,000,000 tons or enough for 7,500 years. The iron ore, primarily red hematite, is found chiefly in the region of which Birmingham is the centre. In 1905 Alabama produced 3,782,831 tons of iron ore; in 1923 there were shipped from the mines 6,922,663 tons valued at \$15,540,198. Only 1,375,000 tons were mined in 1932, but by

1935 production had risen to 3,240,000 tons, and Alabama stood third among the ore-producing states of the union. Production in 1948 was 11,919,057 tons. Gold, silver, lead, copper, tin, graphite, and bauxite have also been produced. In 1948 Alabama



STEEL MILLS IN OPERATION AT BIRMINGHAM, ALABAMA

The coal formation, which underlies about 20% of the area of the State, is responsible for the development of the steel and iron mills that make Birmingham the chief industrial centre of the South

produced minerals to the value of \$182,987,000, ranking 16th among the states and producing 1.65% of the product of the whole union, coal, iron ore, cement and clay products being the chief mineral products of the state.

Manufactures.—The growth of manufactures in Alabama has been as remarkable as the revelation and exploitation of the state's mineral wealth. In 1880 the capital invested in manufactures was \$9,668,008, little more than that of 1860; by 1890 it had increased to \$46,122,571; in 1900 it amounted to \$70,370,081, in 1919 to \$455,592,733. On account of the proximity of coal, iron and limestone to each other, the manufacture of iron and steel, prior to the depression of the 1930s, was the most extensive in the state. The first blast furnace in Alabama was set up in 1818; from then until the Civil War numerous Catalan forges were in operation. In 1876 the first pig iron with coke for fuel was produced. In 1895 it was demonstrated that Alabama pig iron could be sent to Liverpool and sold more cheaply than the English product, and Birmingham (Alabama) came consequently to rank among the world centres of the pig iron trade. The pig iron produced in the state in 1860 was valued at \$64,590, in 1900 at \$13,487,769, in 1923 at \$63,561,614, in 1933 at \$10,047,165 and in 1948 at \$145,358,582. Manufacture of steel and steel products began in 1888 but was not successful until the Duplex process was used. On account of the irregular quantities of iron and phosphorus present in Alabama ores, this special process, representing a combination of the Bessemer and open-hearth processes, is necessary. In 1923 Alabama ranked seventh among the states in steel production, with an output worth \$75,042,823; however, the census of manufactures in 1933 failed to list it among the chief steel-producing states. In 1948 Alabama produced 4.9% of the steel made in the nation, having an annual capacity of 3,548,000 tons. To meet the demand from the iron and steel industries coke production rose to a value of \$44,577,384 in 1923 and was \$7,091,000 in 1933; in 1948 6,015,460 tons worth \$57,611,881 were produced. In 1950 Alabama was the leading state in the production of cast-iron pipe.

A remarkable development of the cement industry occurred after 1910, made possible by the presence of almost inexhaustible deposits of limestone in the heart of rich coal fields, side by side with extensive areas of shale and clay in a territory served by adequate hydroelectric power. In 1924 the output was about 2,000,000 bbl., with a value of \$2,645,000; in 1947 the product was 9,510,000 bbl., valued at \$16,664,000.

The quantity of lumber and naval stores produced has been

notable. In 1923 the output of sawn lumber was valued at \$52,792,121, of which yellow pine represented \$46,289,706, oak \$1,474,347, and poplar \$1,307,823. The total value of lumber cut in 1933 was \$14,222,244; in 1948 it was \$303,900,000. In 1923, 131 turpentine and rosin factories turned out products valued at \$2,809,815; in 1933 the product of 76 active factories was worth \$1,661,682.

The manufacture of cotton goods, after a long period of early beginnings, developed rapidly from 1890, in which year there were only 13 cotton mills in the state, one more than in 1850; in 1900 there were 31, with an annual product valued at \$8,153,136, representing an increase of 272% over the product (\$2,190,771) of 1890; by 1923 there were 61 establishments, employing 20,785 people, with products valued at \$86,384,724, and in 1933 there were 75 establishments with 28,762 workers and products worth \$66,939,045. The product of all textile industries in the state in 1948 was valued at \$485,500,000. During the 1940s the factories of the state consumed more raw cotton than the state produced.

In the 30 years from 1899 to 1929 the annual value added by manufacturing in Alabama increased from \$34,112,000 to \$258,125,000, but this had declined by 1933 to \$113,470,000. In 1947 there were, on the average, 206,136 industrial employees in the state, who received \$444,647,000 in salaries, the value added by manufacturing being \$876,933,000.

Between 1910 and 1940 the manufacture of hydroelectric power became one of the state's most important industries. By 1950 three great dams had been built across the Coosa river, three across the Tallapoosa, and three across the Tennessee. In 1947 United States government plants and private plants at these dams had a capacity of 959,563 kw., at which time total electric-generating capacity in the state from all sources was 1,348,333 kw.

Transportation.—Alabama rivers are navigable for a total distance of some 2,000 mi., but obstructions sometimes prevent the use of a continuous route. The United States government spent millions of dollars on the elimination of these impediments and on the improvement of Mobile harbour. National, state and city funds were used to improve the facilities of the port of Mobile. During the closing months of 1920 the first vessel of a fleet of government-owned-and-operated self-propelled barges made its way down the Mississippi river to New Orleans and through the Mississippi sound to Mobile and then up the rivers to Birmingham and Cordova, in the heart of the Warrior coal fields, a system of locks and dams having canalized the Tombigbee and Warrior rivers, making the latter navigable deep into the mineral region of the Cumberland plateau. An amendment to the state constitution having authorized the use of the credit of the state for the purpose of constructing a great system of docks at Mobile, an act of the legislature at the session of 1923-24 provided for an issue of \$10,000,000 of bonds for that purpose, and a special commission was put in charge of the work. The commission acquired for the state approximately 400 ac. of land with a water-frontage of two miles, on the northern outskirts of the city.

The port in 1951 had excellent docking facilities.

Railroads are the main carriers of the products of the mineral region. Here all the large systems of the southern states find an entrance: the Gulf, Mobile and Ohio, the Southern, the Louisville and Nashville, the St. Louis-San Francisco, the Illinois Central, the Seaboard Air Line, the Atlantic Coast Line, and the Central of Georgia forming connections with northern and Atlantic states. The total main-line mileage of railways in the state on Dec. 31, 1948, was 4,742 or 2.11% of the national total.

In 1950 there were 7,634 mi. of state highways, of which 7,119 mi. were paved; there were 52,579 mi. of county roads, of which 2,910 mi. were paved. In 1930 there were 277,146 motor vehicles registered; in 1949 the number was 540,265.

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ture and the United States Geological Survey; the bulletins of the Alabama Agricultural Experiment Station (published at Auburn, from 1888); the bulletins and reports of the Alabama Geological Survey (published at Tuscaloosa and Montgomery); and the following works: *Alabama Handbook: Agricultural and Industrial Resources and Opportunities* (Montgomery, 1919); R. M. Harper, *Resources of Southern Alabama* (1920). The history of the state may be found in T. P. Abernethy, *The Formative Period in Alabama* (1905); M. C. Boyd, *Alabama in the Fifties* (1931); W. Brewer, *Alabama* (1872); J. B. Clark, *Populism in Alabama* (1927); C. S. Davis, *The Cotton Kingdom in Alabama* (1939); C. P. Denman, *The Secession Movement in Alabama* (1933); L. Dorman, *Politics in Alabama from 1850 to 1860* (1937); J. E. Doster, *Alabama's First Railroad Commission, 1881-1885* (1949); W. L. Fleming, *Civil War and Reconstruction in Alabama* (1905); W. Garrett, *Reminiscences of Public Men in Alabama* (1872); A. J. Going, *Bourbon Democracy in Alabama: 1874-1890* (1951); P. J. Hamilton, *Colonial Mobile* (1897); A. B. Moore, *History of Alabama* (1935); M. B. Owen, *The Story of Alabama*, 5 vol. (1949); T. M. Owen, *History of Alabama and Dictionary of Alabama Biography*, 4 vol. (1921); J. A. Pickett, *A History of Alabama* (1851); J. B. Sellers, *The Prohibition Movement in Alabama, 1702 to 1943* (1943) and *Slavery in Alabama* (1950); W. R. Smith, *Debates in the Secession Convention of Alabama* (1861); and C. G. Summersell, *Mobile: History of a Seaport Town* (1949). The *Biennial Alabama Official and Statistical Register*, published by the state department of archives and history at Montgomery, gives the names of all officials, the election statistics, etc. The quarterly *Alabama Review* (from 1947) contains miscellaneous articles on Alabama history. For government see W. V. Hallaway and Charles W. Smith, Jr., *Government and Politics in Alabama* (1941); and W. Cooper, *Municipal Government and Administration in Alabama* (1940). (J. F. Do.)

"ALABAMA" ARBITRATION. The facts of this case are as follows: In 1861 the southern states of North America seceded and set up a separate government. Hostilities began with the capture of Fort Sumter by the Confederates on April 13, 1861. On the 19th President Lincoln declared a blockade of the southern ports. On May 14 the British government issued a proclamation of neutrality, by which the Confederates were recognized as belligerents. This example was followed shortly afterwards by France and other states. In June 1862 the vessel, the "Alabama," originally known as "No. 290," was being built by Messrs. Laird at Birkenhead. She was then nearly completed and was obviously intended for a man-of-war. On June 23 Mr. C. F. Adams forwarded to Earl Russell a letter from the United States consul at Liverpool giving certain particulars as to her character. This letter was laid before the law officers, who advised that, if these particulars were correct, the vessel ought to be detained. On July 21 sworn evidence, which was supplemented on July 23, was obtained and laid before the commissioners of customs (who were the proper authorities to enforce the provisions of the Foreign Enlistment Act of 1819), but they declined to move. On July 23, the same evidence was laid before the law officers, who advised that there was sufficient ground for detention. By some accident, the papers were not returned till July 29. Instructions were then issued to seize the vessel, but she had already sailed on the evening of the 28th. Although she remained for two days off the coast of Anglesey, there was no serious attempt at pursuit. She afterwards made her way to the Azores, where she received her armament, which was brought from Liverpool in two British ships. Captain Semmes there took command of her under a commission from the Confederate government.

After a most destructive career she was sunk off Cherbourg by the "Kearsarge" on June 19, 1864.

On these facts the United States government alleged against Great Britain two grievances: first the recognition of the southern states as belligerents and a general manifestation of unfriendliness in other ways; second, the breach of neutrality in allowing the "Alabama," the "Florida," the "Shenandoah" and other Confederate vessels to be built and equipped on British territory.

Correspondence followed extending over several years and in 1871 a commission was appointed to determine the mode in which the questions at issue might be settled. The British commissioners suggested that the "Alabama" should be submitted to arbitration. The American commissioners refused "unless the principles which should govern the arbitrators in the considera-

tion of the facts could be first agreed." Eventually it was agreed that the three following rules should apply: A neutral government is bound—(1) to use due diligence to prevent the fitting out, arming or equipping within its jurisdiction of any vessel, which it has reasonable ground to believe is intended to cruise or to carry on war against a power with which it is at peace, and also to use like diligence to prevent the departure from its jurisdiction of any vessel intended to cruise or carry on war as above, such vessel having been specially adapted, in whole or in part, within such jurisdiction, to warlike use; (2) not to permit or suffer either belligerent to make use of its ports or waters as the base of naval operations against the other, or for the purpose of the renewal, or augmentation of military supplies or arms or the recruitment of men; (3) to exercise due diligence in its own ports and waters and as to all persons within its jurisdiction to prevent any violation of the foregoing obligation and duties. These rules were embodied in the treaty of Washington (1871), which provided that the "Alabama" claims should be referred to a tribunal composed of five arbitrators, one to be named by each of the contracting parties and the remainder by three neutral powers. Art. 6 provided that the arbitrators should be governed by the three rules quoted above, and by such principles of international law not inconsistent therewith as the arbitrators should determine to be applicable to the case. By the same article the parties agreed to observe these rules as between themselves in future, and to bring them to the knowledge of other maritime powers. Art. 7 gave power to the arbitrators to award a sum in gross if Great Britain were adjudged in the wrong.

The treaty was, on the whole, welcomed in England. The United States appointed Mr. C. F. Adams as arbitrator and Mr. J. C. Bancroft Davis as agent. The British government appointed Sir Alexander Cockburn as arbitrator and Lord Tenterden as agent. The arbitrators appointed by the three neutral powers were Count Sclopis (Italy), M. Staempfli (Switzerland), Baron d'Itajuba (Brazil). The first meeting of the tribunal took place on Dec. 15, 1871, in Geneva. As soon as the cases had been formally presented, the tribunal adjourned till the following June. There followed immediately a controversy which threatened the collapse of the arbitration. The United States claimed damages not only for the property destroyed by the Confederate cruisers, but for such "indirect losses" as the transference of the American marine to the British flag, the enhanced payments of insurance, the expenses of pursuit and the prolongation of the war. They also revived the charges of "insincere neutrality" and "veiled hostility" which had figured in the diplomatic correspondence, and had been repudiated by Great Britain, and dwelt at length upon the premature recognition of belligerency, the unfriendly utterances of British politicians and the material assistance afforded to the Confederates by British traders. These claims for indirect losses, etc., caused great excitement in England. That they were within the treaty was disputed, and it was argued that, if they were, the treaty should be amended or denounced. In Oct. 1872 Lord Granville notified to General Schenck, the United States minister, that the British government did not consider that the indirect losses were within the submission, and in April the British counter-case was filed without prejudice to this contention. On June 15 the tribunal reassembled and the American argument was filed. To save the situation Mr. Adams persuaded his colleagues to make a spontaneous declaration that by the principles of international law the indirect claims ought to be excluded from their consideration. The discussion then turned mainly on the question of the measure of "due diligence." The United States contended that it must be a diligence commensurate with the emergency or with the magnitude of the results of negligence. The British government maintained that while the measure of care which a government is bound to use in such cases must be dependent more or less upon circumstances, it would be unreasonable to require that it should exceed that which the governments of civilized States were accustomed to employ in matters concerning their own security or that of their citizens.

The tribunal adopted the view suggested by the United States.

It found that Great Britain was legally responsible for all the depredations of the "Alabama" and "Florida" and for those committed by the "Shenandoah" after she left Melbourne.

In the case of the "Alabama" the court was unanimous; in the case of the "Florida" Sir A. Cockburn alone, in that of the "Shenandoah" he and Baron d'Itajuba, dissented from the majority.

In the cases of the other vessels the judgment was in favour of Great Britain.

The tribunal decided to award a sum in gross, and (Sir A. Cockburn again dissenting) fixed the damages at \$15,500,000 in gold.

On Sept. 14 the award was formally published, and signed by all the arbitrators except Sir A. Cockburn, who filed a lengthy statement of his reasons.

The first of the Washington Rules, with the substitution of the words "the means at its disposal" for the words "due diligence," was adopted by Art. 8 of the Hague Convention XIII., 1907.

See L. A. Atherley-Jones and H. H. L. Bellot, *Commerce in War* (1907). (H. H. L. B.)

ALABAMA CITY, formerly a city of Etowah county, Alabama, U.S.A., 60 mi. N.E. of Birmingham; it was annexed to Gadsden (*q.v.*) in 1932.

ALABAMA RIVER, a river of Alabama, U.S.A., formed by the Tallapoosa and Coosa rivers, which unite about 6 mi. above Montgomery.

It flows west as far as Selma, then south-west until, about 45 mi. from Mobile, it unites with the Tombigbee to form the Mobile and Tensas rivers, which discharge into Mobile bay.

The course of the Alabama is tortuous; its width varies from 600 to 900 ft., depth from 3 to 7 ft.; its length by the United States Survey is 312 m.; by steamboat measurement, 420 m. The river crosses the richest agricultural and timber districts of the State, and railways connect it with the mineral regions of north central Alabama. The principal tributary of the Alabama is the Cahaba (about 200 m. long), which enters it about 10 m. below Selma. Of the rivers which form the Alabama, the Coosa crosses the mineral region of Alabama, and is navigable for light-draft boats from Rome, Georgia (where it is formed by the junction of the Oostenaula and Etowah rivers), to about 117 m. above Wetumpka (about 192 m. below Rome and 26 m. below Greensport), and from Wetumpka to its junction with the Tallapoosa; the channel of the river has been considerably improved by the Federal government. The navigation of the Tallapoosa river (which has its source in Paulding county, Ga., and is 250 m. long) is prevented by shoals and a 60 ft. fall at Tallassee, a few miles north of its junction with the Coosa. The Alabama, which is navigable throughout the year, is an important carrier of cotton, cotton seed, fertilizer, cereals, lumber and naval stores.

ALABASTER or ARBLASTIER, WILLIAM (1567–1640), English Latin poet and scholar, was born at Hadleigh, Suffolk, and was educated at Westminster school and Trinity college, Cambridge. Alabaster served with the expedition of Robert Devereux, earl of Essex, to Cadiz in 1596, and embraced the Roman Catholic faith while he was in Spain. He was imprisoned in the Tower for his religious opinions in 1598 and 1599. His mystical writings brought him into conflict with the Inquisition, and he was imprisoned in Rome for a short time. He escaped, returned to England, abjured Catholicism and received a prebend in St. Paul's Cathedral, which he held until his death in April 1640.

Alabaster's Latin tragedy, *Roxana*, written while he was at Cambridge, is modelled on *La Dalida* of Luigi Groto, and was first published in 1632. Samuel Johnson praised it as the only Latin verse worthy of note written in England before Milton's *Elegies*. One book of an epic poem in praise of Elizabeth, entitled *Elisais, apotheosis poetica*, is preserved at Emmanuel college, Cambridge. It was admired by Edmund Spenser. "Who lives that can match that heroic song?" he says in "*Colin Clout's come home againe*." Other works by Alabaster are mystical in character and owe much to his study of the Kabbala. They include *Apparatus in revelationem Jesu Christi* (Antwerp, 1607), *Ecce*

Sponsus venit (1633), *Lexicon Pentaglotton* (1637) and mystical commentaries on Revelations and the Pentateuch.

See T. Fuller, *Worthies of England* (ii. 343); Pierre Bayle, *Dictionnaire, Historique et Critique* (1734); J. P. Collier, *Bibl. and Crit. Account of the Rarest Books in the English Language* (vol. i. 1865); also the *Athenaeum* (Dec. 26, 1903), where Mr. Bertram Dobell describes a ms. in his possession containing 43 sonnets by Alabaster.

ALABASTER, a name applied to two different mineral substances. The alabaster of the ancients is mostly a granular aggregate of crystals of calcium carbonate—i.e., it is really a marble (*q.v.*). The alabaster of modern times is a granular form of the mineral gypsum (*q.v.*). It is usually white, pink or yellowish in colour, often with darker streaks and patches, and is very soft (hardness 1.5 to 2) so that it can be scratched by the finger nail. It can be readily distinguished from marble by the fact that it does not effervesce with acid. Alabaster is found in beds interstratified with red sandstones and marls deposited in the beds of salt lakes during an arid period: in England, chiefly in the Keuper marls of the midlands, especially at Chellaston in Derbyshire, Fould in Staffordshire, and near Newark, Nottinghamshire, also in the neighbourhood of Carlisle, near Watchet in Somerset and Penarth in Glamorgan, all in the Trias.

On the Continent the centre of the alabaster trade is Florence, where it is found in Miocene and Pliocene strata, and is extensively used for statuary work and carving of ornamental objects. The best kind is pure white and translucent, but by careful heating in nearly boiling water it can be made nearly opaque, resembling marble. This appears to be due to partial dehydration.

(R. H. RA.)

ALABASTROS or **ALABASTOS**, a Greek vase, shaped like an urn. The most common type of the alabastros stands on four feet that balances, in appearance, its rather wide mouth. (See POTTERY AND PORCELAIN: *Greek Pottery*.)

ALACALUF, an Indian tribe, almost extinct, living in the west Patagonian channels, chiefly in the vicinity of Ración sound. Formerly they were much more numerous, and their canoes might be seen southward from the Gulf of Peñas to Brecknock peninsula in Tierra del Fuego, including the Straits of Magellan. Their culture in general closely resembles that of the other canoe-using tribe of Tierra del Fuego, the Yahgan (*q.v.*). The use of planked canoes by the Alacaluf has suggested the possibility of culture transference from Polynesia, but the Alacaluf planked canoe is demonstrably a local development.

See J. M. Cooper, "Analytical and Critical Bibliography . . . of Tierra del Fuego," in *Bureau of American Ethnology Bulletin* 63 (1917).

ALACOQUE or **AL COQ**, **MARGUERITE MARIE** (1647–1690), French nun and founder of the devotion to the Sacred Heart of Jesus, was born at Lauthecourt on July 22, 1647, and died on Oct. 17, 1690. Having been cured of paralysis, as she believed by the intercession of the Blessed Virgin, in 1671 she entered the Visitation convent at Paray-le-Monial and in the following year made her final vows. After a long period of severe austerities she testified that Christ had revealed to her His heart burning with love for man, and bade her establish the Holy Hour, communion on the first Friday of the month and the feast of the Sacred Heart to be observed on the Friday after the octave of Corpus Christi. The devotion to the Sacred Heart spread rapidly throughout Christendom, and Marguerite Marie was pronounced venerable in 1824, blessed in 1864, and finally on May 13, 1920, was canonized.

Her writings and autobiography are contained in *Vie et Oeuvres par les Contemporaines*, 2 vols. (Paris, 1901), her autobiography being published again at Paray-le-Monial in 1918. See also E. Bougaud, *Life of St. Margaret Mary Alacoque* (New York, 1920).

ALAGOAS, a maritime state of Brazil, bounded north and west by the State of Pernambuco, south and west by the State of Sergipe, and east by the Atlantic. It has an area of 11,031 square miles. A dry, semi-barren plateau, fit for grazing only, extends across the western part of the State, breaking down into long fertile valleys and wooded ridges towards the coast, giving the country a mountainous character. The coastal plain is filled with lakes (*lagoas*), in some cases formed by the blocking up of river outlets

by beach sands. The valleys and slopes are highly fertile and produce sugar, cotton, tobacco, Indian corn, rice, mandioca and fruits. Hides and skins, mangabeira rubber, cabinet woods, castor beans and rum are also exported. Cattle-raising was formerly a prominent industry, but it has greatly declined. Manufactures were developed to a limited extent only, though protective tariff laws were adopted for their encouragement. The climate is hot and humid, and fevers are prevalent in the hot season. The capital, Maceió (pop. 124,544), is the chief commercial city of the state, and its port (Jaraguá) has a large foreign and coastwide trade. The principal towns are Alagoas, formerly the capital, picturesquely situated on Lake Manguaba, 15 mi. southwest of Maceió, Palmeira dos Índios (pop. 67,202) and Santana do Ipanema (pop. 61,456). Before 1817 Alagoas formed part of the *capitania* of Pernambuco, but in that year the district was rewarded with a separate government and in 1823 became a province of the empire. The advent of the republic in 1889 changed the province into a state. Pop. (1950) 1,106,454.

ALAIN DE LILLE (Alanus de Insulis) (c. 1128–1202), French theologian and Latinist, lived at Montpellier, and finally retired to the Abbey of Cîteaux, where he remained until his death. His varied learning won for him the title of *Doctor universalis*. He was famed in his day for two of his Latin poems, *De planctu naturae*, a satire on human vices, and *Anticlaudianus*, a long verse treatise on the arts and on morals. Alain shared in the reaction against scholasticism, and laid stress on the share of faith in the apprehension of religious truth. He must be classed with the so-called Summists. But his *De arte seu de articulis catholicae fidei*, which was a "summa" of Christian theology, brings the principles of mathematical science to bear on Christian dogma. He also wrote a treatise *contra haereticos*.

The works of Alain de Lille have been published by Migne, *Patrologia latina*, vol. cxx. A critical edition of the *Anticlaudianus* and of the *De planctu naturae* is given by Th. Wright in vol. ii. of the *Anglo-Latin Satirical Poets and Epigrammatists of the Twelfth Century* (London, 1872). See Hauréau, *Mémoire sur la vie et quelques oeuvres d'Alain de Lille* (Paris, 1885); M. Baumgartner, *Die Philosophie des Alanus de Insulis* (Münster, 1896).

ALAIS: see **ALÈS**.

ALAJUELA, a province of Costa Rica, Central America, extending southward from the border of Nicaragua to the Meseta Central: area, 3,653 sq.mi.; pop. (1940), 137,943. The capital of the province (Alajuela), served by the Pan American highway and a branch line of the coast-to-coast railway, is in the highly productive and populous central valley: elev., 3,185 ft.; mean annual temp., 68° F.; pop. (1940), 9,232.

The province is predominantly agricultural in its economy, producing large quantities of sugar cane, coffee, cereals, fruits, subsistence crops and cattle.

ALAMANNI or **ALLEMANNI**, a German people first mentioned by Dio Cassius. They dwelt in the basin of the Maine, to the south of the Chatti (*q.v.*). They were a conglomeration of various tribes. The Hermunduri formed the preponderating element, and there were among the others the Iuthungi, Bucinobantes and Lentienses. From the 4th century A.D. onwards we hear also of the Suebi (*q.v.*) or Suabi. The Hermunduri belonged to the Suebi, but reinforcements from new Suebic tribes now moved westward. In later times the names Alamanni and Suebi seem to be synonymous. They were continually engaged in conflicts with the Romans, the most famous encounter being that at Strassburg, in which they were defeated by Julian (A.D. 357). Early in the 5th century the Alamanni crossed the Rhine and conquered and settled Alsace and a large part of Switzerland. In A.D. 495 they were conquered by Clovis, from which time they formed part of the Frankish dominions. The Alamanic and Swabian dialects survive in Swiss dialects, and in parts of South Germany, particularly Baden and Württemberg and also parts of Alsace.

See Dio Cassius lxxvii. et seq.; Ammianus Marcellinus, *passim*; Gregory of Tours, *Historia Francorum*, book ii.; O. Bremer in H. Paul, *Grundriss der germanischen Philologie* (2nd ed., Strassburg, 1900), vol. iii. pp. 930 et seq.

ALAMANNI or **ALEMANNI, LUIGI** (1495-1556), Italian statesman and poet, was born at Florence. Luigi joined with others in an unsuccessful conspiracy against Giulio de' Medici, afterwards Pope Clement VII. He was obliged to take refuge in Venice, and, on the accession of Clement, to flee to France. When Florence shook off the papal yoke in 1527, Alamanni returned, and took a prominent part in the management of the affairs of the republic. On the restoration of the Medici in 1530 he had again to take refuge in France, where he enjoyed the favour both of Francis I and Henry II. He died at Amboise on April 18, 1556. His best work, *La Coltivazione* (Paris, 1546), is a didactic poem, written in imitation of Virgil's *Georgics*. His *Opere Toscane* (Lyons, 1532) consists of satirical pieces written in blank verse. An unfinished poem, *Avarchide*, in imitation of the *Iliad*, was the work of his old age and has little merit. It has been said by some that Alamanni was the first to use blank verse in Italian poetry, but the distinction belongs rather to his contemporary Giangiorgio Trissino. He also wrote a poetical romance, *Girone il Cortese* (Paris, 1548); a tragedy, *Antigone*; a comedy, *Flora*, and other poems. His works were published, with a biography, by P. Raffaelli, as *Versi e prose di Luigi Alamanni* (Florence, 1859).

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ALAMBAGH, the name of a large park or walled enclosure, containing the ruins of a country house of the old Oudh court, as well as a beautiful garden, situated about 4m. from Lucknow, near the Cawnpore road, in the United Provinces of India. It was converted into a fort by the mutineers in 1857, and after its capture by the British was of importance in connection with the military operations around Lucknow. Sir Henry Havelock was buried in the garden.

ALAMEDA, a city of Alameda county, California, U.S.A., an island approximately 1 mi. wide and $\frac{1}{2}$ mi. long, at the eastern or mainland side of San Francisco bay, 12 mi. E. of the city of San Francisco. One entire side, $\frac{1}{2}$ mi. in length, faces on a deepwater channel and is used largely as a commercial waterfront. The city of Alameda is connected by the Posey tube and four bridges with its neighbouring cities, including the city of Oakland, and thence with the San Francisco Bay bridge. Pop. (1950) 63,425; (1940) 36,256.

Although largely residential, Alameda is important for its ship-building yards and ship-repair and dry-dock facilities. The city has both heavy and light industrial plants, including food and candy factories. Shipping terminals and warehouses have direct access to water and rail facilities and barge and trucking services. There are large plants for oil storage and distribution.

Alameda is the site of a U.S. naval air station, a maritime commission training school, a coast guard base and an army depot. The city was incorporated in 1854 and in 1917 adopted a city-manager form of government with five councilmen elected by the people. It owns and operates its own electric distributing plant and a golf course. There are swimming and fishing facilities and a yacht harbour and boat clubs facing out on the surrounding waters. Gross assessed valuation in 1950 was \$43,458,610.

ALAMO, THE, historic building in San Antonio, Tex., noted as the scene of a heroic defense in the war between Texas and Mexico. This building is the chapel of the Mission San Antonio de Valero, founded in 1718 by Franciscans, and commonly called the "Alamo mission" from the grove of cottonwood (*alamo*) in which it stood. It originally consisted of the chapel, a convent yard about 100 ft. square, a convent and hospital building and a plaza about $2\frac{1}{2}$ ac. in extent, the whole being surrounded by a strong wall. Upon the disappearance of the Indians from the vicinity the mission was abandoned, and after 1793 it was sometimes used as a fort. In the war for Texan independence Cols. William B. Travis, James Bowie and Davy Crockett, with 180 men, were attacked there by 4,000 Mexicans commanded by Antonio Lopez de Santa Anna. After a siege lasting 13 days, Feb. 23-March 6, 1836, during which about 500 of the attacking force were killed, a breach was made in the walls. In a final assault the Mexicans overpowered and slaughtered the garrison in a

hand-to-hand struggle in the chapel, the five survivors being subsequently killed in cold blood by order of Santa Anna. "Remember the Alamo" became the war cry of the Texans who, under Sam Houston, at San Jacinto, on April 21, 1836, defeated and captured Santa Anna. In 1883 the Alamo building was bought by the state and preserved as a public monument, and in 1913 the city of San Antonio began its restoration.

See A. M. Williams, *Sam Houston and the War of Independence in Texas* (1893); Zavola, *Story of the Siege and Fall of the Alamo* (1911).

ALAMOS DE BARRIENTOS, BALTASAR (1555-1640), Spanish scholar, was born at Medina del Campo in 1555. His friendship with Antonio Pérez (*q.v.*) caused him to be arrested in 1590 and imprisoned for nearly 13 years. His *Tácito español ilustrado con aforismos* (Madrid, 1614) is the only work which bears his name, but he is probably author of the *Discurso del gobierno* ascribed to Pérez. Through the influence of Pedro de Lerma and Gaspar Olivares (*q.v.*) he later attained high position.

ÅLAND ISLANDS, an archipelago at the entrance to the Gulf of Bothnia, about 25 mi. from the coast of Sweden, and 15 mi. from that of Finland. Area 572 sq.mi., with a population of 21,196 (1940). The group which forms the Finnish department of Åland (Ahvenanmaa), consists of nearly 300 islands, of which about 80 are inhabited, the remainder being desolate rocks. These islands form a continuation of a dangerous granite reef extending along the south coast of Finland. They formerly belonged to Sweden, and in the neighbourhood the first victory of the Russian fleet over the Swedes was gained by Peter the Great in 1714. They were ceded to Russia in 1809, and remained Russian until 1917, when Finland was proclaimed an independent and sovereign state. The population centres chiefly in the island of Åland, upon which is the small town Mariehamn. The inhabitants, hardy seamen and fishermen, are mostly of Swedish descent and speech. The surface of the islands is generally sandy, the soil thin and the climate keen; yet Scotch fir, spruce and birch are grown; and rye, barley, flax and vegetables are produced. Great numbers of cattle are reared; and cheese, butter and hides, as well as salted meat and fish, are exported. There are several excellent harbours (notably that of Ytternäs), which were of great importance to Russia from the fact that they are frozen up for a much briefer period than those on the coast of Finland.

History.—When, by an article of the Treaty of Fredrikshavn (Friedrichshamn), Sept. 5-17, 1809, the islands were ceded to Russia, together with the territories forming the grand-duchy of Finland on the mainland, the Swedes were unable to secure a provision that the islands, occupying a position of great strategic importance in relation to the entrance to Stockholm and to the Gulf of Bothnia, should not be fortified. The question was a vital one for Great Britain's trade as well. In 1854, accordingly, during the Crimean War, an Anglo-French force destroyed the fortress of Bomarsund. By the "Åland Convention," between Great Britain, France and Russia on March 30, 1856, it was stipulated that "the Åland islands shall not be fortified, and that no military or naval establishments shall be maintained or created on them."

By the 33rd article of the Treaty of Paris (1856) this convention, annexed to the final act, was given "the same force and validity as if it formed part thereof."

In 1906 it was asserted that Russia, under pretext of stopping the smuggling of arms into Finland, was massing considerable forces at the islands.

The question of the Åland islands created discussion in 1907 and 1908 in connection with the new North sea agreements, but Russia did not raise the issue officially when she saw the aversion of the other powers even to discuss it.

Under the tsardom the islands were united with Finland until the latter country declared her independence in 1917. In Dec. 1917, the Åland islanders claimed the right of self-determination on their own account, and unofficial plebiscites showed a vote in favour of reunion with Sweden. Finland granted the islands autonomy on May 7, 1920, but refused to contemplate their secession. In June the leaders of the secession movement were



MAP SHOWING THE STRATEGIC POSITION OF THE ÅLAND ISLANDS, LYING BETWEEN FINLAND AND SWEDEN IN THE BALTIC SEA. The Åland Islands, a self governing group within the Finnish body politic, were guarded by Russia for over a century because of their strategic position in the Baltic sea. They acquired the right of self determination after the World War (1914-18) and were guaranteed neutralization by the Baltic powers. The majority of the inhabitants are Swedish.

arrested for high treason, and Finnish troops were sent to the island. As this situation was producing a state of serious tension between Finland and Sweden, Great Britain drew the attention of the Council of the League of Nations to the movement on June 19, 1920.

*With the consent of the two interested governments, the Council asked a special commission of jurists whether the question was international or the exclusive concern of Finland. This commission declared the question international, whereupon the Council despatched a special commission of inquiry to the spot. This commission reported against the claim of the islanders to secede from Finland, but declared that the islanders formed a distinct group within the Finnish body politic, and suggested that the maintenance of Finnish sovereignty ought to be made conditional upon the incorporation in the autonomy law of May 7, 1920, of five specific guarantees. The commission also reported in favour of a new convention, to be signed by all the Baltic powers, for the neutralization and demilitarization of the Åland Islands, to replace the international convention of March 30, 1856. This report was accepted by the Council and the two nations. The new neutralization convention came into effect April 6, 1922. After much discussion Finland and Sweden agreed upon strengthening the defenses of the islands (Jan. 1939); the other interested states agreed except for Russia, whose protest postponed action. At the end of the same year Russia invaded Finland. In the peace agreement of March 1940, Russia demanded no concessions in the Åland Islands.

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ALANI, eastern division of the Sarmatians, half-caste Scyths, a wandering people resembling Mongols. First met with north of the Caspian, then (c. 1st century A.D.) spreading into the steppes of Russia, the Alani made incursions into both the Danubian and the Caucasian provinces of the Roman empire. By the Huns they

were cut into two portions, of which the western joined the Germanic nations in their invasion of southern Europe, and, following the fortunes of the Vandals, disappeared in North Africa. Those of the eastern division, though dispersed about the steppes until late mediaeval times, were forced by fresh invading hordes into the Caucasus, where they remain as the Ossetes. (See *SARMATAE* and *SCYTHIA*.)

ALANINE, a *Alanine*, is a constituent, and decomposition product, of many proteins, soluble in water or alcohol, crystallizing in colourless, sharp rhombic prisms, and having marked physiological action.

It has the formula of α amino-propionic acid, $\text{NH}_2\text{CHMe}\cdot\text{CO}_2\text{H}$, and exists in the *d*-, *l*- and *r*-isomeric forms (see *ISOMERISM*).

ALAPAEVSK, a town in Sverdlovsk region of Russian S.F.S.R. Pop. 12,151. Lat. $57^\circ 49'$ N. Long. $61^\circ 40'$ E. It was known for its copper as long ago as 1704, and is in the copper and iron mining area. Since it was linked by rail with Sverdlovsk and Nizhni-Tagil, its importance has greatly increased.

ALARCON, HERNANDO DE, Spanish navigator of the 16th century, was sent by the viceroy of New Spain in 1540 to give naval support to the expedition of Francisco Vazquez de Coronado in his search for the mythical seven cities of Mexico. The junction was never effected. Alarcon sailed up the Gulf of California, and determined with certainty that California was a peninsula, not an island.

He surveyed the coast, ascended the Rio del Tizon or Rio de Buena Guia (Colorado) for 85 Spanish miles and planted a cross at the highest point he reached.

Under the cross he buried a note afterwards found by Melchior Diaz.

See Herrera, Decade VI. book ix. ch. 15; vol. vi. fol. 212 of Madrid edition of 1730, and the report printed in Hakluyt's voyages.

ALARCON, JUAN RUIZ DE (c. 1581-1639), Spanish dramatist, was born about 1581 at Tlacho (Mexico), where his father was superintendent of mines, and died at Cordova on Aug. 4, 1639. Alarcon was educated in Spain, then, after a brief stay in

Mexico, returned to Spain and occupied a small post under the Council of the Indies. His plays were published in 1628 and 1634; the most famous of these is *La Verdad sospechosa*, which was adapted by Corneille as the *Menteur*. Alarcon was pre-occupied with ethical aims, and his gift of dramatic presentation was as brilliant as his dialogue was natural and vivacious. It has been alleged that his foreign origin is noticeable in his plays, but in *El Tejedor de Segovia* he had produced a masterpiece of national art, national sentiment and national expression.

ALARCON, PEDRO ANTONIO (1833–1891), Spanish writer, was born at Guadix March 10 1833. He had a considerable reputation as a journalist and poet when his play, *El Hijo pródigo*, was hissed off the stage in 1857. The failure exasperated Alarcon so much that he enlisted under O'Donnell as a volunteer in the Moroccan campaign. The expedition provided the material for the brilliant *Diario de un testigo de la guerra de Africa* (1859), a masterpiece in its way as a description of campaigning life. On his return from Morocco, Alarcon did great service to the liberal cause as editor of *La Política*. But in the years 1868–74 he ruined his political reputation by a series of rapid changes of front. His literary reputation steadily increased, however. *El sombrero de tres picos* (1874), a clever resetting of an old Spanish tale, lives for its malicious wit and minute observation. His other works include *Cuentos amorios* (1881); *Historietas nacionales* (1881); *El Escandalo* (1875); *El Capitan Veneno* (1881). Alarcon died July 20, 1891.

ALARD, JEAN DELPHIN (1815–1888), famous French violinist and teacher, was professor at the Paris Conservatoire from 1843 to 1875. Sarasate was one of his pupils.

ALARIC (c. 370–410), Gothic conqueror, the first Teutonic leader who stood as a conqueror in the city of Rome, was probably born about 370 on an island named Peucè (the fir) at the mouth of the Danube. He was of noble descent, his father being a scion of the family of the Balthi or Bold-men, next in dignity among Gothic warriors to the Amals. He was a Goth and belonged to the western branch of that nation (sometimes called the Visigoths) who at the time of his birth were quartered in the region now known as Bulgaria, having taken refuge on the southern shore of the Danube from the pursuit of their enemies the Huns.

In the year 394 he served as a general of *foederati* (Gothic irregulars) under the Emperor Theodosius in the campaign in which he crushed the usurper Eugenius. As the battle which terminated this campaign, the battle of the Frigidus, was fought near the passes of the Julian Alps, Alaric probably learnt at this time the weakness of the natural defences of Italy on her north-eastern frontier.

In the shifting of offices which took place at the beginning of the reigns of Arcadius and Honorius, the sons of Theodosius, Alaric apparently hoped that he would receive one of the great war ministries of the empire, and thus instead of being a mere commander of irregulars would have under his orders a large part of the imperial legions. This, however, was denied him, and he remained an officer of *foederati*. His disappointed ambition prompted him to take the step for which his countrymen were longing, for they too were grumbling at the withdrawal of the "presents," in other words the veiled ransom-money, which for many years they had been accustomed to receive. They raised him on a shield and acclaimed him as a king; leader and followers both resolved (says Jordanes, the Gothic historian) "rather to seek new kingdoms by their own labour, than to slumber in peaceful subjection to the rule of others."

Alaric struck first at the eastern empire. He marched to the neighbourhood of Constantinople, but finding himself unable to undertake the siege of the city, he retraced his steps westward and marched southward through Thessaly and the unguarded pass of Thermopylae into Greece. Alaric's invasion of Greece lasted two years (395–96); he ravaged Attica but spared Athens, which at once capitulated to the conqueror, and penetrated into Peloponnesus, capturing its most famous cities, Corinth, Argos and Sparta, selling many of their inhabitants into slavery. Here, however, his victorious career ended. Stilicho, who had come a second time to the assistance of Arcadius, succeeded in shutting up the Goths in

the mountains of Pholoe on the borders of Elis and Arcadia. Alaric escaped with difficulty, and not without some suspicion of connivance on the part of Stilicho. He crossed the Corinthian gulf and marched with the plunder of Greece northwards to Epirus.

Next came an astounding transformation. For some mysterious reason, probably connected with the increasing estrangement between the two sections of the empire, the ministers of Arcadius conferred upon Alaric the government of part of the important prefecture of Illyricum. Here, ruling the Danubian provinces, he was on the confines of the two empires, and, in the words of the poet Claudian, he "sold his alternate oaths to either throne," and made the imperial arsenals prepare the weapons with which to arm his Gothic followers for the next campaign. It was probably in the year 400 that Alaric made his first invasion of Italy, co-operating with another Gothic chieftain named Radagaisus. After spreading desolation through north Italy, and striking terror into the citizens of Rome, Alaric was met by Stilicho at Pollentia (a Roman municipality in what is now Piedmont). The battle (April 6, 402, Easter day) was a victory, though a costly one, for Rome and effectually barred the further progress of the barbarians. Alaric was an Arian Christian who trusted to the sanctity of Easter for immunity from attack, and the enemies of Stilicho reproached him for having gained his victory by taking an unfair advantage of the great Christian festival. The wife of Alaric is said to have been taken prisoner after this battle; and there is some reason to suppose that he was hampered in his movements by the presence with his forces of large numbers of women and children, having given to his invasion of Italy the character of a national migration. After another defeat before Verona, Alaric quitted Italy, probably in 403.

He had not indeed reached Rome, but his invasion of Italy had produced important results. It had caused the imperial residence to be transferred from Milan to Ravenna, it had necessitated the withdrawal of the 20th legion from Britain, and it had probably facilitated the great invasion of Vandals, Suevi, and Alani into Gaul, by which that province and Spain were lost to the empire. We next hear of Alaric as the friend and ally of his late opponent Stilicho. The estrangement between the eastern and western courts had in 407 become so bitter as to threaten civil war, and Stilicho was actually proposing to use the arms of Alaric in order to enforce the claims of Honorius to the prefecture of Illyricum. The death of Arcadius in May 408 caused milder counsels to prevail in the western cabinet, but Alaric, who had actually entered Epirus, demanded that if he were thus suddenly bidden to desist from war, he should be paid handsomely for what in modern language would be called the expenses of mobilization. The sum which he named was a large one, 4,000 pounds of gold (about £160,000 sterling), but under strong pressure from Stilicho the Roman senate consented to promise its payment.

Three months later Stilicho himself and the chief ministers of his party were treacherously slain in pursuance of an order extracted from the timid and jealous Honorius; and in the disturbances which followed the wives and children of the barbarian *foederati* throughout Italy were slain. The natural consequence was that these men to the number of 30,000 flocked to the camp of Alaric, clamouring to be led against their cowardly enemies. He accordingly crossed the Julian Alps, and in Sept. 408 stood before the walls of Rome (now with no capable general like Stilicho to defend her) and began a strict blockade.

No blood was shed this time; hunger was the weapon on which Alaric relied. When the ambassadors of the senate in treating for peace tried to terrify him with their hints of what the despairing citizens might accomplish, he gave with a laugh his celebrated answer, "The thicker the hay, the easier mowed!" After much bargaining, the famine-stricken citizens agreed to pay a ransom of more than a quarter of a million sterling, besides precious garments of silk and leather and three thousand pounds of pepper. Thus ended Alaric's first siege of Rome. At this time, and indeed throughout his career, the one dominant idea of Alaric was not to pull down the fabric of the empire but to secure for himself, by negotiation with its rulers, a regular and recognized position within its borders. His demands were certainly large—the concession of

a block of territory 200 m. long by 150 wide between the Danube and the Gulf of Venice (to be held probably on some terms of nominal dependence on the empire), and the title of commander-in-chief of the imperial army. As all attempts to conduct a satisfactory negotiation with this emperor failed, Alaric, after instituting a second siege and blockade of Rome in 409, came to terms with the senate, and with their consent set up a rival emperor and invested the prefect of the city, a Greek named Attalus, with the diadem and the purple robe. But Attalus rejected the advice of Alaric and lost in consequence the province of Africa, the granary of Rome, which was defended by the partisans of Honorius. The weapon of famine, formerly in the hand of Alaric, was thus turned against him, and loud in consequence were the murmurs of the Roman populace. Honorius was also greatly strengthened by the arrival of six legions sent from Constantinople to his assistance by his nephew Theodosius II. Alaric therefore cashiered his puppet emperor Attalus after 11 months of ineffectual rule, and once more tried to reopen negotiations with Honorius. These negotiations would probably have succeeded but for the malign influence of another Goth, Sarus, the hereditary enemy of Alaric and his house. When Alaric found himself once more outwitted, he marched southward and began in deadly earnest his third siege of Rome. No defence apparently was possible; there are hints, not well substantiated, of treachery; there is greater probability of surprise. However this may be (for our information at this point of the story is miserably meagre) on Aug. 24, 410, Alaric and his Goths burst in by the Salarian Gate on the north-east of the city. The Goths showed themselves not absolutely ruthless conquerors, and there is no reason to attribute any extensive destruction of the buildings of the city to Alaric and his army. Contemporary ecclesiastics recorded with wonder many instances of their clemency: the Christian churches saved from ravage; protection granted to vast multitudes both of pagans and Christians who took refuge therein; vessels of gold and silver, which were found in a private dwelling, spared because they "belonged to St. Peter"; at least one case in which a beautiful Roman matron appealed, not in vain, to the better feelings of the Gothic soldier who had assailed her.

Alaric then marched southwards into Calabria. He desired to invade Africa, which on account of its corn crops was now the key of the position; but his ships were dashed to pieces by a storm in which many of his soldiers perished. He died soon after, probably of fever, and his body was buried under the river-bed of the Busento, the stream being temporarily turned aside from its course while the grave was dug wherein the Gothic chief and some of his most precious spoils were interred. When the work was finished the river was turned back into its usual channel, and the captives by whose hands the labour had been accomplished were put to death that none might learn their secret. He was succeeded in the command of the Gothic army by his brother-in-law, Ataulphus.

Our chief authorities for the career of Alaric are the historian Orosius and the poet Claudian, both strictly contemporary; Zosimus, a somewhat prejudiced heathen historian, who lived probably about half a century after the death of Alaric; and Jordanes, a Goth who wrote the history of his nation in the year 551, basing his work on the earlier history of Cassiodorus (now lost), which was written c. 520.

(T. H.; X.)

ALARIC II. (d. 507), eighth king of the Goths in Spain, succeeded his father Euric, or Evaric, on Dec. 28, 484. His dominions not only included the whole of Spain except its north-western corner, but also Aquitaine and the greater part of Provence. In religion Alaric was an Arian, but he greatly mitigated the persecuting policy of his father, Euric, towards the Catholics and authorized them to hold, in 506, the council of Agde. He appointed a commission to prepare an abstract of the Roman laws and imperial decrees, which should form the authoritative code for his Roman subjects. This is generally known as the *Breviarium Alaricianum*, or *Breviary of Alaric* (q.v.). Alaric endeavoured strictly to maintain the treaty which his father had concluded with the Franks, but Clovis found a pretext for war in the Arianism of Alaric. The two armies met in 507 at the Campus Vogladensis, near Poitiers, where the Goths were defeated, and their king, who took to flight, was overtaken and slain, it is said, by Clovis himself. This battle ended the rule of the Visigoths in Gaul.

ALA-SHEHR (anc. PHILADELPHIA), Aidin vilayet, Turkey, in the Kuzu Chai valley (*Cogamus*), at the foot of the Boz Dag (Mt. Tmolus) 83 mi. east of Smyrna (105 by railway). Population 32,801. Philadelphia was founded by Attalus II. of Pergamum about 150 B.C., became one of the "Seven Churches" of Asia, and was called "Little Athens" on account of its festivals and temples. It was subject to frequent earthquakes. Philadelphia was an independent neutral city, under the Latin Knights of Rhodes, when taken in 1390 by Sultan Bayezid I. and an auxiliary Christian force under the emperor, Manuel II., after a long resistance, when all other cities of Asia Minor had surrendered. Twelve years later it was captured by Timur, who built a wall with the corpses of his prisoners. A fragment of the ghastly structure is in the library of Lincoln cathedral. The town is connected by railway with Afium Qarahisar and Smyrna. It is ill-built, but, as it stands above the wide fertile Hermus plain, the distant view is imposing. There are small industries and a fair trade. A mineral spring yields a heavily charged water, "Eau de Vals," in great request in Smyrna.

See W. M. Ramsay, *Letters to the Seven Churches* (1904).

ALAS, LEOPOLDO (1852-1901), Spanish novelist and critic, was born at Zamora. His reputation rests on his psychological novel, *La Regenta* (1884-85), whose scene is laid in Oviedo. The ruthless analysis of its characters gives it a place among the best novels of the period.

ALASKA, once called Russian America, is a territory of the United States of America, occupying the extreme north-western part of North America and including the adjacent islands. The name "Alaska", an adaptation of the Aleut "A-la-as-ka," means "the great country." The territory of Alaska comprises first, all that part of the continent west of the 141st meridian; secondly, the eastern Diomed Island in Bering strait, and all islands in Bering sea and the Aleutian chain lying east of a line drawn from the Diomedes to pass midway between Copper Island,



BY COURTESY OF AMERICAN MUSEUM OF NATURAL HISTORY.

A RAVEN TOTEM POLE
Totem poles are erected by the Alaskan Indians to the animal from which they think their tribe has descended.

off Kamchatka, and Attu Island of the Aleutians; thirdly, a narrow strip of coast and adjacent islands north of a line drawn from Cape Muzon, in latitude 54° 40' N., up Portland canal to its head, and thence, following the summit of the mountains situated parallel to the coast to the 141st meridian, provided that when the line runs more than ten marine leagues from the ocean the limit shall be formed by a line parallel to the windings of the coast and which shall never exceed the distance of ten marine leagues therefrom. Alaska is bounded on the north by the Arctic ocean, on the west by the Arctic ocean, Bering sea and Bering strait, on the south and southwest by the Gulf of Alaska and the Pacific ocean, and on the east by British Columbia and Yukon territory. The total area of Alaska is 586,400 sq.mi., an area equal to nearly one-fifth that of continental United States or more than twice the size of Texas, the largest state of the union.

Principal Physical Features.—As indicated by the above boundaries, Alaska is of straggling, irregular shape, extending in longitude from about 130° W. to 193° W. or 167° E., as specified in the articles of cession and through more than 20° of latitude, 51° to 71° 25' N. The southern limit lies far out in the Pacific as part of the Aleutian island chain, only 2° north of the boundary between the western half of the United States and Canada. Alaska consists of a compact central mass and two straggling appendages running from its southwestern and south-eastern corners. These three parts will be referred to hereafter respectively, as continental Alaska, Aleutian Alaska and the "Panhandle."

The general ocean coast line is about 4,750 mi. and including the islands, bays, inlets and rivers to the head of tide water, is about

26,000 mi. in length. The entire southern coast is very precipitous, much indented by deep fiords, with only slight stretches of beach or plain. Its elevation gradually decreases as one travels west toward the Aleutians.

A great submarine platform extends throughout a large part of Bering sea. The western and northern coasts are regular in outline, with long straight beaches, and shallows are common in the seas that wash them.

Of the vast number of islands within the boundaries of Alaska and constituting part of its territory, only a few of the more important can be mentioned in an article of this scope. At the southeastern extremity and lying close inland is the Alexander archipelago (*q.v.*) consisting of about 1,100 islands, large and small. Southwest of the Alaska peninsula there are two groups: (1) Kodiak; the largest island, of the same name, is 40 mi. by 100 mi., and may be considered a continuation of the Kenai peninsula. The group's western continuation consists of the Semidi, Shumagin and Sanak clusters; (2) the Aleutian Islands (*q.v.*), sweeping 1,200 mi. or more W.S.W. from the end of Alaska peninsula; west of the mainland in Bering sea, the Pribilof Islands, about 500 mi. S. of Cape Prince of Wales, the small Hall and St. Matthew Islands; to the north, toward Bering strait, the large St. Lawrence Island, with Nunivak near the coast to the southeast. Of the smaller islands within Bering sea, only the Pribilofs (home of the fur seal during breeding season) are of special interest or value.

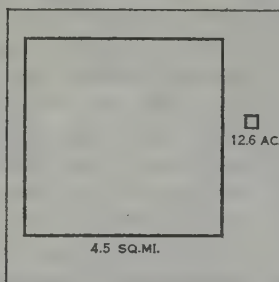
Alaska has mountains, plateaus and lowlands on a grand scale. "In a broad way, the larger features of topography correspond with those of the western States. There is a Pacific mountain system, a central plateau region, a Rocky mountain system, and a Great plains region. These four divisions are well marked, and show the close geographic relation of this area to the southern part of the continent." But the general features of the Pacific mountain system trend parallel to the coast line of the Gulf of Alaska. The Pacific mountain system includes four ranges. The coast range of the Panhandle attains a width of 100 mi., but has no well-defined crestline. The range is characterized by summit levels between 5,000 and 10,000 ft. Continuing the coast range, with which it is closely associated—the Chilkat river lies between them—is the St. Elias range (a term used to include not only the mountains between Cross sound and Mt. St. Elias but the Chugach, Wrangell and Nutzotin mountains), lying in the southeast of the main peninsula or continental Alaska. Among its principal peaks are: Mt. Sanford, Mt. Fairweather and Mt. Vancouver, all higher than 15,000 ft., and Mt. Wrangell, 14,005 ft. (an active volcano), in the Wrangell mountains, Mt. St. Elias, 18,008 ft., and in Canadian territory, Mt. Logan, 19,850 ft. The Aleutian range, of which crest the Aleutian Islands are remnants; fills out the system near the coast. In the Aleutian range, near the base of the Alaska peninsula, there occurred in the early days of June 1912 one of the great volcanic eruptions of historic times. The top of Katmai, a mountain showing no evidence theretofore of volcanic action, was entirely blown off, and about the same time there came into existence in the valley to the northwest a vast number of tiny volcanic vents or fumaroles, later known as the Valley of Ten Thousand Smokes. The mountain and valley were later set apart by proclamation of the president (Sept. 24, 1918) as the Katmai National monument. The Alaska range, which lies south of the Yukon drainage system, connects with the Nutzotin and Skolai branches of the St. Elias range. It is splendidly marked by many snowy peaks, including Mt. Foraker (17,000 ft.) and Mt. McKinley (20,300 ft.), the loftiest peak in North America. North of the Yukon are the Baird and Endicott mountains of the Brooks range, an extension of the Rocky mountains. Between the Pacific mountains and the last-mentioned ranges lies the vast central plateau region or Yukon plateau. Finally, between the Brooks range and the Arctic ocean is the arctic slope region, a sloping plain corresponding somewhat to the interior plains of the United States.

The glaciers of the Panhandle and throughout the rest of the Pacific region are most remarkable—unusual alike for their number and size. Thousands of alpine glaciers from 1 to 15 mi.

long fill the upper valleys and canyons of the mountains. Other glaciers are of the piedmont type. The two most notable glaciers are the Malaspina, largest in the territory, extending 50 mi. along the seaward base of Mt. St. Elias; and the Muir, at the head of the icy straits. The Muir was much visited by tourists prior to the earthquake in 1899, which so shattered the glacier and increased the discharge of ice that steamers no longer found it safe to approach near the face. The condition of the glaciers of Alaska,

generally speaking, appears to be one of recession; many of them now have terminal moraines many miles back.

Chief among the streams of Alaska is the Yukon, 1,800 mi. in length, which practically bisects the main peninsula. The principal feeders of this great river have their sources far away to the southeast in the coastal mountains along the boundary between Alaska, British Columbia and the Canadian Yukon territory. It flows in a general northwesterly direction for about one-half its length, passing through a small section of



TWO SQUARES SHOWING THE RELATIVE AMOUNT OF SPACE AVAILABLE PER PERSON IN ALASKA (4.5 SQ. MI.) AND IN CONTINENTAL UNITED STATES (12.6 AC.)

British Columbia and through territory of the Canadian Yukon till it reaches the 141st meridian. There it enters U.S. territory and, continuing to the northwestward, passes within the Arctic circle for a short distance in the vicinity of Port Yukon. It then turns southwesterly, gathering volume from many tributaries, the principal of which are the Tanana and the Koyukuk, and finally empties its flood into Bering sea through many mouths and over a vast bar, in longitude (approximately) 164° W. and latitude 63° N. The ocean port for the river, where merchandise is transferred by lighterage from ocean vessels to river boats, is a bay on St. Michael Island, lying about 60 mi. to the northeast of the Northern or Apoon mouth. River boats drawing from three and a half to four feet can enter the Apoon mouth and proceed without difficulty, in ordinary stages of water, practically the whole length of the river to Whitehorse, connecting there with the White pass and Yukon railway to Skagway. The period of navigation on the Yukon is from four to four and a half months. The second largest river in Alaska is the Kuskokwim, with its sources in the mountains of the Alaska range south of the Yukon drainage basin, and emptying into the Bering sea about 150 mi. S. of the mouth of the Yukon. It is navigable for about 600 mi. Out of the Alaska and Nutzotin mountains two great rivers flow southward: the Copper, practically unnavigable except for small boats, because of its turbulence and the discharge of glaciers into its waters; and the Susitna, also practically unnavigable. Both these rivers have their sources in lofty mountain masses, and are swift and powerful streams carrying with them much silt.

The Panhandle is remarkably picturesque. The maze of islands of the Alexander archipelago, hundreds in number, are remnants of a submerged mountain system; the islands rise 3,000 to 5,000 ft. above the sea, with luxuriantly wooded tops and bold, sheer sides scarred with marks of glacial action. Through the inner channels, sheltered from the Pacific by the island rampart, runs the "inland passage," the tourist route northward from Seattle, Wash. The interinsular straits are carried up into the mainland shore as fiords heading in rivers and glaciers. Most remarkable are the inlets known as Tracy Arm and Lynn canal (continuing Chatham strait). The first is very deep, with precipitous shores and bordering mountains 5,000 to 6,000 ft. high; the second is a noble fiord 100 mi. long and on an average 6 mi. wide, with magnificent alpine scenery.

Continental Alaska in the interior is essentially a vast plateau. "The traveller between the main drainage areas of the interior is struck by the uniform elevation! Rounded hills, level meads, and persistent flat-topped ridges, composed of rocks of varying

structure, rise to about the same level and give the impression that they are the remnants of a former continuous surface. In height it varies from about 5,000 ft. close to the bases of the mountain systems to less than 3,000 ft. in the vicinity of the main lines of drainage and slopes gradually toward the north."

Geology.—The outstanding features of Alaska are its mountain ranges, most of which consist of closely folded and contorted beds of sedimentary rock and underlying igneous masses, by intrusion of which the sedimentary beds were uplifted. A notable mountain chain is the Alaska range, which is nearly 600 mi. long and 50 to 80 mi. wide. This range, which was elevated to its present height late in Tertiary time, marks an old line of movement that has repeatedly been the site of folding and mountain building. In this range is the Mt. McKinley National Park, a reservation that contains 1,939,199.04 ac, and includes the highest peak in North America, Mt. McKinley, which stands 20,300 ft. above sea-level. Volcanic products, which were poured out at intervals during an immensely long time, form a part of some ranges and make up most of the mass of many peaks. Among these volcanic peaks are the Wrangell mountains and many of the mountains on Alaska peninsula and in the Aleutian chain of islands. On the other hand, Mt. McKinley and Mt. St. Elias consist of masses of intruded granitic rock surrounded by sedimentary beds. The high relief of the larger mountain masses is due to their relatively recent elevation, the forces of erosion not yet having had time greatly to reduce their height.

The general outline of the mountain ranges in Alaska is a continuation of that seen in the region to the south, in Canada, but the course of the ranges in Alaska swings around from north-west to south-west, toward Asia, and the geologic history of the coastal ranges in both continents is doubtless similar. Far to the north lies Brooks range, from the northern base of which runs a series of gently folded beds that extend to the Arctic ocean.

The details of the geological structure and of the petrology of Alaska are extremely complex, and the attempt to trace the geological history of the region is very difficult. The geological record indicates a long series of periods of uplift and depression, of erosion and deposition, of folding and faulting and metamorphism of the beds deposited, and of intermittent volcanism that produced great areas of lava and ashes, which, like all other deposits, were shifted here and there and at some places greatly altered.

The oldest sedimentary deposits are certain pre-Cambrian rocks that lie in a broad belt in the upper Yukon valley, especially in the region between the Yukon and the Tanana, where they include what is called the Birch Creek schist, the bed rock in that region. The conditions and events in early Cambrian time are unknown, but in late Cambrian and in parts of Ordovician time large areas in Alaska appear to have been submerged, for most of the beds formed during those periods are marine deposits. Evidences of emergence, however, are found at some places. In early Devonian time there was a period of elevation, deformation, and subsidence over large areas. Toward the end of the Carboniferous period, in late Pennsylvanian or early Permian time, marine deposition prevailed, perhaps intermittently, until beds of limestone that measured in the aggregate thousands of feet in thickness were laid down over parts of Alaska. The Palaeozoic beds include at many places accumulations of volcanic material, but the greatest eruptions in Palaeozoic time appear to have occurred intermittently near its end, during the Pennsylvanian and Permian epochs. Most of the products of these eruptions lie south of the Alaska range. In late Permian and early and middle Triassic time Alaska was a land surface undergoing erosion. In late Triassic time depression again brought the sea over a large part of Alaska. This submergence was followed by widely extended uplift, which included probably all of Alaska. In early Jurassic time the Pacific and Arctic coasts were submerged and along them were deposited beds of sandstone, shale and limestone. Middle Jurassic deposits cover a somewhat wider area along the Pacific coast. In Jurassic time there was a persistent shore line near the site of the Alaska range.

In early Cretaceous (lower Cretaceous) time renewed submergence brought the sea over much of Alaska, including parts of

the Yukon valley, most of which had been above the sea since the end of Palaeozoic time. A large part of northern Alaska, which had been land since the end of the Triassic period, was also submerged. The deposits of this time include a basal conglomerate and overlying shale and limestone. An uplift and a change in places of sedimentation followed, in later Cretaceous (upper Cretaceous) time, during which the larger topographic features of present Alaska were doubtless outlined. Marine deposits were laid down along the Arctic and Pacific coasts and in the lower and broader parts of the Yukon and probably other valleys. Terrestrial deposits were formed in embayments that stood on the sites of the larger river valleys. The submergence of the Yukon valley gradually increased and as gradually slackened, and swamps were formed in which plants grew and coal beds were laid down. The Cretaceous deposits in the Kuskokwim valley appears to be very similar to those in the lower Yukon valley. While sedimentation was in progress in the Yukon valley the rest of Alaska may have been land. During later Cretaceous time the sea invaded the sites of the Matanuska and Chitina valleys and parts of the southern coastal region. The deposits of this time in Alaska peninsula include marine shale, coal-bearing shale, conglomerate sandstone and shale, probably of mixed marine and terrestrial origin. The end of Cretaceous time on Alaska peninsula appears to have been marked by a period of mountain growth. The Cretaceous beds are greatly folded everywhere and many of them are cut by intrusive rocks and intrusive veins. Deposits of tuff laid down in early Tertiary (Eocene) time show that the diastrophic movements which began late in Cretaceous time culminated in volcanic eruptions. Among the earliest post-Cretaceous deposits are the Tertiary coal-bearing beds. Two groups of coal beds that lie near the Alaska range are reached by the Alaska Railroad, one in the valley of Matanuska river, in lat. $61^{\circ} 45'$, the other along and east of the Nenana river, about lat. 64° . Most of the coal mined is used on the railroad. Beds of lignitic coal are exposed at many places around Cook Inlet and in the lower part of the valley of the Susitna river. The coal-bearing beds, which have been at some places greatly tilted and folded, generally consist of poorly consolidated sand, clay and gravel, and at some places contain abundant remains of plants. Many of the Tertiary rocks, however, consist of hard conglomerate and shale, and include basaltic lava and other volcanic material, as well as intrusive dikes and sills.

By early Quaternary time the great mountain-building movements in the south of the Alaska range had apparently ceased and the larger topographic features of this region, including the Kenai-Chugatch range, the Talkeetna Mountains and the Yukon-Tanana upland, had assumed nearly their present form, although the details of the drainage may have been different, for the climate was milder than it is now. A colder age followed, in which enormous glaciers were formed in the mountains. The Quaternary beds, which include glacial deposits, are widespread. In the Alaska range and in the region south of it such deposits constitute a large part of the unconsolidated surface material. The glaciers abraded the rocks of the highlands and carried down into the lowlands immense quantities of gravel, sand, silt and till, modifying the forms of the higher valleys and leaving thick deposits over large areas. The bluffs along Copper river, for example, consist of glacial deposits more than 500 ft. thick; and moraines, outwash gravel and thick delta fans made up of glacial material cover large areas. The glaciers now appear to be receding, but the deposition of outwash from glaciers is still in active progress at many places, and the great glaciers in the Alaska range and the Wrangell mountains, and especially the glaciers of Kenai Peninsula, Prince William Sound and the coast farther south, are conspicuous features. The higher parts of the Alaska range are the gathering grounds for some of the largest valley glaciers. Five or more of these great tongues of ice are from 2 to 4 mi. wide and 30 to 50 mi. long. The present surface form of the mountains of this range has been produced in large part by the erosive action of these glaciers and of their much larger predecessors.

Great changes in the climate of north-western North America are indicated by the fossil plants. The flora of Alaska was at times evidently that of a temperate or a warmer region.



BY COURTESY OF (1, 2) THE U.S. GEOLOGICAL SURVEY, (3, 4) THE CANADIAN NATIONAL RAILWAYS, (5) PRODUCERS' DISTRIBUTING COMPANY, LTD.

VIEWS IN GLACIER LAND AND THE MOUNTAINOUS REGIONS OF ALASKA

1. Rendu glacier, a large tidewater formation at the northern limit of Glacier Bay, southeastern Alaska
2. View of the Yukon river near Eagle, Alaska
3. General view of Wrangell, near the mouth of the Stikine river
4. Twin glacier, Taku river, which is one of the most accessible of the Alaskan glaciers
5. A typical scene in the mountainous regions of Alaska with campers' cooking outfit in the foreground



BY COURTESY OF (1, 2, 3) THE U.S. DEPT. OF COMMERCE, BUREAU OF FISHERIES, (4, 6) CANADIAN PACIFIC RAILWAY; PHOTOGRAPH, (5) EARL ROSSMAN FROM EWING GALLOWAY

FISHING AND MINING IN ALASKA

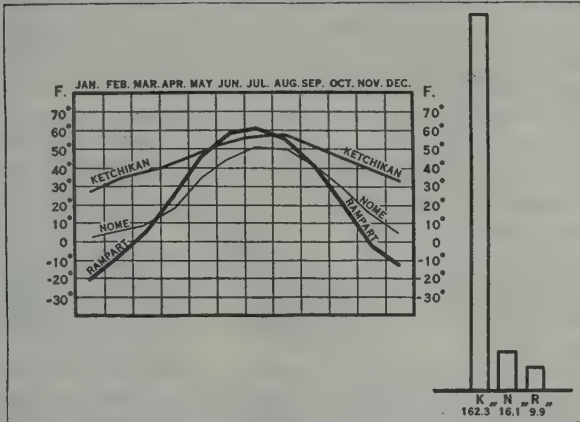
Salmon fishing ranks first among Alaskan industries today. Another interest that has attracted much capital to that part of the world is mining, developed rapidly during recent years but leaving much territory still to be exploited, particularly in the coal districts. It is interesting to note that, whereas the United States purchase price of the Territory of Alaska in 1867 was \$7,200,000, the estimated total output of the fisheries and mines alone for the period 1867-1939 exceeded \$1,874,000,000

1. Beach seining for salmon at Karluk, Kodiak island, Alaska
2. Alaskan cannery
3. Delivery of red salmon at an Alaskan cannery

4. Yukon hydraulic mining, Pine Creek, Atlin, B.C., north-east of Juneau
5. Harbour of Juneau, with A. J. Gold mine plant at right
6. Washing gold at Spruce Creek

The uplifts in Alaska apparently established land connection between North America and Asia at several periods. Across this body of land in Tertiary time horses of early types passed to Asia from the central plains of North America, which appear to have been the first habitat of the horse. Early elephants, or elephant-like creatures, on the other hand, found their way from Asia to America, where their remains have been discovered at many places.

Climate.—Alaska is one of the “ends of the earth” and as such presents many interesting extremes, none more than in its cli-



GRAPH CONTRASTING THE CLIMATIC CONDITIONS OF ALASKA

The curves show the monthly mean temperatures at Ketchikan, on the south-east coast, Nome, on Bering sea, and Rampart, in the interior on the Yukon river. The columns show the normal annual precipitation at these three places

matic features. Enclosed on the north and west by arctic waters, and from the Alaska peninsula down the long coast to the south-eastward by North Pacific waters, with their tempering currents drifting eastward encompassing the islands of the Aleutian group and those farther south, there results a great variation in temperature and precipitation. The climate of the Aleutians is oceanic, with moderate and fairly uniform temperatures, much rain and almost constant fogs. The summers are cooler than along the coast to the east and southward, and the winters milder, with much less snow, seldom going below zero. Clouds laden with moisture from the warm Pacific currents, being swept in upon the mountains and the many glaciers by the prevailing winds, produce a heavy precipitation of rain in summer and snow in winter. Across the coast range in the interior there is an entirely different climate. There the precipitation, of both rain and snow, is comparatively light except upon the high mountain ranges. Low temperatures occur in winter—occasionally as low as -75° or -80° F.—with short, hot summers. In this part of Alaska the ground is permanently frozen to great depth in most of the valleys, but on the drier hillside slopes it frequently happens that but little frost is found. The tempering influence of the ocean currents practically disappears north of the line of the Pribilof Islands, or about the middle of Bering sea, and the regions to the northward and eastward of this are for the most part barren, windswept and inhospitable. Arctic conditions prevail, especially beyond Bering strait. Point Barrow, farthest north (71° plus), is ice-locked for about ten months of the year.

Fauna and Flora.—The fauna of Alaska is very rich and surprisingly varied. The lists of insects, birds and mammals are especially noteworthy. Of these three classes, and of other than purely zoological interest, are mosquitoes, which swarm in summer in the interior in vast numbers; seafowl, which are remarkably abundant near the Aleutians; moose, and especially caribou, which in the past were very numerous in the interior and were of economic importance to the natives. The destruction of the wildlife threatened to expose the Eskimos to starvation, hence the effort made by the United States government to stock western Alaska with domestic reindeer from Siberia. It is, however, the fish and fur-bearing animals of its rivers and surrounding seas

that are economically most distinctive of and important to Alaska. The fishing grounds extend along the coast from the extreme southeast past the Aleutians into Bristol bay.

Herring, cod and salmon abound in almost incredible numbers. Of marine mammals, whales are hunted far to the north in Bering sea and the Arctic ocean, but are much less common than formerly as are also the walrus, the sea otter and the sea lion. Fur seals are increasing in number because of effective government control. The number of fur-bearing land animals is equally large. Sable, ermine, wolverine, mink, land otter, beaver and muskrat have always been important items in the fur trade. There are black, grizzly and polar bears and also two exclusively Alaskan species, the Kodiak (or Kadiak) and the glacier bear. The gray wolf is common; it is the basal stock of the Alaskan sledge dog. The red fox is widely distributed, and the white or arctic fox is very common along the eastern coast of Bering sea. A blue fox, once wild, is now domesticated on Kodiak, the Aleutians and the southern continental coast, and a black fox, very rare, is found in south-eastern Alaska. The silver fox is very rare.

The Alaskan flora is no less varied than the fauna. Wildflowers are alpine in size, colour and profusion. The forests of the coastal region, though hitherto almost unutilized, are of potential value. The balsam fir and in the south the red cedar are found in scant numbers; more widely distributed, but growing only under marked local conditions, is the yellow or Alaska cedar, a very hard and durable wood of fine grain and pleasant odour. Far the most abundant are coast and alpine hemlocks and the tideland or Sitka spruce. The spruce is not confined to this part of Alaska, but is the characteristic and universal tree. The separation of the coast and interior flora is almost complete; only along the mountain passes and river valleys, and rarely there, is there any change of species. Timber, however, is fairly abundant along the entire course of the Yukon above Anvik (about 400 mi. from the mouth), along the great tributaries of the Yukon and along every stream in central Alaska. The woods of the interior consist almost entirely of spruce. On the Yukon flats it grows in a vast forest impenetrably dense. The timber line, which in the Panhandle and along the southern coast of the continental mass runs from 1,800 to 2,400 ft., frequently rises in the interior plateau even to 4,000 ft. Next in importance after spruce in the interior is birch and then balsam poplar. Thickets of alders and willows in wet places and new-made land, aspens and large cottonwoods west of the characteristic spruce area (as on Seward peninsula) are also common. Toward the Arctic circle the timber becomes, of course, sparse, low, gnarled and distorted. The willows in the arctic drainage basin shrink to shrubs scarcely knee-high. Grasses grow luxuriantly in the river bottom and wherever the tundra moss is destroyed to give them footing. Most distinctive is the ubiquitous carpeting of mosses, varying in colours from the pure white and cream of the reindeer moss to the deep green and brown of the peat moss, all conspicuously spangled in the brief summer with bright flowers of the higher orders, heavy blossoms on stunted stalks.

Sedges available for forage grow in the tundra. In August berries are fairly abundant over the interior; one of them, the salmonberry or cloudberry, preserved in seal oil for the winter, is an important food of the natives. The western timber limit is on Kodiak Island. The Aleutian Islands are almost destitute of trees, but are covered with a luxuriant growth of herbage. Climatic differences cannot account for the treeless condition of the country west of this point, and the true explanation lies probably in the fact that in winter, when the seeds of the coastal forests ripen and are released, the prevalent winds west of Kodiak are damp and blow from the south and southwest, while the spread of the seeds requires dry winds blowing from the north and northwest. Such favourable conditions occur only rarely.

Exploration and Early History.—In the early explorations of the northwest coast of America, Spain was first in the field, but there is little evidence to prove that any Spanish navigator sailed as far north as Alaska. Later, and during the period of active Russian exploration, a number of expeditions were sent north from Mexico and at one time Spain claimed the sole right

to navigate the waters of the northern Pacific and issued a prohibition against other nations trading in those waters. Many Spanish names of places along the coast remain today to attest the extent of these explorations. Spain does not appear to have pressed her claims, however, and gradually ceased her efforts in this direction. This may have been because of disputes on her hands in other parts of the world or the wide extent at that time of the Spanish claims in the western hemisphere or possibly, in part, the fact that the climatic conditions of this northern region did not appeal strongly to a people whose life and activities had been spent in warmer climes. To the Russian, on the other hand, these regions were as home.

During the latter half of the 17th century the Russians had been pushing their explorations across Siberia and along the eastern and northern shores of Asia. In 1728 Vitus Bering passed through the strait named after him and Girondeff sighted the American coast in 1731. Bering's second expedition, in company with Alexei Chirikov, sailed from the Siberian coast in 1741. The mainland of America was located and numerous islands visited. This expedition is commonly accepted as fixing the date of the discovery of Alaska. Bering's ship was wrecked in early November on what is now called Bering Island. The crew made such provision as was possible against the cold of the approaching winter, but the privations and hardships were very great. "It was under such circumstances that Vitus Bering died—on this cold, forbidding isle, under the sky of an Arctic winter, December 8, 1741." During the 30 or 35 years following, the Russians were active in exploring the coast and islands and in establishing a trade with the natives.

About the time the American colonies were making their struggle for separation from the mother country, England was beginning her part of the exploration of this northwest coast. Three names stand high in the record of these explorations: James Cook, George Vancouver and Sir Alexander Mackenzie. Cook's expedition sailed from England in July 1776. In the personnel of his expedition were men from the American colonies, and Vancouver, then a midshipman, was of the party. The work begun by Cook was continued by Vancouver during the years 1791 to 1794. W. H. Dall expressed the view generally held concerning Vancouver's work in the statement that: "The explorations which he carried out have not been excelled by any other navigator and were faithfully and thoroughly performed." The Hudson's Bay company was meanwhile advancing its trade and extending its influence westward from the interior of Canada. In 1793 Mackenzie crossed the continent by land to the Gulf of Georgia, returning by the same route. This expedition, although little known, may well be compared with that of Meriwether Lewis and William Clark, in respect both of the difficulties encountered and of its value to his company and government.

The excesses committed by private traders and companies, who robbed, massacred and hideously abused the native Indians, caused the Russian government in 1799 to confine the trade and regulation of its American possessions to a semi-official corporation called the Russian-American company for a term of 20 years, afterward twice renewed for similar periods. Alexander Baranof, chief resident director of the American companies (1790-1819), and one of the administrators of the new company, became famous through the success he achieved as governor. He founded Sitka (*q.v.*) in 1804 after the massacre by the natives of the inhabitants of an earlier settlement (1799) at an adjacent point. The headquarters of the company were at Kodiak until 1805, and thereafter at Sitka.

In 1821 Russia attempted by ukase to exclude navigators from Bering sea and the Pacific coast of her possessions. This led to

immediate protest from the United States and Great Britain. The outcome was a treaty with the United States in 1824 and one with Great Britain in 1825, by which the excessive demands of Russia were relinquished and the boundaries of the Russian possessions were established. In the convention with Great Britain, it was agreed that Russia should have the narrow strip of coast north of 54° 40' and the peninsula and islands westward of the 141st meridian.

The last charter of the Russian-American company expired on Dec. 31, 1861, and Prince Maksutov, an imperial governor, was appointed to administer the affairs of the territory. Authority was granted to an American company in 1864 to make explorations for a proposed Russo-American company's telegraph line overland from the Amur river in Siberia to Bering strait, and through Alaska to British Columbia.

Work was begun on this scheme in 1865 and continued for nearly three years; when the success of the Atlantic cable rendered the construction of the line unnecessary and it was given up, but not until important explorations had been made. Much of this information was made public in 1870 by W. H. Dall in his book *Alaska and its Resources*.

The first official overtures by the United States for the purchase of Russian America were made by Sen. William Gwin of California (1859) during the presidency of James Buchanan. This movement, however, was checked temporarily by the Civil War, which soon followed.

The fishing interests of northwestern United States were next to manifest an interest in the territory to the northward. In 1866 a memorial was adopted by the legislature of the Washington territory, "in reference to the cod and other fisheries," and delivered to Pres. Andrew Johnson. By a treaty signed on March 30, 1867, the purchase was consummated for the sum of \$7,200,000, and on Oct. 18, 1867, the formal transfer of the territory was made at Sitka.

Later History.—After its acquisition by the United States, the history of Alaska was mainly that of the evolution of its administrative system and the varying fortunes of its gold fields, fisheries and sealing industries. Alaska was an unorganized territory from 1867 until May 1884. From 1867-77 the government was in the hands of the department of war, although the customs were from the beginning collected by the treasury, with which the control rested from 1877 until the passage of the so-called Organic act of May 17, 1884. This act extended over Alaska the laws of the state of Oregon so far as they should be applicable, created a judicial district and a land district, put in force the mining laws of the United States and in general gave the administrative system the organization it retained up to the reforms of 1899 and 1900. The history of government and political agitation then centred in the demand for general land legislation and for an adequate civil and criminal law, in protest against the enforcement of a liquor prohibition act, and in agitation for an efficiently centralized administration. After partial and inadequate legislation from 1891 to 1898, the regular system of land surveys was made applicable to Alaska in 1899, and a generous homestead law was provided in 1903. The liberal land policy was completely reversed as a result of the conservation movement inaugurated under Pres. Theodore Roosevelt. The original aim of the movement was to prevent waste of natural resources, but this gradually veered to a protest against corporate control of lands and resources.

An important result of the conservation movement was the increase of reservations in Alaska, about 40,000 sq. mi. being set aside for various purposes, exclusive of mineral and forest withdrawals. For many years, however, the conservation issue remained unsettled and industry languished; with an abundant supply of fuel close at hand, Alaska was forced to import petroleum and coal at great cost; her pulp wood was rotting in the forests; her water power was undeveloped. Only gold and copper mining and salmon fishing increased. Finally during the Woodrow Wilson administration, a leasing policy for coal and oil lands and water power was established by law.

The struggle of Alaska to attain representation at Washington,



BY COURTESY OF AMERICAN MUSEUM OF NATURAL HISTORY
CARVED WOODEN SPOON
USED BY THE INDIANS OF ALASKA

D.C., resulted in 1906 in the authorization of an elected delegate to congress. At each biennial election which followed, home rule was the only important issue, until in 1912 an act was passed granting a limited territorial government. The first territorial legislature was convened at Juneau on March 3, 1913, and the first law passed gave the franchise to women.

The agitation over prohibition dated from 1868; the act of that year organizing a customs district forbade the importation and sale of firearms, ammunition and distilled spirits; the Organic act of 1884 extended this prohibition to all intoxicating liquors. Smuggling flourished; juries steadily refused to convict offenders and treasury officials regularly collected revenue from saloons existing in defiance of law. In 1900 the sale of liquors was authorized under a high licence law. In 1917 congress responded to a legislative petition by passing a dry law for Alaska. In 1940 the people of Alaska rejected territorial liquor control by referendum.



BY COURTESY OF THE FISH AND WILD LIFE SERVICE, DEPT. OF INTERIOR

NATIVE METHOD OF DRYING SALMON EMPLOYED IN WESTERN ALASKA
In summer the Alaskan Indian catches a great quantity of salmon, which is hung over poles to dry and then stored for the winter months

Two events of international interest growing out of Alaska were the fur seal arbitration of 1893 (*see* BERING SEA ARBITRATION), and the Alaskan-Canadian boundary dispute, previously mentioned, settled by an international tribunal of British and American jurists in London in 1903. The boundary dispute involved the interpretation of the words in the treaties of 1825 and 1867 defining the boundary of the Russian (later U.S.) possessions, and also the determining ownership of the Portland canal and the question whether the coastal girdle should cross or pass around the heads of the fjords of the coast. The award of the tribunal made in Oct. 1903 was arrived at by the favourable vote of the three commissioners of the United States and of Lord Alverstone, whose action was bitterly resented by the two Canadian commissioners; it sustained in the main the claims of the United States.

Very little was known about the interior of Alaska previous to 1896, when the gold discoveries in the Klondike stimulated public interest regarding it. From 1895, however, explorations of the United States geological survey and the department of war, as well as those of individuals, established the main features of its physiography and a rather accurate knowledge of its resources.

The federal government began to expand its military establishment in the territory in 1939, after belatedly recognizing the strategic importance of Alaska as a northerly and westerly outpost in the nation's defense system. Throughout World War II Alaska was a vitally important link in the new air routes to the U.S.S.R. During the conflict, this northwestern province, extending from a point 700 mi. N. of Seattle to within sight of the mainland of far eastern Russia, entered increasingly into U.S. national consciousness as the struggle progressed—first, as the objective of Japanese aggression, next, as an important take-off point for attacking Japan, and finally, with peace, as a new frontier for war veterans.

Many new airports were constructed throughout Alaska and the first land link between the territory and the continental United States was completed with construction of the Alaska highway. Vast military expenditures, plus scores of new service industries resulted in substantial increase in the economic levels of almost all regions of the territory; there was no mass exodus of population from Alaska at the war's end.

Accompanying the economic progress was considerable political progress. Alaskans in 1946 voiced their demand for statehood at the ballot box. The appeal for statehood was by no means a new desire, as numerous bills had been introduced in the congress of the United States calling for statehood for Alaska during the preceding years. Backed by the results of the 1946 referendum, Alaska's delegate to congress introduced another bill for Alaska statehood and for the first time congressional hearings were held on the subject. During 1947 and 1948, hearings were held both in Alaska and Washington, D.C. On April 14, 1948, the house committee on public lands reported favourably on a bill to provide for admission of Alaska to the union. The measure, however, did not reach the floor of the house. During the first session of the 81st congress, 1949, the measure again received approval of the committee, and again failed to reach the house for action. It was not until the second session that the house of representatives passed the statehood measure. The senate, however, did not act on the bill during its regular session.

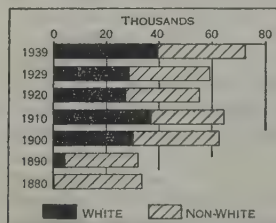
Population.—The population in 1867, at the time of the cession from Russia, was estimated at 30,000, made up mainly of Eskimos and other natives. The population in 1880, at the time of the first enumeration by the United States, was 33,426, which number included only a few hundred white persons: in 1900 it was 63,592 and in 1910, 64,356, while in 1920, partly by reason of the decline in the gold-mining industry, the census recorded only 55,036. In the next census (1929), the population was 59,278; in the 1939 census, 72,524—the latter figure representing an increase of 22.3% over 1929. Of this number, 30,384 were native whites, 8,786 were foreign-born whites and 33,354 were non-whites, mainly persons of native stock. Of the 8,786 foreign-born whites, 2,444 were born in Norway, 1,223 in Sweden, 1,051 in Canada, 665 in Finland and 589 in Germany. No other country contributed as many as 400. Of the 33,354 nonwhite persons, 32,458 were of native stock, comprising 15,576 Eskimos, 5,599 Aleuts and 11,283 Indians.

According to the 1950 census, taken as of April 1, there were 128,643 persons in Alaska, representing an increase of 77.4% over the previous census count, and the largest increase, percentage-wise, of any state or territory. A substantially larger increase would have been recorded but for the almost absolute lack of housing facilities to accommodate those who were desirous of settling in Alaska, many of whom gave up their plans on finding it impossible to secure residential accommodations, and returned to the states.

In the native white population there were 18,651 males and only 11,733 females, making a sex ratio of 159.0 males per 100 females.

The foreign-born white population was even more dominantly male, there being 377 males per 100 females. In the native white population, 5.9% were 65 years old or over; in the foreign-born white, 9.3%; and in the native stock, 2.9%. There were 28,936 employed persons 14 years old or over in the labour force in 1939, of whom 5,061 were engaged in agriculture and trapping (mainly in hunting and trapping), 3,207 in fishing, 4,997 in mining, 4,630 in manufacturing and construction, 4,290 in transportation and trade, and 1,677 in professional and related services. In June, July and August of 1939, however, more than 10,000 persons, largely seasonal workers from the states, were employed in the canning industry.

The towns of Alaska are all small but they are centres for busi-



COURTESY OF U.S. CENSUS BUREAU

POPULATION: 1880-1939

ness and social activities, as well as for government agencies, each serving a wide tributary area, and are therefore relatively more important than towns of similar size in more populous regions. The population of the territory and its principal cities and incorporated towns is summarized in the accompanying table.

Area	Population			Per cent of increase	
	1950 (April 1)	1930 (Oct. 1)	1929 (Oct. 1)	1939-50	1929-39
The territory . . .	128,643	72,594	59,278	77.4	22.3
Urban* . . .	27,705	17,374	7,749	59.5	24.2
Rural . . .	100,938	55,150	51,529	83.0	7.0
Per cent urban . . .	21.5	24.0	13.1	—	—
Principal cities:†					
Anchorage . . .	11,060	3,405	2,277	216.5	53.5
Juneau . . .	5,818	5,729	4,043	1.6	41.7
Fairbanks . . .	5,623	3,455	2,101	62.8	64.4
Ketchikan . . .	5,202	4,695	3,796	10.8	23.7
Sitka . . .	2,800	1,987	1,056	4.7	88.2
Seward . . .	2,063	940	835	11.4	13.5
Nome . . .	1,852	1,559	1,213	18.8	28.5
Kodiak . . .	1,535	804	442	80.2	95.4
Petersburg . . .	1,005	1,323	1,252	21.3	5.7
Wrangell . . .	1,227	1,162	948	5.0	22.6

*Population of cities and towns having 2,500 inhabitants or more; 1950 data preliminary. †Figures for 1950 based on a preliminary, but approximately complete, count of the census returns.

Government.—Alaska's first legislature, which met in 1913 and was patterned after the Washington Territorial act of 1853, consisted of 8 senators and 16 representatives elected from the territory's four judicial divisions. In 1950 the Alaska territorial legislature consisted of 4 senators from each of the four judicial divisions elected to four-year terms and 24 representatives, apportioned in proportion to population, elected to two-year terms, the representation being eight, seven, five and four from the first, third, fourth and second divisions respectively. The members' salaries and transportation to and from the legislative sessions are paid by the federal government. The legislature convenes biennially in odd years for a period not to exceed 60 days, to legislate on territorial matters, not specifically prohibited by the Organic act, adopt a biennial budget and pass on the governor's appointments. The governor is empowered when the need arises to call a special session which may not continue longer than 30 days.

The actual government of Alaska is both federal and territorial. Both the governor and secretary of Alaska are appointed for four-year terms by the president of the United States, the former subject to confirmation by the United States senate. In the governor's absence from the territory, the secretary is acting governor. In some instances the federal and territorial functions overlap; in others they are separate and distinct.

There are four judicial divisions in Alaska with headquarters at Juneau, Nome, Anchorage and Fairbanks. A federal district judge, United States attorney and United States marshal—all presidentially appointed—preside over each. In addition to their judicial duties, the judges issue liquor licences and dispense a small fund for indigents. They likewise appoint the United States commissioners, of whom there were 53 in 1949. The commissioners act as local court magistrates, probate judges and coroners, are unsalaried but paid through a variety of fees. There are no territorial courts. The commissioner's courts have jurisdiction in probate, insanity and minor civil and criminal matters arising under the federal statutes applicable to the territory under territorial laws. Additionally, each incorporated municipality has a magistrate court which has jurisdiction over matters arising under local ordinances. The district courts have the same general original jurisdiction as similar courts in the continental United States, having in addition general jurisdiction in civil, criminal, equity and admiralty cases. Prior to 1947 the marshal's office had the sole responsibility for the maintenance of law and order outside of incorporated towns. In 1947 members of the Alaska highway patrol, a territorial police force, were given full police powers and the authority of the United States marshal. They also were appointed deputy game wardens.

Among the various federal departments operating in Alaska are the department of interior, department of agriculture, department of commerce, department of labour and the treasury department.

Other executive departments of the federal government exercise the same administration respectively in Alaska that they do in other parts of the United States, and virtually every executive branch of the government was represented by mid-20th century.

The principal territorial officers are the attorney general, treasurer, auditor, highway engineer and commissioner of labour, all nominated in party primaries and elected by popular vote for four-year terms. These officials, together with a commissioner of education and the governor, constitute the board of administration which exercises limited administrative functions between legislative sessions. Other territorial officials, such as the commissioners of agriculture, mines and taxation, are appointed by the governor and subject to confirmation by the legislature. Alaska elects its delegate to the federal congress for a two-year term. He represents the territory, is a member of a number of committees in the house of representatives and can speak on the floor as well as introduce bills, but has no vote. The political parties of Alaska send delegates to national conventions where candidates for president and vice-president of the United States are nominated, but Alaska has no vote in the electoral college. All citizens of Alaska—whites, Indians, Aleuts and Eskimos—have the right to vote and in the 1950 election two Eskimos were elected to the senate and two Indians and one Eskimo to the house. The principal territorial agencies are the department of education, department of health, department of public welfare, department of mines, department of agriculture, Alaska veterans affairs commission, department of fisheries, department of aviation and Alaska development board. The latter agency, created by the territorial legislature in 1945, directs most of its activities in behalf of new and expanded industrial and business enterprises in Alaska.

Finances.—The budget for the 1951-53 biennium, exclusive of expenditures for roads, waterfront improvements and airfields, which are financed out of fuel tax receipts, was \$17,973,645, the major items of which were \$8,077,688 for education, \$2,896,000 for welfare, and \$999,000 for health. The governor can veto bills and any specific item in the appropriation bill, but may be overridden by a two-thirds vote of the two houses polling separately.

The fiscal system of the territory underwent a pronounced change at the 1949 session of the territorial legislature. The old licence statute enacted by congress in 1899 and 1900, under which the federal government collected licence fees on certain occupations, professions and lines of business and through the Alaska fund turned them over to the territory, was repealed by an act of congress. The legislature enacted a number of revenue statutes including an income tax on persons and corporations, a business licence tax on occupations, professions and various lines of business, a definite percentage tax on the sale of canned salmon, a raw fish tax, a resident and nonresident fisherman's licence tax, a tax on tobacco and tobacco products, a motor-fuel tax, a graduated tax on fish traps, a tax on automobiles and on drivers and a general property tax. These, together with the old tax on liquor and school tax, constituted the principal source of territorial revenue. For the fiscal year ending June 30, 1950, the department of taxation collected a gross total of \$9,232,421.06.

There were 17 territorial and 4 national banks operating in Alaska on June 30, 1950, with a combined capital of \$1,505,000, surplus and undivided profits of \$3,572,914.62 and total deposits of \$78,103,948.91.

Education and Welfare.—By an amendment to the Organic act passed in 1917, Alaska became responsible for the education of its white population. The Alaska division of the office of Indian affairs, department of the interior, is required to provide for the education of the natives, to train them in industry and to furnish them medical relief. The enrolment in the territorial schools for the session 1949-50 was 13,908 pupils and 544 teachers. Of the total enrolment, 2,418 were in high schools and 11,490 in elementary schools. The school term in incorporated towns ranged from nine to ten months and for rural districts from seven to nine months. During the fiscal year 1950 there were 4,082 natives in the 83 schools supported by the federal government. There were in addition 902 students attending 16 parochial schools. The only

institution of higher education is the land-grant University of Alaska opened at Fairbanks in 1922. Its enrolment for 1949-50 was 509 and 972 were registered in short courses.

The burden of welfare falls on both the territorial and federal governments. The insane of Alaska are cared for at federal expense in a private institution.



BY COURTESY OF THE AMERICAN MUSEUM OF NATURAL HISTORY

A DUGOUT CANOE OF THE TLINGIT INDIAN, A MEMBER OF ONE OF THE FOUR ETHNOLOGICAL RACES IN ALASKA. THE TLINGIT ARE SKILLED FISHERMEN AND HUNTERS, WHO FASHION THEIR CANOES FROM CEDAR LOGS. THE CRAFT VARY IN SIZE AND SHAPE ACCORDING TO PURPOSE. THE TYPE ABOVE IS USED ON INTERIOR WATERS

Fisheries.—The product of the fisheries is about equal to the sum total of all other Alaskan products. The total value of fish marketed between 1867 and 1949 was \$1,930,112,109. In 1949 Alaskan fisheries employed about 33,000 people. The total value of Alaskan fishery products in 1949 was \$98,904,063, a decrease of \$58,799,570 from 1939.

The pack of canned salmon in 1949 was 4,391,051 cases. Halibut products in 1949 were valued at \$4,800,000, an increase of more than \$4,300,000 over 1939. Operators of this particular fishing industry are governed by a voluntary production-control program and by regulations of the International Fisheries commission. Despite the existence of cod-fishing banks from 22 to 90 fm. deep in the Bering sea and east of the Alaska peninsula, little has been done to exploit the enormous cod resources. Whale fishing was suspended during World War II and had not yet been resumed in 1950 because of various economic factors.

Crab, clams and shrimp assumed an important position in Alaska's canning and packing industry. Utilization of fish waste in the production of fish meal, oils and fertilizer also is important. The total value of these products in 1949 was \$2,364,966.

Agriculture and Livestock.—In 1950 the best-developed farming areas were in the Matanuska and Tanana valleys where vegetables and poultry were being raised in unprecedented quantities. There is an abundance of good grazing land in the interior, but the period of winter feeding is about eight months.

The Matanuska valley had proved particularly adapted for breeding dairy cattle. The domesticated reindeer herds in 1949 were estimated at 30,000 head, a reduction of 220,000 during the past ten years. It is estimated that Alaska contains 256,000,000 ac. suitable for grazing of reindeer and capable of supporting 10,000,000 deer.

This industry, however, promises little for the future of Alaska except insofar as it may contribute to the sustenance of the Eskimos.

Furs.—Between 1867 and 1949 Alaska produced furs to the value of about \$192,500,000, of which about 55% represented seal-skins taken on the Pribilof Islands. Value of furs shipped from Alaska to the United States during 1949 was \$2,075,547, exclusive of sealskins from the Pribilof Islands. Up to 1910 the government leased the seal-catching privileges on these islands to private corporations, which killed 2,320,028 seals and paid the government \$9,474,000 in royalties. The land killing of seal was restricted, but pelagic sealing, which was becoming very destructive, could not be controlled by the U.S. government; a treaty was therefore signed in 1911 between the United States, Great Britain, Russia and Japan, abolishing pelagic sealing and providing that the United States was to pay to both Great Britain and Japan 15% of the value of the catch made on the islands. From 1910 killing was pro-

hibited on the Pribilof Islands, except by U.S. agents.

Thanks to these provisions the seal herd increased from 215,000 in 1912 to 3,837,131 in 1949. In 1949, 70,142 sealskins were taken from the herd.

Minerals.—As early as 1861 gold discoveries were made on the Stikine river; repeated discoveries, culminating in the Cassiar district "boom," were made in British Columbia from 1857 to 1874; colorings along the Yukon were reported in 1866-67 and systematic prospecting of the upper river began about 1873. Juneau was founded in 1880; the same year the opposition of the Indians, which prevented the crossing of the mountain passes to the interior, was withdrawn, and after 1880 repeated and scattered discoveries were made on the Lewes, Pelly, Stewart and other streams of the upper Yukon country in Canada. As early as 1883-85 there was a considerable mining excitement caused by these discoveries, and a much greater one in 1887 after the discovery of coarse gold on Forty Mile creek in U.S. territory; but these were as nothing to the picturesque and feverish rush that followed the location of the first Klondike claim in Canadian territory in Aug. 1896.

The total value of the mineral output of the territory from 1880 through 1949 was approximately \$975,000,000. Of this \$535,936,000 was for gold, \$227,408,400 for copper and \$13,622,000 for silver. Alaska also produces coal, lead, tin, platinum, palladium, antimony, tungsten, natural gas, petroleum, marble, gypsum, graphite, barite and sulphur. Copper mining, begun in 1901, was the chief mineral industry for many years, but in 1930 production of that ore began to fall rapidly at the same time gold production expanded. Thus, while the value of the two was close in 1928, the gold output of 1949 was \$8,029,560, as compared with a copper production of but \$1,576. Coal, both bituminous and anthracite, occurs in the Bering river and the Matanuska fields, which lie within reach of the government railway. The territory also contains an abundant supply of subbituminous and lignite coals, which are widely distributed. The production up to and including 1949 had a value of \$31,626,567 with the output for that year standing at 430,000 tons worth \$2,205,900.

Important oil seepages were found at five places on the Pacific seaboard, and at two places in the naval petroleum reserve no. 4 on the north Arctic coast. The withdrawal of all oil lands from entry in 1911 stopped development until 1919, when an oil-leasing law was passed and operations begun in several localities. The production of petroleum, however, was confined to the Katalla field; and when a fire destroyed that refinery in 1933 production was entirely discontinued. The U.S. navy at mid-century was exploring the Arctic field. About 16,500,000 oz. of silver and 18,000 tons of lead had been produced. Almost all the tin output of North America comes from Alaska, chiefly from the York district in the Seward peninsula. The mining of platinum and related minerals began in 1916. Although platinum mining operations expanded during and after World War II, production figures were not announced. Quicksilver mining is carried on in a small way, and in southeastern Alaska high-grade marble is quarried.

Timber Production.—The commercial timber of Alaska is contained in the two great national forests, the Tongass in southeastern Alaska and the Chugach on Prince William sound. They had, in 1940, a total area of 20,878,000 ac., and are estimated to contain 84,000,000,000 bd.ft. of saw timber, of which 73% is western hemlock and 20% Sitka spruce. The remainder is largely western red cedar and Alaskan cedar.

Volume of timber cut in 1949 was 56,000,000 bd.ft.; the stumpage value was \$114,056.

Communication and Transportation.—All commercial communication channels between the territory and the continental United States are operated and maintained by the Alaska Communications system, a branch of the United States army signal corps. Telephone and telegraph services are handled over land-lines, cable lines and radio channels. Established in 1900, the Alaska Communications system at mid-century was operating 14 main and 18 substations in Alaska serving military, federal and territorial government agencies and the general public. Total cash receipts for the fiscal year ending June 30, 1950, amounted to

\$1,102,213.15. An extensive system of radiotelephone stations in isolated communities was established by the Alaska Communications commission, an agency of the territorial government. The Alaska native service operated a total of 102 radiotelephone stations in 1950, the majority located in the arctic regions. There were 14 community telephone exchanges in Alaska with a total of 11,763 instruments.

There were six daily, nine weekly, one bi-weekly and two tri-weekly newspapers published in the territory in 1950, and ten radio broadcasting stations were in operation.

Lack of adequate land transportation routes between Alaska and the United States had a profound effect on the territory's development. The ruts of the oxcart and the covered wagon, the rails and ties flung across the American frontier, were forerunners of development in the western states, but it was many years after much of the early pioneering had been accomplished that transportation routes—highways and railways—were developed in Alaska. Two United States and three Canadian steamship companies regularly serve Alaska as common carriers. In addition several concerns operate as contract carriers in the freight field and on special cruise runs handling passengers. In addition to the common carriers, there were in 1950 about 12,000 vessels of various descriptions used in the fishing industry and for recreational and personal transportation.

Aviation was a pioneer industry in Alaska. Because of the vast distances and rugged terrain separating communities, the aeroplane quickly became the accepted mode of transportation. The first air-mail service began in 1924. By 1950 seven air carriers were certified for operation over 10,064 route miles. In addition, two domestic and one foreign air carrier operated scheduled service over 6,177 route miles within the territory.

Prior to World War II Alaska had no highway system. The principal highway at that time was the Richardson, linking Valdez with Fairbanks. War construction joined the Anchorage road system with the 371-mi. Richardson highway by means of the 104-mi. Glenn highway, connected the Nabesna road with the Alaska International highway, and extended the 42 mi. of the Haines boundary road to connect with the Alaska highway in the Yukon Territory. In 1950 Alaska had an interior highway system of 2,871 mi. There were in addition 356 mi. of road in the national forests, the majority leading from southeastern Alaska communities.

Constructed at the turn of the 20th century, the 111-mi. White Pass and Yukon route extending from tidewater at Skagway to Whitehorse in the Yukon Territory was the first railway built in Alaska. Only 20 mi. of this railway, however, lie in the territory. The United States government authorized construction of the Alaska railroad in 1914. The rail lines were completed from the port of Seward to Fairbanks, a distance of 470 mi., in 1923 at a cost of \$56,000,000. During the fiscal year ending June 30, 1950, the railroad transported 875,561 revenue tons and 104,300 passengers. Its assets were valued at approximately \$83,500,000.

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ALASTOR, in early Greek mythology, the spirit of revenge, that prompts the members of a family to commit fresh crimes to obtain satisfaction. Further acts of vengeance transmit the curse from generation to generation. The word is also used for a man's evil genius which drives him to sin; a man so driven is sometimes called *Alastor*. The epithet is applied to the Furies (Erinyes) as the deities of revenge, and to Zeus when he is invoked as the "Avenger."

ALA-TAU (variegated mountains) is the name given to the following ranges in Asiatic Russia: (1) Terskei, (2) Kunghei and (3) Trans-ili, all three linking the Tian Shan and the Alexander range. (1) Lies south, and (2) and (3) north of and parallel to Lake Issyk-Kul. Average height 6,000-7,000 ft. (Mt. Talgar 14,990 ft.). Snow-line 11,000-11,700 ft. (4) Also called Talastau, west by south from the Alexander range. (5) Dzungarian Alatau, a range bordering the Dzungarian gate, north of the Tian-shan, average height 6,250 ft., max. 11,000 ft. (6) Kuznetsk-Alatau, between the upper Ob and the upper Yenisei, west of the Abakan mountains.

Average height 6,000-7,000 ft.

ALATYR, a town in Chuvash, A.S.S.R. Pop. (1935) 22,689. It is situated in latitude 54° 53' N. and longitude 46° 30' E., at the junction of the Alaty and Sura rivers. It has a grain elevator and an extensive grain trade, also flour mills and starch factories.

ALAUNA, ALAUNUS, the Celtic names of two rivers, etc., in Roman Britain. Hence the modern Allan Water, river Alyn, etc.

ALAUSÍ, a town in the inter-Andine province of Chimborazo, Ecuador, on the Guayaquil-Quito railway and the proposed route of the Pan-American highway. The town is in the plain of Alausi and on the river of the same name. The chief resources of the area are agricultural and pastoral. Population (1942) 11,850.

ÁLAVA, DON MIGUEL RICARDO DE (1770-1843), Spanish general and statesman, was a member of the assembly at Bayonne in 1808 which accepted Joseph Bonaparte as king of Spain, but shortly afterwards joined the national independent party which was fighting in alliance with the English.

He was Spanish commissary at Wellington's headquarters, and became a brigadier-general. In 1815 he was ambassador at The Hague, and was present at the battle of Waterloo. He had served at Trafalgar on the flagship of his uncle, Admiral Alava, and was said to be the only man to have been present at both Trafalgar and Waterloo. He was a deputy to the Cortes in 1820, and in 1822 fought in the militia to support the Cortes against the rebels. Alava took part in the negotiations for the restoration of Ferdinand, but was soon driven into exile. Returning to Spain after Ferdinand's death, he supported Maria Christina against Don Carlos, and was ambassador, first to London (1834) and then to Paris (1835).

He refused to take the oath to the Constitution of 1837, and died in exile at Barèges, France, in 1843.

ÁLAVA, one of the Basque Provinces of northern Spain. Pop. (1940) 112,876, area, 1,176 sq.mi.; density per sq.mi., 96.0. The countship of Treviño (190 sq.mi.) in S. Álava belongs to the province of Burgos. Álava (Basque *arañar*, country set among mountains) is in the west and north-west of a district of mountain and valley, drained by the rivers Bayas and Nervión. The centre of the province is the large, fertile plain of Vitoria which continues to the west the structural trough separating the Sierra de Aralar, on the north, from the Sierra de Andia, on the south. The

Montes de Vitoria separate this plain from the lower plain of Treviño, a dried-up lake basin running east from the Ebro at Miranda and bounded on the south by the Sierras de Toloño and de Cantabria. South of these sierras lies the lowest of the three plains of the province, the Alavese Rioja, with a water-frontage on the Ebro between Haro and Logroño.

Formerly a lordship, governed by an elective *señor*, Álava was incorporated in Castile in 1332 at the request of the electoral corporation of clergy and nobility, who celebrated with Alfonso XI. of Castile the Convention of Arriaga defining administrative relations between the lordship and Castile. The modern province is in many respects transitional between the Basque country and Castile. Castilian is the ordinary language except in the north.

Rainfall is fairly regular, except in the Alavese-Rioja. About a quarter of the soil of the province is cultivated, producing wheat, barley, oats and sugar beet; maize is grown on the Bizcayan and Guipuzcoan border only. Agricultural methods are, for Spain, progressive, owing to the educative effect of sugar-beet cultivation, and artificial fertilizers and modern ploughs are in general use. The wine of the province is renowned, especially that of the Alavese Rioja; attacks of phylloxera have diminished the area devoted to viticulture, but many acres were replanted with American stocks. Forests of chestnut, oak and beech, controlled by the provincial authority, and rough pastures occupy almost half of the province.

Livestock includes horned cattle, sheep, goats and swine. Goats and sheep are exported to Barcelona, cattle to the market of Bilbao. Irrigation is not in use except for horticulture, but the streams are harnessed to supply electric power and light. Salt, lignite and asphalt are worked. Steel, pig-iron and puddled iron are produced, and there are manufactures of beds, furniture, railway carriages, matches, paper, sweets and woollen and cotton goods. Bread-stuffs, colonial products and machinery are largely imported. In Álava the rate of illiteracy is only 16.24%; there are secondary schools at Vitoria, the capital (pop. 1940, 44,341), which is the only town of more than 3,500 inhabitants, and good normal schools for teachers of both sexes.

The province was the scene of heavy fighting in the civil war of 1936-39 before it finally fell to the nationalist armies of Gen. Francisco Franco. (See BASQUE PROVINCES.)

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ALB, a liturgical vestment of the Catholic Church. It is a sack-like tunic of white linen (Lat. *alba*, white) with narrow sleeves, and a hole for the head to pass through, and when secured round the waist by the girdle (*cingulum*) just clears the ground. Albs were originally plain, but about the 10th century the custom arose of ornamenting the borders and the cuffs of the sleeves with strips of embroidery, and this became common in the 12th century. These at first encircled the whole border; but soon it became customary to substitute for them square patches of embroidery or precious fabrics. These "parures," "apparels" or "orphreys" (Lat. *parurae*, *grammata*, *aurifrisia*, etc.) were usually four in number, one being sewn on the back and another on the front of the vestment just above the lower hem, and one on each cuff. A fifth was occasionally added just below the neck opening. In the 16th century the parures began to go out of use, and broad bands of lace soon afterwards replaced them, as in a magnificent specimen preserved at South Kensington. Appareled albs are now only in regular use at Milan (Ambrosian Rite), and, partially in certain churches in Spain; but attempts have been made, especially in England, to revive their use.

The alb is worn by bishops, priests, deacons and subdeacons under the other eucharistic vestments at mass and at functions connected with it. It is sometimes also worn by clerics in minor orders, whose proper vestment is, however, the surplice—itself a modification of the alb. (See SURPLICE.) The alb is supposed to symbolize purity, and the priest, when putting it on, prays: "Make me white, O Lord," etc. In the middle ages the parures were taken to symbolize the wounds of Christ; and at Toledo the singers of the Passion on Good Friday still wear appareled albs.

In England at the Reformation the alb went out of use with the other "Mass vestments," but was reintroduced in the ritual revival of the 19th century. It is now worn in many churches not only by the clergy but by acolytes and servers at the Communion. Where the ritual is a revival of pre-Reformation uses, these albs are frequently appareled. (For the question of its legality see VESTMENTS.)

Both the alb and its name are derived from the *tunica alba*, the white tunic, which formed part of the ordinary dress of Roman citizens under the empire. The date of its definite adoption as a liturgical vestment is uncertain; at Rome—where until the 13th century it was known as the *linea* or *camisia* (cf. the modern Italian *camice* for alb)—it seems to have been thus used as early as the 5th century. But as late as the 9th and 10th centuries the *alba* is still an everyday as well as a liturgical garment, and we find bishops and synods forbidding priests to sing mass in the *alba* worn by them in ordinary life. (See Braun, p. 62.) In mediaeval inventories are sometimes found *alvae*, described as red, blue or black; it is clear, however, from the descriptions of these vestments that in some cases they were actually tunics, the confusion of terms arising from the similarity of shape (see DALMATIC); in other cases the colour applied to the parures, not to the albs as a whole. Silk albs appear in the inventories, but only very exceptionally.

The equivalent of the alb in the Eastern Churches is the sticharion (στίχάριον) of the Orthodox Church (Armenian, *shapik*; Syrian, *Kutina*, Coptic, *stocharion* or *tuniah*). It is worn girdled by bishops and priests in all rites, by subdeacons in the Greek and Coptic rites; ungirdled, by deacons and lectors in all the rites. It is usually white for bishops and priests; for the other orders all colours, except black, may be used. Its material may be linen, wool, cotton or silk; but silk only is the rule for deacons. In the Armenian and Coptic rites the vestment is often elaborately embroidered; in the other rites the only ornament is a cross high at the back, save for bishops of the Orthodox Church, whose sticharia have two vertical red stripes (πόταμοι, "rivers"). As in the West, the vestment is specially associated with the Eucharist. The whole subject is exhaustively treated by Father Joseph Braun in *Die liturgische Gewandung* (Freiburg im Breisgau, 1907). (See also bibliography to the article VESTMENTS.)

ALBA, town and episcopal see, province of Cuneo, Piedmont, Italy, 42 mi. S.E. of Turin by rail. Pop. (1936) 11,072 (town), 17,308 (commune). The fine cathedral, with Gothic façade, was rebuilt in 1486. *Alba Pompeia* was probably founded by Pompeius Strabo (consul 89 B.C.) when he constructed the road from Aquae Statiellae (Acqui) to Augusta Taurinorum (Turin). The emperor Pertinax was born here. It became an episcopal see dependent on Milan in the 4th century. It is the centre of a wine-growing district.

ALBACETE, inland province, southeast Spain, formed in 1833 out of the northern half of Murcia. Pop. (1940), 374,472, area, 5,739 sq.mi.; density per sq.mi. 65.3. A somewhat featureless province except for the Sierra de Alcaraz in the west, Albacete continues southeast of the monotonous arid steppe land of La Mancha. Lying in the southeastern corner of the central plateau, where the border of the plateau is less clearly marked by mountains than elsewhere, the province is crossed by the main routes from Madrid both to the Valencian plain and to the southeast. The drainage is almost entirely to the Mediterranean by the rivers Júcar and Segura, but the rainfall is low and the province contributes little to the volume of these rivers except from the western sierras. In these sierras the snow lies for several months; elsewhere the climate is mild and healthy. About 55% of the province is cultivated land, of which cereals—wheat, barley, oats, rye and maize in order of importance occupy nearly half. Albacete is a stock-raising province, but the acreage devoted to wheat shows a steady rise, with much breaking-up of natural pastures and a corresponding decline in livestock. Of these, sheep, belonging to the large Manchigan breed with its all-round production, are the most important; sheep and wool are exported to Barcelona and Valencia, and cheeses to all parts of Spain.

The vine has suffered much from the repeated attacks of phyl-

loxera, and replacement with local stocks has been unsuccessful; olives are cultivated; the peaches of the Cabriel and Júcar valleys supply canning factories in Valencia. Saffron and esparto (wild) are exported, and employ much labour. There are important pine forests. Manufactures are almost confined to the spinning of hemp and the making of coarse cloth, porcelain, earthenware and cutlery. Brandy is distilled, and there is some trade in wood. Albacete, the capital (pop. 1940, 50,567), and the other important towns, Almansa and Hellín, are described separately. The railroad from Madrid to Albacete passes southwest to Chinchilla, where it bifurcates, one line going to Murcia and the other to Alicante. A large part of the province is accessible only by road. In respect of elementary education, Albacete is one of the most backward provinces. Albacete remained in loyalist hands until the end of the civil war of 1936-39.

ALBACETE, capital of a Spanish province, is in a fertile plain where the Balazote unites with the canal of María Cristina, which flows into the Júcar, 16 mi. to the north. Pop. (1940) 50,567 (mun., 64,222). Albacete comprises the picturesque old upper and lower town mostly erected after the city became a provincial capital in 1833. Chiefly a market-town for saffron and other agricultural produce and for live-stock, it also manufactures matches. Albacete formerly had an extensive trade in cutlery, from which it was named the Sheffield of Spain, and its daggers are still held in high repute by Spaniards.

ALBACORE, a large West Indian fish allied to the tunny (*q.v.*). The name is also applied to an allied species in the Pacific.

ALBA FUCENS (mod. *Albe*), an ancient Italian town on a lofty site (3,347ft.) at the foot of Monte Velino, 4m. N. of Avezzano. Originally a town of the Aequi, on the frontier of the Marsi, it was occupied by a Roman colony and its fortifications (*c.* 300 B.C.) persist. It lay on a hill just to the north of the Via Valeria, which was probably prolonged beyond Tibur at this very period. Later it became a regular place of detention for important State prisoners, such as Syphax of Numidia, Perseus of Macedonia, Bituitus, king of the Arverni. Its strong position made it important in the civil wars. The external walls, a circuit of about 2m., are of polygonal masonry; carefully jointed, with faces smoothed. The gates as a rule come at the end of a long, straight stretch of wall, and are placed so as to expose the right side of an attacking force. On the north there is, for a length of about 150yds., a triple line of defenses of later date, possibly added by the Roman colonists, inasmuch as both the city wall proper and the double wall thrown out in front of it are partly constructed of concrete and faced with finer polygonal masonry.

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ALBA IULIA, a town of Transylvania, Rumania (Ger. *Karlsburg*, Hung. *Gyula-Fehérvár*), situated on the Mureș, 73m. S. of Cluj by rail. Pop. (1930) 12,457. Alba Iulia, which consists of an upper town or citadel, and a lower town, is the seat of a Roman Catholic bishop and has a fine cathedral in 11th century Romanesque, rebuilt in 1443 by John Hunyady in Gothic style. It contains among other tombs that of John Hunyady. Near the cathedral are the episcopal palace and the Bathyanæum, founded by Bishop Count Batthyány in 1794, containing a valuable library with many incunabula and old manuscripts, amongst which is one of the *Nibelungenlied*, an observatory, a collection of antiquities and of minerals. The citadel was built in 1716-35 by the emperor Charles VI. Alba Iulia occupies the site of the Roman colony *Apulum*, and many Roman relics are in the museum. The bishopric was founded in the 11th century by King Ladislaus I. (1078-95). In the 16th century the town became the residence of the independent Transylvanian princes. From this period dates the castle and also the buildings of the university, founded by Gabriel Bethlen and now used as barracks. Alba Iulia with Cluj was the traditional centre of the Rumanian national movement in Transylvania; it was here that Michael the Brave proclaimed himself prince of Transylvania, Walachia and Moldavia; here the union of Transylvania with Rumania was proclaimed in 1918 and King Ferdinand of Rumania was crowned in 1922. Alba Iulia was

not in the territory ceded by Rumania to Hungary at the award of Vienna Aug. 30, 1940, during World War II.

AL-BALADHURI (Ahmad ibn Yahya) (d. 892), native of Baghdad; one of the earliest Arab historians and the best authority for the period of the formation of the Arab empire. His chief work, *Futūh al-Buldān*, gives an account of the conquest of Arabia, Syria, Mesopotamia, Armenia, Egypt and north Africa, Spain, the Mediterranean islands, Nubia, Persia, and Media. It has been translated into English by P. K. Hitti under the title *The Origins of the Islamic State in the Studies in History, Economics and Public Law* series of Columbia university (1916). A second work, *Ansāb al-Ashraf* (Lineage of Nobles), was edited by Flügel (Leipzig 1835).

ALBA LONGA, an ancient city in Latium, on the western edge of the Albanus Lacus, about 12m. S.E. of Rome. Ascanius is the traditional founder and said to be the oldest of Latin cities, destroyed by its daughter city of Rome, under Tullus Hostilius, to which passed the hegemony of the Latin league. It has by many topographers been placed between the Albanus Mons and the Albanus Lacus, according to the indications of Dionysius, at the monastery of Palazzolo; but the position is quite unsuitable and does not answer to Livy's description, *ab situ porrectae in dorso urbis Alba longa appellata* (it was called Alba¹ Longa because it stretched along a narrow ridge); and its site is probably on the west side of the lake, where the modern Castel Gandolfo stands. Confirmation of this may be found in Cicero's description (*Pro Milone*, 85) of the destruction of the shrines and sacred groves of Alba by the construction of Clodius's villa, in the local application of the adjective *Albanus*, and in the position of Castel Gandolfo itself. Only the necropolis remains are preserved; the earliest tombs are Villanovan (about 1100 B.C.). Later ones are 7th and 6th centuries B.C. None was found, as has been alleged, buried by a subsequent eruption of the Alban volcano. The name *Albanum*, from about 150 B.C. till the time of Constantine, meant a villa in the Alban territory. The emperors formed a single estate out of a considerable part of this district, including apparently the whole of the lake, and Domitian was especially fond of it. The imperial villa occupied the site of the present Villa Barberini at Castel Gandolfo, and considerable remains still exist. To the south a camp, with baths, an amphitheatre, a large water reservoir, etc., was constructed for the Second Parthian legion, as his bodyguard, by Septimius Severus. The camp was given up in the time of Constantine, when the *Civitas Albanensis* arose.

The lava Albanus is a green grey volcanic stone with black and white grains in it (hence the modern name, peperino), much used for building material in Rome and its neighbourhood.

For detailed accounts see T. Ashby, *Jour. Phil.* xxvii. 37 (1901); G. Lugli, *Bull. Comm.* (1917-20) and *Ausonia*, ix. 211; x. 210. MacIver, *Villanovans and Early Etruscans* (Oxford, 1924); *Italy in the Iron Age* (Oxford, 1927).

ALBAN, SAINT, the first martyr of Britain, is said to have been born at Verulamium (St. Albans, Hertfordshire) and to have served for seven years in Rome in the army. On his return to Britain he is said by Gildas to have been put to death as a Christian during the persecution of Diocletian (*c.* 286-303), according to Bede, at St. Albans. As there is no certainty that the persecution of Diocletian extended to Britain it is possible that his martyrdom should be ascribed to that under Decius (250-251) or that of Valerian (259-260). A church was built on the place of his martyrdom, *c.* 793. A monastery was subsequently added, and around it the present town of St. Albans gradually grew up. Pope Adrian IV., who was born in the neighbourhood, conferred on the abbot of St. Alban's precedence over his fellow abbots, a right hitherto attached to the abbey of Glastonbury. St. Alban is commemorated in Catholic martyrology on June 22 and in the Church of England on June 17.

See U. Chevalier, *Répertoire des sources historiques* (1905), i. 95; D. Hardy, *Descriptive Catalogue* (1862), i. 1. 3-34, ii. 688.

ALBANI, DAME EMMA, née LAJEUNESSE (1852-1930), celebrated Canadian singer, who was born in Chambly, Quebec.

¹Whether Alba means "white" is very doubtful: it is more probably derived from the root Alp.

on Nov. 1, 1852. She made her first public appearance in Montreal, at the age of seven, and after studying at Milan with Lamperti (having meanwhile adopted for stage purposes the name of Albani, after that of an extinct Italian family) she made her début at Messina in Bellini's *La Sonnambula*, achieving an immediate success, which was repeated when two years later, on April 2, 1872, she made her first appearance at Covent Garden in the same opera. Thenceforward for a long period she enjoyed the widest fame and popularity, being not less esteemed as a woman than admired for her art. She married in 1878 Ernest Gye, who died in 1925, and in the same year she was accorded the D.B.E. She died in London on April 3, 1930.

See her *Forty Years of Song* (1911).

ALBANI or **ALBANO, FRANCESCO** (1578-1660), Italian painter, was born at Bologna. His first master was Denis Calvert, with whom Guido Reni was at the same time a pupil. He was soon left by Calvert entirely to the care of Guido whom he followed to the school of the Caracci. Albani opened an academy in Rome, where he resided for many years. Here he painted, after the designs of Annibal Caracci, the whole of the frescoes in the chapel of San Diego in the church of San Giacomo degli Spagnuoli. His best frescoes are those on mythological subjects, of which there is a larger number in the Verospi, now Torlonia palace. A number of his works are at Bologna, and others at Florence, the Louvre, Dresden and Leningrad.

ALBANIA, called in its indigenous language Shqipëria or Shqipëria ("Eagles' country"), is a state situated on the western coast of the Balkan peninsula, comprising the former Turkish province of Scutari with parts of the province of Janina and of the vilayets of Kosovo and Monastir and having an area of 10,629 sq. mi. and a population estimated at 1,200,000 in 1951. It is bounded on the west by the Adriatic sea, on the north and on the east by Yugoslavia, on the southeast by Greece and on the southwest by the Ionian sea. It became a People's republic after World War II.

The Country.—The Albanian lands lie athwart the mountain chain of the Dinaric Alps, but there, as contrasted with Dalmatia to the north and Greece to the south, these stand back from the sea, from which they are separated by a marshy and malarial lowland, crossed by several important rivers. The actual coast is generally low, and the shore waters are rendered turbid by the silt carried down by the rivers, thus contrasting markedly with the clear blue tint off the limestone country further north. Equally marked is the general absence of the coastal settlements so characteristic of most parts of the Mediterranean. Southward, in the region near the port of Valona, the coastal lowland disappears, and limestone hills again approach the water's edge. In this, the region anciently called Epirus, the Greek mode of life becomes visible, though Greek penetration was always limited. The Albanians have been and still are mainly mountain folk, occupying the hilly interior rather than the coastal lowland. The continuity of the mountain belt gives them a certain cultural unity, while at the same time the fact that it is broken up into a series of small natural regions, more or less isolated from each other, made the growth of a national spirit a slow process. The country has thus three essential features which go far to explain the history and characteristics of its people: because of the littoral plains it marks a definite break in the otherwise mountainous west coast of the peninsula; its elevated hinterland forms a natural refuge between the seaway to the west and the north-to-south land routes of the interior of the peninsula; within the mountain belt lie valleys and basins of considerable productivity, capable of supporting fairly dense populations. The aloofness both of the land as a whole and of its centres of settlement led to Albania's being one of the least known parts of Europe, and within the country the primitive and the modern jostle one another. Thus there are regularly scheduled air routes, wireless stations and a considerable number of roads suitable for motor traffic; but at the same time the simple wooden plow, which scarcely does more than scratch the ground, is of archaic type. The language of the country is practically unknown beyond its own borders.

Structure and Relief.—If Albania be first conceived as consisting of a marginal lowland, crossed by powerful perennial streams, and a complex mountainous hinterland enclosing small fertile basins, the details of the picture may be filled in as follows. To the north the Albanian Alps, built largely of massive limestones, form the outstanding feature. They have a general west-to-east direction, roughly parallel to the course of the lower Drin, below the junction of the two streams of the Black and White Drin. The Black Drin is the effluent of Lake Ochrida (Ohrid), and flows northward, draining a large part of eastern Albania, while the White Drin enters the country from Yugoslavia, flowing in a southerly direction. Below the confluence the river swings round at a sharp angle to cut through wild mountainous country, in a series of inaccessible gorges, on its way to the Adriatic. It receives a number of swift tributaries from the Albanian Alps, these also flowing in deep, steep-sided gorges, for the southern slopes of the mountains are remarkably abrupt and rocky. The result is that the actual valley of the lower Drin is not, as one might suppose, a line of access to the interior, the only practicable route from the coast to the confluence of the two headstreams running well south of the river in the hilly Mirdita region. No bridge crosses the Drin in its gorge section, and as it is too deep to be forded, the inhabitants usually cross it by swimming, supported by inflated skins.

The Albanian Alps rise to heights of 6,500-8,500 ft. above sea level, and to the northwest, where limestones predominate, they are practically a continuation of the high karst of Montenegro. To the northeast, however, other rocks, particularly Palaeozoic schists, appear and the scenery is of a different type. The steep lower slopes are thickly wooded, for the region has one of the highest mean annual rainfalls in Europe. At the higher levels, however, where considerable plateau tracts occur, there are wide summer pastures. Though in the strict sense there is no permanent snow, patches linger throughout the summer, and a very slight change in the climate would give the chain a snowcap. It was heavily glaciated during the Ice Age, and the effects of ice erosion have been to accentuate its inaccessibility and high relief. Except on their margins the mountains are virtually devoid of permanent habitations, and thus at first sight they would appear to form an admirable boundary zone. But, as has been noted by travellers, parts of the higher levels swarm with herdsmen and their flocks during the summer season, and these mountain pastures are an economic necessity to the inhabitants of the lower grounds. Great difficulties have consequently arisen in demarcating frontiers, for the line of the water parting, so often chosen as a basis, may separate a group from its pastures and thus inflict great hardship. In limestone regions, also, the water parting may be very difficult to trace.

Westward the Albanian Alps cease abruptly about 30 mi. from the Adriatic coast, giving place to quite a different type of country. Though much of it lies below 600 ft., it is not a uniform plain, and there is a belt of hills between Lake Scutari (Shkodër) and the sea. The structure is, however, perfectly clear and simple. Low limestone hills indicate that the coastal chains of Dalmatia are continued there, but two separate facts introduce a new note. The first is that depression has taken place on a much greater scale than farther north, and the second is that extensive silting has occurred, so that the sunken hill-ridges are largely submerged beneath a mantle of recent deposits. Lake Scutari itself represents an area of depression in which the filling has been incomplete. The Drin, on emerging from its gorge, swollen by the water from the Albanian Alps, has great difficulty in finding its way through the maze of its own deposits and those of its tributary the Kiri. Up to 1858 it turned southward past Alessio (Lesh) and discharged its waters by a swampy, wooded delta just south of the port called by the Italians San Giovanni de Medua and by the Albanians Shën Gjini. In 1858, during a period of high flood, it broke through to the Bojana (Buenë), the effluent of Lake Scutari, and most of its water now follows this course, the older one carrying but a small part. This caused a rise in the level of Lake Scutari, with a flooding of parts of its margins,

and also obstructed the channel of the Bojana, formerly navigable, by the silt thus poured into it. As in all such changes of river course, deserted channels and pools were left to become breeding places of mosquitoes and thus form foci of malaria.

South of this frontier zone of coastal lowland and inland mountain belt the conditions are much more complicated, both in regard to geological structure and relief. The mere fact that the Drin, after a lengthy course as the Black Drin in the interior, should cut its way through the mountains in a gorge more than 3,000 ft. deep and more than 30 mi. long is enough to suggest that there have been earth movements on a considerable scale. As far as geographical effects are concerned, however, the matter may be simply put. The course of the lower Drin marks a change in the direction of the mountain folds, associated with changes in their characters. The outer or coastal folds have sunk, and at the same time rocks from the west have been thrust over them. The inner folds have been elevated, and as a result their surface rocks, including Tertiary sandstones and Cretaceous limestones, have been for the most part worn off, exposing the deeper beds, mainly serpentines, below. These serpentines give rise to rounded land-forms, far less repellent than massive limestones, even though the elevation is considerable, a number of crests rising more than 6,500 ft. with a maximum of nearly 9,000 ft. The region has also been cut up by river action so that it is by no means uniformly high, but encloses small plains whose floors in some cases sink to only about 650 ft. above sea level.

South of the Semeni river the low ridges rise to greater heights and the limestones reappear beneath the sandstones. Still further south, beyond the Viosa river, the elevation increases to more than 6,000 ft., the limestones are fully developed, the sandstone covering disappears from the crests, though it remains in the intervening furrows, and the lowland gives place to the mountainous Epirus region, continued beyond the frontier into Greece. The vegetation undergoes a corresponding change, woods tend to disappear, and the summits are clothed with scanty herbage, again forming summer pasturages. This type of country is continued southward into Greece, and frontier lines are difficult to draw, for the whole tract is the natural home of wandering shepherds. No notable difference of elevation separates this littoral Epirus area from the mountain zone of interior Albania, but it is still possible to distinguish between the two because of the great simplicity of structure of the western folds.

From the western shores of Lake Ochrida toward the lower Drin there extends northward a mountain belt consisting of a series of blocks separated by mountain passes. This forms a central backbone repelling settlement to its margins. It is highest to the south, where also it forms a single chain, and becomes lower toward the north, where it tends to consist of rows of hills rather than of a single ridge. Finally it merges into the complex hilly country of the Mirdita, south of the lower Drin, where settlement becomes possible on the flanks of the hills as well as in the intervening valleys. Except in the extreme south, most of this central hill belt is heavily wooded, especially with beech. Above the tree limit occur the usual high pastures.

At either side of this chain lie long furrows, each consisting of a succession of basins and gorges and forming one of the most characteristic features of the country. The eastern furrow is traversed by the Black Drin and is bounded by another mountain belt on its eastern side. It might be supposed, therefore, that this mountain belt would form the eastern frontier of Albania with Yugoslavia. But this is only the case to a limited extent, for south of Dibra (Debar), on the Black Drin, the Yugoslav frontier is pushed westward and includes that town, a part of the river and the greater part of Lake Ochrida. This is but another illustration of the difficulty of drawing satisfactory frontiers in the Balkan peninsula. The difficulty here depends on the peculiar topography which is itself a result of recent earth movements. It is a characteristic feature of Macedonia that large depressed basins occur which, even when they are strung along the same river system, are separated physically from one another by mountain sills, cut through by the river in gorges. Because of these sills it happens frequently that basins belonging to

separate river systems are in closer touch with one another than those linked by a single river. The Black Drin shows very markedly this feature of successive basins and gorges, the basins being largest to the south and smaller toward the north. The largest is that which is mainly submerged beneath the waters of Lake Ochrida. It is a general rule in Albania that, as compared with Macedonia, the basins are small and thus only moderately productive and not capable of supporting a dense population. At the same time the intervening gorges tend to be longer and more forbidding, and the possibility of linking effectively successive series of basins by transverse routes is much less notable. These differences have had a cumulative effect on the inhabitants of the two areas, and the present frontier, which assigns the greater part of the larger southern basins to Yugoslavia (the power which holds the adjacent section of Macedonia there) and the smaller, more northerly ones to Albania, is drawn mainly on an ethnic basis, racial distribution there being a reflection of the topography.

Some of the basins on the course of the Black Drin may be noted. The largest, as just stated, is occupied by Lake Ochrida, of which only the southwestern corner falls in Albania. There lies the settlement of Pogradec. Still further south there lies a large basin containing the town of Koritsa (Korçë), but this is best considered with the western furrow rather than with that of the Black Drin. On emerging from the lake that river passes through a heavily wooded gorge to emerge at the basin of Dibra. Though most of this basin lies in Yugoslavia, its Albanian side is also capable of settlement. A low ridge separates this basin from that of Peshkopi (Peshkopi), farther north, and the alternation of basin and sill is continued to and even beyond the confluence of the Black and White Drin. In each basin there tends to be a market centre, but the point of importance is that the floor of the whole basin is capable of yielding cereals, especially maize and wheat, so that each forms a centre of settlement more or less isolated from its neighbours and necessarily self-sufficing.

To the west of the central mountain belt lies the second furrow, differing in several respects from that of the Drin. Though bounded on the west by the hill belt which forms the inner margin of the coastal lowland, it lacks the continuity given to its easterly counterpart by the Black Drin. A belt of highland forming the water parting between the upper Mati and a right-bank tributary of the Shkumbi divides it into a northern and a southern section, drained respectively by the upper Mati and the upper Shkumbi. North and south of this wooded and impassable highland passes permit communication with the Black Drin furrow, downstream from Dibra on the one hand and in the Lake Ochrida area on the other. The latter line is particularly important as it was followed by the Roman Via Egnatia, which passed from Durazzo (Durrës) to Elbasan (placed where the Shkumbi emerges from the hill country) and then by way of the basin traversed by that river to the shores of Lake Ochrida, which was rounded to the north. The existence of this route shows that the Shkumbi furrow is much less isolated than parts of the Drin furrow.

The headstream of the Shkumbi approaches very closely the valley of the Devoli, one of the two feeders of the Semeni river. The Devoli drains the basin of Koritsa, to the south of Lake Ochrida, and may be said to mark the region of convergence of the two furrows, the eastern and the western. Koritsa is a fairly important route centre, being connected southward through Albanian Epirus with Janina in Greek Epirus, eastward with Kastoria in Greek Macedonia, and westward by the Devoli valley with the coastal lowland as with Durazzo via Elbasan and with Valona (Vlonë). To the southwest of the Koritsa basin lies the smaller one of Kolonja, traversed by the Liumi Beratit (Usum), the other feeder of the Semeni.

Climate and Natural Vegetation.—The coastal lowland, together with the littoral part of the Epirus region, has the typical Mediterranean climate, with summer drought accentuated by high summer temperatures. But this type has a limited distribution. Even in the Epirus region the elevation brings changes, diminishing the heat of summer and slightly increasing its rainfall. The southern part of inner Albania, at least in the basins, shows the modified Mediterranean or Macedonian type. The summers are

hot, apparently even hotter than in the lowland, but winter frosts occur.

The natural vegetation reflects these climatic conditions. Near the coast the characteristic Mediterranean scrub or *maquis* occurs, though this has been largely cleared. It had always a somewhat limited distribution, and the most widely distributed plant association in the south is oak wood, or rather oak scrub-forest. The oaks are of the evergreen, drought-resisting type and are not only valuable as sources of fuel but also important in the low grounds as furnishing in their leaves and shoots supplementary winter fodder. Even cattle and horses eat oak leaves in Albania. To the north, with the heavier rainfall, the oak woods give place to luxuriant mixed forest, with beech as a predominant element, mingled with pines and firs. (M. I. N.; X.)

History.—After the division of the Roman empire, northern and southern Albania became the Byzantine provinces of Dyrrachium and Nicopolis. Overrun by the Goths in the 4th and 5th centuries, they were reconquered by Justinian in 535. In 640 northern Albania was invaded by the Serbs. The Bulgarians conquered southern Albania in 861, defeated the Serbs (893-927) and established themselves (976-1014) in the greater part of the Balkan peninsula; but in 1014 the emperor Basil II reconquered southern Albania, which remained under Byzantine rule until 1204, when Michael Comnenus, of the imperial family, founded the independent despotate of Epirus, which included southern Albania, Acarnania and Aetolia. In 1318 the despotate passed to the princes of the house of Orsini, who ruled it until 1358. Meanwhile the Sicilian kings acquired and held central Albania (1271-1368). In 1180 the Serbs had reinstalled themselves in the provinces of Scutari and Prizren, and Stephen Dushan (1331-58) included all Albania in his ephemeral empire. Large numbers of Albanians under Jin Bua Spata and Peter Liosha emigrated southward before Dushan's hordes, took Janina and Arta and penetrated as far as Acarnania and Aetolia (1358), while colonies were established in the Morea, Attica and Boeotia.

After the death of Dushan, Albania fell under the rule of native chieftains; but a Norman knight named Balsha, who had served under Dushan, established a dynasty at Scutari (1366) and induced the chieftains to co-operate under his leadership against the Serbs and Bulgarians. The power of the Balshas was, however, short-lived. At the close of the 14th century the Venetians established themselves at Durazzo, Scutari and Antivari, and in 1421 the dynasty came to an end.

Turkish Rule.—The advance of the Turks, who captured Janina in 1431, reunited the Albanian chieftains (1444-66) under the immortal George Kastrioti of Kroia (see SKANDERBEG) and thereafter under the Venetians. But Kroia surrendered in 1478, Scutari in 1479, Durazzo in 1502 and Antivari and Dulcigno, the last Venetian possessions in Albania, in 1571. Many Albanians fled with their Venetian allies to Dalmatia and Italy. Although more than half the Albanian race abandoned Christianity—in the lowlands that it might enjoy equality with the Turks and in the northeastern highlands that it might obtain their support against its hereditary foes, the Slavs—Ottoman sovereignty was never effectively established, and against it the Albanians intermittently revolted. In about 1760 Mehmed Bushati, pasha of Scutari, rallied the northern clansmen and threw off Turkish suzerainty. His son, Mahmud the Black, routed three Turkish armies, but with the defeat of his grandson Mustafa in 1831 the power of the Bushati was broken. Meanwhile, in southern Albania, the able Ali Pasha of Tepelen (see ALI, known as ALI PASHA), by a combination of cunning and brutality, established a virtually independent state with Janina as its capital and maintained direct relations with foreign powers, but was overthrown by a Turkish army in 1822.

The revival of nationalism in Greece, Bulgaria and Serbia, coupled with the decline of the Turkish empire, induced the Albanians to seek autonomy within the empire while availing themselves of its protection until they were prepared for independence. In 1879 the Porte sought to turn Albanian nationalism to its advantage by encouraging the formation of the Albanian league, which opposed with some success the cession of Albanian territory, as provided for by the treaty of Berlin, to Montenegro and Greece. Once the

league had fulfilled its purpose the Porte suppressed it, although not without much bloodshed. Then in 1908 the Albanians threw in their lot with the Young Turks—whose success was due largely to their support—in the hope that in consequence they would obtain autonomy, but the new regime proved worse than the old, and the Albanians rose in revolt against ottomanization. Throughout 1910-11 they struggled unsuccessfully, but in 1912 a general rising was successful: the vilayet of Kosovo was liberated, Monastir threatened, and in August the Turks were obliged to grant autonomy to Albania, which was to include the vilayets of Scutari, Kosovo, Janina and Monastir. But the Balkan states had envisaged the partition of Albania between them and hastened to precipitate war with Turkey. The Albanians, who wished neither to be classed as Turks and share their fate nor to facilitate the overthrow of their protectors and were without any central administration to guide them, remained neutral except at Janina and Scutari, which were vital to their national existence. On Nov. 28, 1912, Ismail Kemal Vlora, diplomatically supported by Austria-Hungary and Italy, proclaimed Albanian independence at Valona but Russia and France supported the Balkan allies, and a general European war was perhaps only averted by British arbitration. The solution of the problem was entrusted to the Conference of Ambassadors in London, which acknowledged the principle of Albanian autonomy on Dec. 20, 1912, and declared Albania an independent sovereign state on July 29, 1913. But the new state's boundaries included less than half the Albanian race.

World War I.—Prince William of Wied, selected by the powers to rule Albania as *mbret* (king), landed at Durazzo on March 7, 1914; but the machinations and the intrigues of various neighbouring states rendered his position untenable. Unable to extend his authority into the interior, he left Albania on Sept. 3, although he did not abdicate. Meanwhile, to resist the incorporation of southern Albania in the new state, Greece had instigated during February the constitution of a "Provisional Government of Autonomous Epirus" supported by Greeks masquerading as insurgents. The international situation prevented the powers from interfering, and anarchy continued until Greece was authorized officially to reoccupy southern Albania in the autumn. Italian troops occupied Valona in Dec. 1914, and in 1916 the whole of southern Albania, except the Koritsa (Korçë) region, which was occupied from Salonika by the French, who established an autonomous administration. Early in 1915, the Serbs and Montenegrins occupied northern and central Albania after severe fighting, but after their defeat by the Austro-Bulgarian armies these regions were occupied by the latter in 1916. Albania had no central government, although Essad Pasha posed as its president, and local policies were pursued. On June 3, 1917, Gen. Giacinto Ferrero proclaimed the independence of the whole of Albania under Italian protection, repudiating those clauses of the pact of London (1915) which provided for its partition. After the armistice the Italians occupied most of the country, the French remained at Koritsa until June 1920, the Yugoslavs occupied northeastern Albania and an inter-allied administration governed at Scutari until Feb. 1920. In Dec. 1918 a national assembly at Durazzo elected a provisional government and a delegation to the peace conference. But early in 1920 the Albanians, becoming apprehensive of the intentions of the occupying forces, held a congress at Lushnja, appointed a council of regency (representing Roman Catholics, Greek Orthodox, Sunni Moslems and Bektashis), chose Tirana as their capital and elected a more energetic government. The Italians were driven into Valona in June and withdrew from the country in August. The Yugoslavs were now asked to withdraw too but were reluctant to do so. Desultory skirmishing in the northern mountains culminated, in Nov. 1921, in a sudden Yugoslav attack designed to confront Europe with an accomplished fact, but this invasion was stopped by the intervention of the British government which convened a meeting of the council of the League of Nations (of which Albania had become a member on Dec. 17, 1920). On Nov. 9, 1921, the Conference of Ambassadors confirmed the Albanian frontiers of 1913, at the same time proclaiming that its integrity was necessary for the strategic security of Italy; but tension between Albania and its neighbours continued until minor rectifications of the

frontier were completed in 1926.

Ahmed Zogu, Zog I.—Ahmed Zogu, who had become minister of the interior in Albania's sixth postwar cabinet in Dec. 1921 and had added much to his reputation by his suppression of a revolt in the following March, became prime minister in Dec. 1922. Some administrative progress was made with the help of foreign advisers, but Albania sorely needed foreign financial help to develop its modest resources. Zogu's cautious policy of reform was too slow for progressive but politically immature elements, too conciliatory for the irredentists, too national for the mountain tribesmen. His resignation in Feb. 1924 did not satisfy his opponents, and widespread revolt during June drove him and his colleagues into Yugoslavia. Mgr. Fan Noli's government, which then took office, accomplished little, and Zogu was able, with Yugoslav assistance, to organize a well-equipped force with which he crossed the frontier in December and expelled Noli.

On Jan. 22, 1925, a national assembly voted the proclamation of a republic, and on Feb. 1, Zogu was elected president, the regency being abolished. By a generous attitude toward political opponents, Zogu consolidated his position, at the same time making it clear that, although grateful for Yugoslav support, he did not intend to become Yugoslavia's vassal. During Sept. 1923 negotiations with Italy for a loan were concluded and a national bank established, an Italian financial group being the principal shareholder. Relations with Greece, strained over the Graeco-Turkish exchange of populations, in which Greece sought to include the Moslem Albanians of Epirus, were improved through the mediation of the League; and a conciliatory policy toward Yugoslavia improved relations with that country, although proposals for the conclusion of a pact of friendship and security were received unfavourably in Belgrade. Zogu, although anxious to consolidate his position by obtaining support from a neighbouring power without sacrificing independence and although doubtful of the competence of the League—which had failed in his predecessor's case—to prevent his overthrow by bands from across the border, hesitated to turn to Italy, which had acquired already a commercial foothold in the country. But an insurrection in northern Albania in Nov. 1926, perhaps externally inspired, forced his hand. By the pact of Tirana, concluded on Nov. 27, Italy and Albania recognized that any disturbance directed against the established situation of Albania was opposed to their reciprocal political interest and, to safeguard it, undertook to give their mutual support and cordial collaboration.

The pact of Tirana, registered with the League of Nations in Feb. 1927, was followed by the conclusion, on Nov. 22, of a treaty of defensive alliance. Then on Sept. 1, 1928, Zogu was proclaimed Zog I (*q.v.*) king of the Albanians, while a constitution provided for a council of ministers (appointed by the king) and an elected chamber of deputies. Complete religious freedom, existing in practice, was reaffirmed.

Under King Zog, Albania made substantial progress in the educational and economic fields: schools and banks were opened, roads built, a broadcasting station established, the administration improved and the gendarmerie reorganized by an unofficial British mission under Col. W. F. Stirling and (afterward) Gen. Sir J. Percy. In the meantime Italy, under cover of its treaties with Albania, sought by all means to extend its control, pouring in advisers and technicians and a large military mission to train the army. Opposition by Albanian patriots led to the withdrawal of the Italian advisers in 1934, but the breach was patched up by a series of agreements in 1936.

Italian Occupation and World War II.—Italy had repeatedly proclaimed its respect for Albania's sovereignty and integrity, but the Italian general staff looked upon it as a bridgehead for the invasion of the Balkans. On April 7, 1939, Italian troops made a surprise landing in strength and quickly overcame Albanian resistance. The king fled abroad with his family, and an "Albanian National assembly" offered the crown to King Victor Emmanuel III of Italy, who accepted. The Italians built up their strength in Albania and, on Oct. 28, 1940, began their invasion of Greece. They were driven back by the Greeks, who occupied most of southern Albania, but in April 1941 Greece and Yugoslavia were

overrun by the Germans, who in their turn occupied Albania (*see* WORLD WAR II). Then a native guerrilla movement under Communist direction came into being and, with the aid of small British detachments (landed in 1944) drove the axis forces from a large part of the country—simultaneously liquidating its anti-Communist opponents. Col. Gen. Enver Hoxha, commander in chief of the "Albanian Army of National Liberation," became prime minister with the ambitious Lieut. Gen. Koçi Xoxe as his ruthless minister of interior. It followed that Hoxha's "Democratic Front" won 95% of the votes in uncontested elections for a constituent assembly, which proclaimed a republic on Jan. 11, 1946.

Communism.—The dictatorship of Hoxha and Xoxe imposed upon Albania all the trappings and tyrannies of a Communist state subservient to the U.S.S.R. An alliance with Communist Yugoslavia was arranged notwithstanding Albanian national claims to the Kosovo region, while Albania's support of the Greek rebels under Gen. Markos Vafiades and the damage of British warships in the mined straits of Corfu further estranged it from the western powers. Albania was largely reliant upon Yugoslavia at this stage, and its continued independence could perhaps be attributed to soviet hopes that it would be admitted to the United Nations and so bring another vote to the Communist bloc. But when the Yugoslav breach with the U.S.S.R. developed in the summer of 1948 Hoxha held Albania firmly to the soviet side: Xoxe, who held other views and had almost succeeded in supplanting Hoxha, was liquidated with his chief supporters in 1949. Thereafter the U.S.S.R. tightened its grip, and though Albania's immediate value to the soviet cause was diminished by the defeat of the Greek rebels it remained a strategically important advanced base in the Mediterranean area and a thorn in the flank of Yugoslavia. Yugoslavia formally denounced its treaty of friendship with Albania in Nov. 1949; on the other hand diplomatic relations between Albania and Italy were re-established, as Albania needed a convenient source of supply to replace those lost to it by its breach with its eastern neighbour, while Italian security was best served by a friendly policy designed to reduce Albanian dependence upon the U.S.S.R. or Yugoslavia. In the meantime opponents of the Communist regime had been active, and Midhat Frasheri at last succeeded (Aug. 1949), in uniting republicans and royalists. Under Frasheri's leadership a National Committee for Free Albania was established and though Frasheri himself died in the United States two months later his movement continued to grow. (J. Sw.)

The People.—The inhabitants are mainly Albanians, or Shqipëtaras as they call themselves, with a certain admixture of Vlachs, especially in the Epirus region. But not all the Albanians live within the confines of the country. A number, estimated in the 1920s at 250,000, live in southern Italy and Sicily, where their forefathers fled from the Turks in the 15th and 16th centuries. About 50,000 are found in the United States, many emigrants leaving Epirus, a region of poverty. As in other parts of the peninsula, emigration is often temporary, the travellers returning when they have amassed a certain amount of money. In addition roughly a million Albanians live in Greek Epirus, Yugoslav Macedonia and the Kosovo Polje area outside the frontier.

The Albanians have retained their original language and, though dialects occur, the differences are said not to be so marked as to make mutual comprehension impossible (*see* ALBANIAN LANGUAGE). They are divided into Ghegs to the north of the Shkumbi line and Tosks to the south, the latter being apparently the more advanced.

About 69% of the population are Moslem, this being an effect of Turkish rule, but Albanians remained always monogamous. About 10%, mostly in the district of Scutari, are Roman Catholics, while 21%, mostly in the districts of Argyrokastrò (Gjinokastër), Koritsa and Valona are Greek Orthodox. At the census of 1930 (latest taken by mid-20th century) there were 688,280 Moslems, 210,313 Greek Orthodox, 104,184 Roman Catholics and 347 others.

From the psychological standpoint the Albanians, about whose characteristics much has been written, may be said broadly to show the features common to isolated mountain folk. As is fre-

quently the case with such stocks their virtues are apt to be more highly estimated by strangers than by those with whom they come in daily contact. Theft and cold-blooded murder are not crimes, either in the estimation of the individual or of his fellows, but a breach of the plighted word or a violation of the duties of hospitality cuts a man off from his family group, and adultery is uncommon. The blood-feud or vendetta, almost inevitable in a country of such loose organization, has been in the past a scourge, and there are said to be still, at least among the Ghegs, groups which hold that the death, even the accidental death, of a kinsman can only be wiped off by the murder of the guilty person or one of his relatives. Associated with this is the strength of the *bessa* or pledge, which protects its holder absolutely. All women are protected by the *bessa*, and so also is any man accompanied by a woman. Boys under 16 years of age, ecclesiastics and generally all those incapable of bearing arms are also protected, while certain places or routes, some occupations, such as irrigation works, and certain periods confer similar rights.

Towns.—The principal towns, in order of importance, are (pop., 1930 census; 1949 estimates in parentheses): Tirana or Tiranë, the capital, 30,806 (40,000); Scutari or Shkodër, 29,209 (30,000); Koritsa or Korçë, 22,787 (28,000); Elbasan, 13,796 (18,000); Argyrokastrò or Gjinokastër, 10,836; Berat, 10,403; Valona or Vlonë, 9,100; Durazzo or Durrës, 8,739.

SOCIAL AND ECONOMIC CONDITIONS

Agriculture.—The Albanians are almost entirely dependent on the land, carrying on a characteristic combination of pastoral and agricultural occupations. Sheep form the major part of the flocks and yield cheese, which forms an important part of the diet and is exported on a considerable scale, as well as wool and skins. Goats are also reared, but the cattle are of poor breeds, yielding little milk. Oxen, with buffaloes in the swampy plains, are the plow animals. Religion excludes the thrifty pig, save among the Christian tribes, and meat of any kind is a luxury. Even the ewe's-milk cheese is too valuable to be used extensively, and the Albanians are mainly vegetarians, depending on maize bread with vegetables and whey. Horses, donkeys and mules are reared for riding and as pack animals. See Table I.

TABLE I.—*Livestock*
(In thousands)

	1933	1936	1938	1946*
Sheep	1,500.0	1,675.4	1,573.0	1,548.0
Goats	928.5	975.0	923.3	854.0
Cattle	394.8	407.2	391.2	345.0
Pigs	23.5	24.4	15.3	35.0
Horses	66.8	67.8	54.4	50.0
Asses	66.6	68.5	44.6	40.0

*Estimates.

Only 10.9% of the surface is arable. The chief cereal is maize, though wheat, oats and barley are also grown. The area under crops was said to be 52% larger in 1950 than it had been in 1938. In the lower grounds all the characteristic Mediterranean fruit-trees, including olive, orange, lemon, fig, etc., can be grown, but the Albanian shows little aptitude for the more delicate operations of arboriculture. The vine is grown on a fairly large scale, especially in the south of interior Albania, and wine is made, but of a quality only fit for local use. Brandy is distilled from a variety of fruits, including mulberries, and alcoholism is said to be one of the curses of the country. Despite the presence of the mulberry, silkworm-rearing is only carried on a small scale.

TABLE II.—*Agricultural Production*
(In thousand metric tons)

	1930-34	1935-39	1947*
Maize	96.0	128.7	140.0
Wheat	43.3	41.0	54.0
Oats	11.0	10.3	...
Barley	6.6	4.7	...

*Estimates.

Rice is produced in the swampy parts of the lowland, and tobacco is fairly widespread and forms an article of export. See Table II.

Mining and Industry.—The mineral wealth of Albania,

thought to be considerable, is not exactly known, no geological survey having been made. Crude petroleum production was developed by the Italians after 1934, wells being tapped at Kuçovë near Berat, at Pëkishtë southwest of Elbasan and at Selenicë and Patos, about 12 mi. N.E. of Valona. Pipe lines carried the oil to Valona and from there Italian tankers transported it to Italian refineries. Production amounted to 2,000 metric tons in 1934 and to 125,000 tons in 1939 and was believed to have reached 200,000 tons in 1942. In 1950 it was estimated at 150,000 tons; by this time Russian tankers were carrying it to Rumanian or Caucasian refineries.

There is also lignite, asphalt and bitumen on the coastal lowlands and certain interior basins. Lignite was extracted in small quantities in the region of Tirana, Tepeleni and Koritsa (4,400 metric tons in 1938). Asphalt and bitumen were worked at Selenicë, products being exported before World War II to Italy (about 10,000 tons in 1938) and from 1948 to the Soviet Union.

Of metallic minerals, pyrites, chromite, bauxite and copper ore were located: pyrites, apparently in large quantities, in the Mirdita region south of the lower Drin gorge; chromite on the western shore of Lake Ochrida and copper in the Pukë region.

Before World War II there were very few industries in Albania: a cement factory at Scutari, a brewery at Koritsa, a few small brick and tile works, several flour mills and some tobacco factories completed the list. Since World War II industrialization made considerable progress. A Lenin dam and power station were completed near Tirana in 1950, increasing tenfold the electricity supply and fourfold the water supply of the capital. In 1951 a Stalin textile works started production at Fieri: it was said that its yearly production of 20,000,000 m. of cotton fabric would satisfy all the needs of the country. A sugar refinery was also completed with a potential production in excess of the needs of the country.

The volume of mineral production in 1950 was said to be four times greater than that of 1938 and the production of manufacturing industry three times greater.

After World War II Albania concluded on Nov. 27, 1946, an agreement with Yugoslavia establishing for 30 years a customs and economic union between the two countries, and the Albanian five-year plan 1947-52 was coupled with a similar Yugoslav plan. At the end of June 1948 Albania denounced the 1946 treaty with Yugoslavia and, despite its territorial isolation, remained in the soviet-dominated area of eastern Europe. After the completion of a short-term two-year plan (1949-50), under which a total of 3,497,900,000 leks was invested in the national economy, Enver Hoxha on Sept. 24, 1951, announced a new five-year plan (1951-55). The total capital investment would amount to 21,000,000,000 leks; i.e., three times as much as was already invested during the period 1946-50. The total value of the industrial and agricultural production of 1955 was expected to be 416% of that of 1938. Among the projects of this plan was an iron and steel works at Valona and a new hydroelectric power station on the Mati river with a yearly generating capacity of 100,000,000 kw.hr.

Foreign Trade.—Albania's trade balance between World Wars I and II was persistently adverse (see Table III). The country

TABLE III.—*Foreign Trade*
(In thousand gold francs)

	1933	1936	1938
Imports	15,038	16,778	22,080
Exports	5,746	7,435	9,750

was importing not only manufactures but also cereals and flour (16.5% in 1936-38). Chief exports were: crude petroleum (21.6% in 1938), skins (14.3%), live animals (8.3%), cheese (8.5%) and eggs (8.2%). The imports came chiefly from Italy (26% in 1938), Japan (10%), Great Britain (10%) and Germany (7%), while the exports went to Italy (62%), Greece (25%) and the United States (13%).

After World War II, U.N.R.R.A. supplies aided considerably in the country's reconstruction program. No figures of foreign trade were published after World War II.

Communications.—Of the four ports, only Durazzo was fully equipped; Valona, San Giovanni di Medua and Santi Quaranta

(Sarandë) were primitive. There were neither any navigable rivers nor, until World War II, any railways of normal gauge, though during World War I the Austrians had constructed narrow-gauge lines from Scutari to Durazzo, Lushna and Berat, with branches to Tirana, Elbasan and Fieri. In 1951 it was announced that a line of normal gauge was linking Durazzo with Tirana and Elbasan.

The total length of roads available for motor traffic was estimated at 2,000 mi. in 1936 and at 1,766 mi. in 1949. By Dec. 1950 there were about 500 licensed motor cars and 1,200 lorries and buses.

Finance.—Albania being a poor country, the state revenues between World Wars I and II were insufficient to meet the cost of administration and development, so that loans had to be raised abroad. After 1925, for political reasons, "abroad" meant Italy. Unfortunately for the protégée the protectress herself was not too rich, and the loans therefore were rather modest. In 1925 an Italian group advanced 50,000,000 gold francs, and from 1931 to 1934 the Italian state granted 10,000,000 gold francs a year. The Italian state granted a further loan of 40,000,000 in 1936 to be expended over a period of years on specified public works.

The National Bank of Albania was formed in Sept. 1925 with an almost exclusively Italian capital of 12,500,000 gold francs. The National created a currency with the Albanian gold franc (franka ara) as a unit. The franc was convertible and had a parity of 22.225 with the gold pound sterling and 4.566 with the gold U.S. dollar.

TABLE IV.—Summary of Budget Accounts*
(In million francs)

	1933-34	1936-37	1938-39	1939-40	1942-43
Revenue	24.5	18.0	28.6	40.0	74.5
Expenditure	27.5	18.0	28.2	40.0	74.5

*Excluding expenditure on public works effected outside the budget.

The note circulation was of 11,000,000 Albanian francs between 1936 and March 1939, but after the occupation of Albania by the Italian forces inflation started. On Oct. 31, 1939, the note circulation amounted to 27,414,822 francs; there was also a coin circulation of 4,822,530 francs. By Oct. 1940 the note circulation amounted to 51,000,000 francs.

The gold cover remained constant at 7,567,000 francs from 1936 to March 1939, while the reserve in foreign exchange rose during that period from 16,300,000 francs to 45,400,000 francs. In April 1939 the Albanian franc's exchange-rate was fixed at 6.25 Italian lire.

In 1946 a new currency, the lek, was introduced. It was exchanged at the rate of five leks per franc and until June 1948 it was at par with the Yugoslav dinar. In July 1949 a state loan of 250,000,000 leks, the first loan in Albanian history, was launched. On Oct. 1, 1949, all the banknotes issued in 1947 were withdrawn and replaced by new ones, but no information was published as to the amount of the currency circulation.

Five budgets for the period 1933-43 are shown in Table IV. The state budget estimates for 1951 were: revenue 9,500,000,000 leks, expenditure 9,700,000,000 leks. Two-fifths of the expenditure, that is, 3,607,000,000 leks, was earmarked for investment in the national economy, as compared with 2,252,000,000 in 1950. The lek was by now pegged to the soviet rouble. In 1952 the exchange rate was 12.50 leks to the rouble.

Education.—Under the Turkish domination which prohibited teaching in the Albanian language, the Albanians remained overwhelmingly illiterate. Independent Albania, especially under King Zog I, succeeded in creating primary and secondary public instruction. In 1939 there were 663 primary schools with 38,988 male and 17,948 female pupils and 19 secondary schools with 4,810 male and 1,425 female pupils. The secondary schools included a French college at Koritsa, a teachers' college at Elbasan, schools of agriculture at Lushna and Kavaja, and a technical school at Tirana. In 1949 the number of elementary schools was estimated at 1,909 with 162,000 pupils: there were also 145 higher elementary and 20 secondary schools with a total of 19,000 pupils. A pedagogical institute was opened at Tirana in 1946.

(X.)

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ALBANIA, the ancient name of a district in the eastern Caucasus, consisting, according to Strabo (xi. 4. 1-8), of the valley of the Cyrus (Kur) and the land lying between it and the Caucasus range from Iberia to the Caspian sea. The Albani inhabited also the mountain valleys and the land to the north. (Pliny vi. 39). Dionysius of Halicarnassus quotes a tradition that the name arose because the people were the descendants of emigrants from Alba in Italy. Strabo describes them as tall, well made, and in character simple and honest. They worshipped the sun and, more particularly, the moon, the latter being perhaps identical with the great Nature Goddess of Asia Minor (see GREAT MOTHER OF THE GODS). Old age was held in high honour, but it was sacrilege to speak, or even to think, of the dead. The people were nomadic and lived on the abundant natural fruits of the land. In Strabo's time they appear to have been ruled by a single king. The Albani became known to the Romans during Pompey's pursuit of Mithridates the Great (65 B.C.), against which they are said to have opposed a force of 60,000 foot and 20,000 cavalry. Pompey exacted from them a nominal submission, but their independence was not seriously affected by the Romans. In the reign of Hadrian their territory was invaded by the Alani (Th. Mommsen, *Provinces of the Roman Empire*, Eng. trans. 1886), and later they fell under the Sassanid rule. They were driven finally into Armenia by the Khazars and ceased to exist as a separate people. The district subsequently suffered under the successive invasions of Huns, Varangians (who captured the chief town Barda in the 10th century), and Mongols. (See CAUCASUS: History; ARMENIA.)

ALBANIAN LANGUAGE. This Indo-European language is spoken in the mountainous region north of Epirus, south of Montenegro, on the eastern side of the Adriatic, by rather less than a million persons, who have kept to their ancient speech as to their ancient ways.

Apart from a few fragments of the 15th century, the oldest texts belong to the 16th and 17th centuries so that all we have is a modern version not very remote from present day speech. It is therefore difficult to construct an accurate history of the language. From what period Albanian was spoken in its present area and whence it came, cannot be stated with certainty. There is no reason for holding that it came from Thrace and it probably is the continuation of a language which from early times was spoken in this area.

Albanian preserves a number of peculiarities indicating its Indo-European origin, such as the personal pronouns, *ty*, thou; *na*, we; *ju*, you; and verbal forms as *thom*, I say; *thotë*, he says; *thomi*, we say; *thonë*, they say.

It is now modern in type. The article follows the noun. The future is expressed by a periphrasis. I will work is *do të punoj*, literally, there is a will that I should work; or *kam me punue*=I have to work, as in the French, *travaillerai*.

A few indigenous words come directly from the Indo-European stock such as, in the northern dialect (called Guëgue) *dimen*=winter, plural *dimna*; and *ëmën*=name, plural *ëmna*. In Tosk, the southern dialect, these nouns vary in form because *n* between vowels becomes *r*, thus *dimër*, *dimëra* and *emër*, *ëmera*.

The bulk of the vocabulary consists of words borrowed from foreign languages, Albanian being thus a typical Balkan speech in which words have passed from one tongue to another so that we may speak correctly of a Balkan vocabulary despite the fundamental diversity of the individual languages.

Hardly any words can be definitely traced to ancient Greek, whose influence barely reached Albania in classical days. Latin, however, has had a strong influence even from early times and Romance scholars find Latin as well as Romance loan-words. Numerals like *pes*=five, and *dhet*=ten, have an indigenous appearance; but *katër*=four, and *qind*=one hundred, are evidently from Latin. The Latin *amicus* is *mik*, *canis* (dog) is *qen*. *Këndo*, to recite or read comes from *canto*; as *livroj*=work, comes from *laboro*; and *kujtoj*=think, from *cogito*. Without words taken from Latin, the language would be seriously inadequate. It is a language of interest to the student, for we have a country reached by Roman civilization under the empire where the non-urban population preserved its own speech. The vocabulary is

full of Latin words while the grammar and pronunciation have remained constant to indigenous forms.

Many other influences have been at work on Albanian. Mediaeval and modern Greek have furnished many words, often by indirect routes. Other words are of Slav origin. Thus the word *lypsel*—"it is necessary," was borrowed from Serbian, which in turn borrowed it from Greek.

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ALBANUS LACUS (LAGO DI ALBANO), a lake 12 mi. S.E. of Rome. It is at the bottom of an extinct crater, itself on the margin of the great crater of Albanus Mons (*q.v.*). Fed by subterranean springs, it is 560 ft. deep and the banks 400 ft. over water-level. An outlet was made in 398–397 B.C., because the Delphic Oracle said Veii could be taken only when the waters reached the sea; it is still in use and is rock-hewn, 1 mi. long, 6 ft. high and 4 ft. broad with vertical shafts and a sluice chamber. (*See ALBA LONGA.*)

ALBANUS MONS (mod. *Monte Cavo*), the highest point of the volcanic Alban hills, about 13 m. S.E. of Rome, 3,115 ft. above sea-level. It is on the inner crater rim, while Tusculum and Algidus Mons are on the earlier outer crater, about 7 m. wide. Upon the Mons Albanus stood the temple of Jupiter Latiaris, where the annual festival of the Latin League was held.

Little was left of it even in the 17th century, and the charge generally brought against Cardinal York of having destroyed it to build the monastery on the summit cannot be maintained. It is very probable that it was not a large temple (of which indeed no traces have been found) but a precinct containing a number of small shrines. On the other hand, a little below the summit 16 large drums of columns, some four feet in diameter, were found, and probably belonged to some other temple. The road which ascended to the temple is still well preserved for the greater part of the way from Aricia, where it began. It was called Via Triumphalis, because minor triumphs were held on the Mons Albanus.

ALBANY, DUKES OF. The territorial designation of Albany was formerly given to those parts of Scotland to the north of the firths of Clyde and Forth. The title of duke of Albany was first bestowed in 1398 by King Robert III. on his brother, Robert Stewart, earl of Fife (*see* I. below); but in 1425 it became extinct. The dukedom was re-created, *c.* 1458, in favour of Alexander Stewart, "lord of Annandale and earl of March" (*see* II. below), whose son and successor (*see* III. below) left no legitimate heir. The title of duke of Albany was next bestowed upon Henry Stuart, commonly known as Lord Darnley, by Mary, queen of Scots, in 1565. From him the title passed to his son, James VI. of Scotland and I. of England. The title was by him given, at his birth, to Charles, his second son, afterwards King Charles I. By Charles II. it was again bestowed, in 1660, on James, duke of York, afterwards King James II. On July 5, 1716, Ernest Augustus, bishop of Osnaburgh (Osnabrück) (1674–1728), youngest brother of King George I., was created duke of York and Albany, the title becoming extinct on his death without heirs in 1728. On April 1, 1760, Prince Edward Augustus, younger brother of King George III., was created duke of York and Albany; he died without heirs on Sept. 17, 1767. On Nov. 29, 1784, the title of duke of York and Albany was again created in favour of Frederick, second son of George III., who died without heirs on Jan. 5, 1827. On May 24, 1881, Prince Leopold, youngest son of Queen Victoria, was made duke of Albany (*see* IV. below).

I. **ROBERT STEWART** (*c.* 1345–1420), duke of Albany, regent of Scotland, was a natural son of King Robert II. He was made high chamberlain of Scotland in 1382, and gained military reputation by leading several plundering expeditions into England. In 1389 he was chosen governor of Scotland by the estates; and he retained the control of affairs after his brother John became king as Robert III. in 1390. In April 1398 he was created duke of Albany; but in the following year his nephew David, duke of

Rothsay, the heir to the crown, succeeded him as governor, although the duke himself was a prominent member of the advising council. Uncle and nephew soon differed, and in March 1402 the latter died in prison at Falkland. It is not certain that Albany was responsible for the imprisonment and death of Rothsay, whom the parliament declared to have died from natural causes; but the scanty evidence points in the direction of his guilt. Restored to the office of governor, the duke was chosen regent of the kingdom after the death of Robert III. in 1406, as the new king, James I., was a prisoner in London; and he took vigorous steps to prosecute the war with England, which had been renewed a few years before. He suppressed a formidable revolt led by Donald Macdonald, second lord of the isles, who claimed the earldom of Ross and was in alliance with Henry IV. of England. The duke died at Stirling Castle in Sept. 1420, and was buried in Dunfermline abbey. His son, Murdac (or Murdoch) Stewart, succeeded him as duke of Albany and regent, but the dukedom became extinct at his execution in 1425.

See John of Fordun, *Scotichronicon*, continued by Walter Bower, edited by T. Hearne (1722); Andrew of Wyntoun, *The Orygynale Cronykil of Scotland*, edited by D. Laing (1872–79); and P. F. Tytler, *History of Scotland* (1850). *See* also Sir W. Scott's *Fair Maid of Perth*.

II. **ALEXANDER STEWART** (*c.* 1454–1485), duke of Albany, was the second son of James II., king of Scotland, by his wife, Mary, daughter of Arnold, duke of Gelderland. Created duke of Albany before 1458, he also received the lordship of the Isle of Man, and was afterwards captured by an English ship when journeying to Gelderland in 1468. He was soon released, and as he grew to manhood began to take part in the government and defense of Scotland, being appointed in quick succession high admiral, warden of the marches, governor of Berwick and lieutenant of the kingdom. He quarrelled with his brother, king James III., and carried on a series of intrigues with the English, who supported his pretensions to the Scottish crown. He was sentenced to death in 1483 during his absence in England. He died in France two years later.

III. **JOHN STEWART** (*c.* 1481–1536), duke of Albany, regent of Scotland, was born about 1481. In 1515, at the request of the Scottish Parliament, Albany came to Scotland, was inaugurated regent in July, and proceeded to organize resistance to the influence of England and of Margaret Tudor, the queen dowager, sister of Henry VIII. In August he seized the latter and her children at Stirling, and subsequently was occupied in suppressing the rebellion of the Homes, Angus (the second husband of Margaret), and James Hamilton, earl of Arran; Alexander, third lord Home, being beheaded in Oct. 1516. Albany was declared on Nov. 12 heir to the throne, and on June 6, 1517, he returned to France. In August he concluded the treaty of Rouen, by which the alliance between France and Scotland was renewed, and a daughter of Francis I. was to marry James V. Meanwhile disorders had broken out owing to the rivalry between Angus and Arran. Francis I. had secretly engaged himself to Henry VIII. not to allow Albany's departure from France, but he returned at the close of 1521 and immediately became the object of Henry VIII.'s and Wolsey's attacks. He reconciled himself temporarily with Margaret, supported her divorce from Angus, and was now accused by the English Government of harbouring schemes of marrying her himself. This was denied by the Scots, and Henry's demand for the regent's dismissal refused. War broke out in 1522; and in Sept. Albany advanced to within four miles of Carlisle with a large army. The Scots, however, showed unwillingness to fight outside their own frontiers, and Albany disbanded his troops and departed to France, leaving the borders exposed to the enemy. On Sept. 25, 1523, he once more landed in Scotland, bringing with him supplies from France and a considerable body of troops, and on Nov. 3, after an unsuccessful attack on Wark, retreated hastily, and quitted Scotland finally on May 20, 1524. On July 30 his regency was terminated by the declaration of James V. as king. Between 1530 and 1535 he acted as French ambassador in Rome, conducted Catherine de' Medici, his wife's niece, to Paris on her marriage to Henry (afterwards Henry II.) in 1534, and negotiated the marriage of James V.

The regent Albany was a singularly unfortunate commander in the field, but a successful ruler and administrator, and the Scottish court of session owed to him its institution. But he regarded himself more the subject of the king of France than of the king of Scotland, subordinated the interests of the latter state to the former, and disliked his official duties in Scotland.

IV. LEOPOLD GEORGE DUNCAN ALBERT (1853-1884), duke of Albany, youngest son of Queen Victoria, was born on April 7, 1853. He matriculated at Christ Church, Oxford, in Nov. 1872, and pursued his favourite studies of science, art, and the modern languages. In 1876 he left the university with the honorary degree of D.C.L. On coming of age in 1874, he had been made a privy councillor and granted an annuity of £15,000. He travelled on the continent, and in 1880 visited the United States and Canada. He was a trustee of the British Museum, a bencher of Lincoln's Inn, and continued to take an active part in the promotion of education and knowledge generally. On May 24, 1881, he was created duke of Albany, earl of Clarence, and Baron Arklow. On April 27, 1882, he married Hélène Frederica Augusta, princess of Waldeck-Pyrmont, and his income was raised by parliament to £25,000. His death at Cannes on March 28, 1884, was universally regretted. He left a daughter, born in Feb. 1883, and a posthumous son, Arthur Charles Edward, born on July 19, 1884, who succeeded to the dukedom of Albany, and who, on July 30, 1900, became duke of Saxe-Coburg on the death of his uncle. He abdicated on Oct. 22, 1920.

ALBANY, LOUISE MAXIMILIENNE CAROLINE, COUNTESS OF (1752-1824), eldest daughter of Prince Gustavus Adolphus of Stolberg-Gedern, was born at Mons on Sept. 20, 1752. In her youth she was a canoness of Ste. Wandru at Mons, but in her twentieth year she was affianced, at the instigation of the Duke of Berwick and with the secret connivance of the French court, to Prince Charles Edward Stuart, "the Young Pretender," self-styled Count of Albany. They were married at Macerata, near Ancona, on Good Friday 1772, and went to live in the old Stuart palace at Rome and later on in Florence.

The marriage was an unhappy one, and in Dec. 1780 Louise fled to a neighbouring convent and threw herself on the protection of her brother-in-law, Henry Stuart, Cardinal York. She had already in Florence formed the acquaintance of the poet Vittorio Alfieri, who now followed her to Rome. In 1784 a legal separation between the Count and Countess of Albany was arranged, and by Charles's death in 1788 Louise found herself free. In company with Alfieri (to whom rumour said she had been secretly married) she now visited Paris and London, and was cordially received at the English court, George III. granting her an annual pension of £1,600 from the privy purse. Returning to Italy, Alfieri and the countess settled at Florence, where the poet died on Oct. 9, 1803 and was buried in the church of Santa Croce beneath Canova's vast monument erected at Louise's expense. The countess continued to reside in the house on the Lung' Arno at Florence, where she held a salon frequented by scientists and men of letters. She died on Jan. 29, 1824 and was buried in Santa Croce.

The countess bequeathed all her property to the companion of her old age, the French painter, François Xavier Fabre, who ultimately gave the greater part of his legacy to the museum of his native town of Montpellier. Two excellent portraits of the Countess of Albany and of Alfieri, painted by this artist, now hang in the Uffizi Gallery at Florence.

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ALBANY, a municipal town in the county of Plantagenet, on Princess Royal harbour, itself an interior basin of King George sound, on the most southerly stretch of the coast, and towards the south-west corner of West Australia. The coast-line, here largely composed of granite, has sunk in recent geological times, giving rise to magnificent inlets which, however, wave action has to some extent already modified by erosion and the deposition of sand. First occupied in 1826, it was later (1889) connected by rail with the existing West Australian railway system and ultimately became the southern terminus of the Great Southern railway. Albany is 352 mi. distant from Perth by rail. Its fine and equable

climate (mean annual temp.: 58.6°; mean annual rainfall: c. 30") and its scenery brought it into prominence as a summer and health resort, and for long it was the port of arrival and departure for the mail steamers. A coaling station, importing Newcastle (N.S.W.) coal was established; and industries began to rise and flourish. The development of the ports of Fremantle and Bunbury; the substitution of locally mined (Collie) coal for imported coal; the loss of economic hinterland through the development of the State railway system, and the loss of passenger traffic owing to the completion of the west-east transcontinental line severely affected Albany which suffered a decline; but the development of orchards, timber and wheat in the promising southwestern region of the state offered opportunity for progress. Pop. (1933) 4,076.

ALBANY, a city of Georgia, U.S., 170 mi. S.E. of Atlanta, on an elevated plateau at the head of navigation on the Flint river; the county seat of Dougherty county. It is served by the Atlantic Coast Line, the Seaboard Air Line, the Central of Georgia, the Georgia Northern and the Albany Northern railroads and by Eastern Airlines. Pop. (1950) 30,987; (1940) 19,055 by federal census. It is the commercial and social centre of a region which formerly was devoted to cotton raising by Negro tenants on large plantations, but, after the boll weevil reached it about 1915, the region became the world's greatest centre for paper-shell pecan culture; there are more than 70,000 ac. in pecans within a 40-mi. radius of Albany. The region also has small farms with diversified crops. Cotton is still a profitable crop; others are peanuts, cattle, peaches, bright-leaved tobacco, sweet potatoes, watermelons, cantaloupes, hogs, poultry, berries and vegetables.

The city has diversified industries, including peanut and pecan processing plants, a meat-packing plant, farm implement plant, hosiery mills, bottling plants, candy plant and a cotton thread finishing plant.

Albany State college for Negroes is located there. Radium Springs, a resort, is 4 mi. S. of Albany. Turner air force base is located 3 mi. E.

Albany was settled in 1836; planned in 1837 by Nelson Tift from Connecticut; and incorporated in 1838. The commission-city manager form of government was adopted in 1924.

ALBANY, the capital of the state of New York, U.S., a city, a port of entry and the county seat of Albany county; on the west bank of the Hudson river, below the mouth of the Mohawk, 145 mi. N. of New York city; at the crossroads between Boston and Buffalo and between Montreal and New York. It is served by the New York Central, the Delaware and Hudson, the West Shore and Boston and Albany railways; by the steamboat lines on the Hudson; and is a terminus of the state barge canal system.

The area is 19.6 sq.mi. The population in 1950 was 134,382; in 1940 it was 130,577 and in 1930 127,412 by federal census.

Albany lies picturesquely on a series of hills rising sharply from the river. Fine specimens of the Dutch and later colonial architecture are still standing. The Schuyler mansion (built 1761) was dedicated in 1917 as a state historical monument. The Van Rensselaer manor house (1765) was moved in 1893 to the campus of Williams college, Williamstown, Mass. On a commanding site of 7.84 ac. stands the state capital (300 by 400 ft.) of Maine granite, which was built (1867-98) at a cost of \$25,000,000. Across the square is the beautiful colonnaded state education building, which also houses not only the state department of education, but also the state library (established 1818) of 630,000 vol. and the state museum, which has a fine collection of Indian relics. The present city hall (erected 1882), the fifth which the city has used, is a French Gothic structure of pink granite. Many of the schools, banks, hotels, clubs and churches have architectural beauty and dignity. The State Bank of Albany (1803) is probably the oldest building in America continuously used for banking purposes. There are 20 parks, of which Washington and Lincoln are the largest. A zoning ordinance was adopted in 1924 as a foundation for a comprehensive program of building and improvement. Converging railways, water routes and highways, together with a

population of 30,000,000 within a radius of 200 mi., make Albany an important distributing point. Traffic facilities were greatly improved by the New York Central's construction of the "Castleton cut-off" (opened 1924), which diverted rail traffic from the steep grades and congested trackage at Albany across a new bridge 10 mi. below the city. The same company also built a vast terminal classification yard at Selkirk west of the river, with a capacity for 20,000 cars. Albany has a municipal airport, and the deepening of the Hudson (authorized 1925), to give a 27-ft. channel from New York city, made it a very busy seaport.

The Albany port district, embracing the city of Albany, the city of Rensselaer and adjacent lands and water in the Hudson river, is in charge of a commission appointed by the governor. Ground was broken for port development in 1926. Albany has many and diverse industries. It has about 200 factories, with an aggregate output valued at more than \$60,000,000 and products ranging from such staples as stoves, chemicals, textiles and paper, to billiard balls, checkers, dominoes, axle grease, paper towels, college caps and gowns and college pins. About 1,500 men are employed in printing plants. Albany is an important educational centre. The public-school system includes 28 elementary schools, vocational schools for boys and girls, junior high and high schools. The Catholic system consists of 18 parish schools (including 4 high schools), 2 academies and 2 institutions of college grade. There are several private academies. The state college for teachers (opened 1844) has an enrolment of approximately 1,500. The professional schools of Union university, which has its undergraduate college in Schenectady, are situated here; viz., the Albany College of Pharmacy (established 1881); the Albany Law school (1851); and the Albany Medical college (1839).

The Dudley observatory, founded in 1852 as the result of an abortive attempt to establish a national university in Albany, is also affiliated with Union university. Training schools for nurses are maintained by four hospitals. There are two daily papers, the *Knickerbocker News* (1842) and the *Times-Union* (1853).

Albany was probably the second permanent settlement within the borders of the 13 Colonies. Its authentic history dates from 1614, when the agents of the United New Netherland company built a small fort on Castle (now Westerlo) Island, which they occupied for three years as a trading post. In 1624 colonization was begun by the newly organized Dutch West Indian company. Eighteen families of Dutch Walloons arrived; Fort Orange was built on a hill near the present site of the capitol, and the little settlement around it became known as Beverwyck. In 1629 the Dutch government granted to Kiliaen van Rensselaer, a diamond merchant of Amsterdam, a large tract of land (ultimately 1,093 sq.mi.) on both sides of the river, centring at Fort Orange, for a patroonship. His grant was named Rensselaerswyck. The colonists he sent over were capable and industrious, and the settlement prospered. In 1652 Peter Stuyvesant, after a lengthy controversy with the director of Rensselaerswyck, established Beverwyck as an independent village. When Fort Orange was surrendered to the English (Sept. 24, 1664) Beverwyck was named Albany, one of the titles of the duke of York (afterward James II). In 1673-74 Albany again came under Dutch control for about a year, during which time it was called Willemstadt. Meanwhile the Van Rensselaer family in the Netherlands was trying to obtain from the duke of York a patent for the colony which would restore to them the ownership of the former village of Beverwyck. The application came finally to Gov. Thomas Dongan, who declined to grant it because he "did not think it convenient that the second town in the government should be in the hands of private men." The Van Rensselaers thereupon relinquished their claims to Albany, and received a patent (1685) which erected the colony of Rensselaerswyck into an English manor. On July 22, 1686, Governor Dongan granted to Albany a city charter, by which all vacant and unappropriated lands within its limits were vested in the mayor, aldermen and commonality of the city, thus ending the jurisdictional disputes. The first mayor, appointed by the governor, was Peter Schuyler (1657-1724). In 1643, according to Father Isaac Jogues, the settlement consisted of 25 or 30 houses, built along the river; in 1695 the Rev. John Miller found 200 houses; at the first federal census (1790) the population was 3,498; by 1850 it had reached 50,763, 1910,

1900, 253 and in 1950, 134,382. As late as 1750 a Swedish naturalist, Peter Kahn, who wrote a vivid description of the city, found the language and manners still Dutch, though the dress was in English style. Albany became the permanent state capital in 1797.

Its strategic position at the gateway of the Iroquois country and at the head of navigation on the Hudson made Albany highly important throughout the colonial period. In 1689 the first intercolonial convention was held there, when delegates from Massachusetts Bay, Plymouth, Connecticut and New York met to treat with representatives of the five nations and to plan a system of defense. The Albany congress of 1754 was a similar and more important gathering, including commissioners also from New Hampshire, Rhode Island, Pennsylvania and Maryland, which met in anticipation of renewed hostilities with the French. It secured from the Indians assurances of their continued support, and adopted a plan (proposed by Benjamin Franklin) for "one general government" of the English Colonies for purposes of common defense. The "Albany plan," though disapproved both by the home government and by the Colonies, paved the way for the congress of 1765 and the Continental Congress of 1774. During the Revolution the British looked upon Albany as "a capital object to be subdued," and it was the objective of Gen. John Burgoyne's expedition which ended with the battle of Saratoga. In 1839 it became the centre of the "Anti-Rent War," which was precipitated by the death of the last patroon and the attempt of his heirs to collect overdue rents, and was not entirely settled until 1847. The first newspaper, the *Gazette*, was founded in 1771. The *Argus*, founded in 1813, was long the organ of the coterie of New York politicians known as the "Albany regency," and was one of the most influential Democratic papers in the country. The *Evening Journal*, founded in 1830 and edited for 35 years by Thurlow Weed, was equally influential as an organ of the Whig and later of the Republican party.

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ALBANY, a city of Oregon, U.S., on the Willamette river, 77 mi. S. of Portland; the county seat of Linn county. It is on U.S. highways 20 and 99E and is served by the Southern Pacific and the Oregon Electric railways. The population was 10,076 in 1950 and 5,654 in 1940. Albany is an important railway centre. It manufactures furniture, boxes, sashes and doors, plywood, condensed and powdered milk. There are three sawmills, canneries, flour mills, frozen food plants, pipe and building-block manufacturing plants and meat-packing plants, a foundry, machine shops and creameries. The U.S. bureau of mines operates an important zirconium research plant there. Albany is a large turkey-shipping point and is an important seed centre. The city of Albany was settled in 1846 and incorporated as a city in 1865.

ALBANY, a river of Canada, rises in Lake St. Joseph in 91° 25' W. and 50° 55' N., and flows east-northeast into James bay; length, 610 mi.; navigable for nearly half its length, to Martin's falls. There are four Hudson's Bay company posts on its banks, including Fort Albany at its mouth. The Ogoki and Kenogami rivers are the principal tributaries.

ALBANY CONGRESS, a gathering of delegates from several American Colonies important for the plan which it devised for colonial union. In accordance with instructions from the British board of trade (Sept. 18, 1753), 25 delegates, representing the four New England Colonies, New York, Pennsylvania and Maryland, met at Albany, N.Y., on June 19, 1754, for the express purpose of formulating a concerted Indian policy. It was early apparent to the delegates that the question of colonial union was of even greater importance than a common Indian policy, so a committee was appointed to prepare a plan. The plan reported was chiefly the work of Benjamin Franklin and was unanimously adopted. It provided for a president-general to be appointed by the crown, and for a grand council to be elected by the colonial assemblies. This grand council was empowered to raise and pay soldiers, to build forts and to equip vessels to guard the coasts. The necessary funds were to be raised by the grand council, which was to have power to levy taxes and impose general duties. In this grant of power is seen the first suggestion of the important federal principle which underlies the entire federal structure in the United States—the right of the general govern-

ment to operate directly upon individuals. The plan was too comprehensive to suit the various colonial governments, which either rejected or failed to ratify it. It was never formally presented to the British government. As a result of this unfavourable action by the colonial governments the Albany congress failed to solve either the question of colonial union or of joint Indian policy.

See R. Frothingham, *Rise of the Republic of the U.S.* (1881); G. L. Beer, *British Colonial Policy, 1754-1765* (1907); E. B. Greene, *Foundations of American Nationality* (1922); J. T. Adams, *Revolutionary New England* (1923). (C. C. T.)

ALBANY REGENCY, the name given to a coterie of politicians who from about 1820 to 1854 largely controlled the machinery of the Democratic party in the state of New York. The members of this group constituted the first highly effective U.S. political machine. They derived their power chiefly from their great personal influence and political sagacity. On the whole they actively opposed political corruption, though they always acted on the principle, first stated in 1833 by one of their ablest leaders (Marcy), that "to the victors belong the spoils." Among the members of this unofficial body, whose headquarters were at Albany, were Martin Van Buren, W. L. Marcy, Silas Wright and John A. Dix. About 1848 the opponents of the group began to adopt similar tactics, soon dividing the Democratic party into irreconcilable factions, and thereafter the prestige of the "regency" rapidly waned.

ALBATEGNIUS (MOHAMMED BEN GEBIR AL BATANI, commonly called ALBATEGNICES) (c. 850-929), an Arab prince and astronomer, was born at Batan in Mesopotamia. From his observations at Aracte and Damascus, where he died, he was able to correct some of Ptolemy's results, previously taken on trust. He compiled new tables of the sun and moon, long accepted as authoritative, discovered the movement of the sun's apogee, and assigned to annual precession the improved value of 55". Perhaps independently of Aryabhata (born at Pataliputra on the Ganges A.D. 476), he introduced the use of sines in calculation, and partially that of tangents. His principal work, *De Motu Stellarum*, was published at Nuremberg in 1537 by Melanchthon, in a blundering Latin translation by Plato Tiburtinus (c. 1116), annotated by Regiomontanus. A reprint appeared at Bologna in 1645. The original manuscript is preserved at the Vatican; and the Escorial library possesses in manuscript a treatise of some value by him on astronomical chronology.

See Houzeau, *Bibliographie astronomique*, i, 467; M. Marie, *Histoire des sciences*, ii, 113; R. Wolf, *Geschichte der Astronomie*, p. 67; Delambre, *Hist. de l'astr. au moyen âge*, ch. ii; *Phil. Trans.*, 1693 (913), where E. Halley supplies corrections to some of the observations recorded in *De Motu Stellarum*.

ALBATROSS, any one of some dozen species of very large sea birds related to the petrels (*q.v.*) and constituting the order Diomedidae in the order Procellariiformes. They have heavy bodies, exceptionally long narrow wings, a short tail in all except the sooty albatrosses (*Phoebetria*), short legs placed far back, large webbed feet without hind toe and a large stout hooked bill covered with horny plates, with a tube-nostril on either side of the upper mandible. They inhabit colder oceans, often at great distances from land, nine species in lower parts of the southern hemisphere, one over cold waters off Peru and Ecuador and three in the north Pacific. The larger species (44-53 in. long) are known to sailors as gony, the smaller (28-37 in.) as mollymawk or mallewmuck.

The largest species is the wandering albatross (*Diomedea exulans*), one of the two largest and most famous of flying birds, the other being the condor (*q.v.*) with smaller wing-spread but heavier body. The great wandering albatross flies over circumpolar southern seas, 30° to 60° S., and breeds on subantarctic islands. It attains a length of 53 in., yellowish bill 7 in., wing-spread 11.5 ft., and a weight of 20 lb. It is white, with faint wavy black bars on the mantle, and black tips to wings and tail. The sailor's superstition about killing an albatross was used in Coleridge's *Rime of the Ancient Mariner*. In regions of strong winds or gales albatrosses do not flap their wings but glide for hours low over rolling seas, settling on the water to feed on cut-

tlefish and squid, taking flight by fully extending their wings and running against the wind. With salt pork as bait, they are caught on hook and line, cannot take flight from the deck, and become seasick with the roll of the ship. They rarely approach land, and breed on remote oceanic islands, rocky and inaccessible or low of coral sand. Some species have elaborate courtship performances. A single egg, dull white finely speckled near the larger end with brown, is laid December to February (August to January in all others but one) in a depression on the ground, or on trampled grass and debris; both parents incubate the egg, two to three months in different species, and care for the young, which is fed for many months on regurgitated food. The great royal albatross (*D. epomophora*), of Tierra del Fuego and islands south of New Zealand, has bulbous nostril-tubes and is only slightly smaller and whiter than the wandering albatross.

Others of cold southern seas include the white-capped albatross (*D. cauta*), breeding in the southwest Pacific from southeastern Australia to the Chatham Islands and ranging east to western and southeastern South America and west to the Cape of Good Hope; and the black-browed albatross (*D. melanophris*), circumpolar to the pack-ice, breeding on subantarctic islands. Ranging with the latter is the gray-headed albatross (*D. chrysostoma*), slightly further north the yellow-nosed albatross (*D. chlororhynchos*), head white, of the south Atlantic and Indian Oceans, and Buller's albatross (*D. bulleri*), with gray head and white fore-cap, of the south Pacific; the last three have a yellow stripe along the top of the black bill and are known as yellow-nosed mollymawks.

Of the three albatrosses that breed on islands west of Hawaii, and range far over the north Pacific and southwestward, the largest is the short-tailed albatross (*D. albatrus*), 37 in., with pink bill and pale feet, the only white-bodied north Pacific species, now nearly extinct. The Laysan albatross (*D. immutabilis*), length 32 in. and wing-spread 6 ft. 8 in., with sooty mantle and pink feet, is famous for its courtship dance. The commoner, slightly smaller black-footed albatross (*D. nigripes*), 28 in., is sooty brown with whitish around the base of the bill. The Galapagos or waved albatross (*D. irrorata*), mainly dark with white head and neck, breeds in May and June on Hood Island and feeds over the cold Humboldt current off Peru.

Two southern species (*Phoebetria*) have dark plumage, an incomplete white eye-ring and a longer wedge-shaped tail. They are more slender, graceful and skilled in flight. The sooty albatross (*P. fusca*), mainly sooty brown, breeds in the cool southeastern Atlantic, and ranges to South America and the Australian seas; the gray-mantled sooty albatross (*P. palpebrata*), pearl gray with darker head, wings and tail, is circumpolar south of 35° S., and northward with the cold waters along western South America. (G. F. Ss.)

ALBAY (now Legaspi), a municipality (with administrative centre and 19 *barrios* or districts) and capital of the province of Albay, Luzon, P.I., near an inlet on the west shore of the gulf of Albay, about 200 mi. by road S.E. of Manila. Pop. (1939), 41,468, of whom 21,015 were males and 87 were white.

The municipality lies on level ground near the south base of Mayon volcano (7,943 ft., surmounted by the most perfect known volcanic cone) from which it is sheltered by the Linguin hills. Formally established in 1636 under the name of Albay, it had by 1649 a population of about 1,200, a Roman Catholic church, a fortified structure and a partly completed wall. Destructive eruptions of the volcano occurred from time to time, notably in Feb. 1815, when much of the centre and surrounding district was submerged and about 1,200 inhabitants were killed. There was another less violent eruption in 1897. The town was partly destroyed by insurgents in 1900, but civil government under the United States was established in the following year. It was a point of debarkation for the Japanese forces which invaded Luzon and advanced on Manila from the south in Dec. 1941. Under the stable U.S. regime the municipality grew steadily in importance and in the range of its industries. It has railway and steamship connections with the important Philippine towns, and automobile roads lead to various parts of the province as well as to Manila;

it is the centre and exporting point of one of the most productive regions of abacá (Manila hemp). Other native fibres are produced and woven into fabrics for export as well as for home consumption. Palay (rice), maize (corn), copra and sugar are also grown. Of the inhabitants aged 6 to 19, inclusive, 33.1% in 1939 attended school, while 54.3% of the population 10 years old and over was literate. The municipalities of Albay and Legaspi were merged in 1907, and the name was changed to Legaspi in 1925. The vernacular is Bikol. The number of parcels of land declared for taxation in 1938 was 9,039 and the number of owners, 6,294.

ALBEDO (from Lat. *albus*, white), "whiteness," a word used principally in astronomy for the measure of reflecting power. A body shining by reflected light is said to have albedo $\frac{1}{2}$ if it reflects (or scatters outwards) half the light incident on it. The albedo for visual light of the cloud-covered planets (Venus, Jupiter, Saturn, Uranus, Neptune) ranges from 0.56 to 0.73; of the earth 0.44; Mars 0.15; Moon 0.07. (See H. N. Russell, *Astrophysical Journal*, vol. xliii, p. 173.)

**ALBEMARLE, WILLIAM DE FORS or DE FOR-
TIBUS**, EARL OF (d. 1242), was a great-grandson of King Stephen and a son-in-law of William of Blois. He is described by Bishop Stubbs as a "feudal adventurer of the worst type." He was one of the executors of Magna Carta, but frequently changed sides in the civil war that followed, his general aim being to revive the power of the feudal barons. In 1221, 1222 and 1223 he was in revolt, although in each case he was compelled to submit, and was twice excommunicated. He died at sea on his way to the Holy Land on March 26, 1242.

ALBEMARLE, GEORGE MONK or MONCK, 1st duke of. See **MONCK**.

ALBEMARLE, ARNOLD JOOST VAN KEPPEL, 1st earl of (1669-1718), was born in Holland, and accompanied William III. to England in 1688. He was created earl of Albemarle in 1697. The confidant of the king, he returned to Holland at his death, and became a general of horse in the Dutch army. He joined the allied forces in 1703, fought at Ramillies, Oudenarde, and the siege of Lille. He led Marlborough's second line in 1711.

ALBEMARLE, GEORGE THOMAS KEPPEL, 6th earl of (1799-1891), British general, served in the campaign of Waterloo. He was aide-de-camp to the marquess of Hastings in India, returning home in 1823 by way of Persia and St. Petersburg (now Leningrad). He wrote a narrative of the journey, *Journey from India to England* (1825). Gen. Keppel sat in the first reformed parliament as a member for East Norfolk (1832-35) and for Lymington (1847-49). He succeeded to the title in 1851.

See his *Fifty Years of My Life* (1875).

ALBEMARLE AND CHESAPEAKE CANAL, in the United States, connecting Norfolk, Va., with Currituck Sound, N.C., is a portion of the inland navigation between New York, Philadelphia, Baltimore and North Carolina and is connected with the Chesapeake and Delaware and Raritan canals. It is 11.2 mi. long, 80 ft. wide, 12 ft. in depth and has one lock. Its capacity is steamers of approximately 800 tons, drawing 11 ft. of water. The canal was opened in 1860, and the cost of construction was \$1,641,363.

ALBEMARLE SOUND, a large inlet on the Atlantic coast of North Carolina, U.S.A. It has an east and west direction extending along the 36th parallel of north latitude, a length of about 50 mi., and a breadth of from 5 to 15 miles. The depth varies from a few feet to 20 ft. or more. Albemarle is separated from the Atlantic by a long narrow barrier beach. From the northeast end of the Albemarle the long, narrow arm called Currituck sound extends northward about 40 mi. to and beyond the Virginia border. On the southeast Albemarle is connected with Pamlico sound by Croatan sound, and also by a narrower channel, Roanoke sound, separated from the former by Roanoke Island. From Albemarle sound project many bay-like arms, commonly called rivers, because they serve as the mouths of streams; but they are true bays, having a breadth of several miles and a depth about equal to that of the sound. Roanoke river (*q.v.*) is the most important stream emptying into it. Albemarle is connected with Norfolk, Va., harbour partly by natural and partly by artificial waterways (Dismal Swamp canal and the Albemarle and Chesapeake canal),

thus forming an important link in the great inland waterway extending from Massachusetts to Beaufort, North Carolina.

ALBENGA, town and episcopal see, province of Savona, Italy, on the northwest coast of the Gulf of Genoa, 52½ mi. S.W. of Genoa by rail. Pop. (1936), 5,848 (town), 10,698 (commune). Albenga is the ancient *Album Ingaunum* or *Albingaunum*, the chief town of the Ingauni, whose territory reached as far as Genoa. An inscription records the restoration of the walls, forum, harbour, etc., by Constantius A.D. 354. To the east is a well-preserved Roman bridge, Ponte Lungo, nearly 500 ft. long and 11½ ft. wide, with 10 arches, each with a span of 37 ft. To the south is a conspicuous rectangular pillar, 27 ft. high, probably marking a tomb. A good brick Gothic cathedral has an interesting octagonal baptistery (8th or 9th century).

ALBENIZ, ISAAC (1860-1909), Spanish pianist and prolific composer, who only towards the close of his career found his true métier and wrote the works which give him his chief claim to remembrance. These were his brilliant and fascinating piano-forte pieces, such as the suite *Iberia*, reproducing the rhythms and other characteristic features of Spanish popular music. He wrote also a number of works for the stage, including a comic opera, *The Magic Opal*, produced in London, and a more ambitious work, *Pepita Jiménez*, but these were of less account.

ALBERONI, GIULIO (1664-1752), Spanish-Italian cardinal and statesman, the son of a gardener, born near Piacenza, probably at the village of Fiorenzuola. He took priest's orders, and found his way to Rome in attendance on the son of a bishop. During the War of the Spanish Succession Alberoni rendered substantial services to the Duke of Vendôme, commander of the French forces in Italy, and in 1711 he followed him into Spain as his secretary. Two years later Alberoni was appointed consular agent for Parma at the court of Philip V. of Spain, and helped to arrange the king's marriage with Elizabeth Farnese of Parma, by whose influence he was made a member of the king's council, bishop of Malaga, and in 1715 prime minister. Alberoni's foreign policy was to undo the work of the Treaty of Utrecht. He desired to gain the succession of Elizabeth to Parma and Piacenza, then in the hands of Austria. To this end he made hurried attempts to reform the administration and the military and financial organization of Spain. But the impatience of Elizabeth left him no time to mature his plans. In 1718 Alberoni equipped a small expedition to help the Scottish Jacobites against George II, but the fleet was wrecked on its way from Cadiz. The Spanish ambitions in Italy led to the Quadruple Alliance of England, France, Austria and Holland, all of which needed a long period of peace for recovery from the last war, and after the landing in 1718 of Spanish troops at Palermo, French armies and English ships invaded Spain. After the Spanish collapse Alberoni was exiled, and went to Italy, where he took refuge in the Apennines, Pope Clement XI, who was his bitter enemy, having ordered his arrest. On the latter's death Alberoni appeared at the Conclave and took part in the election of Innocent XIII (1721), after which he was imprisoned for a time by the Pope, at Spain's demand. At the next election, he was himself proposed for the papal chair, and secured 10 votes at the Conclave which elected Benedict XIII. He died on June 16, 1752. Alberoni left a number of manuscripts, but the genuineness of the *Political Testament* published under his name at Lausanne in 1753 has been questioned.

An *Histoire du Cardinal Alberoni* up to 1719 was published by Jean Roussel de Missy at The Hague in 1719. A laudatory life, *Storia del Cardinale Giulio Alberoni*, was published by Stefano Bersani, a priest educated at his college, at Piacenza, in 1861. *Giulio Alberoni e il suo secolo*, by Giovanni Bianchi (1901), is briefer and more critical. See also *Lettres intimes de J. Alberoni*, edited by M. E. Bourgeois (1892).

ALBERT I (1875-1934), king of the Belgians, was born at Brussels, April 8, 1875, the younger son of Philip, count of Flanders (1837-1905), who was a brother of Leopold II, and Princess Marie of Hohenzollern. The other children of this marriage were Baldwin (b. 1869), Henriette, afterward duchess of Vendôme (1870-1948), a daughter who died in infancy and Josephine, afterward Princess Charles of Hohenzollern (b. 1872).

The premature death of Prince Leopold, only son of Leopold II, on Jan. 22, 1869, made Prince Baldwin heir presumptive to the Belgian crown, but on his death on Jan. 23, 1891, Prince Albert

became next in the line of succession. He was carefully educated, and showed a marked taste for engineering and mechanics, studying both naval and aerial construction. He received his training in military matters at the École Militaire under Gen. Jungblut, and also became a thorough sportsman, taking much interest in mountaineering and later in aviation. He served as an officer in the Grenadier regiment. On Oct. 2, 1900 he was married at Munich to Elisabeth (b. July 25, 1876), second daughter of Duke Charles Theodore of Bavaria. Three children were born of this marriage: Leopold, duke of Brabant (b. Nov. 3, 1901); Charles, count of Flanders (b. Oct. 10, 1903), and Marie José (b. Aug. 4, 1906). See LEOPOLD III.

Prince Albert also travelled widely, paying a visit to America in 1898, and in 1908 visiting England in order to study naval construction. In April 1909 he went to the Belgian Congo. Starting from the Cape, he visited the Cape province and the Transvaal, going from there to Elisabethville. Thence he traversed the Katanga mineral region and followed the course of the Congo to its mouth. He returned to Belgium in August, and three months later King Leopold died.

On Dec. 23, 1909 Prince Albert took the oath of fidelity to the Belgian constitution, and became king under the name of Albert I. In his speech from the throne, the king emphasized his care for the people's welfare in the words: "Our prosperity depends upon the prosperity of the masses." He occupied himself more especially with the organization of the army, and in May 1913 gave his assent to the law which was designed to secure for Belgium an army of 350,000 men. He also interested himself in various social and legal reforms, while his scientific tastes did not prevent him becoming a friend of art and literature. The economist Waxweiler, the poet Verhaeren and the painter Laermans were on friendly terms with the royal family, the latter receiving personal attention from the queen when he was threatened with the loss of his sight.

Albert was anxious to preserve friendly relations with neighbouring States, and after 1910 paid official visits both to Berlin and Paris. On Nov. 5 and 6, 1913, the king, who had been appointed honorary colonel of the regiment of Hanover Dragoons, visited Germany for the second time. At a reception in Potsdam, the Emperor William II. and Gen. von Moltke informed him that they considered war with France imminent. The king gave warning of this to the French ambassador in Berlin through his own minister plenipotentiary, Baron Beyens. On July 31, 1914, when the European crisis came to a head, the king wrote a personal letter to the German emperor, reminding him of the respect due to Belgian neutrality. Germany replied by the ultimatum of Aug. 2, which in turn was answered by a *fin de non recevoir* and hostilities began. The king took command of the troops and established his headquarters first at Louvain and afterwards at Antwerp. He directed in person the first advance from Antwerp towards Louvain, which was intended to relieve the French and British armies engaged with the forces of Kluck and Bülow. After the fall of Antwerp, the king and queen sent their children to England, while they themselves accompanied the retreating army; when it came to a halt on the Yser they took up their residence at Furnes. From Oct. 17 to 24 the Belgian army, under the king's command, withstood the German invasion without any Allied assistance. During the whole of the war he remained with the troops, having his headquarters at La Panne, where he was exposed to the risk of enemy bombardments. He made continual visits to the front-line trenches, and even surveyed the enemy's lines from an aeroplane. The queen remained with him, acting as a nurse in the Hôpital de l'Océan at La Panne. She also interested herself deeply in the welfare of the soldiers in the trenches, and superintended the establishment of canteens and aid posts. Prince Leopold, King Albert's elder son, lived by his father's wish, the life of a simple soldier in the 12th Regiment.

When the general offensive of Oct. 1918 was undertaken, Albert was appointed commander of the northern army groups, consisting of both Belgians and French, which captured the forest of Houthulst, "the Flandernstellung," Thourout, Ostend and Bruges, and forced the passage of the Lys. On Nov. 11, 1918 the king

and queen made their entry into Ghent, and on Nov. 22 into Brussels, being received with enormous enthusiasm. Even before the signing of the Armistice the king had summoned at Lophem a number of politicians and had arranged a new government containing representatives of the three more important Belgian political parties. After a triumphant reception by parliament, the king made a speech from the throne, in which he urged that all parties should work together for national reconstruction, while, addressing himself to the Allies, he asked for the abolition of Belgian neutrality and of the treaties of 1839 which had left Belgium open to invasion. After the Armistice, King Albert declined the augmentation of his civil list. He occupied himself actively with the improvement of conditions in his country, visiting the devastated areas, and contributing considerable sums to "King Albert's Fund," which was devoted to providing temporary shelter for sufferers from the war.

The king in person presided at the Colonial Congresses of 1920 and 1926 and made important speeches on those occasions. He was actively interested in the development of the Belgian mercantile marine. As before the war, he continued to support the intellectual development of his country. After the war he made official visits to the State universities of Ghent and Liège. In Jan. 1926 King Albert, who had been given honorary degrees by many universities, was elected a member of the *Institut de France*. His constant solicitude for the welfare of his people was shown during the floods which ravaged Belgium in Dec. 1925. On Feb. 17, 1934, while rock-climbing near Namur, King Albert fell and was killed. (See BELGIUM.)

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ALBERT I. (c. 1250–1308), German king and duke of Austria, eldest son of King Rudolph I., was invested with the duchies of Austria and Styria in 1282. On Rudolph's death in 1291 Albert was obliged to acquiesce in the election of Adolph of Nassau as German king, but in 1298 he mustered sufficient allies to enable him to defeat Adolph at Göllheim, near Worms, was elected king at Frankfurt on July 27, and crowned at Aix on Aug. 24. Pope Boniface VIII. declined to recognize him until 1303 when Albert admitted the right of the pope to bestow the imperial crown and promised that none of his sons should be elected king without papal consent. In 1306 he secured the crown of Bohemia for his son Rudolph, but tried in vain to impose his own claims on Thuringia in 1307. His action in abolishing all tolls established on the Rhine since 1250, led to the formation of a league against him by the Rhenish archbishops and the count palatine of the Rhine; but aided by the towns, he soon crushed the rising. He was on the way to suppress a revolt in Suabia when he was murdered on May 1, 1308, at Windisch on the Reuss, by his nephew John, afterwards called the "Parricide," whom he had deprived of his inheritance.

Although a hard, stern man, he had a keen sense of justice when his selfish interests were not involved, and few of the German kings possessed so practical an intelligence. He encouraged the cities, and not content with issuing proclamations against private war, formed alliances with the princes in order to enforce his decrees. The serfs, whose wrongs seldom attracted notice in an age indifferent to the claims of common humanity, found a friend in this severe monarch, and he protected even the despised and persecuted Jews. The stories of his cruelty and oppression in the Swiss cantons first appear in the 16th century, and are now regarded as legendary.

See A. L. J. Michelsen, *Die Landgrafschaft Thüringen unter den Königen Adolf, Albrecht, und Heinrich VII.* (Jena, 1860); G. Droysen, *Albrechts I. Bemühungen um die Nachfolge im Reich* (Leipzig, 1862); J. F. A. Mücke, *Albrecht I. von Habsburg* (Gotha, 1866).

ALBERT II. (1397–1439), German king, king of Bohemia and Hungary, and (as Albert V.) duke of Austria, was born on Aug. 10, 1397, the son of Albert IV. of Habsburg, duke of Austria

He succeeded to the duchy of Austria on his father's death in 1404, and in 1438 succeeded his father-in-law, Sigismund, as German king, though he does not appear to have sought election.

He was crowned king of Hungary and of Bohemia but was unable to obtain possession of the latter country. His reign, which lasted less than two years, was spent in the defence of Hungary against the Turks. He died at Langendorf on Oct. 27, 1439. Albert was an energetic and warlike prince, whose short reign gave great promise of usefulness for Germany.

See W. Altmann, *Die Wahl Albrecht II. zum römischen Könige* (1886).

ALBERT, FREDERICK AUGUSTUS (1828–1902), king of Saxony, was born April 23, 1828, being the eldest son of Prince John, who succeeded to the throne in 1854. In 1849 he served as a captain in the campaign of Schleswig-Holstein against the Danes. When the war of 1866 broke out, the crown prince was placed in command of the Saxon forces opposing the Prussian army of Prince Frederick Charles. No attempt was made to defend Saxony; the Saxons fell back into Bohemia and effected a junction with the Austrians. They took a prominent part in the battles by which the Prussians forced the line of the Iser and in the battle of Gitchin. The crown prince, however, succeeded in effecting the retreat in good order, and in the decisive battle of Koeniggratz (see SEVEN WEEKS' WAR) he held the extreme left of the Austrian position with great tenacity. After peace was made and Saxony had entered the North German confederation, he was placed in command of the Saxon army, which had now become the XII. Army Corps of the North German army. He was a firm adherent of the Prussian alliance.

On the outbreak of war in 1870 he again commanded the Saxons, who formed the extreme left of the German army, at Gravelotte, and with the Prussian Guard carried out the attack on St. Privat, the final and decisive action in the battle. In the march towards Paris the crown prince was given a separate command over the 4th army (army of the Meuse) consisting of the Saxons, the Prussian Guard corps, and the 4th (Prussian Saxony) corps. He took a leading part in the operations which preceded the battle of Sedan, the 4th army being the pivot on which the whole army wheeled round in pursuit of MacMahon; and the actions of Buzancy and Beaumont on Aug. 29 and 30 were fought under his direction; in the battle of Sedan itself, with the troops under his orders, he carried out the envelopment of the French on the east and north. Albert had won the complete confidence of the army, and during the siege of Paris his troops formed the north-east section of the investing force. After the armistice he was left in command of the German army of occupation, a position which he held till the fall of the Commune.

On the conclusion of peace he was made an inspector-general of the army and field-marshal. On the death of his father on Oct. 29, 1873, he succeeded to the throne. The king devoted himself mainly to military affairs, in which his advice and experience were of the greatest value to the German army in general. In 1897 he was appointed arbitrator between the claimants for the principality of Lippe. King Albert married in 1853 Carola, daughter of Prince Gustavus of Vasa, and granddaughter of the last king of Sweden of the house of Holstein. He died June 10, 1902.

ALBERT (1522–1557), prince of Bayreuth, surnamed **THE WARLIKE**, and also **ALCIBIADES**, was a member of the Franconian branch of the Hohenzollern family. His restless and turbulent nature marked him out for a military career; and having collected a small band of soldiers, he assisted the emperor Charles V. in his war with France in 1543. Sharing in the attack on the Saxon electorate, Albert was taken prisoner at Rochlitz in March 1547 by John Frederick, elector of Saxony, but was released as a result of the emperor's victory at Mühlberg in the succeeding April. He then followed the fortunes of his friend Maurice, the new elector of Saxony, deserted Charles, and joined the league which proposed to overthrow the emperor by an alliance with Henry II. of France. Having extorted a large sum of money from the burghers of Nuremberg, he quarrelled with his supporter, the French king, and offered his services to the emperor. Charles,

anxious to secure such a famous fighter, gladly assented to Albert's demands and gave the imperial sanction to his possession of the lands taken from the bishops of Würzburg and Bamberg. After Albert had been placed under the imperial ban in Dec. 1553 on account of his depredations in Franconia, he was defeated by Henry II., duke of Brunswick, and compelled to fly to France. He there entered the service of Henry II., and had undertaken a campaign to regain his lands when he died at Pforzheim Jan. 8, 1557.

See J. Voigt, *Markgraf Albrecht Alcibiades von Brandenburg-Kulmbach* (Berlin, 1852).

ALBERT, PRINCE CONSORT OF ENGLAND (1819–1861), b. at Rosenau Aug. 26, 1819. Francis Charles Augustus Albert Emmanuel was the second son of the hereditary duke of Saxe-Coburg-Gotha (belonging to the Ernestine or elder branch of the royal family of Saxony) by his first wife, the Princess Louise of Saxe-Gotha-Altenburg (d. 1831), from whom the duke was separated in 1824. His father's sister married the duke of Kent, and her daughter, afterwards Queen Victoria of England, was thus his first cousin. They were born in the same year. Albert and his elder brother, Ernest, were educated privately and at the University of Bonn. There Prince Albert studied natural science, political economy, and philosophy; he diligently cultivated music and painting, and excelled in gymnastic exercises, especially in fencing.

The idea of a marriage between him and his cousin Victoria had always been cherished by their uncle, King Leopold I. of Belgium, and in May 1836 the duke of Saxe-Coburg-Gotha and his two sons paid a visit to the duchess of Kent and her daughter at Kensington Palace. The visit was by no means to the taste of King William IV., who disapproved of the match and favoured Prince Alexander of Orange. But Leopold's plan was known to Princess Victoria, and William's objections were fruitless. Princess Victoria, writing to her uncle Leopold (May 23, 1836) said that Albert was "extremely handsome," and (June 7) thanked him for the "prospect of great happiness you have contributed to give me in the person of dear Albert. He possesses every quality that could be desired to render me perfectly happy." In the winter of 1838–39 the prince travelled in Italy, accompanied by Baron Stockmar, the Queen's confidential adviser, formerly Leopold's doctor and private secretary. On Oct. 10, 1839, he and Ernest went again to England to visit the Queen, with the object of finally settling the marriage. The betrothal took place on Oct. 15, and on Feb. 10, 1840 the marriage was celebrated at the chapel-royal, St. James's.

The public life of the Prince Consort cannot be separated from that of the Queen, and it is unnecessary here to repeat such details as are given in the article (see VICTORIA, ALEXANDRINA). The prejudice against him, on account of what was regarded as his undue influence in politics, was never fully dissipated till after his death. His co-operation with the Queen in dealing with the political responsibilities which devolved upon the sovereign represented an amount of conscientious and self-sacrificing labour which cannot easily be exaggerated; and his wisdom in council could only be realized, outside a very small circle, when in later years the materials for the history of that time became accessible. He was indeed a man of cultured and liberal ideas, well qualified to take the lead in many reforms which the England of that day sorely needed. He was specially interested in endeavours to secure the more perfect application of science and art to manufacturing industry.

The Great Exhibition of 1851 originated in a suggestion he made at a meeting of the Society of Arts, and owed the greater part of its success to his intelligent and unwearied efforts. He had to work for its realization against an extraordinary outburst of angry expostulations. Every stage in his project was combated. In the House of Peers, Lord Brougham denied the right of the Crown to hold the exhibition in Hyde Park; in the Commons, Colonel Sibthorp prophesied that England would be overrun with foreign rogues and revolutionists, who would subvert the morals of the people, filch their trade secrets from them, and destroy their faith and loyalty towards their religion and their sovereign.

Prince Albert was president of the exhibition commission, and every post brought him abusive letters, accusing him, as a foreigner, of being intent upon the corruption of England. He was not the man to be balked by talk of this kind, but quietly persevered, looking always to the probability that the manufacturing power of Great Britain would be quickened by bringing the best manufactured products of foreign countries under the eyes of the mechanics and artisans. The exhibition was opened by the Queen on May 1, 1851, and was a colossal success; and the realized surplus of £150,000 went to establish and endow the South Kensington Museum (afterwards renamed "Victoria and Albert") and to purchase land in that neighbourhood.

Similar institutions, on a smaller scale but with a kindred aim, always found in him warm advocacy and substantial support. It was chiefly at meetings in connection with these that he found occasion for the delivery of addresses characterized by profound thought and comprehensiveness of view, a collection of which was published in 1857. One of his best speeches is the inaugural address which he delivered as president of the British Association for the Advancement of Science when it met at Aberdeen in 1859. The education of his family and the management of his domestic affairs furnished the Prince with another very important sphere of action, in which he employed himself with conscientious devotion.

As the Prince became better known, public mistrust began to give way. In 1847, but only after a significantly keen contest with Earl Powis, he was elected chancellor of Cambridge University; and he was soon afterwards appointed master of Trinity House. In June 1857 the formal title of Prince Consort was conferred upon him by letters patent, in order to settle certain difficulties as to precedence that had been raised at foreign courts.

But in the full career of his usefulness he was cut off. During the autumn of 1861 he was busy with the arrangements for the projected international exhibition, and it was just after returning from one of the meetings in connection with it that he was seized with his last illness. Beginning at the end of November with what appeared to be influenza, it proved to be an attack of typhoid fever, and, congestion of the lungs supervening, he died on Dec. 14. The grief of the Queen was overwhelming and the sympathy of the whole nation marked a revulsion of feeling about the Prince himself which was not devoid of compunction for earlier want of appreciation. The magnificent mausoleum at Frogmore, in which his remains were finally deposited, was erected at the expense of the Queen and the Royal Family; and many public monuments to "Albert the Good" were erected all over the country, the most notable being the Albert Hall (1867) and the Albert Memorial (1876) in London. His name was also commemorated in the Queen's institution of the Albert medal (1866) in reward for gallantry in saving life, and of the order of Victoria and Albert (1862).

BIBLIOGRAPHY.—By the Queen's authority, her secretary, General Grey, compiled *The Early Days of the Prince Consort*, published in 1867; and *The Life and Letters of the Prince Consort* (1st vol., 1874; 2nd, 1880) was similarly edited by Sir Theodore Martin. A volume of the *Principal Speeches and Addresses of Prince Albert*, with an introduction by Sir Arthur Helps, was published in 1862. See also C. F. von Stockmar, *Memoirs* (1872); the *Letters of Queen Victoria* (1907); and Lytton Strachey, *Queen Victoria* (1921). (H. C.)

ALBERT (1490–1568), last grand master of the Teutonic Order, and first duke of Prussia, was born at Ansbach, May 16, 1490, the third son of Frederick of Hohenzollern, prince of Ansbach and Bayreuth, and Sophia, daughter of Casimir IV., king of Poland. In 1511 Albert was made grand master of the Teutonic Order, which had held East Prussia under Polish suzerainty since 1466. In 1519 Albert was at war with his Polish suzerain, and



THE ALBERT MEMORIAL IN LONDON, BEGUN IN 1872 AND COMPLETED IN 1876. ERECTED IN MEMORY OF ALBERT, PRINCE CONSORT OF ENGLAND

though a truce was made in 1521 the dispute, which was referred to the emperor, remained unsettled. Albert was then converted to Protestantism, and, supported by the advice of Martin Luther, determined to make Prussia a hereditary duchy, though he was at the same time assuring Pope Adrian VI. that he intended to reform the Order and repress Lutheranism among the knights. Eventually in 1525 a treaty was signed at Cracow by Sigismund I. of Poland, agreeing to the creation of a duchy, provided it were held as a Polish fief, and Albert was formally invested on Feb. 10.

The new duke proceeded to further Protestantism in East Prussia. He was deposed from the grand mastership, but the Teutonic knights were unable to recover Prussia, and, although he was placed under the ban of the empire, it was never enforced. In imperial politics Albert was fairly active. Joining the league of Torgau in 1526, he acted in unison with the Protestants, and was among the princes who banded themselves together to overthrow Charles V. after the issue of the *Interim* in May 1548. The early years of Albert's rule in Prussia were fairly prosperous. Although he had some trouble with the peasantry, the lands and treasures of the church enabled him to propitiate the nobles and for a time to provide for the expenses of the court. He did something for the furtherance of learning by establishing schools in every town and by giving privileges to serfs who adopted a scholastic life. In 1544, in spite of some opposition, he founded a university at Königsberg, where he appointed his friend Osiander to a professorship in 1549. But Osiander's divergence from Luther's doctrine of justification by faith involved him in a violent quarrel with Melancthon, who had adherents in Königsberg, and these theological disputes soon created an uproar in the town. The duke strenuously supported Osiander, and the area of the quarrel soon broadened. After Osiander's death in 1552, a preacher named John Funck, with an adventurer named Paul Scalich, exercised great influence over him. The state of turmoil caused by these religious and political disputes compelled the duke to consent to a condemnation of the teaching of Osiander, and in 1566 the estates appealed to Sigismund II., king of Poland, who sent a commission to Königsberg. Scalich saved his life by flight, but Funck was executed; the question of the regency was settled; and a strict form of Lutheranism was declared binding on all teachers and preachers. The duke, a disappointed man, lived for two years longer, and died at Tapiau on March 20, 1568.

See J. Voigt, *Briefwechsel der berühmtesten Gelehrten des Zeitalters der Reformation mit Herzog Albrecht von Preussen* (Königsberg, 1841); K. Lohmeyer, *Herzog Albrecht von Preussen* (Danzig, 1890); E. Joachim, *Die Politik des letzten Hochmeisters in Preussen, Albrecht von Brandenburg* (Leipzig, 1892).

ALBERT III. (1443–1500), duke of Saxony, surnamed ANIMOSUS or THE COURAGEOUS, younger son of Frederick II., the Mild, elector and duke of Saxony, was born Jan. 27, 1443, and, after escaping from the hands of Kunz von Kaufungen, who had abducted him and his brother Ernest, passed some time at the court of the Emperor Frederick III. in Vienna. After the death of the Elector Frederick in 1464, Albert and Ernest ruled their lands together, but in 1485 a division was made by the Treaty of Leipzig, and Albert received Meissen, together with some adjoining districts, and founded the Albertine branch of the family of Wettin.

In 1475, Albert took a prominent part in the imperial campaign against Charles the Bold, duke of Burgundy, and in 1487 led an expedition against Matthias Corvinus, king of Hungary, which failed owing to lack of support on the part of the emperor. In 1488 he marched with the imperial forces to free the Roman king Maximilian from his imprisonment at Bruges, and after the king returned to Germany in 1489, Albert restored the authority of Maximilian in Holland, Flanders and Brabant. In 1498 Maximilian bestowed upon him the title of hereditary governor (potestat) of Friesland, but he had to make good his claim by force of arms. He was engaged in repressing a rising in Friesland when he died at Emden, Sept. 12, 1500. Albert, who was a man of great strength and considerable skill in feats of arms, delighted in tournaments and knightly exercises. His rule was a period of prosperity in Saxony in spite of the large sums which he spent campaigning in the emperor's service.

See F. A. von Langenn, *Herzog Albrecht der Beherzte, Stammvater des königlichen Hauses Sachsen* (Leipzig, 1838); O. Sperling, *Herzog Albrecht der Beherzte von Sachsen als Gubernator Frieslands* (Leipzig, 1892).

ALBERT, DUKE OF WÜRTTEMBERG (1865-1939), German general, the son of Duke Philip of Württemberg, was born in Vienna on Dec. 23, 1865. As the king and queen of Württemberg had no male heir, he was the heir presumptive to the Württemberg throne. He passed through the different grades of a military career and was appointed general in command of the XI. Army Corps at Cassel in 1906, and in 1908 was entrusted with the command of the Württemberg Army Corps. In 1913 he was advanced to the rank of generaloberst (colonel-general, immediately below field-marshal), and was appointed inspector-general of the VI. Army inspection. At the outbreak of World War I he took over the leadership of the IV. Army on the western front, was advanced to the rank of field-marshal-general in 1916 and appointed chief-in-command of the group of armies on the front in Alsace-Lorraine, which fought under his leadership until the end of the war. He married in 1893 the late Archduchess Margarete Sophie of Austria (d. 1902), the sister of the Archduke Francis Ferdinand, who was assassinated at Sarajevo. He died Oct. 29, 1939, at Stuttgart, Germany.

ALBERT I. (c. 1100-1170), margrave of Brandenburg, surnamed "the Bear," was the only son of Otto the Rich, count of Ballenstädt, and Eilika, daughter of Magnus Billung, duke of Saxony. He inherited the valuable Saxon estates of his father in 1123, and on his mother's death in 1142 succeeded to one-half of the lands of the Billungs. About 1123 he received from Lothair, duke of Saxony, the margraviate of Lusatia. In 1128 his brother-in-law, Henry II., margrave of the Saxon north mark, died, and Albert, disappointed at not receiving this fief, attacked Udo, the succeeding margrave, and was consequently deprived of Lusatia by Lothair. His services in Italy in 1132 were rewarded in 1134 by the investiture of the north mark, which was again without a ruler. For three years he was occupied in campaigns against the Wends, and by an arrangement made with Pribislaus, duke of Brandenburg, Albert secured this district when the duke died in 1150.

Taking the title margrave of Brandenburg, he pressed the warfare against the Wends, extended the area of his mark, did much for the spread of Christianity and civilization therein, and so became the founder of the margraviate of Brandenburg. In 1137 his cousin, Henry the Proud, had been deprived by King Conrad III. of his Saxon duchy, which was given to Albert. But he was driven from Saxony and also from his mark by Henry, and compelled to take refuge in South Germany, and when peace was made in 1142 he renounced the Saxon dukedom and received the counties of Weimar and Orlamünde.

It was possibly at this time that Albert was made arch-chamberlain of the empire, an office which afterwards gave the margraves of Brandenburg the rights of an elector. In 1162 Albert accompanied the Emperor Frederick I. to Italy, and distinguished himself at the storming of Milan. In 1164 he joined a league of princes formed against Henry the Lion, and peace being made in 1169, Albert divided his territories among his six sons. He died Nov. 13, 1170, and was buried at Ballenstädt. His personal qualities won for him the surname of "the Bear," and he is also called by later writers "the Handsome."

See L. von Heinemann, *Albrecht der Bär* (Darmstadt, 1864).

ALBERT III. (1414-86), elector of Brandenburg, surnamed *ACHILLES* because of his relentless energy and physical strength, and his combination of shrewdness and knight-errantry, was the third son of Frederick I. of Hohenzollern, elector of Brandenburg. Albert was born at Tangermünde on Nov. 9, 1414, and died at Frankfurt on March 11, 1486. On the division of territory which followed his father's death in 1440 he received the principality of Ansbach; on the death of his brother John in 1464 he inherited Bayreuth; and in 1470, on the abdication of his brother Frederick II., he became elector of Brandenburg. His main object was family aggrandizement, and he became as powerful among the northern as the elector of the Palatinate

among the southern princes. He saw that division of inheritance weakened the family power, and he devised the famous *Dispositio Achillea* of 1473, which decreed that the mark of Brandenburg should descend intact to the eldest son, the younger son receiving the Franconian possessions of the Hohenzollerns. Both sections of the family lands were to descend thenceforward by primogeniture, a new principle in the succession of the German princely houses. He married his daughter Barbara to Henry VI. of Glogau, and after her husband's death secured a part of his Pomeranian lands for his daughter in 1482. The power of Brandenburg declined with his death. It is said that the old warrior, who had spent the greater part of his life either in fighting against the towns which desired to maintain their independence, or the princes who sought reforms, or in purely dynastic struggles, realized at the end of his life that military strength was useless so long as Germany had no sound peace, no good system of law and no general currency.

See *Das kaiserliche Buch des Markgrafen Albrecht Achilles, Vorkurfürstliche Periode, 1440-70*, ed. by C. Hoefler (Bayreuth, 1850); *Kurfürstliche Periode*, ed. by J. von Minutoli (1850); *Quellensammlung zur Geschichte des Hauses Hohenzollern*, Band I., ed. by C. A. H. Burkhart (Jena, 1857); O. Franklin, *Albrecht Achilles und die Nuremberger, 1440-53* (1866); *Politische Korrespondenz des Kurfürsten Albrecht Achilles, 1470-86*, ed. by F. Priebatsch (Leipzig, 1894-98); J. G. Droysen, *Geschichte der preussischen Politik* (1855-86).

ALBERT (1490-1545), elector and archbishop of Mainz, and archbishop of Magdeburg, was the younger son of John Cicero, elector of Brandenburg, and was born June 28, 1490, and died at Aschaffenburg Sept. 24, 1545. In 1513 he became archbishop of Magdeburg and administrator of the diocese of Halberstadt. In 1514 he obtained the electorate of Mainz, and in 1518 was made a cardinal.

Meanwhile to pay for the pallium of the see of Mainz and to discharge the other expenses of his elevation, Albert had borrowed a large sum of money from the Fuggers, and had obtained permission from Pope Leo X. to conduct the sale of indulgences in his diocese to obtain funds to repay this loan. For this work he procured the services of John Tetzel, and so indirectly exercised a potent influence on the course of the Reformation. When the imperial election of 1519 drew near, the elector's vote was eagerly solicited both by the partisans of Charles (afterwards the Emperor Charles V.) and of Francis I., king of France, and he appears to have received a large amount of money for the vote which he cast eventually for Charles. Albert's large and liberal ideas, his friendship with Ulrich von Hutten, and his political ambitions, appear to have raised hopes that he would be won over to the reformed faith; but after the peasants' war of 1525 he ranged himself definitely among the supporters of Catholicism. He was nevertheless compelled to grant religious liberty to the inhabitants of Magdeburg in return for 500,000 florins.

During his latter years indeed he showed more intolerance towards the Protestants. Albert adorned the *Stiftskirche* at Halle and the cathedral at Mainz in sumptuous fashion, and took as his motto the words *Domine, dilexi decorum domus tuee*. A generous patron of art and learning, he counted Erasmus among his friends.

See J. H. Hennes, *Albrecht von Brandenburg, Erzbischof von Mainz und Magdeburg* (Mainz, 1858); J. May, *Der Kurfürst, Kardinal, und Erzbischof Albrecht II. von Mainz und Magdeburg* (Munich, 1865-75); W. Schum, *Kardinal Albrecht von Mainz und die Erfurten Kirchenreform* (Halle, 1878); P. Redlich, *Kardinal Albrecht von Brandenburg, und das neue Stift zu Halle* (Mainz, 1900).

ALBERT (FRIEDRICH RUDOLF ALBRECHT), ARCHDUKE (1817-1895), Austrian field-marshal, the eldest son of the Archduke Charles (Karl Friedrich), was born Aug. 3, 1817, in Vienna. After having been educated under the careful superintendence of his father, he entered the Austrian army as a colonel of infantry in 1837, and was transferred to the cavalry arm in 1839, and became a lieutenant-field-marshal in 1843. He learned the art of war from Radetzky. At this time the Austrian generals and staff officers had committed themselves blindly to the strategic method of the Archduke Charles, the tradition of whose practical soldiery survived only in Radetzky and a few others. Albert chose to follow Radetzky, and was thus saved from the

pseudo-scientific pedantry which brought defeat to the Austrian arms in 1859 and in 1866.

He fought under Radetzky as a volunteer throughout the campaign of 1848, having been present at the action of Pastrengo and the battles of Santa Lucia and Custoza. In the following campaign he applied for and obtained the command of a division in the 2nd corps (under d'Aspre), though his previous grade had been that of commander-in-chief. The splendid fighting of the corps at Novara was decisive, and Radetzky named d'Aspre, Count Thurn, and the archduke as the general officers worthy of the greatest rewards. In 1850 he became a general of cavalry, and in 1851 military and civil governor of Hungary, a position which he retained until 1860, when he was relieved at his own request.

Soon afterwards he was appointed to succeed Radetzky as commander-in-chief in Italy, and in 1863 he was promoted to the rank of field-marshal. When war became imminent in 1866, the archduke took command of the field army in Italy. For the story of the campaign of 1866 in Italy, see ITALIAN WARS. The operations of the archduke, who disposed of considerably inferior forces, were crowned with success in the brilliant victory of Custoza (June 23), and his reputation as a general-in-chief was firmly established during only eight days of field operations, though it is possible that his chief of staff, Lieutenant-Field-marshal von John, contributed not a little to the success of the Austrian arms.

The result of Custoza was the retreat and complete immobilization of the whole Italian army, so that Albert was able to dispatch the greater part of his troops to reinforce the Bohemian army, when, after having been defeated by the Prussians, it fell back on Vienna. On July 10 the archduke was summoned to Vienna to take supreme command of the forces which were being collected to defend the capital, but peace was made before further hostilities took place. From this time, under various titles, he acted as inspector-general of the army.

Like his father, and with better fortune, he was called upon to reorganize the military system of his country on an entirely new plan, learned, as before, by defeat. The principle of universal short service, and the theory of the armed nation, were necessarily the groundwork of the reforms, and the consequent preparation of all the national resources for their task in war, by the superintendence of peace administration, by the skilful conduct of manoeuvres, was thenceforward the task of his lifetime. In 1870 he conducted the military negotiations preparatory to an alliance with France, which, however, was not concluded. He retained personal control of the army until his last illness, which he contracted at the funeral of his nephew Francis, ex-king of Naples. His only remaining brother, the Archduke Wilhelm, had died a few months before, as the result of an accident. He himself died Feb. 18, 1895. His only son died in childhood, and his nephew Archduke Frederick (born 1856) inherited his great possessions, including the Albertina, a famous collection of books, manuscripts, engravings and maps, founded by Duke Albert of Saxe-Teschen.

Among the military works of the Archduke Albert, *Über die Verantwortlichkeit im Kriege* created a sensation, and was translated into English and French. He also wrote *Gedanken über dem Militärgesetz*; *Über die höhere Leitung im Kriege*; and *Kritische Betrachtungen über den Feldzug 1866 in Italien*. He was the principal editor of the military works of his father.

See Mathes v. Bilabruock, "Gedenkrede auf Weiland Sr. K. u. K. H. Erz. Albrecht," *Mil.-Wissenschaftl. Verein* (1895); Teuber, *F. M. Erz. Albrecht, ein Lebensbild* (Vienna, 1895); Duncker, *F. M. Erzherzog Albrecht* (Vienna and Prague, 1897).

ALBERT, also named ALEXANDRE MARTIN (1815–1895), the first industrial working-man to enter a government, was a member of the French Provisional Republican Government in Feb. 1848. He signed all decrees "ALBERT, *owrier*," and followed implicitly the guidance of Louis Blanc (*q.v.*). He was sentenced to ten years' deportation on political grounds in 1849. On his release he secured employment as a gasworker.

ALBERT, MADAME (*c.* 1805–1846), French actress, whose maiden name was Thérèse Vernet, was born of a family of players. Her grace, beauty, and distinction of manner made her the idol

of Paris, and her circle of admirers was widened by long tours of the provinces and abroad.

ALBERT (OF AIX) (fl. *c.* A.D. 1100), historian of the first crusade, was canon and *custos* of the church of Aix-la-Chapelle. He wrote a *Historia Hierosolymitanæ expeditionis* or *Chronicon Hierosolymitanum de bello sacro*, a work in 12 books, between 1125 and 1150. This book gives the history of the first crusade and of the Latin Kingdom of Jerusalem down to 1121. It was well known during the middle ages, and was largely used by William, archbishop of Tyre, for the first six books of his *Belli sacri historia*. The first edition of the history was published at Helmstadt in 1584, and a good edition is in the *Recueil des historiens des croisades*, tome iv. (Paris, 1841–87).

See M. Pigeonneau, *Le Cycle de la croisade et de la famille de Bouillon* (1877); F. Krebs, *Zur Kritik Alberts von Aachen* (Münster, 1881); H. von Sybel, *Geschichte des ersten Kreuzzugs* (Leipzig, 1881); B. Kugler, *Albert von Aachen* (Stuttgart, 1885); F. Vercruysee, *Essai critique sur la chronique d'Albert d'Aix* (Liège, 1889).

ALBERT, LAKE (A. NYANZA), Uganda, situated in 1° 9' to 2° 17' S., and 30° 30' to 31° 35' E. Its greatest length is 100 mi., its greatest breadth 22 mi., and its greatest depth 55 ft. The area is approximately 1,640 sq. mi.; *i.e.*, about the size of Lancashire. The height of the lake surface above sea level is given as 2,037 ft., but this is liable to seasonal and other fluctuations.

The lake lies on the floor of the western branch of the Rift valley. Thermal springs occur at Kibiro, and again between the Murchison falls, on the Victoria Nile, and Wadelai. At Kibiro salt springs are exposed on the strand in the dry season, and give rise to a native trade in salt. At the southern end of Albert Nyanza is a wide plain, traversed by the Semliki river, which enters the lake through a swamp of tall weeds, chiefly ambach and papyrus. On both the eastern and western sides the walls of the Rift valley are close to the lake, the water in many cases washing the base of the cliffs. Elsewhere the narrow foreshore is thickly wooded. The ascent to the plateaux is generally by a series of abrupt steps. On the western side the mountains present many pointed and conical summits, some of which may be nearly 8,000 ft. above the lake; on the eastern side the cliffs rise sharply for 1,000 to 2,000 ft. On either coast wild ravines, densely wooded, break the outline of the mountains. Through these gorges and over the plateau-edge fall magnificent cascades. Towards the north the hills recede from the coast and on both sides flats extend for distances varying from 5 mi. to 15 mi. On the eastern side, 92 mi. from the southern end of the Nyanza, the Victoria Nile enters the lake, here not more than 6 mi. across, through a wilderness of woods, the delta of the Nile extending over 4 mi. The mouth of the main stream is obstructed by a bar of its own formation; the current is sluggish; there are many side channels, and the appearance of the lake gives no hint that a great river has joined its waters. For 5 mi. or 6 mi. north of the junction of the Victoria Nile the lake suffers no material diminution in width. Then, however, the eastern and western shores approach each other, and a current is perceptible flowing north. The lake has become the Bahr-el-Jebel, or Mountain river, as this section of the Nile is called. Albert Nyanza is shallow; at its southern end the water for a considerable distance is not more than 3 ft. deep. The deepest soundings give only 50 ft. to 55 ft., the average depth being 30 to 40 ft.

The Albertine Basin of the Nile.—Albert Nyanza receives the whole of the drainage of Edward Nyanza and the Semliki river, and with them forms the "Albertine" Nile system. Its waters, as stated above, mingle with those of the Victoria Nile. There is evidence of very considerable shrinkage in the size of these lakes. Within human times the level of Albert Nyanza appears to have been 1,000 ft. higher than it is at present. The causes of this fall have not been fully explained. Both tectonic and climatic agencies may be involved. River erosion is probably also a complicating factor. In recent geological times the valley to the north of Edward Nyanza, then much larger than now, was blocked. The removal of the block led to the shrinkage of the lake and the formation of the Semliki, which found its way to the more northern lake—Albert Nyanza. Gradually the Semliki eroded its bed, and consequently the level of Edward Nyanza



BY COURTESY OF THE CANADIAN PACIFIC RAILWAY

VIEW OF LAKE LOUISE IN THE CANADIAN ROCKIES

Lake Louise, viewed from a trail along the edge of the water looking toward Mt. Lefroy on the left, and Mt. Victoria in the centre, both crowned with glaciers. In the early morning perfect pictures of the glaciers are mirrored in the depths of the blue and green shaded waters



PHOTOGRAPHS, (1, 5) PIX-HARMON FROM PUBLIX, (2) PIX FROM PUBLIX, (3, 4, 6) PAUL'S PHOTOS

VIEWS OF ALBERTA

1. A snow cornice in the Canadian Rockies
2. Skiers at a lodge in Banff
3. Bridge of the Banff-Jasper highway over Athabasca falls in Jasper National park. In the background is Mount Kerkesslin
4. Tongue of the Athabasca glacier (right) in Jasper National park
5. Lake Minnewanka, Banff
6. Airlview of Calgary, looking northwest

continued to fall. The process continues but is checked by the existence of the rock barrier which stretches across the Semliki. This stream leaves Edward Nyanza at its northwest end in $0^{\circ} 8' 30''$ S., and after a course of about 160 mi. enters Albert Nyanza in $1^{\circ} 9'$ N. In its upper and in its lower course the river flows either through high alluvial plains, in which it has scored a deep channel, or across swamp land. In the middle section, which has a length of some 75 mi., the river runs in a deep narrow valley covered with the densest forest. On the west this valley is bounded by the Congo mountains, which form the wall of the Rift valley, on the east by the mighty range of Ruwenzori, whose heights tower over 16,000 ft. above sea level. In this length of 75 mi. the river falls in cataracts and rapids over 800 ft.

Albert Nyanza, on the other hand, is threatened in the distant future with destruction from another cause—the filling of its bed by the alluvium poured into it by the Semliki, the Victoria Nile and other streams. The Semliki receives directly or indirectly the whole of the drainage of Ruwenzori, and also that of the eastern face of the Congo mountains as well as the drainage basin of Edward Nyanza. The Semliki, as it emerges from the region of forest and cataracts and deposits much of its burden, becomes sluggish as its slope flattens out. This process has formed a large plain at the south end of Albert Nyanza, which has seriously encroached upon the lake. At the northern end of the lake the sediment brought down by the Victoria Nile is producing a similar effect. Nyamsasi, which was an island at the southwest end in 1889, has become a peninsula. Islands which in 1876 were on the east coast no longer exist; they now form part of the foreshore. On the other hand, the shrinkage of the lake level caused the appearance in 1885 of an island where in 1879 there had been an expanse of shallow water. It seems probable that, in a period geologically not very remote, the "Albertine" system will consist of one great river, extending from the northern slopes of the Kivu range, where the Ruchuru has its rise, to the existing junction of the Victoria Nile with Albert Nyanza.

The combined drainage area, including the water surface of Edward Nyanza, the Semliki and Albert Nyanza, is some 16,600 sq. mi. Throughout this area the rainfall is heavy (40 in. to 60 in. or more per annum), the volume of the Semliki in flood being not less than 700 cu. mi. per second. Of the water received by Albert Nyanza annually (omitting the Victoria Nile from the calculation) between 50% and 60% is lost by evaporation, while 24,265,000,000 cu. mi. are annually withdrawn by the Bahr-el-Jebel. The "Albertine" system plays a comparatively insignificant part in the annual flood rise of the White Nile, but to its waters are due the maintenance of a constant supply to this river throughout the year.

Discovery and Exploration.—Albert Nyanza was first reached by Samuel Baker on March 14, 1864, near Vacovia, a small village of fishermen and salt-makers on the east coast. Albert Nyanza was entered on his map as a vast lake extending about 380 mi. But the circumnavigation of the lake by Gessi Pasha (1876) and by Emin Pasha in 1884 showed that Baker had been deceived as to the size of the lake. The lake forms part of the (British) Uganda Protectorate, but the northwest shores were leased in 1894 to the Congo Free State. Of this leased area a strip 15 mi. wide, giving the Congo state a passageway to the lake, was to remain in its possession after the determination of the lease. (See also NILE.)

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ALBERTA, province of Canada, created 1905. Area 255,285 sq. mi. (land 248,800, water 6,485). The population in 1951 was 939,501.

Geography and Geology.—Alberta has a natural geographical boundary only on its western side, the watershed of the Rocky mountains. On the north the parallel of 60° N. separates it from the Northwest Territories, on the east the meridian of 110° W. from Saskatchewan and on the south the parallel of 49° N. from

the United States. Geographically it is thus divided as between the wooded mountain slope from the hills, and the drainage basins of three river systems below. A small southern part of the province is drained by the Milk river, a tributary of the Missouri. Of the rest of the province the lower half, mainly prairie land, the more thickly settled portion, is drained by the waters and branches of the South and North Saskatchewan. The northern, less settled portion, a more rolling country of woods and grassland, is drained by the Athabasca and the Peace.

Geologically the greater part of Alberta belongs to the interior continental plain showing in the southwest a general elevation of about 3,500 ft. and in the extreme northeast at the Great Slave river only 600 ft. The mountainside strip of the eastern slope of the Rockies is a part of the Cordilleran belt; the summits of the Rockies bordering Alberta show an altitude of 8,000 to 9,000 ft. with many peaks over 10,000, while the passes used by the railways show 4,450 ft. for the Crownstee Pass station, 5,332 for Kicking Horse (C.P.R. main line) and 3,711 for Yellowhead Pass station (C.N.R.).

Climate.—Sir Frederic Stupart, director of the Meteorological Service of Canada (1894–1929) said that "it is doubtful whether any other territory on the face of the globe has a climate as variable in the winter as that of Alberta." The normal winter is cold, extreme cold persisting in some years from November to March, inclusive, but in others the Chinook winds, the warm winds from the west carried over the Rockies, dominate the winter. April shows an average temperature of 53° at Calgary, 53° at Edmonton, 58° at Medicine Hat. The average July–August temperatures are 75° at Calgary, 74° at Edmonton, 82° at Medicine Hat, with a usual summer limit of 90° and records of over 100° . The isothermal lines run from the Rockies to the United States border in a southeastern direction. The January mean temperature of 0° passes a little north of Edmonton and crosses lower Saskatchewan to North Dakota. The line of -15° slants across northern Alberta passing Fort Vermilion on the Peace river and circling the lower Hudson bay to Ungava. The four winter months, December to March, show averages: Calgary 18° , Edmonton 14° , Dunvegan 6° and Chipewyan -3° . The summer isotherms are complicated and diverge greatly from an east to west direction to form loops. Most of the province shows July isotherms of 60° to 65° . The Peace river country round Dunvegan and the Lake Athabasca district have much the same summer heat as Calgary with longer sunlight, favouring growth. The average rainfall till the end of July is nearly equal to that of Ontario except in the drier southern belt. A change of wind from a northeast blow to a southwestern Chinook at times changes the temperature from 20° below to 40° above zero in a few hours.

History.—Alberta was originally a part of the Hudson's Bay territory granted by the charter of 1670. It remained long unknown. Following the lead given by Pierre de la Vérendrye, Pierre Boucher, sieur de Boucherville, made his way across the plains and set a temporary stockade, Fort Jonquière, at the foot of the Rockies in 1751. But even in 1774 the Hudson's Bay company had no post west of Cumberland House, established that year on the lower Saskatchewan. The North West company, formed in 1783, disregarding the Hudson's Bay company charter, first penetrated that empty region. Under their auspices Alexander Mackenzie in 1789 descended the Athabasca and the Mackenzie to the sea and in 1792–93 ascended the Peace river and crossed the Rockies to the Pacific. Mackenzie founded Fort Chipewyan (Lake Athabasca) in 1789. Both companies founded posts near Edmonton (1795) but the fur trade developed northward.

The transfer of the northwest in 1869 from the Hudson's Bay company to the new dominion led to surveys for railroads (Sir Sandford Fleming, 1871) and to the Homestead act for settlement (1875), the establishment of the Northwest mounted police (1873) and, on completion of the Canadian Pacific railway (1885), to a continued influx of settlement from older Canada, from overseas and across the border which assumed the proportions of an invasion after 1900. Migration from continental Europe was a special feature. Settlement led to territorial government at first under the Northwest Territories act of 1875. An act of 1882 separated out four provincial "districts" (Assiniboia, Saskatchewan, Alberta, Athabasca) leaving west of Hudson bay the area north of 60° as Northwest Territories (see NORTHWEST TERRITORIES). Later in the same year Regina was established as the seat of government. There first appeared on the map the name Alberta (lower half of the present) as a tribute to Queen Victoria, recalling the memory of the prince consort through his daughter Princess Louise Alberta. At the census of 1901 Alberta and Athabasca (the area now Alberta) had a population of 73,022; Calgary, of 4,392; and Edmonton, of 4,176. The ensuing rapid settlement led in 1905 to the creation of the present province of Alberta, beside the sister province of Saskatchewan. The provinces had at once the status conferred by the British North America Act of 1867 but, to facilitate settlement, the public domain remained under federal control until 1929, when it was transferred to the provinces. Good times brought rapid growth, with the organization of education (University of Alberta at Edmonton, 1907), the professions and cultural life but with grain farming as the economic basis. The population reached 374,295 in 1911 and 588,454 in 1921. The service of Alberta in World War I belongs in general Canadian history.

The ministerial government of the new province was at first oper-

ated by parties formed on the standing model of conservatives and liberals. But the special agrarian interests of the province led to the creation of a United Farmers' association, which presently entered the political sphere and gained control of the government in 1921. The United Farmers' policy was chiefly connected with co-operative marketing of grain which gained great ascendancy and prestige by the temporary success of provincial "pools" united by a central marketing board for the prairie provinces. Depression and the collapse of prices proved too great a burden for the pools, which gave place to government regulations of wheat prices. The result led to the defeat of the farmers' parties by the Social Credit party, led by William Aberhart, which gained office in 1935 and undertook to pass legislation for forced conversion of the public debt, or cancellation, whole or partial, of existing land mortgages, the issue of provincial paper money in the form of legal tender certificates and the restriction of the press. All these measures underwent judicial revision and abrogation by both local and federal disallowance, and by the decisions of the supreme court of Canada and then of the privy council. For details of this complicated record see the special *Rowell-Sirois Report of 1940* and the *Case for Alberta* as presented by the province under that name to the above commission.

Resources.—The natural resources of Alberta are on a colossal scale. Of its total land area of 248,800 sq.mi., 136,640 was classed (1946) as agricultural land present or potential, of which 48,295 was forested land fit to be cleared for agriculture. Of a total of 130,620 sq.mi. of forest land, 37,560 is nonproductive land, but it serves to shelter game and conserve rainfall. The geological survey of Canada estimates the coal area of the province at 16,588 sq.mi. containing a possible reserve of 47,874,300,000 tons. Petroleum from the subterranean oil pools of the Turner valley, Leduc, Redwater, Woodbend and other foothill areas constitutes 97% of the Canadian output. Geological investigation points to the existence of similar pools in the Peace River district. Natural gas is found abundantly in different localities while the tar sands of the Athabasca offer a major potential source of oil not yet put to commercial use. In point of water power Alberta at mid-20th century showed available 24-hr. horsepower (at ordinary six months' flow) of 1,258,000; actual turbine installation (Dec. 1949) was 107,225 h.p. This compares with a Canadian total available of 42,899,000 h.p. and installed 11,613,333 h.p. The fisheries of Alberta include whitefish, pickerel, trout, etc., from its lakes and rivers.

Population.—The population of Alberta, census of 1951, was 939,501; Calgary, 129,060; Edmonton, 159,639. In national and cultural origin because of migration as described above it is more varied than the people of any other Canadian province. The Canadian census classification did not show Americans (of the U.S.) as a racial class but distributed them by origin. Taken thus (1941 census) the population of Alberta was 53% British, 10% German, 7.5% Ukrainian, 5% French, 3.6% Norwegian, 2.8% Polish, 1.7% Dutch, 1.6% Italian and the rest various with 2% native Indian.

Finance.—The province of Alberta had at its inception a public revenue of \$1,425,059, which had grown by 1947 to \$4,626,000. The gross public bonded debt, nil in 1905, reached \$29,000,200 in 1916 and \$139,350,000 by 1947. The chief sources of revenue are federal subsidies, gasoline taxes, succession duties, corporation taxes and revenue from liquor control and petroleum leases.

Agriculture.—In the economy of Alberta agriculture naturally fills the largest place. Its relative place may be gauged from the following data, collected in 1948: total gross value of production in Canada \$18,143,186,852; in Alberta \$1,073,361,412 (compare Ontario leading with \$7,672,980,044); total net value of agriculture production in Canada \$1,994,391,000; in Alberta \$388,420,000 (compare Ontario leading with \$496,334,000). In 1948 agriculture accounted for 58% of the net output of the province as compared with 16% for manufactures, 12% for mining and 9% for construction.

Agriculture in Alberta was greatly aided by irrigation of the drier areas. Surface waters were vested in the crown and the Irrigation Districts acts of Alberta provided for forming districts, initiating projects and raising loans by local votes. The chief sources of water are the Bow, the St. Mary, the Milk and the Oldman rivers. The total irrigable area of the 15 major projects as reported in 1948 was 719,035 ac. and in addition there were about 700 private irrigation systems covering 70,000 irrigable acres.

Crops.—In Alberta the 1949 area planted in spring wheat was 7,586,000 ac. (average, 1943-47, 6,402,000 ac.), as compared with oats, 2,255,000 ac. (average, 1943-47, 3,098,000 ac.), and barley, 2,118,000 ac. (average, 1943-47, 2,073,000 ac.). Rye (planted both spring and fall) is a lesser crop—in 1949, 325,000 ac. (average, 1943-47, 181,000 ac.). Sugar beets expanded from 14,000 ac. in 1935 to 32,000 in 1949. Statistics show for Alberta, for 1949, field crops \$338,778,000 (compare 1940, \$136,572,000); farm animals \$205,733,000 (1948) (compare 1940, \$47,801,000); milk \$43,102,000; poultry and eggs \$22,845,000; fur farming \$3,761,727; clover and grass seed \$10,241,000.

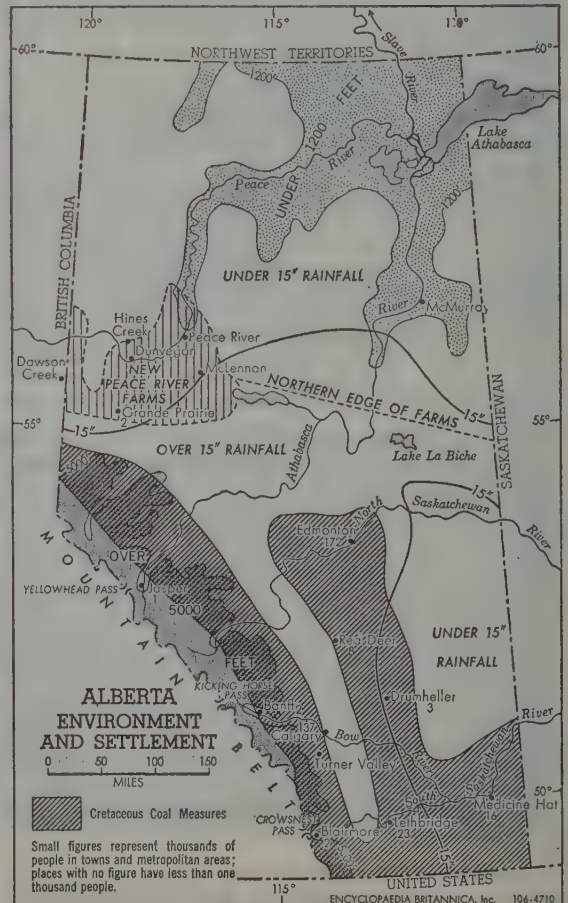
Environment and Settlement.—In order to understand the possibilities of settlement in Alberta, the general environment must be studied closely; the necessary data are charted in the accompanying map. The mountain belt of Alberta (more than 5,000 ft.) is confined to the extreme southwestern margin along the Rocky Mountain uplift. There are many complicated formations, mainly of Cambrian age. But on the eastern edge the much younger Cretaceous forma-

tions are also involved in the folding. Consequently there are valuable coal seams, especially in the vicinity of Kicking Horse pass and Crownsnest pass, right in the mountain area.

Throughout the south of Alberta the formations are fairly level-bedded, and are almost all of Cretaceous age. Coal seams are found at three levels in these Cretaceous rocks; and for a time they were thought to contain almost the largest resources of coal in the world. Later estimates gave them about 47,874,300,000 tons, about equal to the resources of the Bohemian or Donetz coal fields in eastern Europe. Red Deer, Drumheller and Lethbridge contain the chief coal mines worked in these fairly level coal seams. (The coal measures are indicated in the map.) Just below the lowest coal seams a layer of porous rocks at Turner Valley contains petroleum, about 3,000 ft. below the surface. In 1947 a new major field was discovered at Leduc, 18 mi. S. of Edmonton, and there are other fields of almost equal importance in production in other parts of Alberta.

Despite these important petroleum resources, it is because of agriculture that Alberta shows greatest promise. The rainfall conditions are satisfactory in most of the province, excluding the southeast corner. The rain lines for 15 in. are shown in the map and form a sort of wet belt across the province about the latitude of Edmonton. The rain falls off to 11 in. in the extreme northeast, and also near Medicine Hat. The cooler climate of the north of the province gives the rainfall more value than in the far southeast, where ranching replaces farming to some extent. The main areas occupied in the Peace River settlements are shown, and by 1941 there were almost 50,000 settlers there. In 1911 there had only been 1,100 people in the district. Grand Prairie, Peace River and McLennan are three of the small towns. To the northeast of Edmonton the notable population extends only to Lake La Biche; the edge of settlement is shown on the map.

Thus, of the 940,000 people living in Alberta, almost the whole number lie south of the line joining Lake La Biche to Dunvegan, while in the rather arid portion north of Medicine Hat the population is



URBAN AND RURAL SETTLEMENT IS SHOWN IN RELATION TO ALBERTA'S CLIMATIC AND PHYSIOGRAPHIC ENVIRONMENT AND TO THE PRINCIPAL NATURAL RESOURCE OF THE PROVINCE—COAL

also very sparse. If reference is made to the temperature maps of Canada, it will be found that the July isotherm of 57° F.—which determines the climatic limits of crops—runs far to the north of any part of Alberta. Hence, it may be expected that a hay-potato-oats type of farming would in the distant future expand over a good deal of the empty country of north Alberta. However, since Alberta has much greater coal resources than the other provinces, and since the oil resources invite subsidiary chemical plants, it seems likely that there might also be increasing development of industrial settlement.

Government Aid.—Extensive and detailed assistance to the farming community is given by the provincial department of agriculture through field crop, livestock, dairy, poultry, veterinary services, agriculture branches. Expert agriculturists located in 43 different districts conduct short courses, field days and lecture demonstrations. Publications on agriculture and home economics are distributed free. Students attend each year the schools of agriculture at Olds and Vermilion, each school having a demonstration. A provincial horticultural station is maintained at Brooks.

Manufactures.—As in all the prairie provinces manufactures in Alberta occupy a secondary place and are confined to secondary forms of manufacture rather than the heavy industries. Of particular importance are the 69 flour mills of the province, and the meat-packing plants of Edmonton. Other manufactures in Edmonton are those of furniture, general lumber, biscuits and clothing, and oil refining. The manufactures of Calgary include meat packing, woodworking, oil refining and a nitrogen plant. The total (1947) value of manufactures in the province was (gross) \$296,054,129. At the latest complete classification (1947) Calgary was reported as having 246 establishments with 7,790 employees; Edmonton 222 with 7,625; Medicine Hat 27 with 1,049; and Lethbridge 37 with 893.

Transport and Communications.—The southern half of Alberta is well supplied with railways now extending northward to connect with steam navigation down the Mackenzie river system. The total mileage in 1949 apart from second tracks and sidings was 5,643. The Canadian Pacific railway, the first road constructed across the province, created the town of Calgary as a proper junction point for a line on the North Saskatchewan at Fort Edmonton. The Grand Trunk Pacific (later Canadian National), initiated in 1903 and completed in 1915, was built across the more fertile valley of the South Saskatchewan to pass through the Yellowhead pass and so to Vancouver by the valley of the Fraser with a northern branch to reach the Pacific 500 mi. farther north at the mouth of the Skeena river (Prince Rupert). There is a third railway route, the most southerly and the shortest, through the Rockies via the Crownsnest pass by the Canadian Pacific railway. From both of the present railway systems branch lines reach various points in the southern province. Northern connections from Edmonton are made by the Canadian Pacific to the Athabasca river waterways (Fort McMurray) and across the Peace River valley (C.P.R.) to Hines Creek and to Dawson Creek (B.C.), just beyond the provincial boundary. This point became the railroad for the Alaska highway, military and international, connecting with rail at Fairbanks, Alaska. The Banff-Jasper highway, completed in 1940, connects Banff, Lake Louise and Jasper.

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ALBERT EDWARD NYANZA: see EDWARD, LAKE.

ALBERTI, DOMENICO (c. 1710–1740), Italian musician, achieved unawares something like immortality in musical history as the writer of dozens of sonatas in which the melody is supported from beginning to end by an extremely familiar, but nowadays little-esteemed, formula of arpeggio accompaniment, consequently known as the Alberti bass.

ALBERTI, LEONE BATTISTA (1404–1472), Italian painter, poet, philosopher, musician and architect, was born in Venice on Feb. 18, 1404. He was so skilled in Latin verse that a comedy he wrote in his 20th year, entitled *Philodoxius*, deceived the younger Aldus, who edited and published it as the genuine work of Lepidus. In music he was reputed one of the first organists of the age. At Rome he was employed by Pope Nicholas V in the restoration of the papal palace, and of the foundation of Acqua Vergine, and in the ornamentation of the magnificent fountain of Trevi. At Mantua he designed the church of Sant' Andrea, at Rimini the church of San Francesco, which is generally esteemed his finest work, and in Florence the principal façade of the church of Santa Maria Novella, as well as the family palace now known as the Palazzo Strozzi. His most celebrated treatise is that on architecture, *De Re Aedificatoria*, which was translated into Italian, French, Spanish and English.

See Passerini, *Gli Alberti di Firenze* (1869–70); Mancini, *Vita di Alberti* (Firenze, 1882); V. Hoffmann, *Studien zu Leon Battista Alberti's zehn Büchern: De Re Aedificatoria* (Frankenberg, 1883).

ALBERTINELLI, MARIOTTO (1474–1515), Italian painter, was born in Florence, and was a fellow pupil and partner

of Fra Bartolommeo, with whom he painted many works. His chief paintings are in Florence, notably his masterpiece, the "Visitation of the Virgin" (1503) at the Uffizi.

ALBERTITE, a pyrobitumen (see BITUMEN) so named from the type occurrence in Albert county, New Brunswick. It is jet black in colour, has a brilliant lustre and a conchoidal to hackly fracture. It occurs typically in veins up to many feet in thickness and is a derivative of petroleum. (J. R.)

ALBERT LEA, a city of Minnesota, U.S.; the county seat of Freeborn county; the population, predominantly Scandinavian, was 13,488 in 1950 and 12,200 in 1940 by the federal census. It is on federal highways 65, 69 and 16, and is served by the Rock Island, the Chicago, Milwaukee, St. Paul and Pacific, the Illinois Central and the Minneapolis and St. Louis railways. The city is between Lake Albert Lea and Fountain lake in the south central part of Minnesota.

Diversified manufactures include food and beverage products, building equipment, tools and machinery, castings, wood products, fertilizer, concrete products, paint, plastic, clothing, athletic equipment, prefabricated buildings, shaving cream and numerous others.

The city takes its name from Col. Albert Miller Lea (1808–91), a West Point graduate (1831) who visited the area in 1835 as topographer with the U.S. dragoons. Colonel Lea wrote extensively of the area and is credited with naming the state of Iowa. A post office was established at Albert Lea in 1855, and the city received its charter in 1878. The city has a council-manager form of government.

ALBERT MEDAL, a British decoration instituted in 1866 as an award for signal acts of bravery in saving life at sea, and extended in 1877 to acts of bravery on land. The conditions governing the award were amended in 1905. There are two classes, each with two divisions. The medal, which is in gold for the 1st class and bronze for the 2nd, is oval, and bears the monogram V.A. The ribbon is either blue (for bravery at sea) or crimson (for bravery ashore) with white vertical stripes.

ALBERTUS MAGNUS, ALBERT OF COLOGNE (1206?–1280), scholastic philosopher called *doctor universalis*. Albert was born of the family of the counts of Bollstädt, at Lauingen, in Suabia. In 1223 he joined the Dominican order, and after teaching in turn at Cologne, Hildesheim, Freiburg, Ratisbon, Strasbourg and again at Cologne, was sent to Paris from 1245 to 1248, and there acquired great fame. (Roger Bacon, who was by no means friendly toward Albert, speaks of him as "the most noted of Christian scholars.") When he returned to Cologne in 1248 to organize the *studium generale*, Thomas Aquinas, who had been under his direction at Paris, went with him. From 1254 to 1257 he was provincial of the German province, during which time he defended the Mendicants against the University of Paris and its spokesman, William of St. Amour. From 1260 to 1262 he held the bishopric of Ratisbon. From that date to 1270, when he returned to Cologne as a *lector*, he seems to have been travelling about preaching a crusade in Germany and Bohemia, and undertaking various other ecclesiastical missions in Würzburg and Strasbourg. In 1277 he returned to Paris to defend the doctrines of Aquinas against the condemnations of Bishop Tempier. Albert's works, which were mostly completed before 1256, were published in 21 folio vol. by Jammy at Lyons in 1651, and reprinted in 36 vol. by Borguet (Paris, 1890). They include paraphrases of all of Aristotle's works, a commentary on the *Sentences* of Peter Lombard, an incomplete *Summa Theologiae*, a treatise against Averroes and the curious *De Causis et Processu Universitatis*—a work of Neoplatonic colouring.

Albert has a remarkable affinity with the early Franciscan philosophers of Oxford; thus, his love of experimental science, and his knowledge of geography, astronomy, medicine, zoology and botany, are strongly reminiscent of Robert Grosseteste and Bacon, while his interweaving of Aristotelian, Arabian, Jewish, Neoplatonic and Augustinian elements bears a close resemblance to the system of Thomas of York. However, as far as his Dominican successors are concerned, Albert's chief influence seems to lie in his successful propagation of an esteem for Aristotle. Hence, his project of "adapting Aristotle to the use of the Latin races" was fulfilled in spite of the intense distrust of Aristotle that had been

aroused by the Paris condemnations of his works on natural science and metaphysics in 1210, 1215, 1231 and 1245.

See J. Sighart, *Albertus Magnus, sein Leben und seine Wissenschaft* (1876); Paget Toynbee, "Some Obligations of Dante to Albertus Magnus" in *Romania* (1895); E. Michael, *Geschichte d. deutschen Volkes vom 13. Jahrh.* (1903) v. iii. p. 445 seq. (for Albert's scientific interests); A. Schneider, *Die Psychologie Alberts d. Gr.* (1906); C. Baumecker, *Witelo* (1908) (for Albert's Neoplatonism); H. Lauer, *Die Moraliatheologie Alberts d. Gr.* (1911); P. Mandonnet, *Siger de Brabant* (1911); L. Gaul, *Albert des Grossen Verhältnis zu Plato* (1913); G. von Hertling, *Albertus Magnus, Beiträge zu seiner Würdigung* (1914).

ALBERUS, ERASMUS (c. 1500–1553), German humanist and poet, was born at Sprendlingen, near Frankfurt, and died at Neubrandenburg on May 5, 1553. He was almost the only member of Luther's party who commanded an effective weapon of satire. He ridiculed the Franciscan order in his *Barfüßer Mönche Eulenspiegel und Alkoran* (1542, preface by Luther), and gave his views on church and state in a collection of fables entitled *Buch von der Tugend und Weisheit* (1550). Some of his hymns are used in the Lutheran hymnal.

BIBLIOGRAPHY.—*Das Buch von der Tugend und Weisheit* has been edited by W. Braune (1892); the 16 *Geistliche Lieder* by C. W. Stromberger (1857). Alberus's prose writings have not been reprinted in recent times. See F. Schnorr von Carolsfeld, *Erasmus Alberus* (1894).

ALBI, a city of south-west France, in the department of Tarn, 48 m. N.E. of Toulouse, on a branch line of the Southern railway. Pop. (1946) 34,342. It occupies a commanding position on the left bank of the Tarn, where its valley broadens as it emerges from the high *Plateau Central* toward the plain of Toulouse; a bridge crosses to La Madeleine (a suburb).

Albi (*Albiga*) was capital of the Gallo-Roman Albigenes, and later of the viscounty of Albigeois, a fief of the counts of Toulouse. From the 12th century onward its bishops encroached on the authority of the viscounts and, after the Albigenian War, lost their estates, which passed ultimately to the Crown. By a convention (1264), the chief temporal power was granted to the bishops. A nucleus of narrow, winding streets is surrounded by boulevards, beyond which lie modern quarters. The cathedral of Sainte Cécile, a fine Gothic fortress-church built in 1277–1512, is without transepts or aisles; the rood-screen and the choir-enclosures (about 1500) are masterpieces. The 14th-century archbishop's palace to the northeast is fortified.

The church of St. Salvi belongs to the 13th and 15th centuries. There are dye-works, cement-works, coal-mines, glass-works and important flour-mills. Hats, cloth fabrics, umbrellas, artificial silk and agricultural implements are also made. Trade is in wheat, wine, and prunes. Albi is the seat of an archbishop (1678), a prefect, and a court of assizes. It has tribunals of first instance and of commerce, a board of trade arbitrators and a chamber of commerce.

ALBIA, a city of Iowa, U.S., 68 mi. S.E. of Des Moines, in a fertile farming and stock-raising district and in the Albia coal field; the county seat of Monroe county. It is a junction point of the Burlington, the Wabash, and the Minneapolis and St. Louis railways, and is the northern terminus of the Iowa Southern Utilities company. It has several industrial plants, and is an important distributing centre for the coal and agricultural products of the region. The population in 1950 was 4,823; in 1940, 5,157.

ALBIGENSES, the usual designation of the heretics—and more especially the Catharist heretics—of the south of France in the 12th and 13th centuries. This name appears to have been given to them at the end of the 12th century, but the designation is hardly exact, for the centre of the movement was at Toulouse and in the neighbouring districts rather than at Albi (the ancient *Albiga*). The heresy, which had penetrated into these regions probably by trade routes, came originally from eastern Europe. The name of Bulgarians (*Bougres*) was often applied to the Albigenes, and they always kept up intercourse with the Bogomil sectaries of Thrace. Their dualist doctrines, as described by controversialists, present numerous resemblances to those of the Bogomils (*q.v.*), and still more to those of the Paulicians, with whom they are sometimes connected. It is exceedingly difficult,

however, to form any very precise idea of the Albigenian doctrines, as our knowledge of them is derived from their opponents, and the very rare texts which have come down to us, emanating from the Albigenes (e.g., the *Rituel cathare de Lyon*, ed. by Cunitz, Jena, 1852, and the *Nouveau Testament en provençal*, ed. by Clédat, Paris, 1887), contain very inadequate information concerning their metaphysical principles and moral practice. What is certain is that, above all, they formed an anti-sacerdotal party in permanent opposition to the Roman Church, and raised a continued protest against the corruption of the clergy of their time. The Albigenian theologians and ascetics, the Cathari or *perfecti*, known in the south of France as *bons hommes* or *bons chrétiens*, were few in number; the mass of believers (*credentes*) were perhaps not initiated into the Catharist doctrine; at all events they were free from all moral prohibition and all religious obligation, on condition that they promised by an act called *convenenza* to become "hereticized" by receiving the *consolamentum*, the baptism of the Spirit, before their death or even in *extremis*.

The first Catharist heretics appeared in Limousin between 1012 and 1020. Protected by William IX., duke of Aquitaine, and soon by a great part of the southern nobility, the movement gained ground in the south, and in 1119 the Council of Toulouse in vain ordered the secular powers to assist the ecclesiastical authority in quelling the heresy. The people were attached to the *bons hommes*, whose asceticism and anti-sacerdotal preaching impressed the masses, and the movement maintained vigorous activity for another hundred years, until Innocent III. ascended the papal throne. At first he tried pacific conversion; but his envoys had to contend not only with the heretics, the nobles who protected them and the people who listened to them and venerated them, but also with the bishops of the district, who rejected the extraordinary authority which the pope had conferred upon his legates. At last (1209) the pope ordered the Cistercians to preach the crusade against the Albigenes. This implacable war, which threw the whole of the nobility of the north of France against that of the south, and destroyed the brilliant Provençal civilization, ended, politically, in the Treaty of Paris (1229), which destroyed the independence of the princes of the south, but did not extinguish the heresy, in spite of the wholesale massacres of heretics during the war. The Inquisition, however, operating unremittently in the south at Toulouse, Albi and other towns during the whole of the 13th century and a great part of the 14th, succeeded in crushing it. There were indeed some outbursts of rebellion, some fomented by the nobles of Languedoc (1240–42) and others emanating from the people of the towns, who were embittered by confiscations and religious persecutions, but the repressive measures were terrible. In 1245, the royal officers assisting the Inquisition seized the heretical citadel of Montségur, and 200 Cathari were burned in one day. Moreover, the Church decreed severe chastisement against all laymen suspected of sympathy with the heretics (Council of Narbonne, 1235; Bull *Ad extirpanda*, 1252).

Hunted down by the Inquisition and now abandoned by the nobles of the district, the Albigenes became more and more scattered, hiding in the forests and mountains, and only meeting surreptitiously.

The sect, moreover, was exhausted and could find no more adepts in a district which, by fair means or foul, had arrived at a state of peace and political and religious unity.

BIBLIOGRAPHY.—See C. Schmidt's *Histoire de la secte des Cathares ou Albigeois* (1849), which is still the most important work on the subject. On the ethics of the Catharists, see Jean Guiraud, *Questions d'histoire et d'archéologie chrétienne* (1906); and P. Alphanéry, *Les idées morales chez les hétérodoxes latins au début du XIII^e siècle* (1903). See also under **CATHARS**.

ALBINO, a biological term (Lat. *albus*, white) for a pigmentless individual of a pigmented race. Pigmentation depends upon the presence and interaction in the tissues of colour-bases, chromogens, colourless in themselves, and ferments or enzymes which, acting upon the colour-bases, yield coloured products. If, therefore, either of these ingredients of pigmentation is absent from the constitution of an individual, it must perforce remain pigmentless, albinotic, even though in the environment in which it



BY COURTESY OF [2] GEORGE G. GOODWIN, AMERICAN MUSEUM OF NATURAL HISTORY, NEW YORK; PHOTOGRAPHS, (1, 3, 4) NEVILLE KINGSTON

VARIOUS SPECIMENS OF ALBINOS

1. Lobster with the normal blue pigment almost entirely lacking
2. First photograph ever taken of an albino Killimanjaro giraffe (*Giraffa camelopardalis tippelskirchi*), in Kenya, by the Snyder-Macnab
- East African expedition, 1938
3. White peacock whose tail is like watered silk in appropriate light
4. Albino squirrel, uncommon in the wild state

lives there are agents, such as sunlight, which are known to stimulate the production of pigment in the tissues of animals and plants exposed to their action. An albino is an individual whose tissues lack the power to elaborate either the ferments or the colour-bases.

In man the general colour of the skin ranges from the fair, almost pigmentless, condition of the Scandinavian to the almost ebony blackness of the natives of certain parts of Africa. These differences have been employed in the classification of races into white, yellow, red, brown, and black. The colour of the skin proper is creamy white. To this is added a tinge of yellow due to the presence of a yellow pigment in the skin. A further ingredient is black, due to the presence of minute granules of melanin, itself sepia in colour but, in masses, so completely absorbing the light that it appears black. Lastly, the red colour of the blood circulating in the minute vessels of the skin adds its tint. It is possible, by using a spinning top with a combination of these colours, white, yellow, red, and black in different proportions, to match any particular skin colour, and it is found, when this is done, that in all pigmented skins all these four colours can be identified, and that different proportions of the yellow and the black in combination correspond to different racial skin colorations. The relative proportions of these two pigments vary greatly in different individuals and in different regions of the body of one and the same individual.

Albinism is the condition, as estimated by this test, in which the black pigment is absent and in which the yellow is present only in relatively small amount.

The eyes of the albino are pink, this colour being the red of the blood circulating in the retinal blood vessels, as seen through the transparent tissues in front. The eyes are extremely sensitive to light and so the eyelids are kept partially closed, while blinking and a general wrinkling of the skin around the eyes are associated conditions which give to the albinotic individual a characteristic appearance. The hair on all parts is white, and all tissues, such as the brain and spinal cord, which in the normal individual are more or less pigmented, are in the albino completely devoid of this melanin.

In the normal individual this black pigment would seem to serve a useful purpose. In the case of the pigmented eye, the intensity of the light falling upon the retina is adequately diminished by the absorbing power of the retinal pigment, and this same melanin in the skin and hair, it is assumed with reason, protects the individual from the rays of the sun in tropical climes. The albino is seriously embarrassed in consequence of its deficiency, the albino animal much less so than the plant, however. Commonly in the breeding of corn or sorghum, when the self-fertilized seeds from an apparently normal green plant are sown, it is found that amongst the seedlings a number of spindling white plants make their appearance only to wither. They die because they lack the pigment chlorophyll, so essential in the manufacture of food, and therefore in the life of the plant. When the seeds of such an albino-producing plant are carefully sown and the number of chlorophyll-possessing and chlorophyll-lacking seedlings are counted, it is found that the greens outnumber the albinos by about three to one. From this it is known that the parent plant was heterozygous for its character green, that albinism in plants as in animals behaves in inheritance as a simple Mendelian recessive, and that in the case of these plants this character in the homozygous condition (*see MENDELISM*) is lethal, since in the absence of chlorophyll the plant cannot assimilate its food.

Albinism has been recorded in the great majority of the species, breeds, and varieties of domesticated animals and of cultivated plants. There are many records of instances of the condition among wild mammals and birds. In the case of mankind it has been observed in most races and probably occurs in all. Its frequency is not known, but it is estimated at perhaps one in 10,000. To-day it is possibly most frequent among the Indians of Arizona and Mexico. Whatever may be the exact frequency of the albinotic in a species, it is certain, since the condition behaves as a Mendelian recessive, that there are far more "car-

riers" than affected individuals in any race in which albinos appear, and that though originally the condition made its appearance as a "sport" or mutation, resulting from some definite change in the hereditary material of some one individual, since that time its reappearance in the stock is the result of the shuffling and reshuffling of the hereditary factors in their transmission from generation to generation and of the matings of apparently normal individuals who, however, are heterozygous for this particular character, not showing the taint but carrying it and transmitting it to their progeny.

The differently coloured races of a species all have albinotic strains and these may each possess the colour-bases or the ferments of the particular race to which it belongs. Albinos are all alike in that they are unpigmented, but they differ remarkably in respect of their unexpressed pigmentation. Properly planned breeding experimentation reveals the hidden. Pigmented races are not coloured uniformly: there is always some suggestion of a differential regional distribution of pigment, some indication of a pattern, and breeding experimentation has shown that the hereditary factors for the different patterns are transmitted from one generation to another quite independently of those which relate to the actual colour of the skin or coat. Thus it is that an albino that cannot exhibit a pattern because it has no colour can possess in its hereditary constitution factors for one or other of the various patterns. It is known, for example, that when a pure-bred self-coloured mouse is mated with an albino, the pattern of the coats of the offspring is determined by hereditary factors that are known to be absent from the self-coloured stock and to be present in the stock out of which the albino was derived.

So far, complete albinism only has been discussed. Partial albinism is also known, and a study of this condition reveals the fact that the interaction of colour-base and colour-developer is conditioned by such agencies as temperature. The Himalayan rabbit is an excellent example of partial albinism. In this breed the eye is pink and the fur of the body is unpigmented, but the ears, legs, tail, and nose are black. It has been shown that if an area of the white-furred body is shaved and the animal kept in the cold (5-9°C) the new fur that grows is black, whereas if the animal is kept in a warmed room, the new fur is white as before. The baby coat of the Himalayan is all white and the pattern develops after a few weeks when the young are moving freely about. But if the naked baby rabbit is taken from the rest for about ten minutes on two successive days and exposed to a temperature of about 17°C, and especially if it is sponged with cold water, the fur when it is developed later is black all over the body. It follows that the essential ingredients for pigmentation are present in all parts of the skin but that ordinarily the pigment is elaborated only in certain well-defined areas. The Himalayan is a self-coloured race, but the power to elaborate pigment at ordinary temperatures differs in different regions of the body, certain areas being albinotic because normally the temperature of these parts is not that at which the enzyme and colour-base which are undoubtedly present can in their interaction yield pigment.

In certain animals such as the arctic fox, the stoat or ermine, and several hares, and in certain birds, the ptarmigan for example, the pigmented pelage or plumage of the summer and autumn is replaced in the winter by a white one. In the case of the hare, it is held by some that the autumn coat is moulted completely and that the winter coat is a new growth; others hold that there is no moulting but that the autumn coat itself becomes unpigmented; still others are of the opinion that both processes are involved, a whitening of the old fibres and a new growth of non-pigmented fibres. In the ptarmigan the pigmented feathers certainly become white. It is probable that in the hare and similar forms the whiteness is due to the presence of air in the pigmented fibres and consequently to the irregular reflection of the light from the surfaces of these air bubbles. In the case of the ptarmigan it is possible that the whiteness of the winter plumage is due to a seasonal increase in the activity of the thyroid gland, for it is established that if the active principle of the thyroid gland is administered to pigmented domestic fowls, the new feathers as they grow tend to be non-pigmented. It has not yet been shown conclusively that

this seasonal change from the pigmented to the non-pigmented condition is to be regarded as an instance of seasonal albinism.

Occasionally albinotic frogs or axolotls are recorded, but it is doubtful whether all these cases are true examples of albinism. It is more probable that they are individuals in which the pituitary gland or hypophysis at the base of the brain is abnormal; for experiment has shown that if this gland is removed from these animals, the pigment cells in their skin no longer expand and that therefore the animals must preform remain very pale in colour. An injection of the active principle of the gland, pituitrin, turns them coal-black almost at once. (See GENETICS; HEREDITY; COLOURS OF ANIMALS; MELANISM.)

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ALBINOVANUS PEDO, Roman poet, flourished during the Augustan age. He wrote a Thesis, referred to in a letter from his friend Ovid (*Ex Ponto*, iv. 10), epigrams which are commended by Martial (ii. 77, v. 5) and an epic poem (*cf.* Quintilian x. i. 90) on the exploits of Germanicus under whom he probably served (*Tac. Ann.*, i. 60). This may have been used as a source by Tacitus. All that remains of his works is a beautiful fragment, preserved in the *Suasoriae* (i. 15) of Seneca, describing the voyage of Germanicus (A.D. 16) through the river Ems to the Northern Ocean. Three elegies were formerly attributed to Podo by Scaliger; two on the death of Maecenas (*In Obitum Maecenatis* and *De Verbis Maecenatis moribundi*), and one addressed to Livia (*Consolatio ad Liviam de Morte Drusi* or *Epicedion Drusi*, usually printed with Ovid's works); but it is now generally agreed that they are not by Podo. The *Consolatio* has been put down as the work of a 15th century Italian imitator, there being no mss. and no trace of the poem before the publication of the *editio princeps* of Ovid in 1471. There is an English verse translation of the elegies by Plumptre (1907).

*See Haupt, *Opuscula*, i. (1875); Bährens, *Poetae Latini Minores* (1879) and *Fragmenta Poetarum Latinorum* (1886); Haube, *Beitrag zur Kenntnis des Albinovanus Podo* (1880).

ALBINUS, BERNARD SIEGFRIED (1697-1770), was born at Frankfurt-on-the-Oder, and from 1718 to his death on Sept. 9, 1770, occupied the chair of anatomy, surgery and medicine at Leyden. He was the first to show by injections the connection of the vascular systems of the mother and the foetus. He also edited with Boerhaave the works of Vesalius and of Harvey. But he is chiefly famed for the excellent drawings in his *Tabula sceleti et musculorum corporis humani* (Leyden, 1747). His *De ossibus corporis humani ad auctiores suos libellus* appeared at Leyden, 1726.

ALBION, the most ancient name of the British Isles, generally restricted to England (in Ptolemy Ἀλονίον; Lat. *Albion*, Pliny 4, 16 [30], 102). The name is perhaps Celtic but the Romans connected it with *albus*, white, in reference to the chalk-cliffs of Dover, and A. Holder (*Alt-Keltischer Sprachschatz*, 1896) translates it *Weissland*, "white-land." The early writer (6th century B.C.) whose *Periplus* is translated by Avienus (end of 4th century A.D.) does not use the name Britannia; he speaks of νῆσος Ἰέρων καὶ Ἀλβιδίων ("island of the Ierni and the Albiones"). So Pytheas of Massilia (4th century B.C.) speaks of Ἀλβιον and Ἰέρων.

ALBION, a city of Calhoun county, Mich., U.S., on the Kalamazoo river, 18 mi. W. of Jackson. It is on the Michigan Central railway, and is connected by buses with cities as far north as Grand Rapids and Owosso. The population was 10,395 in 1950 and was 8,345 in 1940 by the federal census. It has 16 factories. On a commanding site in the east part of the city is Albion college (Methodist Episcopal; coeducational), which has an enrolment of about 1,200 students. Albion was settled in 1831, incorporated as a village in 1866 and chartered as a

city in 1885. A mayor-commission form of government was adopted by the city.

ALBITE: see FELSPAR.

ALBOCARBON or **WHITE CARBON**: see NAPHTHALENE.

ALBOIN (d. 573), king of the Lombards and barbarian conqueror of northern Italy, succeeded his father Audoin about 565. The Lombards at that time occupied Noricum and Pannonia, and were engaged in constant war with the Gepidae. Alboin obtained the alliance of the Avars, and with their help destroyed the Gepidae, slew their king, Cunimund, in battle and married his daughter, Rosamund. On April 1, 568, Alboin had assembled his people with a great number of allies, among them 20,000 Saxons, to cross the Alps and form a new settlement in Italy. There appears to be no truth in the legend that the Lombards were invited to attack Italy by the Byzantine general Narses. This was in effect a migration rather than a mere invasion. The Roman defenses were overrun, Milan was occupied (Sept. 4, 569) and Pavia was invested. Lombard rule was established in northern Italy. But Alboin was murdered in 573 at the instigation of Rosamund, whom Alboin had insulted, so the story goes, by making her drink wine from her father's skull.

The authorities for the history of Alboin are Procopius, Paulus Diaconus and Agnellus (in his history of the church of Ravenna).

See Thomas Hodgkin, *Italy and Her Invaders*, vol. v (1916).

ALBONI, MARIETTA (1823-1894), Italian opera singer, was born at Cesena, Romagna, and studied at Bologna, where she became a pupil of G. A. Rossini. She had a magnificent contralto voice, and made her first appearance at La Scala, Milan, in 1843. In England her reputation was established by her appearance at Covent garden in 1847, and she had brilliant success both in Europe and in the United States. She lived in Paris from 1866 onward, and died at Ville d'Avray in 1894.

ALBORADA (*Span.*) signifies strictly a sunrise song or morning serenade akin to the French *aubade* (q.v.) but is now applied to a particular kind of instrumental music of a popular type to be heard in certain parts of Spain, the instruments employed being generally the bagpipes and side drum.

ALBORNOZ, GIL ALVAREZ DE, Spanish cardinal, was born at Cuenca early in the 14th century and died at Viterbo in 1367. He was made archbishop of Toledo in 1337 and cardinal in 1350. In 1353 Innocent VI sent him from Avignon as legate into Italy with a mission to secure the restoration of the papal authority in the states of the church. By 1362 he had paved the way for the return of Urban V to Rome. As legate, Alborno showed himself to be an astute manager of men and an effective fighter. He began by making use of Cola di Rienzi, whose release from prison at Avignon he secured. After the murder of the tribune in 1354 Alborno pursued his task of restoring the pope's authority by intrigue and force. A work by Alborno on the constitution of the church of Rome, first printed at Jesi in 1473, is now very rare.

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ALBRECHT, the German form of Albert (q.v.).

ALBRECHTSBERGER, JOHANN GEORG (1736-1809), famous Austrian musical theorist and teacher, was born at Kloster-Neuburg, and died in Vienna. He studied composition under the court organist, Mann, and became one of the most learned and skilful contrapuntists of his age. In 1772 he was appointed organist to the court of Vienna, and in 1792 *Kapellmeister* of St. Stephen's cathedral. His fame attracted a large number of pupils, among whom were Beethoven, Johann Hummel and Ignaz Moscheles. His compositions, consisting of preludes, fugues and sonatas for the piano and organ, string quartets, etc., are of small importance, and most of them exist only in manuscript, being preserved in the library of the Vienna Gesellschaft der Musikfreunde. In 1790 he published at Leipzig his *Gründliche Anweisung zur Komposition*. A collection of his writings on harmony, in three volumes, was published under the care of his pupil Ignaz von Seyfried (1776-1841) in 1826 (English version 1855).

ALBRET, the name of a powerful French family, originating in Labrit, a small village in the Landes of Gascony, on the main road from Bordeaux to Dax and to Bayonne, which it owned in the 10th century. The lord of Albret spread his power by degrees over the surrounding country, obtaining many lordships in Bazadais, Condomois, Bordelais and the countries of the Adour. The family of Albret was divided between several branches. The most powerful of these branches, the eldest, played an important part during the Hundred Years' War and at the beginning of the modern period. Arnaud-Amanieu fought the English troops in Guienne victoriously after 1369 and married Margaret of Bourbon, King Charles V's sister-in-law. His son Charles became constable of France, but was killed at the battle of Agincourt in 1415. Family alliances caused Alain d'Albret, the Great, to be one of the most powerful French lords at the end of the 15th century, and the power of his house was still further increased in the 16th: its head became king of Navarre and prince of Béarn through the marriage of Jean d'Albret, Alain's son, to Catherine of Foix-Grailly; and its patrimonial lands were raised to the rank of duchy (1555). Lastly, a great-granddaughter of Alain the Great, Jeanne, married Antoine de Bourbon; and their son, after the dynasty of the Valois had ceased to be, became king of France as Henry IV.

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ALBUERA, LA (or **ALBUERA**), a small village of Spain, in the province of Badajoz, 13 mi. S.E. of the town of that name, insignificant in itself but celebrated because of the victory gained there on May 16, 1811, by the British, Portuguese and Spaniards, under Viscount Beresford, over the French army commanded by Marshal N. J. de Dieu Soult. Pop. (1940) 1,909.

After Portugal had been cleared of the French invading army under André Masséna, Wellington sought to secure his position by recovering the frontier fortresses. He himself invested Almeida while Beresford was sent, with 10,000 Spaniards, 9,000 Portuguese and 9,000 British only, to lay siege to Badajoz. But the latter was hardly in position before Soult moved upon him from the south with 27,000 veterans. Beresford took up a covering position at Albuera, astride the road to Badajoz, but his dispositions were faulty and Masséna, feinting at a direct thrust down the road, made a concealed manoeuvre round the allied right flank. There the Spanish were cut to pieces or dispersed, a British brigade, hurrying to their aid, was annihilated by the French cavalry, and only a thin line of 1,800 British "redcoats" strung out on a ridge intervened between the French mass of manoeuvre and complete victory. Thin as it was, being a line, it overlapped the front of the massed French columns, and thus gained full value from its fire. For half an hour both sides poured a heavy musketry fire into each other's ranks at point-blank range, and then the nerves of the French snapped under the exorbitant toll, and their columns rolled back down the slopes, gaining momentum as they went until their retirement became a rout. The French losses were about 8,000, and those of the British 4,000 in all, while the Spaniards lost 1,400. Strategically, Beresford's decision to fight was a mistake, for the siege had already been abandoned on Soult's approach; it exposed him to disaster when isolated, and even as it was the losses grievously impaired Wellington's strength. But morally, it had a vital influence on subsequent encounters.

ALBUFERA DE VALENCIA, lagoon, 7 mi. S. of Valencia in Spain, about 12 mi. long, 14 mi. broad and 12 ft. deep (max.), with a narrow outlet to the sea under control. It is rich in fish and wild fowl; rice is grown around it. Napoleon made Marshal L. G. Suchet duke of Albufera (1812) after the conquest of Valencia. After the battle of Vittoria (1813) he lost the domain but kept the title. Later, the Spanish nation gave the revenues of Albufera to the duke of Wellington.

ALBULA PASS, the principal route from the north to the Upper Engadine in the Grisons. It was used in the 13th century and a carriage road (highest point, 7,595 ft.) was made across it in 1865, but for a long time it was not so much used as the easier and more direct Julier pass (7,504 ft.). The opening of the railway

in 1903, however, vastly increased its importance. Starting from Coire the railway follows the Rhine to Reichenau (6½ mi.), and then the Hinter Rhine to Thusis (10½ mi.). It then runs through the grand Schyn gorge (cut by the Albula torrent) to Tiefenkaastell (7½ mi.), where it leaves the Julier road on the right (south) and continues to follow the course of the Albula past Filisur and Bergün (12½ mi.) to the mouth (5,879 ft.) of the tunnel (¾ mi. in length; highest point, 5,987 ft.) which has been pierced below the pass. The railway descends through the Bevers glen to Bevers (2½ mi.), in the Upper Engadine, about 5 mi. below St. Moritz, which is 56 mi. from Coire by this route.

ALBUM, in ancient Rome, a board chalked or painted white, on which public notices were inscribed in black. The *Annales Maximii* of the Pontifex Maximus, the annual edicts of the praetor, the lists of senators and jurors, the *Acta Diurna*, etc., were exhibited in this manner. In modern times "album" denotes a book of blank pages in which autographs, sketches or the like are collected. In law, the word is the equivalent of *mailles blanches*, for rent paid in silver ("white") money.

ALBUMAZAR or properly **ABU-MAASCHOR** (805-885), Arab astronomer, was born at Balkh, flourished at Baghdad and died at Wasid in central Asia. His principal works were translated into Latin: *De Magnis Conjunctionibus* (Augsburg, 1489), *Introductorium in Astronomiam* (Venice, 1506) and *Flores Astrologici* (Augsburg, 1488). He maintained in the first that the world, created when the seven planets were in conjunction in the first degree of Aries, will come to an end at a like conjunction in the last degree of Pisces. Albumazar's name is used for the subject of *L'Astrologo* by Gian Battista del Porta (1606), a play which was adapted in *Albumazar* by John Tomkis, played before James I in 1614, revived by J. Dryden in 1748.

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ALBUMINOIDS: see **PROTEINS**.

ALBUMINS: see **PROTEINS**.

ALBUMINURIA is the name for the condition in which the urine contains abnormal amounts of albumin. Other proteins and similar compounds such as albuminoses and proteoses occasionally also are found in the urine, and these conditions are called proteinurias. Excessive loss of protein from the body produces serious physiologic changes, and even the loss of small amounts may profoundly affect its metabolism. Therefore, the detection of albumin in the urine is of great diagnostic importance, for its presence may indicate serious pathologic changes in the body, particularly in the kidneys.

The urine may contain red blood cells or haemoglobin, a protein found in red blood cells, but these conditions are not classified as albuminuria. Although the urine normally contains minute amounts of albumin, under normal conditions the kidneys do not permit the escape of appreciable amounts of the blood proteins. However, when the kidneys are diseased, particularly in nephritis (see **KIDNEY, DISEASES OF**), their ability to prevent the loss of protein is seriously affected and these substances appear in readily detectable amounts in the urine. In severe albuminuria the loss of protein may be from one gram to two grams per 100 c.c. of urine.

Protein may also appear in the urine as a result of injury or disease of parts of the urinary tract other than the kidneys, and is referred to as "accidental," "false" or "postrenal" albuminuria.

The diagnosis of albuminuria is made by means of chemical tests which result in precipitation and coagulation of the protein dissolved in the urine. Usually in these tests acids, such as nitric, sulphosalicylic or acetic, are added to the urine, and when this is done, protein, if present in the urine, will form a white or cream-coloured precipitate. The use of heat when the urine is acid also will cause the coagulation of protein. Determination of the amount of protein in the urine requires more elaborate chemical tests which usually depend upon chemical analysis for nitrogen in the precipitated protein.

Under certain conditions, the urine of individuals apparently quite healthy may contain albumin (physiologic albuminuria). The most common causes are strenuous muscular exercise, excessive protein in the diet or exposure to cold. Protein is also commonly found in the urine of infants and in urine in the later stages of pregnancy. The appearance of albuminuria may be intermittent (paroxysmal albuminuria) and without obvious cause. A special example of physiologic albuminuria is orthostatic or postural albuminuria, which dis-

appears when the patient remains in bed but reappears when the patient gets up.

The chief significance of albuminuria is in reference to nephritis in which, characteristically, albumin appears in the urine. Frequently, however, during the course of the disease, protein is absent and a careful study is necessary in order to evaluate properly the urinary findings. Repeated tests are usually necessary before the signs and symptoms of the patient can be correlated with the presence or absence of albuminuria.

A special proteose, known as Bence Jones protein, may rarely be found in the urine. It occurs in connection with certain diseases, such as a cancer of the bone called multiple myeloma (see CANCER), and similar proteoses may also be found in the urine of persons ill with leukemia, osteomalacia and myxoedema. The presence of Bence Jones protein in the urine can be determined because, unlike albumin, the white precipitate which forms in the presence of heat and acetic acid at 60° C. dissolves when the temperature is raised to 100° C., again to reappear when the mixture is cooled. Albumin remains in the precipitated form at the temperature of 100° C.

The presence of albuminuria is so significant and serious that insurance companies usually will not insure persons who have this condition, although in the light of present knowledge of transient and physiologic albuminuria a more lenient attitude on the part of insurance companies is evident. (T. B. M.)

ALBUQUERQUE, ALPHONSO D' (in old Portuguese *AFONSO D'ALBOQUEQUE*), (1453-1515), surnamed *THE GREAT*, and *THE PORTUGUESE MARS*, was born in 1453 at Alexandria, near Lisbon, and educated at the court of Alphonso V. In 1503 he set out on his first expedition to the east. He sailed round the Cape of Good Hope to India, where he obtained from the king of Cochín permission to build a Portuguese fort. He returned home in July 1504, and King Emmanuel gave him the command of a squadron of five vessels in the fleet of 16 which sailed for India in 1506 under Tristão da Cunha. After a series of attacks on the Arab cities on the east coast of Africa, Albuquerque separated from Da Cunha and captured (Sept. 1507) the island of Ormuz, in the Persian gulf, which was then one of the chief centres of commerce in the east. He was unable long to maintain his position.

With his squadron increased by three vessels, he reached the Malabar coast at the close of 1508, and produced a commission from the king empowering him to supersede the governor Francisco de Almeida. The governor's reply was imprisonment, from which Albuquerque was released only on the arrival of the grand marshal of Portugal with a large fleet. An unsuccessful attack upon Calicut in Jan. 1510 was immediately followed by the investment and capture of Goa. Albuquerque abandoned the town in August, to return with the reinforcements in November, when he obtained undisputed possession. He next directed his forces against Malacca, which he subdued after a severe struggle. He remained in the town nearly a year to consolidate the position. In 1512 he sailed for the coast of Malabar. On the voyage, Albuquerque's vessel, the "Flor de la Mar," which carried the treasure he had amassed in his conquests, was wrecked, and he himself barely escaped with his life. In September of the same year he arrived at Goa, where he quickly suppressed a serious revolt headed by Idalcán.

Albuquerque had been for some time under orders from the home government to undertake an expedition to the Red sea, in order to secure that channel of communication exclusively to Portugal. He accordingly laid siege to Aden in 1513, but was repulsed; a voyage into the Red sea, the first ever made by a European fleet, led to no substantial results. His last success was the recapture in 1515 of the island of Ormuz, which remained in the possession of the Portuguese until 1622. Albuquerque had several enemies at the Portuguese court, and on his return from Ormuz, at the entrance of the harbour of Goa, he met a vessel from Europe bearing dispatches announcing that he was superseded by his personal enemy, Soarez. He died at sea on Dec. 16, 1515. Before his death he wrote a letter to the king in dignified and affecting terms, vindicating his conduct and claiming for his son the honours and rewards due to himself.

His body was buried at Goa, and it is, perhaps, the most convincing proof possible of the justice of his administration that, many years after, Moslems and Hindus used to go to his tomb to invoke protection against the injustice of his successors.

His natural son Afonso published a selection from his father's papers under the title *Commentarios do Grande Afonso d'Albuquerque*.

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ALBUQUERQUE, MATHIAS DE (d. 1647), Portuguese general, was governor of Pernambuco in 1624 and, after the Dutch captured Bahia, governor general of North Brazil. As governor in Pernambuco again in 1629 he had to meet the Dutch invasion of that province, and in 1630 was forced to surrender Olinda and the forts of the Recife. Sent back to Portugal in disgrace in 1635, he took part later in the Portuguese War of Liberation, defeating the Spaniards under Mölingen at Montijo, on May 26, 1644, and thereby earning the title of count of Allegrete. He died at Lisbon June 9, 1647.

ALBUQUERQUE, the largest city of New Mexico, U.S., is in the valley of the Rio Grande, at an altitude of 5,196 ft., in the approximate centre of the state. It is the county seat of Bernalillo county and a division point on the Santa Fe railway. It is on federal highways 66 and 85, and is also served by bus and air lines. Population by the federal census of 1950 was 97,012; in 1940 it was 35,449. The bracing climate and the large proportion of sunny days have given it a reputation as a health resort, and it has several private sanatoria for the treatment of tuberculosis.

Albuquerque distributes vast quantities of supplies and material of all kinds to the sheep and cattle industry, to mining and timbering operations and to smaller cities and towns throughout the state. A large air force base (Kirtland field) is located there, as is Sandia base of the Atomic Energy commission.

Among items manufactured and processed in Albuquerque are brick and tile, concrete pipe, truck bodies, trailers, furniture, chemicals, clothing, batteries, brushes, caskets, precision machinery, playground equipment, leather goods, fabricated iron and steel, felt and cloth emblems, flour, candy, ice cream and dairy products, lumber, mattresses, meat products, metal tanks and culverts, signs, optical goods, sashes and doors, tents and awnings. In addition, the Santa Fe railway maintains large railroad shops.

Albuquerque is the seat of the University of New Mexico (opened in 1892), with a registration of approximately 4,600 students in 1951. An adaptation of the pueblo style of architecture has been used in the university buildings.

Within easy motoring distance are the Indian pueblos of San Felipe, which has a church built by Fray Cristóbal de Quinones (d. 1609); of Isleta and Santo Domingo, where fine ceremonial dances are performed; of picturesque Laguna, with its interesting mission church; and of Acoma, perched on a precipitous mesa 357 ft. high, which was already very old when Fray Marcos arrived in 1539.

The "old town," which lies along the river bank, was founded in 1706 by Don Francisco Cuervo y Valdes, and named by him after the duke of Albuquerque, a viceroy of New Spain. The duke ordered the name to be changed to San Felipe de Albuquerque, as a compliment to the reigning king. With the passage of time it became reduced to one word, and that word lost one of its "r's."

The mission church of San Felipe de Neri (1735) is still standing, and the entire district keeps its old Spanish character. It was an important centre in the Spanish and the Mexican occupations.

During the Civil War it was occupied by Confederate troops (Feb. 1862) under Gen. Henry Hopkins Sibley, who soon afterward advanced into northern New Mexico. In his retreat into Texas he made a stand there, on April 8, 1862, against a detachment of Union troops commanded by Col. R. S. Canby.

The modern city was founded in 1879; the railway reached it in 1880; by 1890 it had a population of 3,785. A city-manager form of government was adopted later.

ALBURY, a small country town of rising importance in Goulburn county, New South Wales, Austr. Situated at an elevation of 542 ft. on the right (north) bank of the river Murray,

approximately 1,470 mi. from its mouth, Albury marks the head of possible navigation (July-December) on this stream, though infrequent river steamers normally ply only as far as Echuca. Its position, again, on the western flank of the eastern highlands, not far from the point of debouchment of the Murray, and in the general line of connection between Melbourne and Sydney, constitutes Albury a crossing-place of some importance. As a fording point it has figured in the history of Australian exploration. In 1883 the Victoria and New South Wales railway systems were connected at this point, and Albury is now a bridge town on the main line linking Victoria and New South Wales (Albury-Sydney c. 350 mi., Albury-Melbourne c. 190 mi.), and also the eastern and western portions of the continent (Transcontinental line, Fremantle and Perth-Brisbane). The river is crossed by means of an iron bridge from Wodonga on the Victorian side, and here also is a break of gauge (Victorian system: 5' 3"; N.S.W.: 4' 8½"). A little above Albury is the confluence of the Murray with its tributary the Mitta Mitta. Albury, therefore, figures in the now historic River Murray Agreement (1914), and it has acquired further considerable importance as a result of the execution of the schemes under that agreement, such as the nearby Hume reservoir. Albury, which has a mean annual temp. of 60.7°, mean annual rainfall of 27.65 in., of which 18.9 in. falls in the seven months, April-October, is the centre and virtual capital of the eastern Riverina, a rich agricultural and pastoral district producing wheat, fruit and sheep. Albury became a municipality in 1859, and has shown a steady rise in population (1891, 5,447; 1921, 7,752; 1933, 10,543).

ALCAEUS or **ALKAIOS** (c. 600 B.C.), Greek poet, holds second place in the Alexandrian lyric canon. He was a contemporary of Sappho, and a member of one of the noble families of Mitylene.

In the war against the Athenians (606), he fled from battle with the loss of his shield. His political enemies drove him into exile, but towards the end of his life he is said to have been pardoned by Pittacus. His poems, which were written in the Aeolic dialect, included hymns; political poems (*stasiōtika*), in which he abused the tyrants, his political enemies; love-songs; and drinking-songs. He seems to have invented the Alcaic metre, and was regarded as a model by Horace.

See Bergk, *Poetae Lyrici Graeci* (1882); also *The Songs of Alcaeus*, by J. Easby-Smith (Washington, 1901); Plehn, *Lesbiacorum Liber* (1826); Flach, *Geschichte der griechischen Lyrik* (1883-84); Farnell, *Greek Lyric Poets* (1891). New fragments edited by J. M. Edmonds (1909). See also Edgar Lobel, *Ἀλκαίου Μέλῃ, the Fragments of the Lyrical Poems of Alcaeus* (Oxford, 1928).

ALCAICS, the name of several lyric verses, from Alcaeus of Lesbos, their supposed inventor. They comprise:

(1) Alcaic hendecasyllable: $\underline{\times} \quad \underline{\times} \quad \underline{\times} \quad \underline{\times} \quad \underline{\times} \quad \underline{\times} \quad \underline{\times} \quad \underline{\times} \quad \underline{\times} \quad \underline{\times} \quad \underline{\times}$

Examples: Latin, "odi profanum vulgus et arceo."
English imitation, "O mighty-mouthed inventor of harmonies."

(2) Alcaic decasyllable: $\underline{\times} \quad \underline{\times} \quad \underline{\times} \quad \underline{\times} \quad \underline{\times} \quad \underline{\times} \quad \underline{\times} \quad \underline{\times} \quad \underline{\times} \quad \underline{\times}$

Examples: Latin, "virginibus puerisque canto."
English imitation, "Milton, a name to resound for ages."

(3) Alcaic enneasyllable: $\underline{\times} \quad \underline{\times} \quad \underline{\times} \quad \underline{\times} \quad \underline{\times} \quad \underline{\times} \quad \underline{\times} \quad \underline{\times} \quad \underline{\times}$

Examples: Latin, "audita Musarum sacerdos."
English imitation, "God-gifted organ-voice of England."

The Alcaic stanza consists of (1) twice repeated, followed by (3) and then (2), once each. It was a great favourite, not only of its inventor, but of Horace, who made some very slight modifications to adapt it to Latin. In modern languages it has been imitated by Tennyson (from whom the above English lines are taken) and occasionally by poets in other languages, but never with much success.

The manner in which the lines should be divided into feet is, in this as in all "Aeolic" metres, a highly controversial point.

ALCAIDE, a Spanish title meaning the governor of a fortress (Arabic *al-quā'id*).

ALCALÁ (Moorish *al kala*, the "Fortress" or "Castle"), the name of thirteen Spanish towns, all founded or named by the Moors. Alcalá de Henares, pop. (1940) 18,013, is separately described on account of its historical importance. Alcalá la Real

(8,437), a picturesque town with a fine abbey, is situated in the mountainous south-west part of Jaén. Its distinctive name *la Real*, "the Royal," was conferred in memory of its capture by Alfonso XI. of Leon in 1340. In 1810 the French under Count Sebastiani here defeated the Spaniards. Alcalá de los Gazules (6,135), on the river Barbate, in the province of Cadiz, trades in cork and agricultural produce. Alcalá de Guadaira (17,758), on the river Guadaira, near Seville, is popularly called Alcalá de los Panaderos, or "Alcalá of the Bakers," because it supplies Seville with large quantities of bread; it also manufactures for export the best "Seville oil."

ALCALÁ DE HENARES, Spain, 17 mi. E.N.E. of Madrid, on the river Henares. Pop. (1940) 18,013 (mun., 18,419). Alcalá de Henares contains a military academy. The town has been identified with the Roman *Complutum*, destroyed about 1000, and rebuilt by the Moors in 1083. Later its university, founded by Cardinal Jimenes de Cisneros in 1510, was second only to that of Salamanca. Here the famous *Complutensian Polyglot* Bible was prepared from 1514 to 1517. The college of San Ildefonso completed in 1583, was the chief university building. Its modernized Gothic church, the Colegiata, contains the 16th century marble monument of Jimenes (d. 1517) and a fine *eredos*.

On the removal of the university to Madrid in 1836 the town declined, and the university buildings became archives of state departments and of the Inquisition. One of the principal libraries is the former palace of the archbishops of Toledo.

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ALCALDE, the title in Spanish for officials of some somewhat varied functions in which, however, there is always a judicial element. *Alcalde de corte* was a judge of the palace court, having jurisdiction in and about the residence of the king. But the title is now exclusively used for the mayor of a town or village who discharges the functions of a justice of the peace. The title of *alcalde* must be carefully distinguished from *alcaide* (*q.v.*) which means the governor of a fortress.

ALCAMENES, a Greek sculptor of Lemnos and Athens. He was a younger contemporary of Pheidias and noted for the delicacy and finish of his works, among which a Hephaestus and an Aphrodite "of the Gardens" were conspicuous. Pausanias says (v. 10, 8) that he was the author of one of the pediments of the temple of Zeus at Olympia (see GREEK ART), but this seems a chronological and stylistic impossibility. At Pergamum there was discovered in 1903 a copy of the head of the Hermes "Propylaeus" of Alcamenes (*Athenische Mittheilungen*, 1904, p. 180). It is safer, however, to judge him by the sculptural decoration of the Parthenon, in which he must almost certainly have taken a share under the direction of Pheidias.

ALCAMO, province of Trapani, Sicily, 24 mi. W.S.W. of Palermo direct (51½ mi. by rail). Pop. (1936) 38,129 (town), 38,396 (commune). The Saracenic chief Al-Kamuk erected the castle (A.D. 828), considerably altered since. Frederick II removed the site lower down (1233). The surrounding district is very fertile.

ALCÁNTARA, a small seaport of Brazil, in the State of Maranhão, on the west shore of the bay of São Marcos, 16 mi. from the city of São Luiz by water. It has a fairly good harbour, and excellent cotton and rice are grown in the vicinity and shipped from the port.

ALCÁNTARA, western Spain, province of Cáceres, on a rocky height on the left bank of the river Tagus, 7 mi. from the Portuguese frontier. Pop. (1940) 4,404 (mun., 4,657). Alcántara (in Arab. "the bridge") owes its name to the magnificent Roman bridge which spans the Tagus on the northwest, built about A.D. 105, in honour of the emperor Trajan and at the cost of eleven Lusitanian communities. A small temple, dedicated to Trajan and other deified emperors, adjoined the bridge on the left bank. Though it has been identified with Norba Caesarea and with Interamnium, it is doubtful whether there was a Roman town here. It became famous about 1215 as the stronghold of the knights of Alcántara, many of whose grand masters lie buried in the 13th-century Gothic church.

ALCAVALA, a duty charged in Spain and its colonies until the invasion of Napoleon (from Arab. *al-quabalah*, "tax," *quabala*, "to receive"; cf. Fr. *gabelle*). Originally imposed in 1341 by Alphonso XI. to secure freedom from the Moors, it was an *ad valorem* tax of 10%, increased afterwards to 14%, on the selling price of all commodities, whether raw or manufactured, and chargeable as often as they were sold or exchanged. This was a monstrous imposition which subjected every farmer, manufacturer, merchant and shopkeeper to the continual visits and examination of the tax-gatherers, whose number was necessarily very great.

ALCAZAR, B. DEL (1530-1606), Spanish poet, was born at Seville. He served under the Marqués de Santa Cruz and afterwards in the households of the Duque de Alcalá and of the Conde de Gelves. Alcazar belonged to the Italianate school and modelled himself on Martial. The grace and cynicism of Baltasar del Alcazar are manifested in his *Poesías* (ed. F. R. Marín, 1910).

ALCÁZAR DE SAN JUAN or **ALCÁZAR**, Spain, province of Ciudad Real, and an important railway junction, where the lines to the east and south-east diverge from the main line to Andalusia. Pop. (1940) 23,083 (mun., 26,141). Alcázar trades in wine and manufactures soap, gunpowder, chocolate and inlaid daggers. It is sometimes identified with the Roman *Alce*, captured by Tiberius Sempronius Gracchus in 180 B.C. It derives its name from its mediaeval Moorish castle (*al-kasr*), afterwards garrisoned by the knights of St. John. The entire district is associated with Cervantes and with the action of *Don Quixote* (El Toboso, 12 mi. E.N.E.; Argamasilla de Alba, 22 mi. S.E.). Local antiquaries even identify the knight with Don Rodrigo de Pacheco, whose portrait adorns the parish church.

ALCESTER, FREDERICK BEAUCHAMP PAGET SEYMOUR, BARON (1821-95), British admiral, was born April 12, 1821. Entering the navy in 1834, he served in the Mediterranean and the Pacific, was for three years flag-lieutenant to his uncle Sir George Seymour, and was promoted to be commander in 1847. He had a distinguished naval record and held a series of high commands. In 1880-83 he was commander-in-chief of the fleet in the Mediterranean, and in 1880 had also the chief command of the European squadron sent to the coast of Albania as a demonstration to the Porte to cede Dulcigno to Montenegro. In July 1882 Admiral Seymour commanded at the bombardment of Alexandria and in the subsequent operations on the coast of Egypt, for which service he was raised to the peerage, received a parliamentary grant of £25,000, the freedom of the City of London and a sword of honour. He retired from the service in 1886, and died in London, March 30, 1895.

ALCESTER (aul'stūr), a market-town, Warwickshire, England, 16 mi. W.S.W. of Warwick on the G.W. and L.M.S. railways. Population of rural district (1938) 11,610. It is situated at the junction of the small stream Alne with the Arrow, a northern tributary of the Avon.

The name (Alnecester, Alnycester) signifies "the camp on the Alne." A small Romano-British town or village was situated here on the road which ran from Derby to join the Fosse Way near Cirencester. Pavements, potsherds, coins and burials have been found, but nothing to indicate an important station. No written document relating to Alcester exists before the reign of Henry I. when it seems to have been a royal borough, but the title of borough soon lapsed. In the reign of Henry III. a moiety of the manor was purchased by Sir Walter Beauchamp, who granted a charter establishing a Tuesday market for corn, cattle and all kinds of merchandise, and also obtained grants of fairs. In 1444 Sir John Beauchamp purchased the remaining moiety of the manor, and was granted an additional fair. From this date the Beauchamps were lords of the whole manor until it passed by female descent to the Grevilles in the reign of Henry VIII. In 1140 a Benedictine monastery was founded here by Ralph Boteler of Oversley, and received the name of the Church of Our Lady of the Isle, owing to its insulation by a moat meeting the River Arrow. The monastery was suppressed among the smaller houses in 1536. Traces of the moat and the foundations are still to be seen in Priory Close. The ancient fairs sur-

vived to the end of the 19th century. The church of St. Nicholas was rebuilt in 1734.

The manufacture of needles, which employed nearly 1,000 hands in 1830, is now unimportant, having been absorbed into the centre of the industry at Redditch, but needle stamping and scouring are carried on. There are implement and cycle works, metal glazing and polishing being a special feature.

ALCESTIS, in Greek legend, the wife of Admetus (*q.v.*).

ALCHEMY. In the narrow sense of the word, alchemy is the pretended art of making gold and silver, or transmuting the base metals into the noble ones. The idea of such transmutation probably arose among the Alexandrian Greeks in the early centuries of the Christian era; thence it passed to the Arabs, by whom it was transmitted to western Europe. Its realization was a leading aim of chemical workers down to the time of Paracelsus and even later. Alchemy in its wider and truer significance stands for the chemistry of the middle ages. The idea of transmutation, in the country of its origin, had a philosophical basis, and was linked up with the Greek theories of matter then current. Thus, by supplying a central philosophical principle, it to some extent unified and focused chemical effort, which previously, so far as it existed at all, had been expended on acquiring empirical acquaintance with a mass of disconnected technical processes. Alchemy in this sense is merely an early phase of the development of systematic chemistry; in Liebig's words, it was "never at any time anything different from chemistry."

Regarding the derivation of the word, there are two main views which agree in holding that it has an Arabic descent, the prefix *al* being the Arabic article. But according to one, the second part of the word comes from the Greek *χυμela*, pouring, infusion, used in conjunction with the study of the juices of plants, and thence extended to chemical manipulations in general; this derivation accounts for the old-fashioned spellings "chymist" and "chymistry." The other view traces it to *khem* or *khamé*, hieroglyph *khmi*, which denotes black earth as opposed to barren sand, and occurs in Plutarch as *χυμela*. On this derivation alchemy is explained as meaning the "Egyptian art"; i.e., the art of the black land. The first occurrence of the word is said to be in a treatise of Julius Firmicus, an astrological writer of the 4th century, but the prefix *al* there must be the addition of a later copyist. In English, *Piers Plowman* (1362) contains the phrase "experimentis of alcomonye," with variants "alkenemye" and "alnameye." The prefix *al* begins to be dropped about the middle of the 16th century.

Origins of Alchemy.—Numerous legends cluster round the origin of alchemy. According to one story, it was founded by the Egyptian god Hermes (Thoth), the reputed inventor of the arts and sciences; after him later alchemists called their work the "hermetic art," and the seal of Hermes, which they placed upon their vessels, is the origin of the common phrase "hermetically sealed." Another legend asserts that the fallen angels taught the arts to the women they married, their instruction being recorded in a book called *Chemā*. A similar story appears in the Book of Enoch, and Tertullian has much to say about the wicked angels who revealed to men the knowledge of gold and silver, of lustrous stones and of the power of herbs, and who introduced the arts of astrology and magic upon the earth. Another legend to be found in Arabic sources, asserts that alchemy was revealed by God to Moses and Aaron. But there is some evidence that, in accordance with the strong and constant tradition among the alchemists, the idea of transmutation did originate in Egypt with the Greeks of Alexandria. In the Leyden museum there are a number of papyri which were found in a tomb at Thebes in 1828, written probably in the 3rd century A.D., though their matter is much older. Some are in Greek and demotic, and one, of peculiar interest from the chemical point of view, gives a number of recipes, in Greek, which show a considerable knowledge in the manipulation of base metals to form alloys which simulate gold, and are intended to be used as a workshop manual in the manufacture of imitation jewellery. Possibly this is one of the books about gold and silver of which Diocletian decreed the destruction about A.D. 290. It has been suggested by M. P. E. Berthelot (*q.v.*) that the workers in

these processes, which were a monopoly of the priestly caste and were kept strictly secret, though fully aware that their products were not truly gold, were in time led by their success in deceiving the public to deceive themselves also, and to come to believe that they actually had the power of making gold from substances which were not gold. Philosophical sanction and explanation of this belief was then found by bringing it into relation with the theory of the *prima materia*, which was identical in all bodies but received its actual form by the adjunction of qualities expressed by the Aristotelian elements—earth, air, fire and water. Some support for this view is gained from study of the alchemical writings of the period. Thus, in the treatise known as *Physica et Mystica* and falsely ascribed to Democritus (such false attributions are a constant feature of the literature of alchemy), various recipes are given for colouring and gilding metals, but the conception of transmutation does not occur. This treatise was probably composed at a date not very different from that of the Leyden papyrus. Later, however, as in the *Commentary* on this work written by Synesius to Dioscorus, priest of Serapis at Alexandria, which probably dates from the end of the 4th century, a changed attitude becomes apparent. The more practical parts of the recipes are obscured or omitted, and the processes for preparing alloys and colouring metals, described in the older treatise, are by a mystical interpretation represented as resulting in real transmutation.

But while there are thus some grounds for supposing that the idea of transmutation grew out of the practical recipes of Alexandrian Egypt, the alchemy which embraced it as a leading principle was also much affected by eastern influences such as magic and astrology. The earliest Greek alchemical writings abound in references to oriental authorities and traditions. Thus the pseudo-Democritus, who was the reputed author of the *Physica et Mystica*, which itself concludes each of its recipes with a magical formula, was believed to have travelled in Chaldaea, and to have had as his master Ostanos the Mede, a name mentioned several times in the Leyden papyrus, and often by early Christian writers such as Tertullian, St. Cyprian and St. Augustine. The practices of the Persian adepts also are appealed to in the writings of the pseudo-Democritus, and of Zosimus and Synesius. The philosopher's egg, as a symbol of creation, is both Egyptian and Babylonian. In the Greek alchemists it appears as the symbol at once of the art and of the universe, enclosing within itself the four elements. The conception of man, the microcosm, containing in himself all the parts of the universe or macrocosm, is also Babylonian, as again probably is the famous identification of the metals with the planets. Even in the Leyden papyrus the astronomical symbols for the sun and moon are used to denote gold and silver, and in the *Meteorologica* of Olympiodorus lead is attributed to Saturn, iron to Mars, copper to Venus, tin to Hermes (Mercury) and electrum to Jupiter. Similar systems of symbols, but elaborated to include compounds, appear in Greek mss. of the 10th century, preserved in the library of St. Mark's at Venice. Subsequently electrum (an alloy of gold and silver) disappeared as a specific metal, and tin was ascribed to Jupiter instead, the sign of mercury becoming common to the metal and the planet.

Literature of Alchemy.—A considerable body of Greek chemical writings is contained in mss. belonging to the various great libraries of Europe, the oldest being that at St. Mark's, just mentioned. The contents of these mss. are all of similar composition, and in Berthelot's opinion represent a collection of treatises made at Constantinople in the 8th or 9th century. The treatises are nearly all anterior to the 7th century, and most appear to belong to the 3rd and 4th centuries; some are the work of authentic authors like Zosimus and Synesius, while others, such as profess to be written by Moses, Democritus, Ostanos, etc., are of clearly fictitious authorship. Some of the same names and the same works can be identified in the lists of the *Kitáb-al-Fihrist* (written by al-Nadim toward the end of the 10th century). But the Arabs did not acquire their knowledge of this literature at first hand. The earliest Hellenic culture in the east was Syrian, and the Arabs made their first acquaintance with Greek chemistry, as with Greek philosophy, mathematics, medicine, etc., by the

intermediary of Syriac translations. (See ARABIAN PHILOSOPHY and SYRIAC LITERATURE.) Examples of such translations are preserved in mss. at the British Museum, partly written in Syriac, partly in Arabic with Syriac characters. In Berthelot's opinion, the Syriac portion represents a compilation of recipes and processes undertaken in the Syrian school of medicine at Baghdad under the Abbassids in the 9th or 10th century, and to a large extent constituted by the earlier translations made by Sergius of Resaena in the 6th century. They contain, under the title *Doctrine of Democritus*, a fairly methodical treatise in ten books comprising the *Argyropoeia* and *Chrysopoeia* of the pseudo-Democritus, with many recipes for colouring metals, making artificial precious stones, effecting the *diplosis* or doubling of metals, etc. They give illustrations of the apparatus employed, and their close relationship to the Greek is attested by the frequent occurrence of Greek words and the fact that the signs and symbols of the Greek alchemists appear almost unchanged. The other portion seems of somewhat later date. Another Syriac ms., in the library of Cambridge University, contains a translation of a work by Zosimus which is so far unknown in the original Greek. Berthelot gives reproductions of the British Museum mss. in vol. ii of *La Chimie au moyen âge*.

Several alchemical treatises, written in Arabic, exist in manuscript in the National Library at Paris and in the library of the University of Leyden, and have been reproduced by Berthelot, with translations, in vol. iii of *La Chimie au moyen âge*. They fall into two groups; those in one are largely composed of compilations from Greek sources, while those in the other have rather the character of original compositions. Of the first group the most interesting and possibly the oldest is the *Book of Crates*; it is remarkable for containing some of the signs used for the metals by the Greek alchemists, and for giving figures of four pieces of apparatus which closely resemble those depicted in Greek mss., the former being never, and the latter rarely, found in other Arabic mss. Its concluding words suggest that its production was due to Khalid ben Yezid (died in 708), who was a pupil of the Syrian monk Marianus, and according to the *Kitáb-al-Fihrist* was the first Moslem writer on alchemy. The second group consists of a number of treatises professing to be written by Jabir, celebrated in Latin alchemy as Geber (*q.v.*). Internal evidence suggests that they are not all from the same hand or of the same date, but probably they are not earlier than the 9th nor later than the 12th century. The Arabic chroniclers record the names of many other writers on alchemy, among the most famous being Rhazes and Avicenna who were physicians.

But the further development of alchemy took place in the west rather than in the east. With the spread of their empire to Spain the Arabs took with them their knowledge of Greek medicine and science, including alchemy, and thence it passed to the nations of western Europe, through the medium of Latin translations which began about the 11th century. The *Liber de compositione alchemiae*, which professes to be by Morienus—perhaps the same as the Marianus who, according to legend, was the teacher of Khalid—was translated by Robertus Castrensis, who states that he finished the work in 1182. The earlier translations, such as the *Turba Philosophorum* and other works printed in collections like the *Artis auriferæ quam chemiam vocant* (1572), *Theatrum chemicum* (1602) and J. J. Manget's *Bibliotheca chemica curiosa* (1702), are confused productions, written in an allegorical style, but full of phrases and even pages taken literally from the Greek alchemists, and citing by name various authorities of Greek alchemy. They were followed by treatises of a different character, clearer in matter, more systematic in arrangement, and reflecting the methods of the scholastic logic. These are farther from the Greek tradition, for although they contain sufficient traces of their ultimate Greek ancestry, their authors do not know the Greeks as masters and cite no Greek names. So far as they are Latin versions of Arabico-Greek treatises, they must have been much remodelled in the course of translation; but there is reason to suppose that many of them, even when pretending to be translations, are really original compositions. It is curious that although we possess a certain number of works on alchemy written in Arabic,

and also many Latin treatises that profess to be translated from Arabic, yet in no case is the existence known of both the Arabic and the Latin version. The Arabic works of Jabir, as contained in mss. at Paris and Leyden, are quite dissimilar from the Latin works attributed to Geber, and show few if any traces of the positive chemical knowledge, as of nitric acid (*aqua dissolutiva* or *fortis*) or of the mixture of nitric and hydrochloric acids known as *aqua regis* or *regia*, that appears in the latter. The treatises attributed to Geber, in fact, appear to be original works composed not earlier than the 13th century and fathered on Jabir in order to enhance their authority.¹ If this view be accepted, an entirely new light is thrown on the achievements of the Arabs in the history of chemistry, for the chemical knowledge attributed to the Arabs has been so attributed largely on the basis of the contents of the Latin Geber, regarded as a translation from the Arabic Jabir. If, then, those contents do not represent the knowledge of Jabir, and if the contents of other Latin translations, which there is reason to believe are really made from the Arabic, show little, if any, advance on the knowledge of the Alexandrian Greeks, evidently the part played by the Arabs must be less, and that of the westerners greater, than is generally supposed.

The descent of alchemical doctrine can thus be traced with fair continuity for 1,000 years, from the Greeks of Alexandria down to the time when Latin alchemy was firmly established in the west, and began to be written of by historical authors like Albertus Magnus, Roger Bacon and Arnoldus Villanovanus in the 13th century. But side by side with this literary transmission Berthelot insists that there was another mode of transmission, by means of the knowledge of practical recipes and processes traditional among jewellers, painters, workers in glass and pottery and other handicraftsmen. The chemical knowledge of Egyptian metallurgists and jewellers, he holds, was early transmitted to the artisans of Rome, and was preserved throughout the dark ages in the workshops of Italy and France until about the 13th century, when it was mingled with the theories of the Greek alchemists which reached the west by way of the Arabs. Recipes given in the Leyden papyrus reappear in the *Compositiones ad Tingenda* and the *Mappae Clavicula*, both workshop recipe books, one known in an 8th century ms. at Luca, and the other in a 10th century ms. in the library of Schlettstadt; and again in such works as the *De Artibus Romanorum* of Eraclius and the *Schedula Diversarum Artium* of Theophilus, belonging to the 11th or 12th century.

Chinese Alchemy.—It is a debated question whether alchemy in China was indigenous or imported. The great authority, E. O. von Lippmann, believed it was brought in during the 8th century, when the port of Canton was opened to foreigners. All materials were believed to consist of the prime substance *tao*, but to differ in properties in proportion to the relative content of *yang* and *yin*. These were opposing qualities variously described as odd and even, light and dark, warm and cold, male and female, spiritual and material. Consequently, transmutation seemed entirely possible. The Chinese also accepted a five element theory: water, fire, wood, metal and earth, which changed one into the other in an unending cycle. The preparation of *tan*, or elixir of life, was one of the principal objectives. The most famous Chinese alchemist was Ko Hung, 4th century A.D. His treatises are still extant. He states that vegetable medicinals will prolong life, but immortality can be achieved only by the use of a divine elixir prepared from minerals and metals.

Theory of Transmutation.—The fundamental theory of the transmutation of metals is to be found in the Greek alchemists, although in details it was modified and elaborated by the Arabs and the Latin alchemists. Regarding all substances as being composed of one primitive matter—the *prima materia*—and as owing their specific differences to the presence of different qualities imposed upon it, the alchemist hoped, by taking away these qualities, to obtain the *prima materia* itself, and then to get from it the particular substance he desired by the addition of the appropriate qualities. The *prima materia* was early identified with mercury, not ordinary mercury, but the "mercury of the philosophers," which was the essence or soul of mercury, freed from the four Aristotelian elements—earth, air, fire and water—or rather from the qualities which they represent. Thus the operator had to remove from ordinary mercury, earth or an earthy principle or quality, and water or a liquid principle, and to fix it by taking away air or a volatile principle. The *prima materia* thus obtained had to be treated with sulphur (or with sulphur and arsenic) to confer upon it the desired qualities that were missing. This sulphur again was not ordinary sulphur, but some principle derived from it, which constituted the philosopher's stone or elixir—white for silver

and yellow or red for gold. This is briefly the doctrine that the metals are composed of mercury and sulphur, which persisted in one form or another down to the 17th century. Of course there were numerous variations and refinements. Thus in the *Speculum Naturale* of Vincent of Beauvais (c. 1250) it is said that there are four spirits—mercury, sulphur, arsenic and sal ammoniac—and six bodies—gold, silver, copper, tin, lead and iron. Of these bodies the first two are pure, the last four impure. Pure white mercury, fixed by the virtue of white noncorrosive sulphur, engenders in mines a matter which fusion changes into silver and united to pure clear red sulphur it forms gold, while with various kinds of impure mercury and sulphur the other bodies are produced. Vincent attributes to Rhazes the statement that copper is potentially silver, and any one who can eliminate the red colour will bring it to the state of silver, for it is copper in outward appearance, but in its inmost nature silver. This statement represents a doctrine widely held in the 13th century, and also to be found in the Greek alchemists, that everything endowed with a particular apparent quality possesses a hidden opposite quality, which can be rendered apparent by fire. Later, as in the works attributed to Basil Valentine, sulphur, mercury and salt are held to be the constituents of the metals.

It must be noted that the processes described by the alchemists of the 13th century are not put forward as being miraculous or supernatural. They rather represent the methods employed by nature, which it is the end of the alchemist's art to reproduce artificially in the laboratory. It was widely believed that worked-out mines would replenish themselves in time as a result of the growth of the minerals in the earth. But even among the late Arabian alchemists it was doubted whether the resources of the art were adequate to the task; and in the west, Vincent of Beauvais remarks that success had not been achieved in making artificial metals identical with the natural ones. Thus he says that the silver which has been changed into gold by the projection of the red elixir is not rendered resistant to the agents which affect silver but not gold, and Albertus Magnus in his *De Mineralibus*—the *De Alchemia* attributed to him is spurious—states that alchemy cannot change species but merely imitates them—for instance, colours a metal white to make it resemble silver or yellow to give it the appearance of gold. He has, he adds, tested gold made by alchemists, and found that it will not withstand six or seven exposures to fire. But scepticism of this kind was not universal. Roger Bacon—or more probably some one who usurped his name—declared that with a certain amount of the philosopher's stone he could transmute a million times as much base metal into gold, and on Raimon Lull was fathered the boast "Mare tingere[m] si mercurius esset."

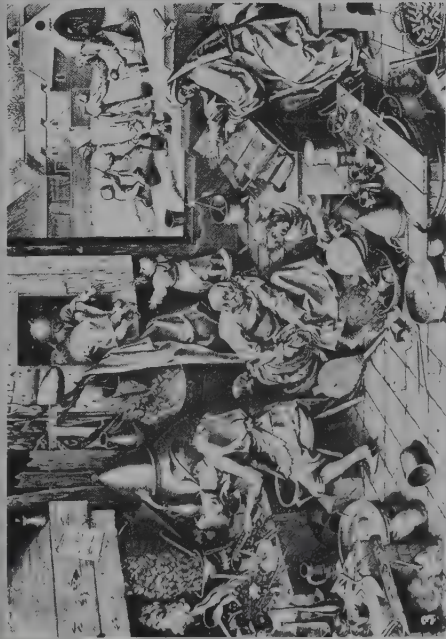
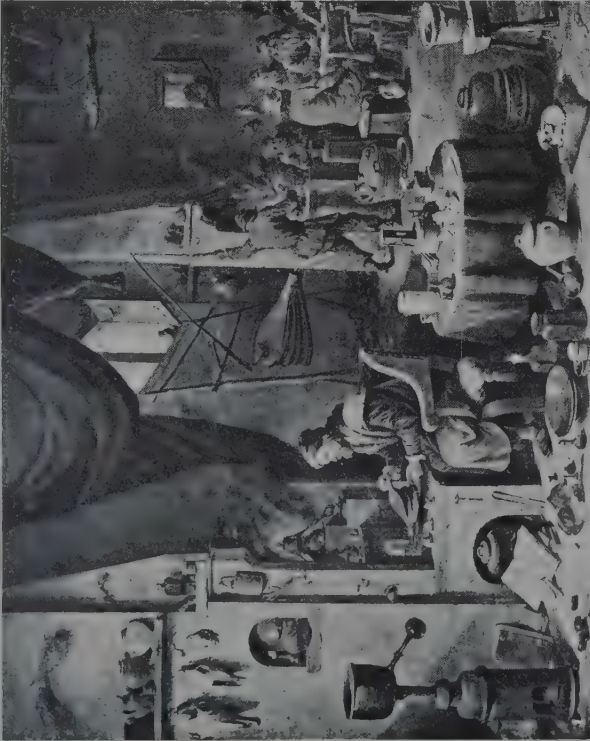
Later History of Alchemy.—In the earlier part of the 16th century Paracelsus gave a new direction to alchemy by declaring that its true object was not the making of gold but the preparation of medicines. This union of chemistry with medicine was one characteristic of the iatrochemical school of which he was the precursor. The search for the elixir of life had usually gone hand in hand with the quest for the philosopher's stone. The alkahest or universal solvent was likewise an objective of some alchemists. Increasing attention was paid to the investigation of the properties of substances and of their effects on the human body, and chemistry profited by the fact that it passed into the hands of men who possessed the highest scientific culture of the time. Still, belief in the possibility of transmutation long remained orthodox, even among the most distinguished men of science. Thus it was accepted, at least academically, by Andreas Libavius (d. 1616); by F. de la Boë Sylvius (1614-72), though not by his pupil Otto Tachenius and by J. R. Glauber (1603-68); by Robert Boyle (1627-91) and, for a time at least, by Sir Isaac Newton and his rival and contemporary, G. W. Leibnitz (1646-1716); and by G. E. Stahl (1660-1734) and Hermann Boerhaave (1668-1738). Though an alchemist, Boyle, in his *Sceptical Chemist* (1661), cast doubts on the "experiments whereby vulgar Spagyrist are wont to endeavour to evince their salt, sulphur and mercury to be the true principles of things," and advanced towards the conception of chemical elements as those constituents of matter which cannot be further decomposed. With J. J. Becher (1635-82) and G. E. Stahl, however, there was a reversion to earlier ideas. The former substituted for the salt, sulphur and mercury of Basil Valentine and Paracelsus three earths—the mercurial, the vitreous and the combustible—and he explained combustion as depending on the escape of this last combustible element; while Stahl's conception of phlogiston—not fire itself, but the principle of fire—by virtue of whose loss combustible bodies burned, was a near relative of the mercury of the philosophers, the soul or essence of ordinary mercury.

Perhaps J. B. van Helmont (1577-1644) was the last distinguished investigator who professed actually to have changed mercury into gold, though impostors and mystics of various kinds continued to claim knowledge of the art long after his time. After the early years of the 20th century, however, the possibility of the transmutation of elements entered upon a new phase.

(See RADIOACTIVITY.)

¹These conclusions, which are due mainly to Berthelot, have been criticized by E. J. Holmyard and by J. R. Partington (*Nature*, 1923, vol. iii, pp. 191, 219). The former believes Geber to have been Jābir ibn Haiyān (8th century), and the latter believes the Latin works are correctly ascribed to Geber. See J. Ruska's essay "Pseudo-Geber" in Bugge's *Das Buch der Grossen Chemiker* (1929).

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BY COURTESY OF (3) THE TRUSTEES OF THE BRITISH MUSEUM; PHOTOGRAPH, (1) HANFSTÄNGL

LABORATORIES OF ALCHEMISTS

1. "The Alchemist," by David Teniers the Younger (1610-90)
2. Holding a salamander in the fire. From "The Book of Lambsprink"
3. "The Alchemist at Work," attributed to Pieter Bruegel the Elder, about 1558
4. "The German Alchemist," attributed to Hans Holbein the Younger (1497-1543)

Berthelot, *Les Origines de l'alchimie* (1885); *Collection des anciens alchimistes grecs* (text and translation, 3 vols., 1887–88); *Introduction à l'étude de la chimie des anciens et du moyen âge* (1889); *La Chimie au moyen âge* (text and translation of Syriac and Arabic treatises on alchemy, 3 vols., 1893); G. W. Gessmann, *Die Geheimsymbole der Chemie und Medizin des Mittelalters* (1900); John Ferguson, *Bibliotheca chemica* (2 vols., 1906); H. S. Redgrove, *Alchemy: ancient and modern* (2nd ed., 1922); E. O. von Lippmann, *Die Entstehung und Ausbreitung der Alchemie* (2 vols., 1919–1931); A. P. Hopkins, *Alchemy, Child of Greek Philosophy* (1934); H. Kopp, *Die Alchemie in älterer und neuerer Zeit* (1886); J. E. Mercer, *Alchemy, its Science and Romance* (1921); M. M. P. Muir, *The Story of Alchemy and the Beginnings of Chemistry* (1902); J. Read, *Prelude to Chemistry* (1936); K. Schneider, *Geschichte der Alchemie* (1832, reissued 1927); J. M. Stillman, *The Story of Early Chemistry* (1924); A. E. Waite, *Lives of Alchemystical Philosophers* (1888); and *The Secret Tradition in Alchemy* (1926); M. Chikashige, *Alchemy and Other Chemical Achievements of the Ancient Orient* (1936); H. C. Bolton, *The Follies of Science at the Court of Rudolph II* (1904). (H. M. R.; X.)

ALCIATI, ANDREA (1492–1550), Italian jurist, was born in Alzano, near Milan, on Jan. 12, 1492. He was one of the first to interpret the civil law by the history, languages and literature of antiquity, and to substitute original research for the servile interpretations of the glossators. His *Emblems*, a collection of moral sayings in Latin verse, was translated into French, Italian and Spanish.

ALCIBIADES (c. 450–404 B.C.), Athenian general and politician. He belonged to the family of the Alcmaeonidae, and was a near relative of Pericles. He was very handsome and possessed great wealth, which he squandered in every sort of dissipation and extravagance, including the upkeep of a fine stud of horses (Thuc. vi. 12, 16). He was an admirer of Socrates, who saved his life at Potidaea (432), a service which Alcibiades repaid at Delium; but he could not practise his master's virtues, and there is no doubt that the example of Alcibiades strengthened the charges brought against Socrates of corrupting the youth (399). In 421 he came to the fore as the political opponent of Nicias and the peace-party, and engineered an anti-Spartan alliance between Athens and the democracies of Argos, Mantinea and Elis. Sparta was thus placed in a critical position, and the policy might have been successful had Athens given it whole-hearted support. But in 418 Alcibiades was not re-elected general, and Sparta broke up the confederacy by the crushing victory of Mantinea. On the failure of Nicias in Thrace (418–417) he became the chief advocate of the Sicilian expedition, partly from policy and partly from private ambition, and was appointed commander jointly with Nicias and Lamachus. But on the day before the expedition sailed there occurred the mysterious mutilation of the Hermæ, and Alcibiades was accused not only of being the originator of the crime, but also of having profaned the Eleusinian mysteries. He demanded an immediate inquiry, but his enemies obliged him to set sail with the charge still hanging over him. When he reached Sicily he was recalled to stand his trial, but on the journey home he escaped to Sparta. Learning that he had been condemned to death in his absence, he openly joined the Spartans and persuaded them to send Gylippus to assist the Syracusans and to fortify Decelea in Attica, advice which proved the ruin of Athens. He then passed over to Asia Minor, induced many of the Ionic allies of Athens to revolt, and made an alliance with the Persian satrap Tissaphernes. But in a few months he had lost the confidence of the Spartans and made an enemy of King Agis. He therefore retired to the court of Tissaphernes (412), and hoping to secure his recall to Athens, advised the satrap to withdraw his active support from Sparta. At the same time he conspired with the oligarchic party at Athens, who brought about a revolution in 411 but did not recall Alcibiades. He therefore attached himself to the fleet at Samos, which remained loyal to the democracy, and was recalled by Thrasybulus, but he did not at once return to Athens. Being appointed commander in the neighbourhood of the Hellespont, he defeated the Spartan fleet at Abydos (411) and Cyzicus (410), and recovered Chalcedon and Byzantium. These successes encouraged him to return to Athens, where he was welcomed with enthusiasm (407); proceedings against him were cancelled, and he was appointed general with full powers. But the Athenians did not fully trust him, and

the defeat at Notium (407) led them to dismiss him from his command. He thereupon retired to the Thracian Chersonesus. After the final defeat of Athens he took refuge in Phrygia with Pharnabazus, who was induced by the Spartans to have him murdered (404).

Alcibiades possessed great charm and brilliant abilities but was absolutely unprincipled. His advice, whether to Athens or Sparta, oligarchs or democrats, was dictated by selfish motives, and the Athenians could never trust him sufficiently to take advantage of his talents. "They feared," says Thucydides, "the extremes to which he carried his lawless self-indulgence, and . . . thought he was aiming at a tyranny . . . therefore, though his talents as a military commander were unrivalled, they entrusted the administration of the war to others; and so they speedily shipwrecked the state" (Jowett's trans.).

BIBLIOGRAPHY.—Thuc. v., vi., vii. 18; viii.; Plato, *Symposium*; Xen. *Hellenica* I. and II.; *Alcibiades*, by Plutarch and Cornelius Nepos; Houssaye, *Histoire d'Alcibiade* (1873); G. Grote, *History of Greece*; E. F. Benson, *The Life of Alcibiades* (1929); Ed Meyer, and works quoted under GREECE: *Ancient History*; also PELOPONNESIAN WAR.

ALCIDAMAS, of Elaea, in Aeolis, Greek sophist and rhetorician, flourished in the 4th century B.C. He was the pupil and successor of Gorgias and taught at Athens at the same time as Isocrates. We possess two declamations under his name: *Περὶ Σοφιστῶν*, directed against his rival Isocrates and setting forth the superiority of extempore over written speeches (a recently discovered fragment of another speech against Isocrates is probably of later date); *Ὀδυσσεύς*, in which Odysseus accuses Palamedes of treachery during the siege of Troy (this is generally considered spurious). Of other works only fragments and the titles have survived: *Μεσσηνιακός*, advocating the freedom of the Messenians and containing the sentiment that "all are by nature free"; a *Eulogy of Death*, in consideration of the wide extent of human sufferings; a *Τέχνη* or instruction-book in the art of rhetoric; and a *Φυσικός λόγος*. Lastly, his *Μουσείον* (a word of doubtful meaning) contained the narrative of the contest between Homer and Hesiod, two fragments of which are found in the *Ἰγών Ὀμήρου καὶ Ἡσιόδου*, the work of a grammarian in the time of Hadrian. A 3rd-century papyrus (Flinders Petrie, *Papyri*, ed. Mahaffy, 1891, pl. xxv.) probably contains the actual remains of a description by Alcidamas.

See fragments in Müller, *Oratores Attici*, ii. (1858); Vahlen, *Der Rhetor Alkidamas* (1864); Blass, *Die attische Beredsamkeit*; and the edition by Blass, 1881.

ALCINOUS (Gr. ἄλ-κῖν-ῶ-ῶς), in ancient Greek legend, king of the Phaeacians, in the island of Scheria, son of Nausithous and grandson of Poseidon. His reception and entertainment of Odysseus (*q.v.*), who when cast by a storm on the shore of the island was relieved by the king's daughter, Nausicaa, is described in the *Odyssey* (vi., xiii.). Scheria was identified in very early times with Corcyra, where Alcinoos was revered as a hero. In the Argonautic legend, his abode was the island of Drepane (Apoll. Rhodius iv., 990).

ALCINOUS, the Platonic philosopher, lived probably in the time of the Caesars. He was the author of an analysis of Plato's philosophy, and attributed to Plato ideas of other philosophers. He produced latterly a synthesis of Plato and Aristotle with an admixture of Pythagorean or Oriental mysticism, and is closely allied to the Alexandrian school of thought. He recognized a God who is unknowable, and a series of beings (*δαίμονες*) who hold intercourse with men. He recognized also ideas and matter, and borrowed largely from Aristotle and the Stoics.

The *Ἐννοιῶν* has been translated by Pierre Balbi (Rome, 1469) and by Marsilio Ficino; into French by J. I. Combes-Dounous (1800); and into English by Thomas Stanley in his *History of Philosophy*. Editions: Heinsius (Leyden, 1630); Fischer (Leipzig, 1783); in Aldine Edition of Apuleius (Venice, 1521, 1532); Fell (1667). See Ritter, *Geschichte der Philosophie*, iv. 249.

ALCIPHRON, Greek rhetorician, was probably a contemporary of Lucian (2nd century A.D.). He was the author of a collection of fictitious letters, of which 124 (118 complete and six fragments) have been published; they are written in the purest Attic dialect and are considered models of style. The scene is throughout at Athens; the imaginary writers are country people,

fishermen, parasites and courtesans, who express their sentiments and opinions on familiar subjects in elegant language. The "courtesan" letters are especially valuable, the information contained in them being chiefly derived from the writers of the New Comedy, especially Menander.

BIBLIOGRAPHY.—*Editio princeps* (44 letters) (1499); S. Bergler (1715); Eng. trans. by T. Monro and W. Beloe (1791); E. E. Seiler (1856); R. Hercher (1873); M. A. Schepers (1905); F. A. Wright (1923). A German trans. of *Hetärenbriefe*, by A. W. Plankl (München, 1925).

ALCIRA, eastern Spain, province of Valencia; on the left bank of the river Júcar. Pop. (1940) 20,951 (mun. 24,518). Alcira is a walled town, surrounded by palm, orange and mulberry groves, and by low-lying and unhealthy rice-swamps. Silk, fruit, rice and cabinet woods are its chief products. It has a Roman bridge and has been thought to be the Roman Saetabula or Suero; it was later a Moorish trading station.

ALCMAEON, of Argos, in Greek legend, was the son of Amphiarus (*q.v.*) and Eriphyle. When his father set out with the expedition of the Seven against Thebes, which he knew would be fatal to him, he enjoined upon his sons to avenge his death by slaying Eriphyle and undertaking a second expedition against Thebes. After the destruction of Thebes by the Epigoni, Alcmaeon carried out his father's injunctions by killing his mother, as a punishment for which he was driven mad and pursued by the Erinyes from place to place.

On his arrival at Psophis in Arcadia, he was purified by its king Phegeus, whose daughter Arsinoe (or Alpheisboea) he married, making her a present of the fatal necklace and the robe of Harmonia. But the land was cursed with barrenness, and the oracle declared that Alcmaeon would never find rest until he reached a spot on which the sun had never shone at the time he slew his mother. Such a spot he found at the mouth of the river Achelous, where an island had recently been formed by the alluvial deposit; here he settled and, forgetting his wife Arsinoe, married Callirrhoe (*q.v.*), the daughter of the river-god.

His new wife longed for the necklace and robe, and Alcmaeon, returning to Psophis, obtained possession of them, on the pretence that he desired to dedicate them at Delphi. When the truth became known he was pursued and slain by Phegeus and his sons. After his death Alcmaeon was worshipped at Thebes; his tomb was at Psophis in a grove of cypresses.

His story was the subject of an old epic and of several tragedies, but none of them has been preserved.

See Apollodorus iii, 7; Thucydides ii, 68, 102; Pausanias viii, 24, x, 10; Ovid, *Metam.* ix, 400 et seq.

ALCMAEONIDAE, a powerful Athenian family, which played a leading part in the politics of the 5th and 6th centuries, B.C. They claimed descent from Alcmaeon, the great-grandson of Nestor, who emigrated from Pylos to Athens at the time of the Dorian invasion of Peloponnesus. During the archonship of an Alcmaeonid Megacles (?632 B.C.) Cylon, who had unsuccessfully attempted to make himself "tyrant," was treacherously murdered with his followers. The curse or pollution of blood-guilt thus incurred (*cf.* esp. Hdt. v, 70–71 and Thuc. i, 126–27) was frequently in later years raked up for political reasons; the Spartans even demanded that Pericles (*q.v.*) should be expelled as accused at the beginning of the Peloponnesian War. All the members of the family went into banishment, and having returned in the time of Solon (594) were again expelled (538) by Peisistratus (*q.v.*). Alcmaeon seems to have made his fortune through the favour of the kings of Lydia.

The great wealth of the family enabled them during their exile to enhance their reputation and secure the favour of the Delphian Apollo by rebuilding the temple after its destruction by fire in 548. Their importance is shown by the fact that Cleisthenes, tyrant of Sicyon, gave his daughter Agariste in marriage to the Alcmaeonid Megacles in preference to all the assembled suitors after the undignified behaviour of Hippocleides. Megacles led the merchant party in opposition to the tyrant Peisistratus which occasioned the third exile of the family (Hdt. i, 59). Under the statesman Cleisthenes (*q.v.*), son of Megacles and Agariste, the Alcmaeonids became supreme in Athens about 510 B.C. He drove out the

tyrants, defeated the Spartan attempt to set up an oligarchy, and by his reforms secured the Athenian democracy. To the Alcmaeonids, however, was generally attributed (though Herodotus disbelieved the story) the treacherous raising of the shield as a signal to the Persians at Marathon, but, whatever the truth of this may have been, there can be little doubt that they were not the only one of the great Athenian families to make treasonable overtures to Persia. Pericles and Alcibiades were both members of the Alcmaeonid family. Nothing is heard of them after the Peloponnesian War.

See Herodotus vi, 121–131, and articles on ALCIBIADES, CLEISTHENES, GRAECO-PERSIAN WARS, PERICLES and *Camb. Anc. Hist.*, vol. iv, ch. vi, § 6 and ch. viii.

ALCMAN or **ALCMAEON** (the former being the Doric form of the name), the founder of Doric lyric poetry, to whom was assigned the first place among the nine lyric poets of Greece in the Alexandrian canon, flourished in the latter half of the 7th century B.C. He was a Lydian of Sardis, who came as a slave to Sparta, where he lived in the family of Agesidas, by whom he was emancipated and given the citizenship. His mastery of Greek shows that he must have come very early to Sparta, where, after the close of the Messenian wars, the people were able to bestow their attention upon the arts of peace. Alcmán composed various kinds of poems in various metres; Parthenia (maidens' songs), hymns, paeans, prosodia (processionals) and love songs, of which he was considered the inventor.

He was evidently fond of good living, and traces of Asiatic sensuousness seem out of place amid Spartan simplicity. The fragments are scanty, the most considerable being part of a *Parthenion* found in 1855 on an Egyptian papyrus; some hexameters discovered in 1898 were attributed to Alcmán or Erinna (*Oxyrhynchus papyri*, i, 1898).

For general authorities see **ALCAEUS**.

ALCMENE (álk-mā-nā), in Greek mythology the daughter of Electryon, king of Mycenae, and wife of Amphitryon. She was the mother of Heracles by Zeus, who assumed the likeness of her husband during his absence.

See Plautus, *Amphitruo*.

ALCOBAÇA, a town of Portugal, in the district of Leiria. Pop. (1940) 4,016. Alcobaca is chiefly interesting for its Cistercian convent, now partly converted into schools and barracks. The monastic buildings, a square, 725 ft. across, were founded in 1148 and completed in 1222. During the middle ages it rivalled the greatest European abbeys in size and wealth. It was supplied with water by an affluent of the Alcoa, which still flows through the kitchen. The convent was partly burned by the French in 1810, secularized in 1834, and afterward gradually restored. Portions of the library are now preserved in the public libraries of Lisbon and Braga. The monastic church (1222) is a good example of early Gothic, somewhat defaced by Moorish and other additions.

ALCOCK, JOHN (c. 1430–1500), English divine, was born at Beverley in Yorkshire and educated at Cambridge. In 1461 he was made dean of Westminster, and thereafter his promotion was rapid in church and state. In the following year he was made master of the rolls, and in 1470 was sent as ambassador to the court of Castile. He was consecrated bishop of Rochester in 1472 and was successively translated to the sees of Worcester (1476) and Ely (1486). He twice held the office of lord chancellor, and exhibited great ability in the negotiations with James III of Scotland. He died at Wisbech castle on Oct. 1, 1500.

Alcock was one of the most eminent pre-Reformation divines; he was a man of deep learning and also of great proficiency as an architect. Besides founding a charity at Beverley and a grammar school at Kingston-upon-Hull, he restored many churches and colleges; but his greatest enterprise was the erection of Jesus college, Cambridge, which he established on the site of the former convent of St. Radigund.

Alcock's published writings, most of which are extremely rare, are: *Mons Perfectionis, or the Hill of Perfection* (London, 1497); *Gallioctus Johannis Alcock episcopi Eliensis ad fratres suos curatos in sinodo apud Barnwell* (1498), a good specimen of early English printing and quaint illustrations; *The Castle of Labour*, translated from

the French (1536); and various other tracts and homilies.

See J. Bass Mullinger's *Hist. of the University of Cambridge*, vol. i.

ALCOCK, SIR JOHN WILLIAM (1892-1919), English aviator, was born in Manchester on Nov. 6, 1892, the son of a horse dealer. Before World War I he had been in possession of the aviation certificate for two years, when he joined the royal naval air force as an instructor in 1914. In 1916 he was posted at no. 2 wing at Mudros. Here he performed many famous exploits, including the bombing of Constantinople on Sept. 30, 1917.

He was forced to alight at sea near Suvla bay on his return from this expedition, and he and his companions swam ashore, and were taken prisoners by the Turks. After leaving the air force in March 1919, he made a flying record with Lieut. Arthur Whitten Brown by flying from St. John's, Newfoundland, to Clifden, Ireland, in 16 hr. 12 min. He was then created K.B.E. A week later Alcock was flying to Paris in an amphibian aeroplane when he sustained fatal injuries at Côte d'Evrard, Normandy, on Dec. 18, 1919. (See AVIATION, CIVIL; TRANS-OCEANIC AND TRANS-CONTINENTAL FLIGHTS.)

ALCOCK, SIR RUTHERFORD (1809-1897), British consul and diplomatist, was the son of Thomas Alcock, who practised medicine at Ealing, near London, and himself followed the medical profession. In 1836 he became a surgeon in the marine brigade which took part in the Carlist war, and gaining distinction by his services was made deputy inspector general of hospitals. He retired from this service in 1837, and seven years later was appointed consul at Fuchow in China, where, after a short official stay at Amoy, he performed the functions, as he himself expressed it, "of everything from a lord chancellor to a sheriff's officer." Fuchow was one of the ports opened to trade by the treaty of 1842, and he then had to maintain an entirely new position with the Chinese authorities. In so doing he was eminently successful, and earned for himself promotion to the consulate at Shanghai. Thither he went in 1846 and made it an especial part of his duties to superintend the establishment and laying out of the British settlement, which developed into such an important feature of British commercial life in China. In 1858 he was appointed consul general in the newly opened empire of Japan, and in the following year was promoted to be minister plenipotentiary. In those days residence in Japan was surrounded with many dangers, and the people were intensely hostile to foreigners. In 1860 Alcock's native interpreter was murdered at the gate of the legation, and in the following year the legation was stormed by a body of Ronins, whose attack was repulsed by Alcock and his staff. Shortly after this event he returned to England on leave. Already he had been made a C.B. (1860); in 1862 he was made a K.C.B., and in 1863 hon. D.C.L. Oxon. In 1864 he returned to Japan, and after a year's further residence he was transferred to Peking, where he represented the British government until 1871, when he retired. But though no longer in official life his leisure was fully occupied. He was for some years president of the Royal Geographical society, and he served on many commissions. He was twice married, first in May 1841 to Henrietta Mary, daughter of Charles Bacon, who died in 1853, and secondly (July 8, 1862) to the widow of the Rev. John Lowder, who died on March 13, 1899. He was the author of several works, and was one of the first to awaken in England an interest in Japanese art; his best-known book was *The Capital of the Tycoon*, which appeared in 1863. He died in London on Nov. 2, 1897. (R. K. D.)

See A. Michie, *The Englishman in China during the Victorian Era, as Illustrated in the Career of Sir Rutherford Alcock* (Edinburgh, 1910).

ALCOFORADO, MARIANNA (1640-1723), Portuguese authoress, writer of the *Letters of a Portuguese Nun*, was the daughter of a landed proprietor in Alemtejo. Béja, her birthplace, was the chief garrison town of that province, itself the principal theatre of the 28 years' war with Spain that followed the Portuguese revolution of 1640, and her widowed father, occupied with administrative and military commissions, placed Marianna in her childhood in the wealthy convent of the Conception for security and education. She made her profession as a Franciscan nun at 16 or earlier, without any real vocation, and lived a routine life in

that somewhat relaxed house until her 25th year, when she met Noel Bouton. This man, afterward Marquis de Chamilly and marshal of France, was one of the French officers who came to Portugal to serve under the great Captain Frederick, Count Schomberg, the reorganizer of the Portuguese army. During the years 1665-67 Chamilly spent much of his time in and about Béja, and probably became acquainted with the Alcoforado family through Marianna's brother, who was a soldier. Custom then permitted religious to receive and entertain visitors, and Chamilly, aided by his military prestige and some flattery, found small difficulty in betraying the trustful nun. Before long their intrigue became known and caused a scandal, and to avoid the consequences Chamilly deserted Marianna and withdrew clandestinely to France. The letters to her lover which earned her renown in literature were written between Dec. 1667 and June 1668, and they described the successive stages of faith, doubt and despair through which she passed. As a piece of unconscious psychological self-analysis they are unsurpassed; as a product of the Peninsular heart they are unrivalled. These five short letters written by Marianna to "expostulate her desertion" became a classic. They form one of the few documents of extreme human experience, and reveal a passion which in the course of succeeding centuries lost nothing of its heat. Perhaps their dominant note is reality, and, sad reading as they are from the moral standpoint, their absolute candour, exquisite tenderness and entire self-abandonment have excited the wonder and admiration of great men and women in subsequent ages, from Madame de Sévigné to W. E. Gladstone and Rainer Maria Rilke, the latter having also translated the letters into German (Leipzig, 1913). There are signs in the fifth letter that Marianna had begun to conquer her passion, and after a life of rigid penance, accompanied by much suffering, she died at the age of 83. The letters came into the possession of the Comte de Guillaumes, director of the *Gazette de France*, who turned them into French, and they were published anonymously in Paris in Jan. 1669. A Cologne edition of the same year stated that Chamilly was their addressee, which is confirmed by St. Simon and Duclos, but the name of their authoress remained undivulged. In 1810, however, Boissonade discovered Marianna's name written in a copy of the first edition by a contemporary hand, and the veracity of this ascription was placed beyond doubt by the later investigations of Luciano Cordeiro, who found a tradition in Béja connecting the French captain and the Portuguese nun. The letters created a sensation on their first appearance, running through five editions in a year, and, to exploit their popularity, second parts, replies and new replies were issued from the press in quick succession. Notwithstanding that the Portuguese original of the five letters is lost, their genuineness is as patent as the spuriousness of their followers, and though Rousseau was ready to wager they were written by a man, the principal critics of Portugal and France decided against him. It is now generally recognized that the letters are a verbatim translation from the Portuguese.

A foreign bibliography of the *Letters*, containing almost 100 numbers, will be found in Cordeiro's admirable study, *Soror Marianna, A Friaça Portuguesa*, 2nd ed. (Lisbon, 1891). Besides the French editions, versions exist in Dutch, Danish, Italian, German and English; an English bibliography is given by Edgar Prestage in his translation *The Letters of a Portuguese Nun (Marianna Alcoforado)*, 3rd ed. (London, 1903). The French text of the *éditio princeps* was printed in the 1st ed. (1893) of this book. Edmund Gosse in the *Fortnightly Review*, vol. xlix (old series) p. 506, shows the considerable influence exercised by the *Letters* on the sentimental literature of France and England. Later, following publication of Rilke's *Duino Elegies*, in which the Portuguese nun figured pointedly, there was a renewal of interest in the *Letters*, and additional translations included those in English by E. A. Ashwin (1929) and Donald E. Ericson (1941); there was also a reissue of the Rilke translation, *Portuguese briefe* . . . in Leipzig in 1941.

(E. Pr.; X.)

ALCOHOL, the name applied in scientific terminology to any member of a class of organic compounds (see ALCOHOLS). Of Arabic origin, the word was originally *al-Koh'l* (*al* "the" and *Koh'l* "powdered antimony") or later any very fine powder. For many centuries the word (*Koh'l*) was used to designate an impalpable powder used in the east for painting the eyebrows. Its modern meaning is of comparatively late date. Paracelsus and Libavius both used the term to denote a fine powder, the latter speaking of an

alcohol derived from antimony. Paracelsus also used the term to denote a volatile liquid; *alcohol* and *alcohol vini* occur often in his writings, and once he adds *id est vino ardente*.

In contradistinction to the broad scientific use of the word, the term alcohol is popularly used to designate one particular member of the scientific group (ethyl alcohol or ethanol) having the formula C_2H_5O . Alcohol, as an article of widespread consumption and use, has various other names; e.g., spirits of wine, eau de vie, aqua vitae, cologne spirits, grain alcohol, ethyl alcohol, methyl carbinol.

Ethyl alcohol, in consequence of its ready formation by yeast fermentation of saccharine plant and fruit juices occurs frequently in nature in an impure state and very low concentrations. Because of its volatile nature and the widespread occurrence of yeast fermentation, traces of alcohol can occasionally be detected in rain and snow. In the vegetable kingdom, it occurs, mixed with ethyl butyrate, in the unripe seeds of *Heracleum giganteum* and *H. sphondylium*. Ethyl alcohol has been isolated in minute amounts from the brain, blood and liver of nonalcoholic humans, dogs and pigs (A. O. Gettler, 1932). It is present in the urine of persons suffering from diabetes and is regularly present in the body fluids—blood, saliva, perspiration, urine—of healthy men after excessive consumption of alcoholic beverages.

In consequence of its ready formation by yeast fermentation of fruit juices and other carbohydrate-containing liquids, alcohol in its impure state was known to the ancients in the form of wine, beer, mead, etc. Knowledge concerning its composition, method of formation and preparation in a pure anhydrous state was not obtained until late in the 18th century. In 1796, Johann Tobias Lowitz (1757–1804) first prepared alcohol free from water. Nicolas Théodore de Saussure (1767–1845) determined its composition in 1808, although Lavoisier had previously established its qualitative composition. Sir Edward Frankland, by demonstrating its relation to the hydrocarbon ethane (CH_3CH_3), proved it to be CH_3CH_2OH , one hydrogen atom of the ethane molecule being replaced by the hydroxyl group.

The oldest preparation of ethyl alcohol is still the most important, namely, the fermentation of glucose and of materials related to it. Blackstrap molasses, grains and saccharine juices of vegetable origin are the chief sources of fermentation sugars. The choice of raw material depends upon supplies and local economics. After 1920 sugars derived from wood or wood pulp manufacture assumed increasing importance as raw materials for the manufacture of alcohol in Germany and the Scandinavian countries, and to a minor extent in the U.S. (1950). In 1929 the process of producing ethanol (synthetic) from ethylene gas was started in the U.S. Approximately 104,000,000 gal. were made by this process in 1950. Production of ethanol from ethylene was first accomplished by Hennell in Faraday's laboratory in 1826. Rediscovered by Marcellin Berthelot in 1855, the process was the basis for a company organized in 1862 by Cotelte to make alcohol from ethylene in illuminating gas. Cotelte's company failed financially and it was not until 1929 that the process became a commercial reality. Another formidable competitor of the fermentation process appears to be the U.S. modification of the Fischer-Tropsch process, started in Germany during the period 1930 to 1940, for the production of hydrocarbons from carbon monoxide and hydrogen. The U.S. modification of the process produces considerable quantities of by-product organic compounds, a considerable portion of which is ethyl alcohol.

Properties.—Pure ethyl alcohol is a mobile, colourless, liquid having a mild, agreeable odour and a burning taste. It boils at $78.3^\circ C$. at a pressure of 760 mm. of mercury (absolute); is a syrupy liquid at $-90^\circ C$. and freezes at $-114.5^\circ C$. Its densities at 0° , 20° , 25° and $40^\circ C$. are respectively 0.806, 0.789, 0.785 and 0.772. It burns in air with a blue, smokeless flame producing water and carbon dioxide. Its combustion is attended by the evolution of great heat (7.11 kg. cal./gram) (see *Uses*, below). The vapours of alcohol form explosive mixtures with air. Ethyl alcohol is miscible with a host of substances, and next to water, is the most widely used solvent, readily dissolving a large number of solid and liquid organic compounds, resins, hydrocarbons and

many mineral salts. Most gases are readily soluble in alcohol at $20^\circ C$., and under atmospheric pressure, 100 volumes of alcohol will dissolve 7 volumes of hydrogen, 2 volumes of oxygen, 12 volumes of nitrogen, or 30 volumes of carbon dioxide. The mixing of alcohol with water is accompanied by contraction in volume and a rise in temperature. On account of its strong affinity for water, it is widely used as a drying agent.

Taken internally, alcohol acts as a narcotic and is the principal active ingredient present in all spirituous liquors.

Alcohol forms a minimum boiling mixture with water which, under atmospheric pressure, boils at $78.15^\circ C$. and contains 95.6% by weight of alcohol. For this reason, anhydrous alcohol (100% alcohol) cannot be obtained by the direct rectification (fractional distillation) of spirituous liquors. Anhydrous alcohol is prepared commercially by special processes involving the use of dehydrating agents or water-entraining liquids. The majority of alcohol used in commerce is obtained by the direct fractional distillation of spirituous liquors and contains some water. The standard commercial strength in the U.S. (190 proof) contains 92.46% alcohol by weight and 7.54% of water.

Determination.—The percentage of alcohol present in a mixture of pure water and alcohol is readily determined by obtaining the specific gravity or density of the aqueous mixture and referring to tables specially prepared for this purpose. If other substances are present, as in the case of beer and wines, it is usually necessary to separate them by distillation. The percentage of alcohol present in beer may be determined, for example, by taking a 200 cc. sample of the beer and distilling until exactly 100 cc. of distillate have been obtained. All of the alcohol is in the distillate, the density of which is then taken by means of a pycnometer or hydrometer. The percentage of alcohol found in the distillate divided by two is the alcoholic strength of the beer. The standard tables relating the specific gravities of aqueous alcoholic solutions to the percentage of alcohol present are expressed in various terms depending upon the requirements of the government or other authority by whom the tables were prepared. The usual forms give the percentage of absolute alcohol by weight (degrees according to Richter) or by volume (degrees according to Tralles). Arbitrary standards are in general usage in Great Britain, the United States and other countries. Proof spirit (U.S.) contains 50% ethanol by volume; British proof spirit contains 49.3% ethanol by weight or 57% by volume.

The strength of an aqueous alcoholic solution may be estimated by determining its refractive index, and referring to specially prepared tables which correlate the refractive indexes with the alcoholic strengths of aqueous solutions (John Holmes; see *Trans. Chem. Soc.*, 1913, vol. 103 p. 2,165).

Traces of ethyl alcohol can be detected by converting it into ethyl benzoate on shaking with benzoyl chloride and sodium hydroxide; by warming it with iodine and potassium hydroxide thus producing iodoform, recognizable by its characteristic odour; or by oxidation to acetaldehyde by means of a chromic acid mixture.

Anhydrous alcohol suspected of containing water may be tested by the addition of four volumes of gasoline or kerosene. The mixture becomes turbid if the alcohol contains as much as 1% of water. A precise method for determining even minute traces of water involves the direct titration of the alcohol with a solution of iodine, sulphur dioxide and pyridine dissolved in methanol. The reagent serves as its own indicator. (W. M. D. Bryant, J. Mitchell, Jr., Donald Milton Smith, "Analytical Procedures Employing Karl-Fisher Reagent. II The Determination of Alcoholic Hydroxyl," *Journal, American Chemical Society*, vol. 62, p. 1, 1940.)

Uses.—Aside from its use in beverages, alcohol is a valuable industrial solvent and chemical intermediate and is regarded as the most important accessory chemical.

Medicine and the pharmaceutical industry make wide use of ethyl alcohol as a chemical intermediate, therapeutic agent and general solvent. Its solvent power is particularly useful for the extraction of medicinals from plant and animal tissues and for compounding tonics, elixirs, cough syrups, tinctures, liniments, antiseptics, medicinal soaps, etc.

Hundreds of pharmaceutical chemicals, such as ether, ethylene, chloroform, iodoform, barbiturates, atabrin, etc., are manufactured from ethyl alcohol.

As an industrial raw material, alcohol gives rise to a host of chemical products. These products are so numerous and have such a multiplicity of applications that modern man is in daily contact with dozens of materials derived chemically from alcohol or through the use of alcohol as a solvent. A few well-known examples are synthetic rubber, explosives, fuel antiknock agents, dyestuffs, plastics, varnishes, shellac, industrial solvents, paint removers and automotive antifreezes.

The antifreeze properties of ethyl alcohol are well known. In 1945 approximately 45,000,000 gal. were used in the United States alone for the manufacture of automotive antifreezes and for de-icing aircraft propellers and carburetors.

Alcohol is an excellent fuel for internal combustion engines. It is used for special applications (automotive and motor boat racing), and in countries deficient in petroleum. As a motor fuel, alcohol may be used alone or in combination with hydrocarbons. Its antiknock value is excellent and it is a good solvent for other antiknock compounds. As a source of convenient heat, alcohol is widely used throughout the world as fuel in alcohol lamps or gelled alcohol preparations commonly known as "canned heat." It makes an excellent rocket fuel and as such, supplied the motive power for the German V-2 rockets in World War II.

Fiscal Data.—Ethyl alcohol is a fruitful source of revenue to most of the governments of the world. In Great Britain the excise duty on spirits was increased several times during the period 1938 to 1944. In 1938 the excise duty was £3 12s. 6d. per proof gallon. A rate of £7 17s. 6d. went into effect in April 1947. The total net receipts of duty from spirits were £35,700,000 in 1938-39 and £63,600,000 in 1944-45. Customs and excise duties on beer and wines for the same year were respectively £287,731,215 and £4,490,774.

In the U.S. the adoption of prohibition greatly diminished the revenue importance of alcohol, but repeal restored it to its former standing. Thus, after falling from \$483,050,854 in the fiscal year 1919 to \$26,452,028 in 1926, the tax yield on distilled spirits, fermented liquors, etc. rose in 1939 to approximately \$600,000,000 and because of an increase in tax levy, the revenue for the fiscal year 1949 amounted to \$2,200,000,000. Additional revenues, amounting to several millions of dollars annually, are collected by the individual states. The federal revenue tax on potable alcohol was increased from \$2.25 in 1940 to \$9.00 per proof gallon in 1944. The great industrial importance of alcohol necessitated the introduction of a duty-free product retaining its suitability for the many purposes for which it may be used in the arts and manufactures. (See ALCOHOL IN INDUSTRY; PROOF SPIRIT.)

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ALCOHOL, PATHOLOGICAL EFFECTS OF. The pathological effects of alcohol are due to a chronic poisoning rather than an acute. Large doses may, however, cause death almost instantaneously by a reflex action on the heart or by cardiac and respiratory depression after the drug has been absorbed. If the alcohol is taken in the form of spirits, the subject usually becomes thin, probably owing to the spirits so affecting the gastrointestinal tract that little or no nourishment is absorbed; if beer is the form of drink the subject is liable to become fat. Prolonged drinking of any form of alcohol makes persons less able to withstand operations and diseases, such as phthisis and pneumonia, and is the direct cause of certain diseases of which the chief are the following:

Chronic Gastritis.—This is most likely to occur in those who drink spirits. The action of the strong alcohol on the stomach sets up an inflammatory condition which, owing to the continued action of the irritant, never subsides, with the result that permanent damage results and the proper digestion of food cannot take

place and the patient becomes thinner and thinner.

Cirrhosis of the Liver (gin-drinker's liver).—The quantity of alcohol associated with this condition differs with different persons; in some cases a few months' indulgence may suffice, in others it may be a matter of years. Whether the alcohol itself or some toxin caused by gastro-intestinal disturbance acts on the liver is not certain, but the result is a chronic inflammation which passes on to an extensive growth of fibrous tissue. This by its contraction compresses and destroys the liver cells and seriously impedes the flow of blood through the veins of the organ. The size of the liver varies within wide limits, but is usually small owing to the contraction of the fibrous tissue. The most important and constant result of this contraction is the effusion of fluid from the compressed and distended veins into the peritoneal cavity, constituting one of the types of dropsy called ascites. The patient gradually becomes more and more ill and death often ensues within a few months of the appearance of ascites. (See LIVER AND GALL-BLADDER, DISEASES OF.)

Multiple or Peripheral Neuritis (see NEURITIS).

Gout (*g.v.*).—The habitual drinking of heavy or sweet wines may be one of the causes of this disease, as may be excessive beer drinking when combined with poor or insufficient food.

Mania may at times be due to chronic alcoholic poisoning and possibly chronic Bright's disease. Certainly the kidneys will be affected more or less adversely by the toxins resulting from the gastro-intestinal disturbance.

Delirium tremens (see DELIRIUM) occurs in habitual drinkers.

ALCOHOL IN INDUSTRY. The principle of taxing and regulating alcoholic beverages was applied to alcohol itself until industrial needs brought about special legislation granting tax-free alcohol for industrial purposes. The industrial importance of ethyl alcohol was first recognized in England, where exhaustive experiments were carried out about the year 1853 to ascertain whether it would be possible to treat ethyl alcohol in such a manner that it could be used industrially without any risk of the government being defrauded of its revenue from beverage alcohol.

INDUSTRIAL ALCOHOL IN THE U.S.

Prior to 1906 all ethyl alcohol used in the U.S. carried a heavy revenue tax that effectively restrained any increase in its industrial use. On Dec. 17, 1897 a joint committee of congress investigating the industrial importance of ethyl alcohol reported: "The uses of alcohol other than as a beverage are more largely and widely extended than is generally supposed. But while the use of alcohol as a beverage is purely voluntary its employment for all other purposes is legitimate and necessary. No article entering into manufacture or the arts whether of domestic or foreign production performs more beneficial functions. There is scarcely a manufacturer in the country who does not use alcohol in the production of his goods to a greater or lesser extent."



PLANT OF U.S. INDUSTRIAL CHEMICALS, INC., AT BALTIMORE

This plant, with its full rail and water facilities, occupies an admirable position for the manufacture of industrial alcohol. In the foreground are the huge storage tanks for molasses; at the right centre are the molasses tank steamers, with one of them unloading her cargo. The fermenting building, power plant and still houses are on the upper left.

Passage of the Taxfree Industrial and Denatured Alcohol act in 1906 removed the tax on alcohol intended "for use in the arts and industries and for fuel, light and power" provided it had been denatured and rendered unsuitable for use as a beverage.

Supplemental laws were later enacted as manufacture, distribution, sale and use of industrial alcohol became vital to the national welfare. For further information on regulations concerning the manufacture, denaturization and distribution of industrial alcohol see "Industrial Alcohol Regulations III" (1942), U.S. treasury department bureau of internal revenue.

TABLE I.—Principal Raw Materials Used in the Manufacture of Ethyl Alcohol

Raw Material	1948	1949
Molasses (gal.)	174,364,000	155,283,000
Ethyl sulphate (gal.)	109,245,000	131,819,000
Grain and grain products (lb.)	421,465,000	138,531,000
Sulphite liquors (gal.)	237,364,000	229,549,000
Potatoes (lb.)	318,003,000	1,002,029,000
Pineapple juice (gal.)	4,909,000	2,660,000
Ethylene gas (lb.)		36,697,000

Completely Denatured Alcohol.—This is ethyl alcohol which has been rendered extremely obnoxious by the addition of denaturants according to a limited number of formulas prescribed by the U.S. internal revenue bureau, and so made entirely unfit for beverage purposes, as well as injurious if used externally. It may be bought and sold without keeping records or making reports to the internal revenue bureau, but persons dealing in, storing or using such alcohol in quantities exceeding ten barrels or drums during a period of 30 days must keep such commercial records as will enable any government officer to trace its receipt and disposal.

Of the three formulas (no. 12, no. 13, no. 14) possible in 1951 for completely denatured alcohol, composition of no. 14 follows:

- 100 parts by volume ethyl alcohol, of not less than 160° proof.
- 3.0 parts by volume Dehydrol-o or a compound similar thereto.
- 1.75 parts by volume of methyl ethyl ketone.
- 1.5 parts by volume of kerosene.

Specially Denatured Alcohol.—This is designed for distribution to approved manufacturers, under regulations, protected by a bond to guarantee the faithful performance of the conditions stipulated by the government. In such formulas only those denaturants are used which will not materially interfere with the special manufacturing use to which the alcohol is to be put. There were, in 1951, about 60 formulas for specially denatured alcohol authorized by the government for more than 400 different uses.

Industrial Uses.—Ethyl alcohol is the most widely used solvent next to water; after it has been properly denatured, it enters directly or indirectly into the manufacture of varnishes, paints, synthetic leather, antifreeze solutions, explosives, motion picture film, inks, tobacco, lacquers, anaesthetics, antiseptics, chemicals and hundreds of other products.

TABLE II.—U.S. Production of Industrial Alcohol for Specified Years

Fiscal Years	Denatur- ing plants	Completely denatured	Specially denatured	Total
		(In wine gal.)		
1907	8	1,397,861	382,415	1,780,276
1918	40	10,328,455	39,834,501	50,163,016
1927	94	56,093,748	39,354,933	95,448,681
1935	39	38,740,079	58,284,395	97,031,074
1939	37	36,522,358	64,995,485	101,517,843
1937	38	22,118,378	80,084,281	102,202,659
1939	38	17,179,433	83,561,077	100,740,510
1941	43	17,676,172	135,834,261	153,510,433
1942	62	28,628,181	179,217,153	207,845,334
1943	76	24,360,788	108,524,631	222,894,419
1944	66	52,331,701	471,781,825	524,113,586
1945	65	53,087,533	404,008,004	527,095,537
1948	40	34,897,780	149,394,037	184,281,826
1949	47	30,221,402	164,273,211	174,494,703
1950	46	4,414,058	170,259,583	174,673,641

Prior to World War II the normal consumption of industrial alcohol in the United States was approximately 100,000,000 wine gallons per year. With the outbreak of hostilities industrial demand for alcohol in the U.S. began to rise partially for direct export purposes, but principally as a result of expanded manufactur-

ing to fill the requirements of warring nations. With the entrance of the U.S. into the war in 1941, the alcohol requirements for munitions, synthetic rubber and other war uses as well as the needs of allied nations under lend-lease agreements raised the industrial alcohol requirements to unprecedented figures. Peak production of approximately 640,000,000 wine gallons was reached during the last year of the war. This enormous production was accomplished by installation of new plants; suspension of the manufacture of beverage alcohol and use of the equipment possessed by the beverage alcohol industry to produce approximately 200,000,000 wine gallons of industrial alcohol per year.

The synthetic rubber industry, which depended almost entirely upon alcohol for its raw materials during the war years, used tremendous quantities of alcohol. Allocations to this industry alone in the years 1943, 1944 and 1945 were respectively 126,000,000, 330,000,000 and 340,000,000 wine gallons. In spite of elimination of the use of industrial alcohol from all but essential manufacturing industries under a strict war allocation system, the quantity of industrial alcohol required for antifreeze, indirect military and civilian uses rose to approximately 160,000,000 gal. per year. Quantities used by some of these essential manufacturing industries for the year 1944 in millions of gallons were: chemical solvents, 42; gasoline, antiknock, 25.2; rayon and plastics, 20.4; surface coating industry, 15; cellulose and resins, 12; industrial processing, 9; vinegar, 10; proprietaries, 6; food and medicinals, 3; government (excluding military), 2.4; hospitals and science, (excluding government), 1.2.

GREAT BRITAIN

Industrial Methylated Spirits.—Legislation in 1855 authorized the use, for purely manufacturing purposes, of duty-free spirits mixed with 10% by volume of wood naphtha (an impure methyl alcohol), the product being unfit for beverage purposes and known as "methylated spirits." By the Revenue act of 1906 "methylated spirits" became "industrial methylated spirits" and the volume of wood naphtha was reduced to 5%. Methyl alcohol was selected because it is very difficult to remove even by distillation, and because its presence can readily be detected. Industrial methylated spirits are for use in industrial and other operations for which mineralized methylated spirits are unsuitable. By regulations dated Dec. 7, 1925, a pharmaceutical chemist could be authorized to obtain industrial methylated spirits for sale as such or for other specified purposes under defined conditions.

Industrial Methylated Spirits (Pyridinized).—Regulations dated Dec. 7, 1925, authorized industrial methylated spirits (pyridinized), having the same composition as industrial methylated spirits, with an added $\frac{1}{2}$ of 1 part of crude pyridine, to be used in the manufacture of "finish" for sale.

Mineralized Methylated Spirits.—From 1861 to 1891 retail sales of methylated spirits were allowed in small quantities for domestic purposes, but use in large quantities or in manufacture was permitted only under excise supervision. In 1890, a new form known as "mineralized methylated spirits" was introduced, free from revenue supervision, for general use, the difference consisting in the further addition of $\frac{1}{2}$ of 1% of mineral naphtha. Mineralized methylated spirits in 1947 were a mixture of 90 parts by volume of alcohol, $\frac{1}{2}$ parts of wood naphtha, and $\frac{1}{2}$ part of crude pyridine, adding to every 100 gallons of the mixture $\frac{1}{2}$ gal. of mineral naphtha and not less than $\frac{1}{10}$ oz. of a powdered aniline dye (methyl violet).

Power Methylated Spirits.—Use of alcohol for power purposes under the name "power methylated spirits" was legalized by the Finance act of 1920. Such spirits are prepared (regulations of 1921) as follows: 92 parts of alcohol, 5 parts of benzol, $\frac{1}{2}$ part of crude pyridine and 2 $\frac{1}{2}$ parts of wood naphtha, together with $\frac{1}{10}$ oz. of spirit red III dye to each 100 gal. of the mixture. Power methylated spirits are liable to duty at the rate of 9d. per gallon, which is the rate of duty on gasoline. When mixed with 25% of gasoline, benzol or other approved substance, such spirits may be distributed and used, without restriction, for power purposes.

Nondistillable (Specially Denatured) Spirits.—The Fi-

nance act of 1902 made it possible to use duty-free spirits in any art or manufacture when it is proved that the use of methylated spirits is unsuitable or detrimental. The spirits must be rendered unfit for use as a beverage before and during use. Frequently a suitable denaturant is found in some acid used or produced during the manufacturing operations, or the alcohol is a constituent of some mixed solvent. Thus the employment of pure alcohol denatured with 2% of pure methyl alcohol was allowed in the production of insulin without onerous excise restrictions. The use of duty-free pure spirits by "universities, colleges and other public institutions for research and teaching" was laid down in regulations issued in May 1911.

Customs and Excise.—Under the Finance act of 1921 an allowance of 5*d.* per proof gallon, approximately 8*d.* per bulk gallon, is made on spirits used for preparing industrial methylated spirits and power methylated spirits; or on spirits received for use in the arts and manufacture. Imported spirits used for the manufacture of mineralized methylated spirits are charged a differential duty of 2*s.* 10*d.* or 2*s.* 11*d.* per proof gallon if foreign, and 4*d.* or 5*d.* per gallon if empire. When used for other purposes, empire spirits are free of duty, while foreign spirits are charged 2*s.* 6*d.* per proof gallon. Duty-paid spirits used for medicinal or scientific purposes are subject to a rebate equal to the difference between the duty paid and 14*s.* 9*d.* per proof gallon.

Industrial Uses.—Ethyl alcohol is a very important industrial raw material. Its solvent powers are widely used in the preparation of pure chemicals, explosives, pharmaceuticals, medicinals, etc. Millions of gallons are used annually for the preparation of varnishes, finishes, stains and paints. As a chemical intermediate, alcohol gives rise to a host of useful compounds, such as ether, chloroform, dyestuffs, ethylene and acetaldehyde. Various scientific and medicinal operations require its use.

Industrial methylated spirits are largely employed for varnishes, finishes, stains and paints. Large quantities of pyridinized spirits are used in finishes. Mineralized methylated spirits are largely used in burning lamps and for cleaning purposes. Nonmethylated (specially denatured) spirits are primarily used in the manufacture of ether, pharmaceuticals, extracts, ethyl esters, dyestuffs, explosives, smokeless powders and for scientific research. The use of power methylated spirits practically ceased during World War II.

TABLE III.—Consumption (Proof Gal.) of Industrial Spirits in the United Kingdom

Spirits	1938-39	1941-42	1944-45
Industrial methylated spirits*	13,002,984	11,553,221	12,301,703
Mineralized methylated spirits	2,710,249	2,083,827	2,304,680
Power methylated spirits	11,567,539	4,236	17,411
Nonmethylated (specially denatured)	19,038,812	45,684,985	42,328,733
Medicinal and scientific uses (not entirely duty-free)	494,090	492,187	314,542
Totals	46,813,674	59,818,456	57,417,069

*Includes 450,000, 217,000, 182,000 proof gallons respectively in 1938-39, 1941-42, 1944-45 of industrial methylated spirits (pyridinized).

OTHER COUNTRIES

The Netherlands legalized the use of denatured alcohol in 1865; in 1872 France permitted its use under a special tax, and in 1879 Germany authorized its employment. Authorization dates in other European countries followed: Austria in 1888, Italy in 1889, Sweden in 1890, Norway in 1891, Switzerland in 1893 and Belgium in 1896. Alcohol became widely used by German industry; its application for light and power started about 1887. In 1895 a distillation tax was imposed from which a refund was paid on alcohol used for other than beverage purposes.

In France a formula for general use prescribed that to 100 l. of spirit, which must not contain more than 1% of essential oils and must indicate at least 90% alcohol at 15° C., must be added 5.5 l. of "Methylene type régée." The latter must indicate at least 90% alcohol, contain 25% acetone and at least 2.5% pyrogenous impurities produced by wood distillation. Should the use to which the alcohol is to be put justify such a course, a special formula for denaturing is allowed.

Prior to World War II, the use of alcohol for industrial purposes in Germany and France was on the increase. France de-

TABLE IV.—Production of Industrial Alcohol in Several Countries of the World, Various Dates

Country	Data year	Production (Estimated U.S. wine gallons, 190-proof)
South American area		
Argentina	1930	5,560,000
Brazil	1941	32,000,000 (includes beverage alcohol)
Brazil	1915-1943	42,000,000 (of which 21,000,000 was anhydrous)
Costa Rica	1943	730,000 (½ to liquor—½ to motor fuel)
Cuba	1942	27,000,000
Cuba	1944	78,000,000
Cuba	1945	100,000,000
Haiti	1943	3,000,000
Mexico	1943	12,100,000
Nicaragua	1943	752,000 (plus 3,000,000 gal. rum)
Panama	1930	222,936 (mostly used as beverage)
Peru	1936	846,000
Salvadore	1943	200,000 (plus 1,400,000 gal. rum)
Asia		
China	1937	7,400,000
Indo-China	1938	9,200,000
Japan	1935	794,442 (?)
Japan	1933	5,000,000
Philippines	1936	9,050,000
Australia	1943	26,500,000
Queensland	1940	4,800,900
Europe		
Algeria	1938 (?)	17,300,000
Austria	1935	5,280,900
Belgium	1938	5,300,000
Czechoslovakia	1938	27,000,000
Denmark	1939	2,600,000
England	1938	49,560,000
France	1936	100,000,000
France	1938	125,000,000
Germany	1937	105,000,000
Greece	1935	4,513,000
Hungary	1937	1,103,000
Italy	1938	29,000,000
Netherlands	1939	14,000,000 (?)
Netherlands	1938	7,000,000
Poland	1939	20,000,000
Rumania	1936 (1938?)	5,800,000
Spain	1933	21,000,000
Sweden	1935	1,000,000
Syria	1940	87,000
Sudan (Africa)	1938	4,800,000
United States	1945	580,000,000 (estimated)
Canada	1938	7,100,000
World total.	(1938)	915,000,000

natured 12,000,000 bulk gallons in 1922, and 19,000,000 bulk gallons in 1925. Use of industrial alcohol in Germany increased from 24,750,000 bulk gallons in 1924-25 to 26,500,000 in 1925-26.

In Australia there are four classes of industrial alcohols; the principal substances used as denaturants are wood naphtha, pyridine, benzene (petroleum) and crystal violet. Canada provides for three grades of denatured alcohol and seven grades of specially denatured alcohol: wood alcohol is the main denaturant but benzene, iodine, benzene, nitro-benzene and other substances are used. New Zealand has four kinds of "methylated spirits" the denaturants being wood naphtha, pyridine, mineral naphtha, turpentine and shellac according to the intended use. The Union of South Africa has methylated spirits which are produced by the admixture of alcohol with crude methyl alcohol and pyridine bases or simpson oil and pyridine bases with ethyl alcohol. In India the generally accepted official formula prescribed the addition of 0.5% cahout choucine and 0.5% pyridine bases of mineral origin. The production of industrial alcohol through the world steadily increased during the years immediately preceding World War II.

POWER ALCOHOL

Although alcohol can be used like gasoline in modern automobile engines it cannot be used with maximum efficiency by itself because it requires a higher degree of compression than such engines provide and also because, unless special arrangements are made, a cold motor will not start readily on alcohol. After mixture with benzol, gasoline or with ether in varying proportions, it can, however, be employed successfully. In countries with a deficiency of petroleum supplies or with excess agricultural products a great deal of time and effort was expended toward the successful utilization of alcohol as a motor fuel. The general tendency to increase compression ratios of automobile engines following World War II tended to eliminate the first disadvantage. The problem, however, remained primarily one of economics, successful competition of alcohol with gasoline being possible only in agricultural countries having no petroleum resources of their own. Many of the petroleum-deficient countries have adequate supplies of coal. Progress in the liquefaction of coal and in the catalytic syntheses of organic liquids (hydrocarbons and chemicals from carbon mon-

oxide and hydrogen) indicated that the liquid fuel requirements of coal-producing countries would be met by these means.

Miscibility.—Alcohol of the strength usually employed as a liquid fuel, viz., 95% by volume, will mix with ether in all proportions, and motor fuels consisting of alcohol and ether are in use, e.g., Natalite. Alcohol will not form a stable mixture with benzol or petrol under all conditions of temperature, but increased miscibility at low temperature can be obtained by the addition of a third substance, and higher alcohols, of which butyl and amyl alcohol are the best, and many other liquids, have been patented for the purpose. If anhydrous or absolute alcohol is employed, miscibility with gasoline is obtained under all practical conditions of use.

Absolute Alcohol.—The production of absolute alcohol is based on two main processes: (1) the use of solid and liquid dehydrating agents, and (2) dehydration by distillation of alcohol in the presence of liquids immiscible with water, such as benzene. The high latent heat of evaporation of alcohol explains very largely its antidetonating (antiknock) effect on gasoline.

This property may lead to its more general use in antidetonate mixtures.

Power Alcohol as a Motor Fuel.—Investigations started by the British government in 1920 showed, according to the official memorandum; that: "The production of alcohol in any considerable quantities from vegetable materials grown in the United Kingdom is not economically possible owing to: (1) insufficient acreage; (2) the high cost of cultivation and harvesting; (3) the high cost of manufacture; and (4) the fact that the most suitable raw materials are also important food stuffs." Another official memorandum, issued in Dec. 1921, suggested that there were possibilities in some of the dominions, colonies and protectorates of making alcohol from molasses, and from suitable root and tuber crops, but not for export to the United Kingdom in view of the low price of gasoline.

Extensive investigations of the problem in the United States in the late 1930s produced identical results. It could be concluded, therefore, that the use of power alcohol as a substitute for gasoline would be limited to tropical and semitropical countries having inadequate petroleum supplies or to countries subsidizing the use of power alcohol for nationalistic reasons.

Production of Power Alcohol Prior to World War II.—Substantial efforts to manufacture and use power alcohol were made in British Guiana, on several large sugar plantations. In India, the use of the mahua flower (*Bassia latifolia*) to produce power alcohol was taken up by the Hyderabad government and a factory was erected at Kamareddi. In Malaya, the possibilities of making alcohol from the juice of the nipa palm were the subject of investigation. A large factory for the production of an alcohol-ether motor fuel was built in Mauritius. In Natal a motor fuel composed of approximately 55 parts of alcohol and 45 parts of ether, and known as "Natalite," is manufactured from molasses and, to some extent, from maize. Motor fuel was produced successfully in 1923 in New Zealand from waste potatoes, grain, fruit, molasses and various shrubs and roots. In Queensland a factory in the Mackay sugar district was built with an output of about 1,000,000 gal. of 95% alcohol a year. South Africa also has devoted a good deal of attention to producing industrial and power alcohol from agricultural crops.

Approximately 1,000,000 gal. per year of an alcohol-ether motor fuel was produced in Cuba from molasses during the period 1937 to 1940. Czechoslovakia produced a composite fuel known as "Dynalcol," a mixture of approximately three parts of alcohol to four parts of benzol. France passed a law in 1923 prescribing a "Carburant National." It required all importers of gasoline, benzol, benzene, toluene and coal distillation products, either alone or mixed, to purchase from the state a quantity of absolute alcohol corresponding to a minimum of 10% on the quantity of gasoline, etc., imported during the preceding month. The alcohol is to be used exclusively in motor fuels consisting of not less than 95 and not more than 105 parts by volume of absolute alcohol to 100 parts by volume of hydrocarbons.

The law later became inoperative because users of the Carburant

National were not satisfied with it, and it entailed a considerable loss to the state. The national liquid motor fuel in Germany, "Monopolin," was composed of 45% gasoline, 45% alcohol and 10% benzol.

Surplus molasses was used to some extent in the production of alcohol for domestic purposes and for power in Brazil, Argentina, the Hawaiian and Philippine Islands. Japan had two motor fuels containing approximately 50% alcohol. In Sweden and Norway power alcohol was obtained from the distilleries operating on sulphite lyes. The latter country was reported to have distillery capacity capable of supplying 25% of its motor fuel requirements. (D. G. Z.)

ALCOHOLISM: see DRUNKENNESS.

ALCOHOLOMETRY: see ALCOHOL: Determination.

ALCOHOLS, in organic chemistry, a class of compounds of which ethyl alcohol (see ALCOHOL) is perhaps the most common member. They are derived from paraffinoid and nonaromatic hydrocarbons by the replacement of one or more hydrogen atoms by hydroxyl groups. This definition excludes such compounds as the phenols (hydroxy derivatives of benzene, naphthalene and other aromatic hydrocarbons) which are more acidic than the true alcohols.

Alcohols are classified on two distinct principles, one depending upon the number of hydroxyl groups present, the other on the nature of the remaining groups attached to the carbon atom which carries the hydroxyl group. Monohydric alcohols contain only one hydroxyl group; dihydric alcohols, known as glycols, contain two; trihydric alcohols, known as glycerols, contain three.

The second principle leads to alcohols of three distinct types, known as primary, secondary and tertiary (H. Kolbe, 1860). The genesis of these types may be readily understood by considering the relation which exists between the alcohols and the parent hydrocarbon. In methane, CH_4 , the hydrogen atoms are of equal value, and hence only one monohydric alcohol, viz., CH_3OH , can be derived from it. This compound, methyl alcohol (carbinol), is the simplest primary alcohol, and it is characterized by the grouping $\text{-CH}_2\text{OH}$. Ethane, C_2H_6 , in a similar manner, can only give rise to one alcohol, namely ethyl alcohol or methylcarbinol, $\text{CH}_3\text{CH}_2\text{OH}$, which is also primary. Propane, $\text{CH}_3\text{CH}_2\text{CH}_3$, can give rise to two alcohols—a primary alcohol, $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ (normal propyl alcohol or ethylcarbinol), formed by replacing a hydrogen atom attached to a terminal carbon atom, and a secondary alcohol, $\text{CH}_3\text{CH}(\text{OH})\text{CH}_3$ (isopropyl alcohol or dimethylcarbinol), when the substitution is effected on the middle carbon atom.

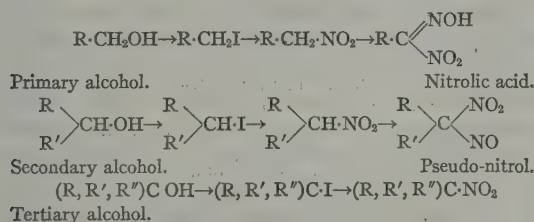
The grouping CH.OH characterizes the secondary alcohols; isopropyl alcohol is the simplest member of this class. Butane, C_4H_{10} , exists in the two isomeric forms—normal butane, $\text{CH}_3\text{CH}_2\text{-CH}_2\text{CH}_3$, and isobutane, $\text{CH}(\text{CH}_3)_3$. Each of these hydrocarbons gives rise to two alcohols: *n*-butane gives a primary and a secondary; and isobutane a primary, when the substitution takes place in one of the methyl groups, and a tertiary, when the hydrogen atom of the -CH group is substituted. Tertiary alcohols are thus seen to be characterized by the group -C.OH , in which the residual valencies of the carbon atom are attached to alkyl groups. The three types of alcohol may be formulated as follows: $\text{R.CH}_2\text{-OH}$ (primary); $(\text{RR}')\text{CH.OH}$ (secondary); $(\text{RR}'\text{R}'')\text{C.OH}$ (tertiary).

Properties.—The alcohols are neutral in reaction, and the lower members possess the property of entering into combination with salts, in which the alcohol plays the same role as does water of crystallization. Sodium or potassium dissolves in the alcohols with the formation of alcoholates (alkoxides), the hydrogen of the hydroxyl group being replaced by the metal. With strong acids water is split off and esters are formed. The halide esters of the paraffin alcohols, formed by heating the alcohols with the halogen acids, are more conveniently prepared by the action of the phosphorous halide on the alcohol. Energetic dehydration gives rise to olefinic hydrocarbons, but under certain conditions ethers (see ETHER [IN CHEMISTRY]) are obtained.

The physical properties of the alcohols exhibit a gradation with the increase of molecular weight. The lower members are

colourless mobile liquids, readily soluble in water and exhibiting a characteristic odour and taste. The solubility decreases as the carbon content rises. The normal alcohols containing 1 to 16 carbon atoms are liquids at the ordinary temperatures; the higher members are crystalline, odourless and tasteless solids, closely resembling the fats in appearance. The boiling points of the normal alcohols increase regularly about 19° for each CH_2 increment; this is characteristic of all homologous series of organic compounds. Of the primary, secondary and tertiary alcohols having the same empirical formula, the primary have the highest, and the tertiary the lowest, boiling point; this is in accordance with the fairly general rule that a gain in symmetry is attended by a fall in the boiling point.

Distinctive Tests for Primary, Secondary and Tertiary Alcohols.—Many reactions serve to distinguish these three types of alcohol. Of chief importance is their behaviour on oxidation. The primary alcohols are first oxidized to aldehydes (*q.v.*), which, on further oxidation, yield acids containing the same number of carbon atoms as in the original alcohol. Secondary alcohols yield ketones (*q.v.*), which are subsequently oxidized to a mixture of two acids. Tertiary alcohols yield neither aldehydes nor ketones, but a mixture of two or more acids. Another method is based upon the different behaviour of the corresponding nitroalkane with nitrous acid. The alcohol is first acted upon with phosphorus and iodine, and the resulting alkyl iodide is treated with silver nitrite, which gives the corresponding nitroalkane. The nitroalkane is then treated with potassium nitrite dissolved in potassium hydroxide solution, and sulphuric acid is added. By this treatment the primary nitroalkane yields a nitrolic acid, the potassium salt of which forms an intense red solution; the secondary nitroalkane forms a pseudo-nitrole which gives an intense blue solution, while the tertiary compound does not react with nitrous acid. The reactions outlined above may be thus represented:

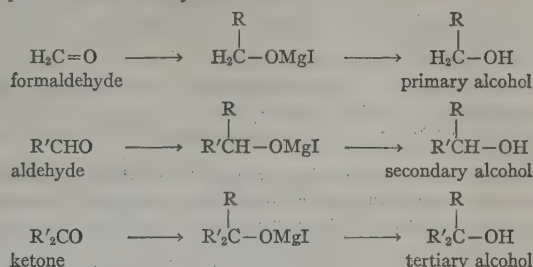


By heating to the boiling point of naphthalene (218°C.) tertiary alcohols are decomposed, while heating to the boiling point of anthracene (360°C.) suffices to decompose secondary alcohols, the primary remaining unaffected. These changes, which can be followed out by determinations of the vapour density, provide a method for characterizing alcohols.

Preparation.—Monohydric alcohols may be readily prepared from the corresponding alkyl halide by the action of moist silver oxide (which behaves as silver hydroxide); by the saponification of their esters; or by the reduction of polyhydric alcohols with hydriodic acid, and the subsequent conversion of the resulting alkyl iodide into the alcohol by moist silver oxide. Primary alcohols are obtained by decomposing their sulphuric acid esters (from sulphuric acid and the olefines) with boiling water; by the action of nitrous acid on primary amines; or by the reduction of aldehydes, acid chlorides or acid anhydrides. Secondary alcohols result from the reduction of ketones; and from the reaction of zinc alkyls on aldehydes or formic acid esters. Tertiary alcohols were first synthesized by A. Butlerow in 1864, by reacting with a zinc alkyl (methyl or ethyl) on an acid chloride; an addition compound was first formed, which decomposed with water to give a ketone. When, however, a second molecule of a zinc alkyl was allowed to react, a compound was formed which gave a tertiary alcohol when decomposed with water.

The Grignard reaction (*see* GRIGNARD REAGENTS) affords one of the most generally valuable means of synthesizing the three classes of monohydric alcohols, the process being based on the addition of a Grignard reagent to a carbonyl group. When added to formaldehyde, a primary alcohol is obtained. With any other

aldehyde a secondary alcohol is produced, whereas with a ketone the product is a tertiary alcohol.



For this purpose, the aldehydes and ketones are often replaced by esters and other types of compounds.

The following monohydric alcohols receive special treatment under their own headings: ALLYL ALCOHOL; AMYL ALCOHOLS; BENZYL ALCOHOL; BUTYL ALCOHOLS; METHYL ALCOHOL and PROPYL ALCOHOLS.

ALCOTT, AMOS BRONSON (1799-1888), U.S. educationalist and writer, was born of farming stock in Wolcott, Conn., Nov. 29, 1799. Extravagant pedlar, visionary schoolteacher, peripatetic philosopher, Bronson Alcott gives the lie to all theories of Yankee shrewdness and thrift. "A venerable Don Quixote," as Carlyle termed him, "all bent on saving the world by a return to acorns and the golden age," he was ridiculed by the majority of his contemporaries, including J. R. Lowell in *A Fable for Critics* and by some of the transcendentalists. But R. W.



THE CONCORD HOME OF AMOS BRONSON ALCOTT, NEW ENGLAND TRANSCENDENTALIST WHOM CARLYLE CALLED "THE POTATO QUIXOTE"

Emerson, although recognizing his limitations, remained a staunch friend; and educators have long since adopted many of the theories of this "American Pestalozzi." His truth to his ideals seems to have involved more suffering for his wife, Abigail May, and his four daughters than for himself. School after school had to be given up, in part because of the conservatism of his patrons, in part because of harsh criticism such as that of Harriet Martineau, and in part because of too rigid adherence to his principles, as when he refused to dismiss the little Negro girl who disrupted his Boston group. Indeed, Alcott was too visionary even to be a satisfactory day-labourer. In later life his western lecturing trips were made pleasant and financially profitable through his "riding in Louisa's chariot" and being known as the "grandfather of *Little Women*"; and his long-cherished dream of presiding over a Concord summer school of philosophy and literature was fulfilled. He had early received some recognition in England. He died on March 4, 1888, just before his celebrated daughter.

Since in Alcott's lifetime his writings were recognizably inferior to his informal lectures or "conversations," it is natural that few should search today for the vignettes of contemporaries and the nuggets of wisdom scattered through his "Orphic Sayings" in the *Dial*, his *Tablets* (1868), *Concord Days* (1872) and *Table Talk* (1877). The poem *New Connecticut* (1887) and some of the *Sonnets and Canzonets* (1882) are of autobiographic value, and his *Observations on the Principles and Methods of Infant Instruction* (1830), together with Elizabeth Peabody's transcripts of his classroom procedure in *Record of a School* (1835), etc., reveal his educational innovations. *A. Bronson Alcott: His Life and Philosophy* (1893), by F. B. Sanborn and W. T. Harris, draws largely upon Alcott's diaries, and *Bronson Alcott's Fruitlands* (1915), an interesting compilation by Clara E. Sears, illuminates his unfortunate experiment in communistic plain living and high thinking. *See also* Honoré W. Morrow, *The Father of Little Women* (1927); H. H. Hoeltje, *Sheltering Tree* (1943).

ALCOTT, LOUISA MAY (1832-1888), U.S. author, was born in Germantown, now part of Philadelphia, Pa., Nov. 29, 1832. Like her mother, she felt deeply the family trials and privations caused by the impracticality of her father, Amos Bronson Alcott. In later life she defined a philosopher as "a man up in a balloon, with his family and friends holding the ropes

which confine him to earth and trying to haul him down." When she was still a young girl her journal reflected her determination to earn money and make her family comfortable. Fortunately the Alcotts' wandering life had allowed her plenty of time out of doors, so that a strong body was built up for the active brain, and, as she herself put it, nature gave her a vital sense of God's presence "never to change through forty years of life's vicissitudes, but to grow stronger for the sharp discipline of poverty and pain, sorrow and success."

She started her bread-earning career early as a dolls' dressmaker, and in a few years was putting her hand to anything that would bring in money to purchase necessities and pay off debts for her family—teaching, sewing, even, for a short period, domestic service. "Pot-boilers" at this period brought in five or ten dollars apiece; of a wild, sensational type, they worked off her steam and perhaps gave some facility in writing. Their nature may be judged from "The Baron's Gloves" and "A Whisper in the Dark," which have been included in her collected works. In 1860 \$50 for an *Atlantic* story seemed like wealth and fame indeed. Her first book was *Flower Fables* (1854), tales originally written for R. W. Emerson's little daughter Ellen; but she attained widespread celebrity only after the publication of her *Hospital Sketches*, serially in the *Commonwealth* and in book form in 1863 (republished with additions, 1869). These were a revision of her letters to her family during her period as nurse in the Union hospital at Georgetown, D.C. Her six weeks there in 1862-63 resulted not only in fame but also unfortunately in shattered health, and this, combined with her incessant overwork, finally caused her death, in Boston, March 6, 1888, two days after her father's death.

Of her life the best record is her own. As the "Jo" of *Little Women* (1868), the most popular girls' book ever written in America, she will always live in the hearts of her readers. Although this is probably the most autobiographical of her books, other of her experiences in Boston, Concord and abroad are reflected in *Jo's Boys* (1886); *An Old-Fashioned Girl* (1870); *Shawl Straps* (1872), one of the series *Aunt Jo's Scrap Bag* (6 vol., 1871-79); *Moods* (1864), a much revised novel, and L. Alcott's favourite; *Work* (1873); and many of her shorter pieces. *Little Men* (1871) describes her nephews, children of her older sister, Anna; *Lulu's Library* (3 vol., 1885-89) is named after the little niece whom the artist sister, May, when dying bequeathed to her; and *Jack and Jill* (1880) makes use of the Concord young people.

Miss Alcott's most enduring place is the result of the cheeriness and wholesomeness of her pictures of boy and girl life. Her novels *Moods*, *Work* and *A Modern Mephistopheles* (1877) in the "No Name" series are experimental in technique; and even her juvenile books show the inequalities attendant upon her haste in production and her ill health. In early life poverty was responsible for her steady output; in later life nervous restlessness and perhaps excessive generosity caused her to feel the necessity of supplying all demands upon her. After only one article on Ralph Waldo Emerson, long her idol and her family's truest friend, do we find not the dollar sign in her journal but "a labour of love."

In any estimate, however, her lavishness in giving not only of her money but also of her personal service to relatives, friends and strangers alike and her ardour in the causes of abolition and woman's suffrage must be considered. Through several generations she has held her place among America's most popular writers for children.

By far the best biography is Ednah D. Cheney's *Louisa May Alcott: Her Life, Letters, and Journals* (Boston, 1889), which contains Miss Alcott's early records and also her later annotations. Copious use is made of it by Belle Moses in *Louisa May Alcott, Dreamer and Worker* (1909), and by the writers of numerous shorter sketches.

ALCOY, south-eastern Spain, province of Alicante, on the small river Séripis, and at the terminus of a branch of the Barcelona-Valencia-Alicante line. Pop. (1940) 42,519 (mun., 45,792). Alcoy is built on high ground at the entrance to a gorge. It is a thriving industrial town, with manufactures of linen, woollen goods, agricultural machinery, almond confections and paper, especially cigarette paper. The Salta de las Aguas, a waterfall, provides ample industrial power. For an account of the festival of St. George of Alcoy, see J. A. Llobet y Vallosera, *Apuntes his-*

toricos acerca de las fiestas que celebra cada año la ciudad de Alcoy a su patron San Jorge (Alcoy, 1853).

ALCUIN (ALCHUINE), ecclesiastic and man of learning in the 8th century, who liked to be called by the Latin name of ALBINUS, and at the academy of the palace of Charlemagne took the surname of FLACCUS, was born at Eboracum (York) in 735. Alcuin is important in the European history of his time, because he carried the learning of the British Isles to the court of Charlemagne and so to western Europe. He was educated at the cathedral school of York, under Aelbert, with whom he went to Rome in search of manuscripts. When Aelbert was appointed archbishop of York in 766, Alcuin succeeded him as head of the episcopal school. He again went to Rome in '780, to fetch the *palium* for Archbishop Eanbald, and at Parma met Charlemagne, who persuaded him to come to his court, and gave him the great abbeys of Ferrières and of Saint-Loup at Troyes. The king desired his help in the revival of learning among the Franks. From 781 to 790 Alcuin was Charlemagne's right hand in this enterprise. He had as pupils the king of the Franks, the members of his family and the young clerics attached to the palace chapel; he was the life and soul of the academy of the palace, and we have still, in the *Dialogue of Pepin* (son of Charlemagne) and *Alcuin*, a sample of the intellectual exercises in which they indulged. It was under his inspiration that Charles wrote his famous letter *de litteris colendis* (Boretius, *Capitularia*, i, p. 78), and he founded the palace library. In 790 Alcuin returned to his own country, but Charlemagne needed him to combat the adoptionist heresy, which was making headway in the marches of Spain. At the council of Frankfort in 794 Alcuin upheld the orthodox doctrine, and obtained the condemnation of the heresiarch, Felix of Urgel. After this victory he returned to his own land, but only for a brief period. Charlemagne gave him the great abbey of St. Martin at Tours, and there he passed his last years. Many students flocked to the abbey school; he had numerous manuscripts copied, the calligraphy of which is of extraordinary beauty (see Léopold Delisle in the *Mémoires de l'Académie des Inscriptions*, vol. xxxii, 1st part, 1885). The script used was the Carolingian minuscule from which our own roman type derives. He wrote numerous letters to his friends in England, to Arno, bishop of Salzburg, and above all to Charlemagne. These letters, of which 311 are extant, are filled chiefly with pious meditations, but they form a mine of information as to the literary and social conditions of the time, and are the most reliable authority for the history of humanism in the Carolingian age. Others deal with astronomy, a favourite subject with the emperor. Alcuin died on May 19, 804.

Alcuin is the most prominent figure of the Carolingian renaissance, in which have been distinguished three main periods: in the first of these, up to the arrival of Alcuin at the court, the Italians occupy the chief place; in the second, Alcuin and the Anglo-Saxons are dominant; in the third, which begins in 804, the influence of the Goth Theodulf is preponderant. Besides some graceful epistles in the style of Fortunatus, Alcuin wrote some long poems, and notably a whole history in verse of the church at York: *Versus de patribus, regibus et sanctis Eboracensis ecclesiae*.

He wrote also manuals used in his educational work; a grammar and works on rhetoric and dialectics, written in the form of dialogues. He composed homilies, a treatise *de Fide Trinitatis*, etc., and is said to have revised the text of the Latin Bible.

The complete works of Alcuin have been edited by Froben: *Alcuini opera* (Regensburg, 1777). This edition is reproduced in Migne's *Patrolog. lat.* vols. c and ci. The letters have been published by Jaffé and Dümmler in Jaffé's *Bibliotheca rerum germanicarum*, vol. vi, p. 132-897 (1873). E. Dümmler also published an authoritative edition, *Epistolae aevi Carolini*, vol. ii, p. 1-481, in the *Monumenta Germaniae*, and edited the poems in the same collection: *Poetae latini aevi Carolini*, vol. i, p. 169-341.

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sources de l'histoire Carolingienne, part i (1898); C. J. B. Gaskoin, *Alcuin: His Life and his Work* (1904). See further W. Ueberweg, *Grundriss d. Gesch. d. Phil. des Mittelalters* (1915); M. J. Rhodes, "Learning and Literature till Pope Sylvester II," in *Cambridge Mediaeval History*, vol. iii (1922).

ALCYONE or **HALCYONE**, in Greek mythology, daughter of Aeolus and wife of Ceyx. For their insolence in calling themselves Zeus and Hera, Alcyone was changed into a diver, Ceyx into a kingfisher. In another story, Ceyx was drowned and his body cast on the shore. His wife found the body, and the gods, out of compassion, changed both into kingfishers. The winds ceased to blow during their brooding time, hence the expression "halcyon days," used in ancient and modern times to denote a period of calm and tranquillity (Ovid, *Metam.*, xi, 410 *et seq.*).

ALDABRA ISLANDS, in the Indian ocean, part of the British colony of Seychelles, in 9° 30' S., 46° E., 265 mi. N.W. of the northern point of Madagascar, 630 mi. S.W. of Mahe and 70 mi. W. of the Cosmoledo group. Pop. (1931) 101. The islands, which constitute an oval atoll about 1½ mi. broad, enclose a large but shallow lagoon. Channels divide the ring into four islands, which rise from 20 to 80 ft. above the sea. Grande Terre or South island forms three-fifths of the circumference. The other islands are West island or Ile Picard, Polymnie, Middle island, and several islets (e.g., Île Michel) in the lagoon. The total land area is about 60 sq.mi. Cliffs of coral and limestone are in places replaced by sandy beaches and sandhills. There is very little soil. Dense scrub covers most of the land, but the lagoon shore is bounded by mangrove swamps. The flora and fauna are of great interest. The gigantic land tortoise (*Testudo elephantina*) is now carefully preserved. Peculiar birds include a rail (*Dryolimnas aldabranus*), an ibis (*Ibis abbotti*) and a dove (*Alectroenas sganzini*). The lagoon, more than 50 sq.mi. in area, teems with the hawksbill turtle and the edible turtle. Oysters and large crabs also occur, and a small mussel is found in enormous numbers. The flora includes mangroves, Rubiaceae, Sapotaceae and other forms requiring more than pure coralline material for their growth. The predominant species are Madagascar plants and birds, carried by currents and winds. There are a few endemic species of plants.

In common with the other islands of the Seychelles (which were visited by the John Murray scientific expedition in 1934), Aldabra seems to have been built up on the sunken surface of the old southern continent of Gondwanaland (or Lemuria, as it is sometimes called) by a deposit of foraminifer remains, mostly coccoliths and rhabdoliths; it has never been joined to any other land. At Aldabra the coral foundation is totally above water. The coral limestone of the atoll is vitrified and gives out a ringing sound when struck or simply walked on. The coral is generally reddish, but runs from light yellow to chocolate-brown.

Aldabra was visited by the Portuguese in 1511 but was already known to the Arabs, who gave the name. In the 18th century the islets became dependencies of the French establishments at Bourbon (Réunion). In 1810 with Mauritius, Bourbon (for a time), the Seychelles and other islands, Aldabra became British.

See R. Dupont, *St. Pierre, Astove, Cosmoledo, Assumption and the Aldabra Group of the Seychelles Islands* (1907); J. A. F. Ozanne, *Coconuts and Creoles* (1936); annual *Blue Book and Colonial Report* on the Seychelles.

ALDANOV, MARK ALEXANDROVICH (1889–), Russian novelist and publicist, also known as Landau-Aldanov, was born at Kiev and emigrated to France in 1919. His most considerable work is a trilogy, *The Thinker*, in which the French Revolution is treated with learning and understanding. Later writings include *The Fifth Seal* (1943) and *Before the Deluge* (1947).

ALDBOROUGH, a village in the West Riding of Yorkshire, England, 16 mi. W.N.W. of York. Pop. (1931) 543. There are evidences of settlement from early times, the site being known to the Romans as *Isurium Brigantum*.

ALDEBARAN, α Tauri, one of the 20 brightest stars in the sky, is in the constellation Taurus (q.v.). It is a reddish giant star having a diameter approximately 50 times that of the sun and is located at a distance of about 80 light-years. It is accompanied by a very faint companion star.

ALDEBURGH (ALDBOROUGH), municipal borough on the coast of Suffolk, England, the terminus of a branch of the Eastern Region railway, 99½ mi. N.E. of London. Population (1938) 2,401. The district is exposed, but a fine stretch of sand fringes Aldeburgh bay. To the west the river Alde broadens as if into an estuary, but its outflow is prevented by the sand, and it runs south for nearly 10 mi. parallel with the shore. The sand banks have arrested the encroachments of the sea, which submerged a former site of Aldeburgh.

Aldeburgh (Aldburc) takes its name from the river Alde. There is no pre-Conquest record but at the Domesday survey most of the land was held by Robert Malet, a Norman. In 1155 the manor was granted to the abbey of St. John of Colchester and later to Cardinal Wolsey. In 1567 a Saturday market was granted. In the 16th century Aldeburgh was a place of considerable commercial importance. The earliest charter is that of 1529. In 1548 it was made a free borough, with a charter of incorporation and a market on Wednesday. Later charters were granted in 1553, 1558 and 1567, by James I (who granted two annual fairs) in 1606, and by Charles I, in 1631 and 1637. The fairs and markets became so unimportant that they were discontinued about the middle of the 19th century. The town returned two members to parliament in 1572, and continued to do so until the Reform act of 1832.

Frequent disastrous incursions of the sea reduced Aldeburgh to a mere fishing village, but it is now a golfing centre. There are coastguard and lifeboat stations. A small Moot hall of the 16th century is used for corporation meetings. Slaughtden quay on the Alde admits small vessels, and herring and lobster fishing are carried on. Aldeburgh is governed by a mayor, 4 aldermen and 12 councillors. Area 4.2 sq.mi. It is included in the Woodbridge division of the parliamentary county of East Suffolk.

ALDEGREVER or **ALDEGRAF, HEINRICH** (1502–1558), German painter and engraver, was born at Paderborn, from whence he removed in early life to Soest, where he died. From the close resemblance of his style to that of Albrecht Dürer he has sometimes been called the Albert of Westphalia. There is a good collection of his engravings in the British museum. Specimens of his painting are exceedingly rare. Five pictures are in continental galleries, but the genuineness of the works in the Vienna and Munich collections attributed to him is at least doubtful, the only unchallenged example being a portrait of Engelbert Therlaen (1551) in the Berlin museum.

ALDEHYDES, an important class of chemical compounds having the general formula R.CHO, where R is an alkyl (aliphatic)- or aryl (aromatic) radical. The name is derived from *alcohol dehydrogenatus* (J. Liebig), indicating that these compounds may be obtained from primary alcohols by removal of hydrogen $\text{RCH}_2\text{OH} - 2\text{H} = \text{R.CHO}$.

The group CHO which is to be found in all aldehydes contains the most active form of the carbonyl radical, CO, known to chemists, and it is to the intense reactivity of this radical that the aldehydes owe their importance as organic synthetic agents both in nature and in the chemical laboratory.

Aldehydes are generally named specifically after the acids into which they are converted by oxidation; thus formaldehyde, acetaldehyde and benzaldehyde furnish formic, acetic and benzoic acids, respectively. In more complicated cases, the termination *al* is employed to denote aldehydic functions, according to the Geneva convention of chemists; thus geranial, the aldehyde of lemon-grass oil, is the oxidation product of the alcohol geraniol, contained in geranium oil (see TERPENES).

Many aldehydes are known to chemistry, some being produced artificially, whereas numerous others are found in the vegetable kingdom either free (e.g., cinnamaldehyde in cinnamon oil) or combined in certain glycosides (e.g., benzaldehyde in amygdalin; see GLUCOSIDES, NATURAL).

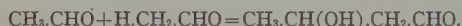
Properties of Typical Aldehydes.—Formaldehyde, H.CHO, the simplest of the aldehydes is a gas at the ordinary temperature (b.p. — 19° C.) and is prepared by passing the vapour of methyl alcohol and air over heated copper gauze. The gaseous aldehyde is collected in water to form a 30–40% solution known commercially

as Formalin. This solution on concentration yields a white amorphous solid known as paraformaldehyde, which is considered to be a complex mixture of substances of type formula $\text{HOCH}_2\text{-(OCH}_2\text{)}_n\text{OCH}_2\text{OH}$, with n possessing values up to about 100. When, however, formaldehyde is distilled from a 60% aqueous solution containing 2% sulphuric acid, it polymerizes to a crystalline modification termed α -trioxymethylene or trioxane, $(\text{CH}_2\text{O})_3$. These polymeric forms are dissociated on heating into the gaseous monomeric formaldehyde.

Acetaldehyde, prepared by oxidation of ethyl alcohol (*q.v.*), by hydration of acetylene (*q.v.*) and by direct synthesis from carbon monoxide and hydrogen (*see below*), is a volatile liquid boiling at 21°C . and miscible in all proportions with water. It is readily polymerized catalytically by traces of zinc chloride, hydrochloric acid, etc., at the ordinary temperature to para-acetaldehyde or paraldehyde (*q.v.*) $(\text{C}_2\text{H}_4\text{O})_3$, a liquid boiling at 124°C . and only moderately soluble in water. Paraldehyde, employed medicinally as a sedative without action on the heart, is administered intravenously as an anaesthetic or hypnotic. When the foregoing polymerization of acetaldehyde takes place in a freezing mixture, metaldehyde or meta-acetaldehyde, $(\text{C}_2\text{H}_4\text{O})_4$, is produced as a white crystalline solid subliming at 112°C .– 115°C . This substance is insoluble in water and when heated in a sealed tube at 100°C . is reconverted into the monomeric form. Metaldehyde, which is produced commercially, has been recommended as a smokeless fuel.

The simultaneous chlorination and oxidation of ethyl alcohol leads to trichloroacetaldehyde which in its hydrated state is the well-known drug chloral hydrate (*see CHLORAL*).

Aldolization.—The transformation of formaldehyde and acetaldehyde into their polymeric forms is a chemical change which is readily reversible by thermal dissociation. In addition to this change, aldehydes have the capacity for undergoing a polymerization in which the carbon atoms of separate molecules become directly attached, so that β -hydroxyaldehydes are formed. This process also is often reversible, especially in the presence of a basic catalyst. This mode of polymerization, which is termed aldolization, is an important reaction in organic synthesis. Aldol (β -hydroxybutyraldehyde) is formed by a polymerization of two molecules of acetaldehyde:



By loss of water aldol passes into the unsaturated crotonaldehyde, $\text{CH}_3\text{CH:CHCHO}$.

The adding of carbon to carbon in a somewhat different manner occurs to a marked degree in formaldehyde. A sixfold polymerization of this substance in the presence of magnesium hydroxide (Loew) furnishes α - and β -acroses, two synthetic sugars which have been identified as inactive fructose and inactive sorbose, respectively. Contrary to the older views, however, this process is now known not to be involved in the photosynthesis of sugars in green plants. (*See PHOTOSYNTHESIS*.)

Resinification.—Acetaldehyde and certain of its homologues are converted into resins under the influence of alkalis. Acrolein, $\text{CH}_2\text{:CHCHO}$, the simplest of the unsaturated aldehydes, is obtained by abstraction of water from glycerine by the agency of alkali bisulphates and phosphoric or boric acid. It is a colourless liquid boiling at 52.4°C . with a disagreeable, tear-exciting odour. In the presence of traces of acids, it readily undergoes polymerization to form a solid resinous material, metacrolein (*see RESINS: Synthetic*). Acrolein forms a dibromide from which E. Fischer by the action of aqueous barium hydroxide obtained the synthetic sugars, α - and β -acroses.

Aromatic Aldehydes.—Benzaldehyde, the most important commercially of the aromatic aldehydes, is usually made from the chlorinated derivatives of toluene. Benzyl chloride, $\text{C}_6\text{H}_5\text{CH}_2\text{Cl}$, heated with aqueous lead or cupric nitrate furnishes benzaldehyde, which is also prepared by heating benzal or benzylidene chloride, $\text{C}_6\text{H}_5\text{CHCl}_2$, with aqueous calcium hydroxide. As prepared by either method, benzaldehyde is contaminated with traces of chlorinated benzaldehydes, and when chlorine-free benzaldehyde is needed it is prepared by the direct oxidation of toluene by chemi-

cal means (manganese dioxide and sulphuric acid) or by electrolytic means (in acetone-sulphuric acid solution with platinum electrodes).

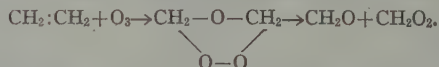
Benzaldehyde is a colourless, highly refractive liquid boiling at 179°C .– 180°C . with the characteristic odour of oil of bitter almonds of which oil it is the essential constituent, being derived from the hydrolysis of the glucoside, amygdalin, present in the almond. It readily absorbs oxygen from the air, becoming oxidized to benzoic acid. With aqueous caustic alkalis it undergoes the Cannizzaro reaction, $2\text{C}_6\text{H}_5\text{CHO} = \text{C}_6\text{H}_5\text{CH}_2\text{OH} + \text{C}_6\text{H}_5\text{CO}_2\text{H}$, yielding molecular proportions of benzyl alcohol and benzoic acid. With alcoholic potassium cyanide, it gives benzoin, $\text{C}_6\text{H}_5\text{CH(OH).CO.C}_6\text{H}_5$. Benzaldehyde is also an important intermediate in the production of colouring matters (*see DYES, SYNTHETIC*). When condensed with acetic anhydride and dry sodium acetate, it yields cinnamic acid, whereas cinnamaldehyde arises from a condensation between benzaldehyde and acetaldehyde in the presence of sodium ethoxide.

Furfural (furfuraldehyde, O-CH:CH
|
 C(CHO):CH), is an example of a non-

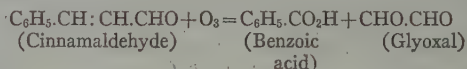
aromatic cyclic aldehyde formerly obtained by the hydrolysis of bran with dilute mineral acid and now manufactured in the U.S.A. by the action of steam and dilute acid on oat hulls and corn cobs and cornstalks contained in large digesters. The volatile furfural (b.p. 160°C .– 162°C .) is isolated and purified by fractional distillation.

General Methods of Preparation.—*Direct Synthesis.*—Arising from a study of chemical reactions under high pressure it has been found that when carbon monoxide and hydrogen are heated together at 360°C .– 380°C . under a pressure of 200 atm. in the presence of a mixed catalyst consisting of the oxides of cobalt, copper, manganese and zinc, a mixture of aliphatic aldehydes is produced among which formaldehyde, acetaldehyde, propionaldehyde and higher aldehydes have been identified (*see PRESSURE CHEMISTRY*).

Action of Ozone on Olefines.—During an investigation of the action of ozone on various organic substances, C. D. Harries discovered that this active form of oxygen has a specific action on carbon compounds containing a double or ethylenic linkage. A molecular proportion of ozone attaches itself to the carbon atoms of the double linking forming an ozonide, which on treatment with water yields an aldehyde and an aldehyde peroxide, the latter becoming transformed into an acid. In the simplest case of ethylene this gas furnishes an explosive ozonide which subsequently gives rise to formaldehyde and formic acid,



A similar ozonization applied to more complex olefines has led to aldehydes which are otherwise prepared only with difficulty:

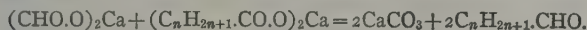


Dehydrogenation of Primary Alcohols.—The primary alcohols may be dehydrogenated either thermally or by oxidation. In the former process the alcohol is passed over a heated metallic catalyst, preferably copper, although nickel, palladium or platinum or such oxides as vanadium pentoxide, V_2O_5 , may be employed. The oxidation of a primary alcohol to an aldehyde is generally effected by aqueous chromic acid (a solution of sodium bichromate and dilute sulphuric acid), but other oxidizing agents such as manganese dioxide and dilute sulphuric acid, or even atmospheric oxygen in presence of platinum black or bone black, may be employed.

Thermal Decomposition of α -Hydroxycarboxylic Acids.—This process, discovered by H. R. Le Sueur, has been worked out chiefly with the higher fatty acids. For example, stearic acid is converted successively into α -bromostearic and α -hydroxystearic acids. The latter acid, on heating at 270°C ., yields margaric

aldehyde, $C_{16}H_{33}.CHO$, and formic acid. Incidentally this method forms a means of passing from common acids such as stearic and palmitic acids, which are readily obtained from natural sources, to acids such as margaric acid, $C_{16}H_{33}.COOH$, which do not occur in nature.

Aldehydes from Calcium Formate and Salts.—Another general method for aldehydes depends on the heating together of an intimate mixture of calcium formate and the calcium salt of some other acid:



Aldehydes from Grignard Reagents.—Grignard reagents (*q.v.*), with the general structure $RMgX$, react with disubstituted formamides $H-CO-NR'R''$ to give products which on hydrolysis yield the aldehydes $RCHO$; and with ethyl orthoformate $HC(OC_2H_5)_3$ to give the acetals $RCH(OC_2H_5)_2$, from which the aldehydes $RCHO$ can be freed by the action of an aqueous acid.

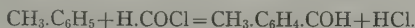
Aldehydes by Reduction.—Acid chlorides $RCOCl$, dissolved in quinoline (*q.v.*), can be reduced to aldehydes $RCHO$ by hydrogen H_2 in the presence of a platinum catalyst.

Aromatic Aldehydes from Phenols.—A long-known process for the conversion of phenols into hydroxy-aryl-aldehydes is associated with the names of C. L. Reimer and F. Tiemann. It consists in treating the phenolic compound with chloroform in presence of concentrated alkalis. With phenol itself the reaction proceeds as follows:

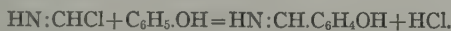


Two isomerides are produced, parahydroxybenzaldehyde and salicylaldehyde (orthohydroxybenzaldehyde). The latter isomeride occurs in the volatile oils of *Spiraea* and in the glucoside, salicin, of the willow.

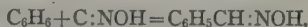
Syntheses Catalyzed by Metal Halides.—The two syntheses described under this heading, which are due to L. Gattermann, are, like those of the preceding section, applicable only to the aromatic series. The first depends on the use of carbon monoxide, this gas and hydrogen chloride being passed into a solution of an aromatic hydrocarbon in a dry solvent in the presence of cuprous and aluminum chlorides. In the case of toluene the condensation gives rise to *p*-tolualdehyde. In all probability the carbon monoxide absorbed by the cuprous chloride forms an intermediate compound, $H.COCl$, with the hydrogen chloride and this unstable formyl chloride under the influence of aluminum chloride condenses with the hydrocarbon to give rise to the aldehyde:



The second Gattermann synthesis involves the use of hydrogen cyanide (anhydrous prussic acid), and since this reagent is now procurable on a manufacturing scale (*see PRUSSIC ACID*) the synthesis offers industrial possibilities. The aromatic substance, which may be a hydrocarbon or a phenol, is dissolved in a dry solvent containing anhydrous aluminum or zinc chloride and to this mixture hydrogen cyanide is added while hydrogen chloride is bubbled in to saturation when the two hydrides interact potentially as $HN:CHCl$:



The aldehyde-imine thus formed as an intermediate product is hydrolyzed when boiled with water into ammonia and the corresponding aldehyde, $HO.C_6H_4.CHO$. In this connection may be mentioned the synthesis of benzaldoxime by R. Scholl, who treated benzene with mercury fulminate and partially hydrated aluminum chloride. The condensation may be regarded as occurring between fulminic acid (*q.v.*) and the hydrocarbon,



General Reactions of Aldehydes.—The aldehydes combine additively with sodium hydrogen sulphite to furnish bisulphite compounds, $R.CH(OH).SO_3Na$. These compounds, being crystallizable and easily hydrolyzed by dilute acid, are frequently used in the purification of the aldehydes. Sodium hydrosulphite also interacts with aldehydes giving rise to compounds of the general

formula $R.CH(OH).SO_3Na$. The formaldehyde compound is the important reducing agent, Rongalite, employed in calico printing for discharging the colour of dyes.

Aldehydes react with hydrogen cyanide to form cyanohydrins, $R.CH(OH).CN$, which are hydrolyzable to α -hydroxycarboxylic acids containing one more carbon atom than the original aldehyde. Aldehydes combine with hydroxylamine to form oximes (*q.v.*), and with phenylhydrazine to phenylhydrazones and with semicarbazide to crystallizable semicarbazones (*see CHEMISTRY: Organic Chemistry*). The action of active metals in the presence of acids reduces aldehydes to primary alcohols, whereas with Grignard reagents they are converted into secondary alcohols. Formaldehyde condenses with aqueous ammonia to form hexamethylenetetramine, $N_4(CH_2)_6$, a urinary antiseptic, urotropine (*q.v.*), whereas the other aliphatic aldehydes combine with ethereal ammonia to give aldehyde-ammonias, which are usually assigned structures of the type $R.CH(OH).NH_2$, but which are actually of uncertain composition and molecular weight; from these the aldehydes can be regenerated by distillation with dilute acid. Aldehydes in general are characterized by the colour reaction of H. Schiff, this being the reddish-violet coloration developed with a solution of magenta or fuchsine which has been decolorized by sulphurous acid.

(G. T. M., X)

ALDEN, ISABELLA (MACDONALD) (1841-1930), U.S. juvenile writer, was born in Rochester, N.Y., on Nov. 3, 1841. She was educated at Seneca Collegiate institute in Ovid, N.Y., and at the Young Ladies' institute in Auburn, N.Y. In 1866 she married the Rev Gustavus R. Alden. Under the pseudonym of "Pansy" she wrote a series of about 75 juvenile works, known as the "Pansy books," and from 1873 to 1896 edited the juvenile periodical *Pansy*. In addition, she wrote *The Prince of Peace*, a life of Christ, and various volumes of fiction for adult readers. She also contributed extensively to religious journals.

ALDEN, JOHN (1599?-1687), one of the Pilgrims who in 1620 emigrated to America in the "Mayflower" and founded the Plymouth Colony. He was a settler of Duxbury, Mass., where he lived for most of his life. From 1633 until 1675 he was an assistant to the governor of the Colony, frequently acting as governor. At the time of his death on Sept. 12, 1687, he was the last male survivor of the "Mayflower" company. He is remembered chiefly because of a popular legend, put into verse as *The Courtship of Miles Standish* by Henry W. Longfellow, concerning his courtship of Priscilla Mullins, whom he married in 1623, after having wooed her first for his friend Miles Standish.



THE ARMORIAL BEARINGS OF ALDEN OF ENGLAND. ANCESTOR OF THE "MAYFLOWER" COLONIST

ALDER (*Alnus*), the name given to a group of shrubs and trees belonging to the birch family (Betulaceae), comprises about 30 species distributed through the north temperate zone. In the new world a few extend south over the mountains of Central America and the South American Andes to Peru and Chile. They are readily distinguished from the birches (*q.v.*) by their stalked, valvate, winter buds, and cones (strobiles) with thick woody scales which persist on the branchlets long after their small winged fruits (nutlets) have been released.

The black alder (*A. glutinosa*), the most important old world species, occurs widespread on wet sites in Europe, Asia and northern Africa, and has become naturalized in the eastern United States. It is the only alder indigenous to Great Britain, where it attains a height of 75 ft. and a diameter of 30 in. The soft, light brown wood is used for many purposes including furniture, piling and charcoal manufacture. The speckled or hoary alder (*A. incana*), usually a large shrub, is found in Europe and northern Asia, and in swamps of eastern United States and Canada. The green alder (*A. viridis*), a small shrub of Europe and Asia, is also

found in eastern North America. The alders of the Rocky mountain region and Pacific slope often become large trees. Among these are the red alder (*A. rubra*), the Sitka alder (*A. sinuata*), and the white alder (*A. rhombifolia*). The red alder, which attains a height of 120 ft. and diameter of 40 in., is the most valuable. The wood is soft, works well, and is largely consumed in the manufacture of inexpensive furniture. In mountain regions alders are among the first woody plants to appear in areas denuded by avalanches and in the rubble around the edges of receding glaciers.

Many alders are prized ornamentals, especially horticultural varieties of the black and speckled alder, and the Japanese alder (*A. japonica*), which is one of the largest and most beautiful members of the genus. (E. S. Hr.)

ALDER FLY, the name given to neuropterous insects of the family *Sialidae* with long filamentous antennae and four large wings, of which the hind pair has the anal area folded fan-wise when at rest. They are sluggish insects found only near fresh water. The eggs are often very numerous and are laid in clusters on plants, etc., close to the water. The larvae are aquatic, living in streams, large rivers or lakes; they are provided with biting jaws and breathe by seven or eight pairs of filamentous abdominal gills. The pupae are found in soil, moss, etc., and there is no cocoon.

Sialis lutaria is the common alder fly of Britain. In North America there are fully 18 species, several of which are common and widely distributed.

ALDERMAN, a term implying the possession of an office of rank or dignity, and, in modern times, applied to an office-bearer in the municipal corporations and county councils of England and Wales, and in the municipal corporations of Ireland and the United States. Among the Anglo-Saxons, earls, governors of provinces and other persons of distinction received this title. Thus we read of the *aldermannus totius Angliae*, who seems to have corresponded to the officer afterwards styled *capitalis iusticiarius Angliae*, or chief justice of England; the *aldermannus regis*, probably an occasional magistrate, answering to the modern justice of assize, or perhaps an officer whose duty it was to prosecute for the crown; and *aldermannus comitatus*, a magistrate with a middle rank between what was afterwards called the *earl* and the *sheriff*, who sat at the trial of causes with the bishop and declared the common law, while the bishop proceeded according to ecclesiastical law. Besides these, we meet with the titles of *aldermannus civitatis*, *burgi*, *castelli*, *hundredi sive wapentachii*, etc. In England, before the passing of the Municipal Corporations act, their functions varied. By the Municipal Corporations act 1835, and other acts, consolidated by the Municipal Corporations act 1882, the aldermen are elected by the councillors for six years, one-half going out every three years. One-fourth of the municipal council consists of aldermen and three-fourths of councillors. In the counties, the number of aldermen is one-third of the number of councillors, except in London, where it is one-sixth.

In the colonial period of U.S. municipal history, the city councils resembled their British prototypes, with aldermen and common councillors sitting together as one body under the chairmanship of the mayor. After the Revolution the municipal councils were the beneficiaries of the popular faith, which placed great confidence in representative assemblies. As the functions of municipalities multiplied, greater jurisdiction came into their hands. Before the Civil War the councils showed a marked tendency to deteriorate in personnel and performance. Deterioration in performance was not always due to venal corruption: the governance of a city in the U.S. during the 19th century would have tested the political wisdom of a sage, so fast was the growth of the average city and so lacking were precedents for meeting the great problems of sanitation, water supply, transportation and the like. Whatever causes existed for the breakdown in municipal government, the result was a placing of greater powers of administration and general jurisdiction with the mayor. After 1900 the tendency was toward councils composed of fewer aldermen who served as a rule for four years. In cities retaining the older mayor-council form of government the size of the council averaged about thirty-five aldermen. Under the commission and commissioner-manager type the size averaged about seven. In a few cities, notably New York, the aldermen were chosen on the basis of the

Hare system of proportional representation. In still a larger number of cities they were subject to such checks as the popular initiative, referendum and recall.

See William Anderson, *American City Government* (1925); R. Fredrick, *The Alderman's Manual* (1935). (J. G. Kn.)

ALDERNEY, northernmost of the larger Channel Islands, $3\frac{1}{2}$ mi. N.E.-S.W., average width 1 mi. Area, 3 sq.mi. Pop. (1931) 1,507, excluding visitors. It lies $49^{\circ}43'$ N. and $2^{\circ}12'$ W. On the N. coast, Braye harbour, with a breakwater 1,000 yd. long, communicates normally almost daily with Guernsey, and weekly with Cherbourg, France. Rocks fringe all the coasts. A dangerous channel nearly 9 mi. wide, the Race, separates it from Cap de la Hague. Here the remnant of the French fleet under Tourville escaped after the defeat of La Hogue in 1692. To the west, the Swinge (Singe), a narrower and equally difficult tidal race, separates Alderney from the uninhabited islands of Burhou, Ortach and others; still further west are the Casquets (light-house) with a long record of shipwrecks. Alderney is a tableland 300 ft. high in the west, but dropping towards the northeast. On the south the cliffs are very steep, elsewhere rocky headlands alternate with open sandy bays, of which the most important are Braye and Longy. At the latter there are evidences of settlement in prehistoric and in Roman times. Cambrian grits occur along the northeast coast, and south of Longy give rise to the Hanging Rocks; diorite and granite occupy the central, and granite-porphry the southwest portion of the island. There are a few streams, but water is obtained mainly from wells. Trees are scarce. The town of St. Anne stands almost in the centre of the island with its arable land around it. This is largely unenclosed and still shows the old arrangement in strips. It was long under a system of continuous corn-growing, now superseded. It is encircled by the grazing lands which were communal until 1830. The modern church (1850), in Early English style, is the work of Sir Gilbert Scott, and a memorial to the Le Mesurier family, in which the hereditary governorship of the island was vested until the abolition of the office in 1825. There is a chain of derelict fortifications round the north coast, but Fort Tourgis on the west and Fort Essex on the east are still used as barracks. The soil of Alderney is fertile; grain and roots are grown and early potatoes are exported. Alderney cattle are largely reared and are usually kept tethered, but the island does not have a stock book separate from Guernsey. Alderney is included in the bailiwick of Guernsey. Its government, consisting of a judge, six jurats, the Douzaine, a procureur du roi, and a greffier, is subordinate to that of Guernsey. German troops occupied the island June 30, 1940, after the French defeat. See CHANNEL ISLANDS.

ALDERSHOT, municipal borough, Aldershot parliamentary division, Southampton, England, 34 mi. S.W. by W. of London, on the S.R. Pop. (1938) 36,120. Area 6.5 sq.mi. Aldershot was a mere village till 1855 when a camp was established. Its germ is to be found in the temporary training camp on Chobham Ridges, formed in 1853 by Lord Hardinge, the military commander-in-chief, who also advised the choice of Aldershot as a permanent camp. The government acted on his suggestion after the experience of the Crimea. Under the Military Works act of 1897 and 1899 large sums were provided for completing the work. The town grew in size and importance as the camp became the centre of military training for the country. Besides troops in barracks, large numbers of militia and volunteer units train at Aldershot, using the famous range at Bisley near by. A heavy program of modernization to meet the needs of the change from horsed to mechanized transport was undertaken in 1936, and in the following year an additional 2,000 acres were acquired. The borough, which was incorporated in 1922, is governed by a mayor, 6 aldermen and 20 councillors, 3 of whom are nominated by the secretary of state for war.

ALDHelm (c. 640-709), bishop of Sherborne, English scholar, was born before the middle of the 7th century. He is said to have been the son of Kenten, who was of the royal house of Wessex, but who was certainly not, as Aldhelm's early biographer Faritus asserts, brother of King Ine. He received his first education in the school of an Irish scholar and monk, Mail-

dulf, Maeldubh, or Meldun (d. c. 675), who had settled in the British stronghold of Bladon or Bladow on the site of Malmesbury. Aldhelm was a pupil of Hadrian, abbot of St. Augustine's, Canterbury, whom he addresses as the "venerable preceptor of my rude childhood." He must, nevertheless, have been 30 years of age when he began to study with Hadrian. His studies included Roman law, astronomy, astrology, the art of reckoning, and the difficulties of the calendar. He learned, according to the doubtful statements of the early lives, both Greek and Hebrew. Ill-health compelled him to leave Canterbury, and he returned to Malmesbury. When Maildulf died, Aldhelm was appointed in 675 to succeed him, and became the first abbot. He introduced the Benedictine rule, and secured the right of the election of the abbot to the monks themselves. The community at Malmesbury increased, and Aldhelm was able to found two other centres of learning at Frome and at Bradford-on-Avon. The little church of St. Lawrence at Bradford may safely be regarded as his. At Malmesbury he built a new church to replace Maildulf's modest building, and obtained considerable grants of land for the monastery. His fame as a scholar rapidly spread into other countries. Aldhelm was the first Englishman, so far as we know, to write in Latin verse, and his letter to Acircius (Aldfrith or Eadfrith, king of Northumbria) is a treatise on Latin prosody for the use of his countrymen. In this work he included his most famous productions, 101 riddles in Latin hexameters. Each of them is a complete picture, and one of them runs to 83 lines. That his merits as a scholar were early recognized in his own country is shown by the encomium of Bede (*Ecc. Hist.* v. 18), who speaks of him as a wonder of erudition. His fame reached Italy, and at the request of Pope Sergius I. (687-701) he paid a visit to Rome, of which, however, there is no notice in his extant writings. He was deputed by a synod of the church in Wessex to remonstrate with the Britons of Domnonia (Devon and Cornwall) on their differences from the Roman practice in the shape of the tonsure and the date of Easter. This he did in a long and rather acrimonious letter to their king Geraint (Geruntius), and their ultimate agreement with Rome is referred by William of Malmesbury to his efforts. In 705 Aldhelm became bishop of the new see of Sherborne. He wished to resign the abbey of Malmesbury which he had governed for 30 years, but yielding to the remonstrances of the monks he continued to direct it until his death. The cathedral church which he built at Sherborne, though replaced later by a Norman church, is described by William of Malmesbury. He was on his rounds in his diocese when he died in the church of Doulting on May 25, 709. He was buried in the church of St. Michael, Malmesbury. Aldhelm wrote poetry in Anglo-Saxon also, and set his own compositions to music, but none of his songs, which were still popular in the time of Alfred, have come down to us.

Aldhelm's works were collected in J. A. Giles's *Patres eccl. Angl.* (1844), and reprinted by J. P. Migne in his *Patrologiae Cursus*, vol. lxxxix. (1850). The letter to Geraint, king of Domnonia, was supposed to have been destroyed by the Britons (W. of Malmesbury, *Gesta Pontificum*, p. 361), but was discovered with others of Aldhelm's in the correspondence of St. Boniface, archbishop of Mainz. A long letter to Eahfrid, a scholar just returned from Ireland (first printed in *Usserii Veterum Epist. Hiber.-Sylloge*, 1632), is of interest as casting light on the relations between English and Irish scholars. Next to the riddles, Aldhelm's best-known work is *De Laude Virginitatis sive de Virginitate Sanctorum*, a Latin treatise addressed about 705 to the nuns of Barking, in which he commemorates a great number of saints. This was afterwards turned by Aldhelm into Latin verse (printed by Delrio, Mainz, 1601). The chief source of his *Epistola ad Acircium sive liber de septenario, et de metris, aenigmatibus ac pedum regulis* (ed. A. Mai, *Class. Auct.* vol. v.) is Priscian. For the riddles included in it, his model was the collection known as *Sympositi aenigmata*. The acrostic introduction gives the sentence, "Aldhelmus cecinit millenis versibus odas," whether read from the initial or final letters of the lines. His Latin poems include one on the dedication of a basilica built by Bugge (or Eadburga), a royal lady of the house of Wessex.

BIBLIOGRAPHY.—Faritius (d. 1117), an Italian monk of Malmesbury, afterwards abbot of Abingdon, wrote a *Vita S. Aldelmi* (ms. Cotton, Faustina, B. 4), printed by Giles and Migne, also in *Original Lives of Anglo-Saxons* (Caxton Soc., 1854); but the best authority is William of Malmesbury, who in the fifth book, devoted to St. Aldhelm, of the *Gesta Pontificum* proposes to fill up the outline of Faritius, using the church records, the traditions of Aldhelm's miracles preserved by the monks of Malmesbury, and the lost "Handbook" or commonplace book of King Alfred. (See *De Gestis Pontificum*, ed.

N. E. S. A. Hamilton, 1870, for the Rolls Series, pp. 330-443.) The life by John Capgrave in his *Legenda Nova* (1516) is chiefly an abridgement of Malmesbury's narrative. Consult also L. Bönhoff, *Aldhelm von Malmesbury* (1804); G. F. Browne, bishop of Bristol, *St. Aldhelm: His Life and Times* (1903); and W. B. Wildman, *Life of S. Ealdhelm, first Bishop of Sherborne* (1905), containing many interesting local details. For some poems attributed to Aldhelm, and printed in Dümmler's edition of the letters of St. Boniface and Lul in *Monumenta Germaniae Historica* (epist. tom. iii.), see H. Bradley in *Eng. Hist. Review*, xv. p. 291 (1900), where they are attributed to Aldhelm's disciple Aethelwald. The very varied sources and the chronology of Aldhelm's work are discussed in "Zu Aldhelm und Baeda," by Max Manitius, in *Sitzungsberichte der kaiserlichen Akad. der Wissenschaften* (1886).

An excellent account of his ecclesiastical importance is given by W. Bright in *Chapters on Early English Church History* (1878).

For his position as a writer of Latin verse consult A. Ebert, *Allgemeine Geschichte d. Literatur des Mittelalters im Abendlande*, vol. i. new edition (1889); M. Manitius, *Geschichte der christlichlateinischen Poesie, etc.* (Stuttgart, 1891), pp. 487-496; also H. Hahn, *Bonifat und Lul ihre angelsächsischen Korrespondenzen*, chap. i. (Leipzig, 1883). The two last-named works contain many further bibliographical references.

ALDINE PRESS, the printing office started by Aldus Manutius at the end of the 15th century in Venice, from which were issued the celebrated Aldine editions of the classics of that time. (See MANUTIUS.) The Aldine Press is famous in the history of typography (*q.v.*), among other things, for the introduction of italics.

ALDRED or EALDRED (d. 1069), English ecclesiastic, became abbot of Tavistock about 1027, in 1044 was made bishop of Worcester, and in 1060 archbishop of York. It is stated by Florence of Worcester that Aldred crowned King Harold II. in 1066, although the Norman authorities mention Stigand as the officiating prelate. After the battle of Hastings, Aldred joined the party who sought to bestow the throne upon Edgar the Aetheling, but when these efforts appeared hopeless he was among those who submitted to William the Conqueror at Berkhamstead. Selected to crown the new King, he performed the ceremony on Christmas Day 1066, and in 1068 performed the same office at the coronation of Matilda, the Conqueror's wife. He died at York on Sept. 11, 1069, and was buried in his own cathedral.

See *The Anglo-Saxon Chronicle*, edited by C. Plummer (Oxford, 1892-99); Florence of Worcester, *Chronicon ex Chronicis*, edited by B. Thorpe (London, 1848-49); William of Malmesbury, *De Gestis Pontificum Anglorum*, edited by N.E.S.A. Hamilton (London, 1870); W. H. Dixon, *Fasti Eboracenses*, vol. i, edited by J. Raine (London, 1863); T. Stubbs, *Chronica Pontificum Ecclesiae Eboracensis*, edited by J. Raine (London, 1879-94); E. A. Freeman, *History of the Norman Conquest*, vol. ii., iii., iv. (Oxford, 1867-79).

ALDRICH, HENRY (1647-1710), dean of Christ Church, Oxford, and in 1692 vice-chancellor of the University, was born at Westminster in 1647, and died at Oxford Dec. 14, 1710. He was a man of versatile talent, who wrote a *Compendium Artis Logicae* used as a text-book in Oxford far into the 19th century, composed many excellent anthems and church services and adapted much church music of Palestrina and Carissimi to English words with skill and judgment. He designed the church and campanile of All Saints and the Peckwater quadrangle of Christ Church.

Dean Aldrich bore a great reputation for conviviality, and wrote a humorous Latin version of the popular ballad:

A soldier and a sailor,
A tinker and a tailor, etc.

Another specimen of his wit is furnished by the following epigram of the five reasons for drinking:

*Si bene quid memini, causae sunt quinque bibendi;
Hospitis adventus, praesens sitis atque futura,
Aut vini bonitas, aut quaelibet altera causa.*

The translation runs:

If on my theme I rightly think,
There are five reasons why men drink:—
Good wine; a friend; because I'm dry;
Or lest I should be by and by;
Or—any other reason why.

ALDRICH, NELSON WILMARTH (1841-1915), American politician, was born at Foster, R.I., on Nov. 6, 1841. His

first political service was as a member (1869–75) and president (1871–72) of the Providence common council. He was a member of the lower house of the Rhode Island legislature in 1875–76, and speaker in the latter year. By this time he had become very influential in Republican State politics, and in 1878 and again in 1880 was elected to Congress. In 1881 he resigned to take a seat in the Senate, where he served continuously for 30 years. By reason of his mastery of parliamentary detail and his skill in bringing about combinations of opposing groups, he became one of the most powerful leaders of the Republicans in the Senate. He was an able champion of protection and an authority on finance, and his knowledge of these subjects was embodied in various tariff and currency enactments. He sponsored the Aldrich-Vreeland currency law of 1908. As chairman of the national monetary commission, brought into existence by that Act, he directed extensive investigations of the banking systems of the world. He published a scheme, based on the information thus secured, for the reform of the American banking system known as the Aldrich plan. He also was largely responsible for the Payne-Aldrich Tariff Act of 1909, which, by reason of its high rates, aroused much opposition, especially in the agrarian districts. Because of his extensive personal financial interests and his intimate connection with powerful financial groups, he came to be looked upon as the special representative of the moneyed interests and of the highly protected industries. He died in New York city on April 16, 1915.

ALDRICH, RICHARD (1863–1937), music critic, was born at Providence, R.I., July 31, 1863. He studied at Harvard under J. K. Paine and in Germany. Associate critic of the *New York Tribune* 1891–1902, he then became music critic to the *New York Times*, holding the position to 1924, except for the period Feb. 1918–May 1919, when he was captain in the Military Intelligence Division, U.S.A. He prepared a volume on Schumann, edited a series of musical biographies, collaborated with H. E. Krehbiel in *History of the Philharmonic Society*, translated Lilli Lehman's *How to Sing*, and wrote *A Guide to Parsifal* and *A Guide to the Nibelungen Ring*.

ALDRICH, THOMAS BAILEY (1836–1907), American author, was born in Portsmouth, N.H., Nov. 11, 1836. The deepest impressions of his boyhood were made by the exotic city of New Orleans, where he spent ten years of his childhood, and the historic town of Portsmouth, which he portrays in his autobiographical *Story of a Bad Boy* (1870). He returned to Portsmouth to prepare for Harvard, a plan which his father's death made impracticable. After spending several years as clerk in his uncle's



FROM STODDARD "POETS' HOMES"

THE HOUSE AT PONKAPOG, MASSACHUSETTS, ONE-TIME HOME OF THOMAS BAILEY ALDRICH, CELEBRATED FOR THE "STORY OF A BAD BOY"

office in New York, the publication of his first book of verse *The Bells* (1855) and the success of his "Baby Bell" caused him to resign to become junior literary critic on the *Evening Mirror*. He soon became sub-editor of N.P. Willis's magazine, the *Home Journal*, and for the remainder of his life, with the exception of the time spent as war correspondent for the *Tribune*, he devoted himself to creative and editorial work. He was for short periods adviser to different publishing houses, but his chief work was with the magazines—the *Saturday Press* (1859–60), the *Illustrated News*

(1863), *Every Saturday* (1865–74), and the *Atlantic Monthly* (1881–90). Although he made intimate friends of the young poets, artists and wits of New York, the cultural atmosphere of New England in which, according to him, he became "Boston plated," and the frequent European tours of his later life undoubtedly were the most influential factors in ripening his art. Few poets have so ruthlessly discarded their earlier poems in their later editions, Aldrich even going so far as to buy and destroy every copy of *Pampinea* (1861) that he could find. His verse is better studied, then, in his later volumes, chiefly *Cloth of Gold* (1874), *Flower and Thorn* (1877), *Friar Jerome's Beautiful Book* (1881), *Mercedes and Later Lyrics* (1884), *Windham Towers* (1890), and the collected editions of 1865, 1882, 1897 and 1906. These showed him to be a poet of lyrical skill, dainty touch and felicitous conceit. In describing some single picture, mood, conceit or episode, no American poet has shown more skill. He repeatedly essayed the long narrative or dramatic poem but with less success. Beginning with the collection of stories entitled *Marjorie Daw and Other People* (1873), Aldrich applied to his later prose work that minute care in composition which had previously characterized his verse. His use of the surprise ending was perhaps the most effective feature of his short stories. *Prudence Palfrey* (1874), *The Queen of Sheba* (1877), and *The Stillwater Tragedy* (1880), novels, lack depth of characterization and vitality; but his *Story of a Bad Boy* (1870) has become an American classic. *A Rivermouth Romance* (1877) and *An Old Town by the Sea* (1893) commemorate with affectionate touch the author's birthplace; *From Ponkapog to Pesth* (1883) is made up of pleasant travel sketches; and *Ponkapog Papers* (1903), of pungent jottings and whimsical essays. Aldrich's later life was saddened by the death of his son, Charles, but his serenity, urbanity and charm never wholly deserted him. He died in Boston, March 19, 1907.

Aldrich's *Writings* were collected in 1897 and in 1907 (Ponkapog ed.). Ferris Greenslet is the author of a sympathetic *Life* (1908), and Mrs. Aldrich wrote a pleasant volume of reminiscence, *Crowding Memories* (1920).

ALDRINGER (ALTRINGER, ALDRINGEN), JOHANN, COUNT VON (1588–1634), Austrian soldier, was born at Diedenhofen (Thionville) in Lorraine. He had behind him 25 years' service in the Spanish Army when he returned to Germany in 1631. He served after Breitenfeld as Tilly's artillery commander, and he was present at the battle of the Lech, where he was wounded. When Tilly died of his wounds, Aldringer, who was now a count of the empire, succeeded to the command. Made field-marshal after the assault of the Alte Veste, near Nuremberg, at which he had been second in command under Wallenstein, duke of Friedland (with whom he was a great favourite), he was next placed at the head of the corps formed by Maximilian I. of Bavaria to support Wallenstein. Finally Aldringer was won over by the court party which sought to displace the too successful duke of Friedland. After Wallenstein's death Aldringer commanded against the Swedes on the Danube, and at the defence of Landshut he fell (July 22, 1634). His possessions descended to his sister, and thence to the family of Clary and Aldringer.

See Brohm, *Johann von Aldringen* (Halle, 1882), and Hermann Hallwich, *Johann von Aldringen* (Leipzig, 1885); also *Allgemeine Deutsche Biographie*, s.v. Gallas, correcting earlier biography of Aldringer in the same work.

ALDROVANDA: see VENUS' FLY-TRAP.

ALDROVANDI, ULISSE (1522–1605), Italian naturalist, was born of noble parentage at Bologna, where he was professor of natural history from 1560 onwards. At his instance the senate of Bologna established in 1568 a botanical garden, of which he was appointed the first director. About the same time he became inspector of drugs, and in that capacity published in 1574 a work entitled *Antidotarii Bononiensis Epitome*, which formed the model for many subsequent pharmacopoeias. The results of his various researches were embodied in a great *Natural History*. The first three volumes, comprising his ornithology, were published in 1599, and a fourth, treating of insects, appeared in 1602. The value of the work is increased by the number and beauty of its illustrations. After his death a number of other volumes

were compiled from his manuscript materials under the editorship of several of his pupils.

ALE, an old word for a fermented liquor obtained chiefly from malt. The derivation is from Ang.-Sax. *æalu*, a sort of beer. In England "ale" is nowadays almost synonymous with "beer." Before the introduction of hops into England from Flanders in the 16th century, ale was the name exclusively applied to malt liquor, the term beer being gradually introduced to describe liquor brewed with an infusion of hops. This distinction does not now apply, except in so far as the term "ale" is not applied to black beers (stout and porter) nor to lager beer. In the United States, however, it was customary to confine the designation "beer" to the article obtained by the bottom fermentation process. In former times the Welsh and Scots had two distinct kinds of ale, called common and spiced ales, the relative values of which were appraised by law in the following terms: "If a farmer have no mead, he shall pay two casks of spiced ale, or four casks of common ale, for one cask of mead." There are numerous varieties of English ales, such as mild ale, which is a full, sweetish beer, of a dark colour and with relatively little hop; pale ale, which is relatively dry, of light colour and of a more pronounced hop flavour than the mild ale; and bitter and stock ales, the latter term being generally reserved for superior beers, such as are used for bottling. The terms pale, bitter, stock, light, etc., are to be regarded as trade distinctions and not as exact definitions of quality or type.

Parish Ales.—In old England an "ale" was synonymous with a parish festival or merry-making at which ale was the chief drink. The word was generally used in composition. Thus there were leet-ales (that held on leet or manorial court day); lamb-ales (that held at lamb-shearing); Whitsun-ales, clerk-ales, church-ales and so on. The word *bridal* is really bride-ale, the wedding feast. Bid-ales, once very common throughout England, were "benefit" feasts to which a general invitation was given, and all the neighbours attending were expected to make some contribution to help the object of the "benefit." (See *Bidding-Weddings* under BRIDE.) These parish festivals were of much ecclesiastical and social importance in mediæval England. The chief purpose of church-ales and clerk-ales, at least, was to facilitate the collection of parish-dues, or to make an actual profit for the church from the sale of the liquor by the churchwardens. These profits kept the parish church in repair, or were distributed as alms to the poor. At Sygate, Norfolk, on the gallery of the church is inscribed:

God speed the plough
And give us good ale enow . . .
Be merry and glade,
With good ale was this work made.

On the beam of a screen in the church of Thorpe-le-Soken, Essex, is the following inscription in raised Gothic letters, on a scroll held by two angels: "This cost is the bachelers made by ales thesen be ther med." The date is about 1480. The feast was usually held in a barn near the church or in the churchyard. In Tudor times church-ales were held on Sundays. Gradually the parish-ales were limited to the Whitsun season, and these still have local survivals. The colleges of the universities used formerly to brew their own ales and hold festivals known as college-ales. Some of these ales are still brewed and famous, like "chancellor" at Queen's college, and "archdeacon" at Merton college, Oxford, and "audit ale" at Trinity, Cambridge. (See BEER.)

See Brand's *Popular Antiquities of Great Britain* (Wm. Carew Hazlitt's edition, 1905).

ALEANDRO, GIROLAMO (HIERONYMUS ALEANDER) (1480–1542), Italian cardinal, one of the greatest scholars of his time, was born at Motta, near Venice on Feb. 13, 1480, and died at Rome on Feb. 1, 1542. He was for some time rector of the University of Paris. In 1520 he was sent to Germany as papal nuncio at the coronation of Charles V., and was also present at the Diet of Worms, where he headed the opposition to Luther. The edict against the reformer, which was finally adopted by the emperor and the Diet, was drawn up and proposed by Aleandro. After the close of the Diet the papal nuncio went to the Netherlands, where he kindled the flames of persecution, two monks of Antwerp, the first martyrs of the Reformation,

being burnt in Brussels at his instigation. In 1523 Clement VII. sent him as nuncio to the court of Francis I. He was taken prisoner at the battle of Pavia (1525), and was released only on payment of a heavy ransom. He was subsequently employed on various papal missions, especially to Germany, but was unable to check the progress of the new doctrines. He was created cardinal in 1536 by Paul III.

Aleandro compiled a *Lexicon Graeco-Latinum* (1512), and wrote Latin verse of considerable merit inserted in M. Tuscanus's *Carmina Illustrum Poetarum Italiorum*. The Vatican library contains a volume of ms. letters and other documents written by him in connection with his various missions against Luther. They were utilized by Pallavicino in his *Istoria del Concilio Tridentino* (i. 23–28), who gives a very partial account of the Worms conference.

Aleandro, who is sometimes called "the elder," must be distinguished from his grand-nephew, also called Girolamo Aleandro (1574–1629). The younger Aleandro was a very distinguished scholar, and wrote *Psalmi poenitentiales versibus elegiacis expressi* (1593); *Gaii, veteris juris consulti Institutionum fragmenta, cum commentario* (1600); *Explicatio veteris tabulae marmoreae solis effigie symbolesque exculptae* (1616).

ALEARDI, ALEARDO, COUNT (1812–1878), Italian poet, was born at Verona on Nov. 4, 1812, and thus soon after his birth became an Austrian subject. Inspired from his cradle with a hatred of the foreigner, he found himself unable to publish his patriotic verses. But the revolutionary year 1848 made an opening for his *Lettere a Maria*. He took an active part in the popular uprising, and was for some time imprisoned. In 1856 he produced the finest of his pieces, an ode to the maritime cities of Italy, and in 1858 a poem on his own misfortunes. After the expulsion of the Austrians from Lombardy he returned to Verona, published his poems in a collected edition (1862), became professor at the Academy of Fine Art, member of the Italian parliament and eventually senator. Aleardi's warmth of patriotic feeling hardly finds adequate expression in his poetry; it is his merit to excel in description, but his fault to substitute description for action.

ALE-CONNER, an officer appointed yearly at the court-leet of ancient English manors for the assize of ale and ale-measures. The *gustatores cervisiae*—called in different localities by the different names "ale-tasters," "ale-founders" and "ale-conners"—were sworn to examine beer and ale, to take care that they were good and wholesome and were sold at proper prices.

With modern methods of assessing the excise on beer and ale the custom of appointing ale-tasters has in most places fallen into disuse.

ALECSANDRI or **ALEXANDRI, VASILE** (1821–1890), Rumanian lyric poet, was born at Bacau in Moldavia and educated first in Jassy and afterwards (1834–39) in Paris. In 1839 he began to collect Rumanian popular songs. He first published his collection in 1844. His *Doine și Lacrimioare*, lyrical poems, appeared at Paris in 1852, and in 1852–53 he produced at Jassy a fuller collection of popular ballads and songs. In 1867 he published some fugitive pieces, written in a lighter vein and entitled *Pastele*; these were followed in 1871 by the *Legende* of similar character. More serious are his dramatic writings which began with *Despot Voda* and culminated in *Ovid*. In later life Alecsandri took an active part in politics; he became minister for foreign affairs (1859–60), and in 1885 was appointed Rumanian minister in Paris. His best title to fame consists in the fact that he gave the first impetus to the collection of Rumanian popular songs and first drew attention to their inimitable charm.

See L. Sainsanu, *Autori Români moderni* (1891), pp. 90 and 318. A complete edition of Alecsandri's writings was published at Bucharest in 1875 seq. (9 vols.).

ALEKHINE, ALEXANDER (1892–1946), champion chess-player, was born in Moscow on Nov. 1, 1892. He displayed precocious ability as a chess-player, and in 1910 he did well at the Hamburg tournament at the age of 17. When World War I broke out in 1914 he was playing at the Mannheim tournament and escaped from internment to serve in the Red Cross division of the Russian army. After the Revolution he became a natural-

ized Frenchman, and studied law at the University of Paris. The victor in many international tournaments, he won the world championship for blindfold chess in 1924, 1925 and 1933. In 1927 he won the world championship from Capablanca (champion since 1921), lost it in 1935 to Dr. Max Euwe, but regained it from Dr. Euwe in 1937. He died March 24, 1946, at Estoril, Portugal.

See his book, *My Best Hundred Games* (Eng. trans., 1927).

ALEMÁN, MATEO (1547–1609?), Spanish novelist and man of letters, was born at Seville. He graduated at Seville university in 1564, studied later at Salamanca and Alcalá, and from 1571 to 1588 held a post in the treasury; in 1594 he was arrested on suspicion of malversation, but was speedily released. In 1599 he published the first part of *Guzmán de Alfarache*, a celebrated picaresque novel which passed through not less than 16 editions in five years, and was translated into French (1600), English (1623) and Latin (1623); a spurious sequel was issued in 1602, but the authentic continuation did not appear till 1604. In 1608 Alemán emigrated to America, and is said to have carried on business as a printer in Mexico City; his *Ortografía castellana* (1609), published there, contains ingenious and practical proposals for the reform of Spanish spelling. Nothing is recorded of Alemán after 1609, but it is sometimes asserted that he was still living in 1617.

BIBLIOGRAPHY.—See J. Hazañas y la Rua, *Discursos leídos en la Real Academia Sevillana de Buenas letras el 25 de marzo de 1892* (Sevilla, 1892); J. Gestoso y Perez, *Nuevos datos para ilustrar las biografías del Maestro Juan de Malara y de Mateo Alemán* (Sevilla, 1896).

ALEMBERT, JEAN LE ROND D' (1717–1783), French mathematician and philosopher, was born at Paris in Nov. 1717. He was a foundling but it afterwards became known that he was the illegitimate son of the Chevalier Destouches and Madame de Tencin. The infant was entrusted to the wife of a glazier named Rousseau who lived close by the Church of St. Jean le Rond, where the child was found. Destouches, without disclosing his identity, provided for the boy, who was educated at the Mazarin College under the Jansenists.

On leaving college he returned to the house of his foster-mother, where he continued to live for 30 years. Having studied law, he was admitted as an advocate in 1738, but did not enter upon practice. He next devoted himself to medicine; but his natural inclination proved too strong for him, and within a year he resolved to give his whole time to mathematics. In 1741 he received his first public distinction in being admitted a member of the Academy of Sciences, to which he had previously presented several papers, including a *Mémoire sur le calcul intégral* (1739). In his *Mémoire sur la réfraction des corps solides* (1741) he was the first to give a theoretical explanation of the phenomenon which is witnessed when a body passes from one fluid to another more dense in a direction not perpendicular to the surface which separates the two fluids. In 1743 he published his *Traité de dynamique*, a work famous as developing the mechanical principle, known as "d'Alembert's principle," first enunciated in 1742 (see *MECHANICS*). In 1744 d'Alembert applied this principle to the theory of the equilibrium and the motion of fluids, *Traité de l'équilibre et du mouvement des fluides*, and all the problems before solved by geometers became in some measure its corollaries. This discovery was followed by that of the calculus of partial differences, the first trials of which were published in his *Réflexions sur la cause générale des vents* (1747). This work was dedicated to Frederick the Great, who made several unsuccessful attempts to induce him to settle in Berlin. In 1763 he visited Berlin, and on that occasion finally refused the office of president of the Academy of Berlin, which had been already offered to him more than once. In 1747 he applied his new calculus to the problem of vibrating chords, the solution of which, as well as the theory of the oscillation of the air and the propagation of sound, had been given but incompletely by the geometers who preceded him. In 1749 he furnished a method of applying his principles to the motion of any body of a given figure; and in 1754 he solved the problem of the precession of the equinoxes, determined its quantity and explained the phenomenon of the nutation of the earth's axis. In 1752 he published an *Essai d'une nouvelle théorie sur la résistance des fluides*, which contains a large number of original ideas and new observations. In

1746 and 1748 he published in the *Memoirs of the Academy of Berlin* "Recherches sur le calcul intégral," a branch of mathematical science which is greatly indebted to him. In his *Recherches sur différents points importants du système du monde* (1754–56) he perfected the solution of the problem of the perturbations of the planets, which he had presented to the academy some years before.

D'Alembert's association with Diderot in the preparation of the *Dictionnaire Encyclopédique* led him to a wider range of work. He contributed the *Discours préliminaire* on the rise, progress, and affinities of the various sciences, which he read to the French Academy on the day of his admission as a member, Dec. 18, 1754. He also wrote several literary articles for the first two volumes of the encyclopaedia, and to the remaining volumes he contributed mathematical articles chiefly. Of d'Alembert's works on other than mathematical subjects the most important is the *Éléments de Philosophie* (1759) in which he discussed the principles and methods of the different sciences. D'Alembert was much interested in music both as a science and as an art, and wrote *Éléments de musique théorique et pratique* (1779), which was based upon the system of J. P. Rameau with important modifications and differences.

D'Alembert continued to the end to lead the quiet and frugal life dictated by his limited means as well as his simple tastes. His later years were saddened by the death of Mademoiselle de Lespinasse, whose acquaintance he made at the house of Madame du Defand. She nursed him assiduously during an illness he had in 1765, and from that period till her death in 1776 they lived in the same house. On her part there seems to have been from first to last nothing more than warm friendship, but his feelings towards her were of a stronger kind and her death deeply affected him. He never recovered his elasticity of spirits, though he continued to occupy himself with his favourite pursuits, and to frequent the society of his brother philosophers. After the death of Voltaire (1778), whose friend and correspondent he had been for more than 30 years, he was regarded as the leader of the philosophical party in the Academy. He died at Paris on Oct. 29, 1783.

BIBLIOGRAPHY.—The scientific works of d'Alembert have never been published in a collected form. The most important of them have been mentioned above, with the exception of the *Opuscules mathématiques* (1761–80). His literary and philosophical works were collected and edited by Bastien (1805). A better edition by Bossange was published at Paris in 1821. The best account of the life and writings of d'Alembert is contained in Condorcet's *Éloge*, presented to the Academy and published in 1784.

ALEMBIC, an apparatus for distillation (*q.v.*) used chiefly by the alchemists, and now superseded by more convenient forms of still, both in the laboratory and in the factory. It consisted essentially of three parts: a vessel containing the material to be distilled and called, from its gourd-like shape, the cucurbit, or matras; a vessel to receive and condense the vapour, called the head, capital, or alembic proper; and a receiver for the distillate, connected by a pipe with the capital. The entire apparatus was sometimes constructed of glass, but more usually the cucurbit was of copper or earthenware, and the capital alone of glass.

ALENÇON, COUNTS AND DUKES OF. The first line of the counts of Alençon was founded by Yves, lord of Bellesme, who in the middle of the 10th century possessed and fortified the town of Alençon. Mabile, countess of Alençon and heiress of this family (d. 1082) married Roger of Montgomery, and from them descended a second house of Alençon which became extinct in the person of Robert IV.; the county of Alençon was then joined to the royal domain. It was successively granted as an appanage to Peter, son of St. Louis (1268), and to Charles, count of Valois, brother of Philip the Fair (1293). The third house of Alençon sprang from Charles, second son of the count of Valois, who was killed at the battle of Crécy in 1346.

The countship of Alençon was raised to a peerage in 1367 and into a dukedom in 1414. John, 1st duke of Alençon, was killed at Agincourt on Oct. 25, 1415, after having with his own hand slain the duke of York. His son, John, was dispossessed of his duchy by the King of England, but reconquered it in 1449. In 1524 the dukedom of Alençon reverted to the crown, in consequence of the

death of the Duke Charles IV. without issue. It was given as a jointure to Catherine de' Medici in 1559, and as an appanage to her son Francis in 1566. It was pawned by Henry IV. to the duke of Württemberg, and subsequently it passed to Gaston, duke of Orleans, by grant of Louis XIII.; to Elizabeth of Orleans, duchess of Guise; to Charles, duke of Berry, grandson of Louis XIV. (1710); and to Monsieur (Louis XVIII.), brother of Louis XVI.

The title of duc d'Alençon was given to Ferdinand of Orleans, son of the duc de Nemours, and grandson of Louis-Philippe.

ALENÇON, north-west France, capital of department of Orne, 36 mi. N. of Le Mans on a branch of the Western railway. Pop. (1946), 19,691. The regularly built town lies in a wide and fertile plain at the confluence of the Sarthe and Briante. The ancient castle, taken by William of Normandy in 1048, is in ruins save for one 14th and two 15th century towers. Notre Dame, the chief church (15th century), has an ornamented Gothic porch, and 16th century stained windows. The manufacture of *point d'Alençon* (a species of lace copied from Venice and introduced by Colbert) is still pursued. Weaving and bleaching of cloth, printing, the manufacture of vehicles, of boots and shoes and of bricks are carried on; there is trade in the horses of the district. Alençon is the seat of a prefect and a court of assizes. It has tribunals of first instance and of commerce, a board of trade arbitrators, a chamber of arts and manufactures, and corn and cloth markets.

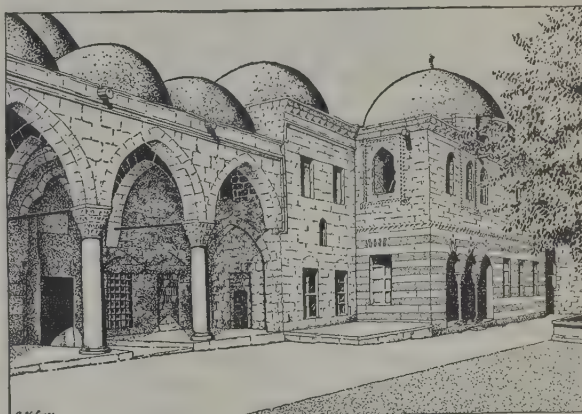
ALENIO, GIULIO (ah-lā-nē-ō) (1582-1649), Italian Jesuit missionary, was born at Brescia. He landed at Macao in 1610, and penetrated into China three years later. During his 30 years' residence in China he adopted the dress and manners of the country, was the first Christian missionary in Kiang-si, and built several churches in Fukien. He wrote in Chinese a *Life of Christ* (Peking, 1635-37, 8 vol.; often reprinted, e.g., in 1887 in 3 vol., and used even by Protestant missionaries) and a cosmography (*I che fang wai ki Hang-chow*, 1623, 6 vol.), which was translated into Manchu under the title *The True Origin of 10,000 Things*, a copy of which was sent from Peking to Paris in 1789. Alenio died at Fuchow in 1649.

For bibliography see de Backer and Sommervögel, *Bibl. de la Cie. de Jésus*, i, 158-160.

ALENTEJO (ALEMTEJO), ancient province of central and southern Portugal; bounded on the north by Beira, east by Spanish Estremadura and Andalusia, south by Algarve and west by the Atlantic ocean and Portuguese Estremadura. Pop. (1940) 669,766; area 9,187 sq.mi. The principal rivers are the Tagus, which divides Alentejo from Beira; the Guadiana, which, crossing the Spanish frontier, flows south through the province; and the Sado, which rises in the Serra de Monchique, and flows to the north. There are extensive plains, notably that lying southwest of the Serra de Portalegre; that of Beja, between the Sado and Guadiana; and of Ourique, farther south between the same rivers. Some portions of these plains are fruitful, others marshy, while large tracts are desolate.

The climate in the lowland is hot and unhealthy in summer because of stagnant marshes. Towards the Spanish frontier the soil is fertile, and in the south are extensive forests of oak, pine, chestnut, cork and ilex, especially on the sides of the Mezquita and Caldeirão ranges. In the more fertile parts, grapes, figs, citrons, pomegranates and other fruits are produced. Wheat is the main crop; maize and rice are also grown, and some attention is given to the rearing of mules, asses, goats, cattle and sheep; while the Alter breed of horses, named after the villages of Alter do Chão and Alter Pedroso (359), near Portalegre, is often accounted the best in the country. Agriculture, however, is backward, the sparse population being mostly concentrated in the towns. Drovers of large swine are fed on the waste lands, affording excellent hams. The mineral wealth of Alentejo, little exploited, includes copper and iron mines and marble quarries. Local industries include preparation of exceptionally fine olive oil, and the manufacture of cloth, pottery and leather. Alentejo is traversed by two main lines of railway, the Madrid-Badajoz-Lisbon and Lisbon-Faro. For administrative purposes the province is divided into the districts of Portalegre in the north, Evora in the central region and Beja in the south.

ALEPPO, a city and province (*muhafizat*) of northern Syria. The city, known under the Seleucids as Beroea, reverted later to its ancient Semitic name of Halab, which it retained. The city stands at a height of 1,220 ft. above sea level between the valleys of the Orontes and the Euphrates in a basin surrounded by low, barren, rocky hills; it is watered by a small stream, the Kuwaik (the ancient Chalys), from which the main water supply is piped to the city. Work on a project to bring water to the city from the Euphrates was in progress by 1951. The province has an area of 8,458 sq.mi. (21,886 sq.km.) and a population of 920,973 (1947) which shows a concentration in the districts to the east, north and northwest of the city. The population of the city was estimated at 337,800 in 1946.



BY COURTESY OF THE METROPOLITAN MUSEUM OF ART

TEKYAH AT ALEPPO OF ABU BEKR, FATHER-IN-LAW OF MOHAMMED
Situated at the northern end of the city, this tekyah, or religious house for the accommodation and ceremonial rites of dervishes, is representative of the many religious buildings in Aleppo

The old city is roughly square and built round the Turkish citadel on the east bank of the Kuwaik. Features of the old city are the bazaars and *khans*, and there are two mosques of particular interest: the Zakariyah, in which is the reputed tomb of Zacharias, the father of John the Baptist; and the Kikanah, into the wall of which is built a basalt block with Hittite inscription. Private houses in the old part of the town have large paved courts in the centre of which is usually a fountain and vines and roses. Modern suburbs stretch out in all directions but have developed mainly westward. The chief are the Aziziya on the northwest and the Hamidiya on the north. The quarter of the poorer Jews is the Bahsith; but Jews also live in the Jamaliya on the west bank of the Kuwaik, which is mainly inhabited by rich Christians. The Armenians have settled on the northern outskirts. The population has a Moslem majority, but the Armenian and Jewish communities and Syrian Christians of all churches are numerous. The Armenian population increased after the cession of Alexandretta (Hatay) to Turkey in 1939. The terminal station of the railway from Rayak (*Damas-Homs et Prolongements*, otherwise D.H.P.) is to the west of the city and of the Kuwaik; a second station, that of the line which links Aleppo with the Baghdad railway at Muslimiyah, is to the northwest. Aleppo is the centre of a network of roads and desert tracks. There is an airfield at Nairab, 3 km. W. of the city. Extremes of temperature are experienced: frost and snow are not uncommon in winter, but during the summer months (May to September) temperatures of from 100° to 115° F. are reached. The average annual rainfall is about 15 in. The climate is healthy and bracing in spite of the prevalence of the Aleppo "button" (leishmaniasis), a boil which persists for some months and leaves an unsightly scar.

Aleppo is traditionally the trading centre of Syria and formerly derived its importance from its position on the route between Europe and Persia and the far east. Trade declined after the discovery of the Cape route, the opening of the land route through Egypt to the Red sea and lastly the cutting of the Suez canal. The cession of the Sanjak of Alexandretta (Hatay) to Turkey in

1939 caused some hardship to Aleppo merchants.

Industries include textiles, carpets and soap. There is also a cement factory. The principal products of the province are cereals, pistachios and walnuts, olives, potatoes, cotton, tobacco, wool and salt. (K. C. B.)

History.—As early as c. 1758 B.C., when the "kings of Khalap [Aleppo] held a great kingdom," the Hittite monarch Murshilish I swept down through the Taurus passes and took the city. The pharaoh Tuthmosis III seized it (1490 B.C.) when he marched north, "laying waste the settlements of the foe of wretched Naharin." About the middle of the 15th century its king allied himself with the king of Khanigalbat, but the Hittite Tudkhalijash (Dudkhalia) II defeated them and sacked Aleppo. The city recovered only to fall to his successors Khattushilish II and Shuppiluliumash (Subbiluliuma); the latter made Telepinush, his son, its king. The region became the battleground between Egypt and the Hittites and the struggle for its possession is reflected in the preface to the treaty (c. 1340 B.C.) between Murshilish II and Rimisharma, king of Aleppo. At the battle of Kadesh on the Orontes (1288 B.C.), where Rameses II barely escaped defeat, a king of Aleppo took part on the Hittite side and was all but drowned. The Egyptians have depicted on their monuments "the wretched chief of Aleppo turned upside down by his soldiers after his majesty had hurled him into the water." In 854 B.C. Shalmaneser II of Assyria visited the city and sacrificed to Adad. Seleucus Nicator (312–280 B.C.) enlarged Aleppo and named it Beroea, after the Macedonian city. In 164 B.C. Menelaus, the fomentor of war with the Maccabees, was put to death by being thrust down into a tower filled with embers, a form of execution peculiar to the place. The name Halab reappears with the Arab conquest of Syria (A.D. 638), when the city was occupied without opposition by Abu 'Uбайдah. Under the Hamdanid Saif ud-Daulah (A.D. 945–967) Aleppo became the capital of an Arab principality. The Byzantine Nicephorus Phocas surprised and sacked the city (962) but failed to capture the citadel. It was temporarily occupied by John Zimisce, emperor of Byzantium in 974. Shortly afterward it received and acknowledged the Egyptian Fatimites, and twice, from 1038 to 42 and from 1058 to 60, Egyptian troops garrisoned the town. From 1084 to 1117 it formed part of the Seljuk dominion. Then succeeded the unsettled times of the crusades. The crusaders, although they seized its territory, never occupied the city. They besieged it in 1118 and again in 1124 (Baldwin II), when, after four months, it was reduced to the utmost extremity before being relieved by an army from Mosul. The 12th century saw three serious earthquakes, 1114, 1139 and, the most serious of all, 1170, after which the city had to be rebuilt by Nureddin. Benjamin of Tudela visited it in 1173. Saladin made it his northern base and stronghold against the crusading princes of Antioch (1183). The Tatar invasions of the 13th and 14th centuries engulfed it, and with the rest of Syria it came under the Mameluke sway at the end of the 13th century. Aleppo surrendered to Timur when he made an incursion into Syria (1400–01). The Mameluke rule in Syria was finally overthrown by the triumph of the Ottoman Turks under Selim I in 1516, the decisive battle being at Merj Dabik, a day's journey west of Aleppo. From the 16th to the 19th centuries it remained in Turkish hands. In the latter part of the 18th and the beginning of the 19th century it suffered grievously from internal feuds (in which the Janisaries took an active part), which were exploited by the Ottoman governors for their own ends. Earthquakes in 1822 and 1830 and visitations of cholera in 1823, 1827 and 1832 left the city a wreck and its population greatly diminished. It could offer but feeble resistance to the army of Mohammed Ali of Egypt in 1833. It then became the centre of Egyptian domination in Syria until it was restored to the Turks in 1840. Tumults and massacres of Christians occurred in 1850 and 1862. On Oct. 26, 1918, it was occupied by British and Arab troops advancing from the south and in 1920 by the French. The city and its vilayet were constituted a separate state under French mandate in 1920, federated with Damascus and Latakia in June 1922 and merged in the mandated state of Syria in 1924. In 1941 Aleppo became part of the Syrian

Republic.

See J. Sauvaget, *Alep* (Paris, 1941); and George Haddad, *Fifty Years of Modern Syria and Lebanon* (Beirut, 1950).

ALES or **ALESIIUS, ALEXANDER** (1500–1565), Scottish reformer, was born at Edinburgh, April 23, 1500. As canon of the collegiate church of St. Andrews he opposed the reformers, but was converted by the arguments and the courageous death of Patrick Hamilton, abbot of Fern in 1528. He escaped to Germany and at Wittenberg signed the Augsburg confession. He went to England in 1535, and was well received by Thomas Cranmer and Thomas Cromwell, but the statute of Six Articles (1539) drove him back to Germany. He was professor of theology at Leipzig at the time of his death (March 17, 1565).

Alesius was the author of a large number of exegetical, dogmatic and polemical works, of which more than 20 are mentioned by John Bale in his *List of English Writers*. In his controversial works he upholds the synergistic views of the Scottish theologian John Major. He wrote an appeal to his native land in *Cohortatio ad Concordiam Pietatis, missa in Patriam suam* (1544), which had the express approval of Martin Luther, and a *Cohortatio ad Pietatis Concordiam ineundam* (1559).

The best early account of Alesius is the *Oratio de Alexandro Alesio* of Jacob Thomasius (April 1661), printed in his *Orationes* (no. xiv [Leipzig, 1683]); the best modern account is by A. W. Ward in the *Dictionary of National Biography*. See also A. F. Mitchell's introduction to Gau's *Richi Vay*, Scottish Text Society (1888).

ALÈS, South France, capital of an arrondissement in the department of Gard, 25 mi. N.N.W. of Nîmes on the P.L.M. railway. Pop. (1946) 34,731. The town is at the foot of the Cévennes, on the left bank of the Gardon, which half surrounds it. The proximity of the high plateau—a region of social difficulty and poverty—made Alès in the 16th century an important Huguenot centre. In 1629 it was taken by Louis XIII. A bishopric was established there in 1694 but suppressed in 1790. The church of St. Jean is a heavy building of the 18th century. Alès has associations with Pasteur and Dumas. The town is one of the most important markets for raw silk and cocoons in the south of France, and the Gardon supplies power to numerous silk mills. It is also the centre of a mineral field, which yields coal, iron, silver, zinc and antimony; its blast furnaces, foundries, tanneries, distilleries, glassworks and engineering works afford employment to many workmen. Alès has a tribunal of commerce, a board of trade arbitrators, and a school of mines. In 1926 the name of the town was changed from Alais to Alès.

ALESIA, the ancient name for a hill in the department of Côte d'Or, France, now Alise-St-Reine. (Pop. of commune [1946] 654.) The site was important in early times. Here Vercingetorix, the Gaulish national leader, was besieged by Caesar in 52 B.C.—the former's surrender leading to the final conquest of Gaul. The native leader is commemorated by a statue on Mt. Auxois. The discovery of the remains of a town and temple in 1906–10 shows that the site remained important through Gallo-Roman times. The ground plan of a large mediaeval structure which has been revealed by excavations, suggests the continuity of interest in this hilltop site into the middle ages. Its situation on a hill top, off modern lines of communication has led to its decay. The region is visited annually by large numbers of tourists.

For account of Alesia see Déchelette *Manuel d'Archéologie*, II, 3, pp. 958 ff., bibl. (1914).

Siege of Alesia, was the climax of the great revolt which endangered Julius Caesar's conquest of Gaul. He was temporarily back in Italy, after his expeditions across the Rhine and the channel, when word came of the general rising (end of 53 B.C.) of most of the Gallic tribes under Vercingetorix, a chieftain of the Arverni (modern Auvergne). Fortunately for Caesar it came before he was entangled in the Civil War, and by rapid counter-measures, involving arduous midwinter marches, he partially restored the situation. But guerrilla warfare on a far-reaching scale undermined his efforts, he was forced to abandon his siege of Gergovia (near modern Clermont-Ferrand) Vercingetorix's own town, and through the Aedui joining in the revolt, was cut off from his base in the south. In this critical situation Caesar first moved to effect a junction with Labienus's detachment, which had with

difficulty returned from an abortive attempt on Lutetia (modern Paris), and then sought a line of retreat back to his base, taking an easterly route. But Vercingetorix, emboldened by success to discard pure harassing strategy, moved to intercept him near modern Langres, and surprised him on the march. The Romans succeeded in repulsing the attack, and Vercingetorix retreated to a fortified camp at Alesia (probably Mont Auxois, near modern Dijon).

Thus assured of his communications being free, Caesar decided to lay siege to Alesia, which now held the soul as well as a large part of the body of the revolt. He completely invested the position, surrounding it with lines of contravallation, ten miles in perimeter and fortified with all the science of Roman field engineering, and outside these he built lines of circumvallation to protect himself from any relieving forces. These soon gathered in great force but inadequate organization, and their onsets were repulsed until, finding that Vercingetorix's sortie was equally ineffectual, they retired. The third and last attempt, made at the weakest spot—a hill which could not be included in the lines of circumvallation—was barely withstood, but with its failure Vercingetorix was forced, from lack of supplies, to surrender. Thereafter, although isolated outbreaks occurred, the Roman grip upon Gaul was not again seriously threatened.

ALESSANDRI, ALESSANDRO (ALEXANDER AB ALEXANDRO) (1461–1523), Italian jurist, was born at Naples about the year 1461. His work entitled *Dies Geniales* appeared at Rome in 1522, and was constructed after the model of the *Noctes Atticae* of Aulus Gellius, and the *Saturnalia* of Macrobius. It consists of a confused mass of heterogeneous materials relating to philology, antiquities, law, dreams, spectres, etc. and is characterized by considerable credulity.

ALESSANDRIA, capital of province of same name and episcopal see, Piedmont, Italy, on the river Tanaro, 57 mi. S.E. of Turin by rail. Pop. (1936) 51,949 (town), 79,327 (commune). Founded in 1168 for defense against the marquis of Monferato and the town of Pavia, it was besieged in 1174 by Frederick Barbarossa for six months without success. The Lombard league then included it among the allied cities and named it Alessandria, after Pope Alexander III. It was ceded to Savoy by the peace of Utrecht in 1713, and its citadel was begun in 1728. Fortifications were made during the French occupation (1800–1814) after Marengo; they were destroyed by the Austrians (1815) and were later rebuilt, but are now obsolete, though Alessandria is still an important fortress. The citadel is on the left bank of the Tanaro, the town on the right. It has various manufactures, especially felt hats, is a commercial centre and the focus of railway lines to Turin via Asti, to Valenza (thence to Vercelli, Mortara—for Novara or Milan—and Pavia), to Tortona, to Novi, to Acqui and to Bra.

ALESSI, GALEAZZO (1512–1572), Italian architect, was born at Perugia, and was probably a pupil of Caporali. He was an enthusiastic student of ancient architecture, and his style gained for him a European reputation. Genoa is indebted to him for a number of magnificent palaces, and his art may be studied in the churches of San Paolo and Santa Vittoria at Milan, in certain parts of the Escorial, and in numerous churches and palaces throughout Sicily, Flanders, and Germany.

See Rossi, *Di Galeazzo Alessi memorie* (Perugia, 1873).

ALETHIOLOGY, an uncommon expression for the doctrine of truth (Gr. ἀλήθεια, truth) used by Sir William Hamilton in his philosophic writings when treating of the rules for the discrimination of truth and error. The term was first used by Lambert in his *New Organon* (1764).

ALETRIUM (mod. ALATRI), a town of the Hernici, about 6 mi. due N. of Frusino, Italy, mentioned 306 B.C. for fidelity to Rome. In Cicero's time it was a *municipium*, and continued in this position throughout the imperial period. Finely preserved fortifications of blocks of local limestone have an outer circuit of about 2½ mi. An embanking wall, the rule in the cities of this part, has a maximum height of about 30 ft. Two gates and three posterns are to be found. A central hill (1,647 ft.) was the citadel. Fortifications of three periods can be traced; the last, perhaps a little

more recent than the city wall, is best preserved. A flat surface was formed partly by smoothing off the rock and partly by the erection of huge terrace walls which rise to a height of more than 50 ft., enclosing a roughly rectangular area of 235 by 115 yd. Two approaches to the citadel pass through the wall.

ALEURITES (Gr. ἀλευρίτης, pertaining to ἄλευρον, ground meal, from ἀλέω, to grind), tropical and subtropical trees of the genus *Aleurites* (Euphorbiaceae), producing apple-sized fruits containing large seeds or nuts rich in drying oils, used in the manufacture of many products. Five species are known: *A. cordata*, Japanese woodoil tree; *A. fordii*, tungoil tree; *A. moluccana*, candlenut tree; *A. montana*, mu-oil tree; and *A. trisperma*, soft lumbang. The first two are the most valuable, since they produce the best oils. Orchard planting in the U.S. began about 1910. Extensive plantings were made during the next 30 years in states from Florida west to eastern Texas. Important planting began about 1925 in Argentina, Australia, Brazil, New Zealand and Nyasaland.

ALEUT (äl'ē-ōt), a native of the Aleutian islands and part of the Alaska peninsula, a branch of the Eskimo stock. They differ from the Eskimo in their brachycephaly, but resemble them in features, and their language, though well differentiated, is fundamentally Eskimo. Their culture, too, is from the same source, though adapted to a raw and wet rather than an extremely cold environment. They came under Russian control, became Orthodox Christians, are now hybrid in blood as well as customs, and reduced in numbers. In 1834 there were 2,200; in 1940, 5,599.

ALEUTIAN ISLANDS, a chain of small islands situated in the North Pacific ocean, and extending about 1,200 mi. westward from the extremity of the Alaskan peninsula toward the peninsula of Kamchatka; they constitute part of the territory of Alaska, U.S.A. The islands, also called Catherine archipelago, comprise four groups—the Fox, Andreanof, Rat and Near Islands. They are all included between 52° and 55° N. and 172° E. and 163° W.

The axis of the archipelago near the mainland of Alaska has a southwest trend, but near the 170th meridian its direction changes to the northwest. This change of direction corresponds to a curve in the line of volcanic fissures which have contributed their products to the building of the islands. The island chain is really a western continuation of the Aleutian range on the mainland. The great majority of the islands bear evident marks of volcanic origin, and there are numerous volcanic cones on the north side of the chain, some of them active; many of the islands, however, are not wholly volcanic, but contain crystalline or sedimentary rocks, and also amber and beds of lignite. The coasts are rocky and surf-worn and the approaches are exceedingly dangerous, the land rising immediately from the coasts to steep, bold mountains.

The climate of the islands is oceanic, with moderate and fairly uniform temperatures and heavy rainfall. Fogs are almost constant. The summers are much cooler than on the mainland at Sitka (*q.v.*), but the winter temperature of the islands and of southeastern Alaska is very nearly the same. The mean annual temperature for Unalaska, the most important island of the group, is about 38° F. The growing season lasts about 135 days, from early in May till late in September, but agriculture is limited to the raising of a few vegetables. The islands are practically destitute of trees, but are covered with a luxuriant growth of herbage, including grasses, sedges and many flowering plants. Attempts have been made to raise sheep and reindeer on the islands, but the industry is still in its infancy with some uncertainty as to future results. The principal occupations of the natives have always been fishing and hunting, and the women weave basketry of exquisite fineness. From the end of the 18th century the Russian fur traders had settlements there for the capture of the seal and the sea otter and the blue and the Arctic fox. Under the American regime seal fishing off the Aleutians, save by the natives, was declared illegal, but the rapid depletion of animals threatened the Aleuts (as the natives are commonly called) with starvation. In later years the raising of foxes, especially of blue fox, was conducted quite extensively throughout the islands and with a fair measure of success. This industry furnished employment to many natives. Fish and sea fowl are extremely abundant.

The natives are rather low in stature, but plump and well-shaped, with short necks, swarthy faces, black eyes and long black hair. They are a branch of the Esquimauan family, but differ greatly from the Eskimo of the mainland in language, habits, disposition and mental ability. They were good fighters until they were cowed by the treatment of the Russians, who practically reduced them to slavery. Christianity was recognized in the form of the Greek Orthodox Church. In dress and mode of life they have adopted outwardly civilized customs.

It is stated that before the advent of the Russians there were 25,000 Aleuts (*q.v.*) on the archipelago, but that the barbarities of the traders nearly extinguished the native population. The total population of the archipelago in 1930 was 5,521. The principal settlements are on the Unalaska Islands. Of these Unalaska, the oldest, settled in 1760-75, has a custom house, a Russian-Greek church, and a Methodist mission and orphanage, and is the headquarters for a considerable fleet of United States coast guard vessels which patrol the sealing grounds of the Pribilofs; adjacent is Dutch Harbor, where a U.S. naval base was established in 1941. The Commander Islands group near the Asiatic coast is geographically, but since the acquisition of the Russian possessions in America not politically, a part of the Aleutian system.

In 1741 the Russian government sent out Vitus Bering, a Dane, and Alexei Chirikov, a Russian, in the ships "Saint Peter" and "Saint Paul" on a voyage of discovery in the North Pacific. After the ships were separated by a storm, Chirikov discovered several eastern islands of the Aleutian group, and Bering discovered several of the western islands, finally being wrecked and losing his life on the island of the Commander group that now bears his name. The survivors of Bering's party reached Kamchatka in a boat constructed from the wreckage of their ship, and reported that the islands were rich in fur-bearing animals. Siberian fur hunters at once flocked to the Commander Islands and gradually moved eastward across the Aleutian Islands to the mainland. In this manner Russia gained a foothold on the northwestern coast of North America. The Aleutian islands consequently belonged to Russia, until that country in 1867 transferred to the United States all its possessions in America.

Three of the western Aleutians—Kiska, Attu and Agattu—were occupied by Japanese forces in 1942 during World War II, but were expelled by U.S. forces the following year and were not threatened thereafter. The naval base at Dutch Harbor was heavily bombed by the Japanese on June 3, 1942, at the time of the battle of Midway. (See WORLD WAR II.)

ALEWIFE (*Pomolobus pseudoharengus*), a fish allied to the shad (*q.v.*), which spawns in great numbers in the tidal parts of the rivers of eastern North America, from the St. Lawrence southward, during the spring. It grows to a length of a foot and is an important food fish.

ALEXANDER, the name of eight Popes:

ALEXANDER I. was bishop of Rome from about 106 to 115. He has been identified, without any foundation, with Alexander, a martyr of the Via Nomentana, whose day is May 3.

ALEXANDER II. (Anselmo Baggio), Pope from 1061 to 1073, was a native of Milan. As bishop of Lucca he seconded the efforts of Hildebrand (afterwards Gregory VII.) for the suppression of simony and the enforcement of the celibacy of the clergy. By Hildebrand's influence he was elected Pope, but the German court nominated Cadalus, bishop of Parma, who was proclaimed at the council of Basel as Honorius II., and marched to Rome. Alexander's ultimate victory over his rival was due to Hildebrand.

ALEXANDER III. (Orlando Bandinelli), Pope from 1159 to 1181, was a Siennese, and teacher of canon law in Bologna and author of the *Stroma*, or the *Summa Magistri Rolandi*, one of the earliest commentaries on the Decretum Gratiani and of *Sentences*, based on the *Introductio ad theologiam* of Abelard. In 1153 he became papal chancellor, and was the leader of the cardinals opposed to Frederick Barbarossa. On Sept. 7, 1159, he was chosen to succeed Adrian IV., a minority of the cardinals, however, electing the cardinal priest Octavian, who assumed the name of Victor IV. This antipope, and his successors Paschal III. (1164-68) and Calixtus III. (1168-78), had the imperial support; but after the

defeat of Legnano, Barbarossa finally (in the peace of Venice, 1177) recognized Alexander as Pope. On March 12, 1178, Alexander returned to Rome, which he had been compelled to leave twice, from 1162 to 1165, and again in 1167. The first period he spent in France, the latter chiefly in Gaeta, Benevento, Anagni and Venice. In March 1179 Alexander held the third Lateran synod, reckoned by the Roman Catholic Church as the 11th oecumenical council; its acts embody among them the present law



POPE ALEXANDER III. BESTOWING THE SWORD UPON DOGE ZIANI OF VENICE. FROM THE FRESCO IN THE PALAZZO PUBBLICO AT SIENA, BY SPINELLO ARETINO (1333-1410).

requiring that no one may be elected Pope without the votes of two-thirds of the cardinals. This synod marks the summit of Alexander's power. Besides checkmating Barbarossa, he had humbled Henry II. of England in the affair of Thomas Becket, he had confirmed the right of Alphonso I. of Portugal to the crown, and even as a fugitive had enjoyed the favour and protection of Louis VII. of France. Nevertheless, soon after the close of the synod the Roman republic forced Alexander to leave the city, which he never re-entered; and on Sept. 29, 1179, some nobles set up the antipope Innocent III. By the judicious use of money, however, Alexander got him into his power, so that he was deposed in Jan. 1180. In 1181 Alexander excommunicated William the Lion of Scotland and put the Kingdom under the interdict. The great Pope died at Civita Castellana on Aug. 30, 1181.

See Herzog-Hauck, *Realencyklopädie*, 3rd ed. i. 340-44; Wetzel and Welte, *Kirchenlexikon*, 2nd ed., 1481. The most elaborate biography is H. Reuter, *Geschichte Alexanders III. und der Kirche seiner Zeit* (2nd ed., Leipzig, 1860).

ALEXANDER IV. (Rinaldo), Pope from 1254 to 1261, was a member of the family of the counts of Segni. On the death of Innocent IV. he was elected Pope at Naples on Dec. 12, 1254. He is described as a stout man, kindly, cheerful, but of no great brilliancy. He succeeded Innocent IV. as guardian of Conradin, the last of the Hohenstaufen, to whom he promised benevolent protection; but in less than a fortnight he conspired against him

and bitterly opposed Conradin's uncle Manfred. Alexander fulminated with excommunication and interdict against the party of Manfred, but in vain; nor could he enlist the kings of England and Norway in a crusade against the Hohenstaufen. Rome itself became too Ghibelline for the Pope, who withdrew to Viterbo, where he died on May 25, 1261. His pontificate was signalized by efforts to unite the Greek and Latin churches by the establishment of the Inquisition in France, by favours to the mendicant orders, and by an attempt to organize a crusade against the Tatars.

The registers of Alexander IV. are published by Bourel de la Roncière and others in the *Bibliothèque des Écoles françaises d'Athènes et de Rome* (Paris, 1895 et seq.).

ALEXANDER V. (Peter Philargès), Pope from 1409 to 1410, was born in Crete of unknown parents and entered the order of St. Francis. He was a member in turn of the Universities of Oxford and Paris, and finally settled in Lombardy, where, thanks to the favour of Gian Galeazzo Visconti, he became eventually archbishop of Milan. Created cardinal by Innocent VII., he worked for the realization of the union of the Church, in spite of the two rival popes. He was one of the promoters of the council of Pisa, and after that assembly had declared Gregory XII. and Benedict XIII. deposed, the cardinals elected Alexander as Pope (June 26, 1409), thus adding a third to the number of rival pontiffs. During his short reign of ten months Alexander V.'s aim was to extend his obedience with the assistance of France. He died suddenly at Bologna in the night of May 3-4, 1410, and it was suspected, though without proof, that he had been poisoned.

ALEXANDER VI. (Rodrigo Borgia), (1431-1503), pope from 1492 until his death, is the most memorable of the corrupt and secular Popes of the Renaissance. He was born, Jan. 1, 1431, at Xativa, near Valencia in Spain. He assumed the name of his mother's family, Borgia or Borja, on the elevation of his maternal uncle to the papacy as Calixtus III. (April 8, 1455). He studied law at Bologna, and after his uncle's election he was created successively bishop, cardinal and vice-chancellor of the church. He served in the Curia under five Popes, and acquired much administrative experience, influence and wealth, although no great power; he was economical in his habits, though on occasion he displayed great splendour and lived in a fine palace. Of his many mistresses, the one for whom his passion lasted longest was Vanozza (Giovanna) dei Cattanei, born in 1442, and wife of three successive husbands. The connection began in 1470, and she bore him children whom he openly acknowledged as his own: Giovanni, afterwards Duke of Gandia (born 1474), Cesare (born 1476), Lucrezia (born 1480), and Goffredo or Giuffrè (born 1481 or 1482). Before his elevation to the papacy, Cardinal Borgia's passion for Vanozza diminished. Her place was filled by the beautiful Giulia Farnese (Giulia Bella), wife of an Orsini, but his love for his children by Vanozza remained as strong as ever, and proved, indeed, the determining factor of his whole career. He lavished vast sums on them and loaded them with every honour.

On the death of Pope Innocent VIII., the three likely candidates for the Holy See were Cardinals Borgia, Ascanio Sforza and Giuliano della Rovere. Borgia, by his great wealth, succeeded in buying the largest number of votes, including that of Sforza, and was elected Aug. 10, 1492, assuming the name of Alexander VI. At first his reign was marked by a strict administration of justice and an orderly method of Government, in contrast with the anarchy of the previous pontificate, as well as by great outward splendour. But he indulged his unbridled passion for endowing his relatives at the expense of the Church and of his neighbours. Cesare, then a youth of 16 and a student at Pisa, was made archbishop of Valencia, his nephew Giovanni received a cardinal's hat, and for the Duke of Gandia and Giuffrè the pope proposed to carve fiefs out of the Papal States and the Kingdom of Naples. Among the fiefs destined for the Duke of Gandia were Cervetri and Anguillara, lately acquired by Virginio Orsini, head of that powerful and turbulent house, with the pecuniary help of Ferdinand of Aragon, king of Naples (Don Ferrante). This brought Ferdinand of Aragon into conflict with Alexander, who consequently made an alliance with the king's enemies, especially the Sforza family, lords of Milan.

In this he was opposed by Cardinal della Rovere, whose candidature for the papacy had been backed by Ferdinand. Della Rovere, feeling that Rome was a dangerous place for him, fortified himself in his bishopric of Ostia at the Tiber's mouth, while Ferdinand allied himself with Florence, Milan, Venice, and the Pope formed a league against Naples (April 25, 1493) and prepared for war. Ferdinand appealed to Spain for help; but Spain was anxious to be on good terms with the pope to obtain a title over the newly discovered continent of America, and could not afford to quarrel with him.

Alexander meditated great marriages for his children. Lucrezia had been married to the Spaniard Don Gasparo de Procida, but the union was annulled, and in 1493 she was married to Giovanni Sforza, lord of Pesaro, the ceremony being celebrated at the Vatican with unparalleled magnificence. But in spite of the splendours of the court, the condition of Rome became every day more deplorable. The city swarmed with Spanish adventurers, assassins, prostitutes and informers; murder and robbery were committed with impunity, heretics and Jews were admitted to the city on payment of bribes, and the pope himself shamelessly cast aside all show of decorum, living a purely secular and immoral life, and indulging in the chase, dancing, stage plays and indecent orgies. One of his boon companions was Jem, the brother of the Sultan Bayezid, detained as a hostage.

Alexander carried on a double policy, always ready to seize opportunities to aggrandize his family. But through the intervention of the Spanish ambassador he made peace with Naples in July 1493 and also with the Orsini. In order to dominate the Sacred College more completely he created 12 new cardinals, among them his own son Cesare, then only 18 years old, and Alessandro Farnese, the brother of Giulia Bella, one of the Pope's mistresses. On Jan. 25, 1494, Ferdinand died and was succeeded by his son Alphonso II. Charles of France now advanced formal claims on the Kingdom, and Alexander authorized him to pass through Rome ostensibly on a crusade against the Turks, without mentioning Naples. But when the French invasion became a reality he was alarmed, recognized Alphonso as king, and concluded an alliance with him in exchange for various fiefs to his sons (July 1494). Preparations for defense were made; but the pope was unable to defend Rome, and came to terms with the invader. Charles conquered Naples and was crowned king there on May 12, 1495, but a reaction set in. A league of the principal powers assembled a force in Italy which threatened Charles's retreat. He withdrew to France, and Ferdinand II., Alphonso's son, was established at Naples with Spanish help.

Alexander availed himself of the defeat of the French to break the power of the Orsini. Virginio Orsini, who had been captured by the Spaniards, died a prisoner at Naples, and the pope confiscated his property. But the rest of the clan still held out, and the papal troops sent against them under Guidobaldo, Duke of Urbino, and the Duke of Gandia were defeated at Soriano (Jan. 1497). Peace was made through Venetian mediation, the Orsini paying 50,000 ducats in exchange for their confiscated lands. The Orsini still remained very powerful, and Alexander could count on none but his 3,000 Spaniards.

Now occurred the first of those ugly domestic tragedies for which the house of Borgia remained infamous. On June 14 the Duke of Gandia, lately created Duke of Benevento, disappeared; the next day his corpse was found in the Tiber. Alexander, overwhelmed with grief, shut himself up in Castle St. Angelo. The rumour spread about that Cesare, the Pope's second son, was the author of the deed, and the search for the assassin then ceased. No doubt Cesare, who contemplated quitting the Church, was inspired by jealousy of Gandia's influence with the Pope. Violent and revengeful, he now became the most powerful man in Rome, and even his father quailed before him.

As he needed funds to carry out his various schemes, the Pope began a series of confiscations, of which one of the victims was his own secretary, in order to enrich him. The process was a simple one: any cardinal, nobleman or official who was known to be rich would be accused of some offense; imprisonment and perhaps murder followed at once, and then the confiscation of his

property. The disorganization of the Curia was appalling, the sale of offices became a veritable scandal, the least opposition to the Borgia was punished with death, and even in that corrupt age the state of things shocked public opinion. The story of Alexander's relations with Savonarola is narrated under the latter heading; it is sufficient to say here that the Pope's hostility was due to the friar's outspoken invectives against papal corruption and to his appeals for a General Council. Alexander, although he could not get Savonarola into his own hands, browbeat the Florentine Government into condemning the reformer to death (May 23, 1498).

The Pope was unable to maintain order in his own dominions; the houses of Colonna and Orsini were at open war with each other, but after much fighting they made peace on a basis of alliance against the Pope. He had annulled Lucrezia's marriage with Sforza in 1497, and arranged her marriage to the Duke of Bisceglie, a natural son of Alphonso of Aragon. Cesare, who renounced his cardinalate, was sent on a mission to France at the end of the year, bearing a bull of divorce for the new king, Louis XII., in exchange for which he obtained the duchy of Valentinois (hence his title of Duca Valentino) and a promise of material assistance in his schemes to subjugate the feudal princelings of Romagna; he married a princess of Navarre. In spite of the remonstrances of Spain and of the Sforza, Alexander allied himself with France in Jan. 1499 and was joined by Venice. By the autumn Louis was in Italy and expelled Lodovico Sforza from the Milanese. In order to consolidate his possessions still further now that French success seemed assured, the Pope determined to deal drastically with Romagna, which although nominally under papal rule was divided into a number of practically independent lordships on which Venice, Milan and Florence cast hungry eyes.

Cesare, nominated *gonfaloniere* of the Church, and strong in French favour, proceeded to attack the turbulent cities one by one (for details see BORGIA, CESARE). But the expulsion of the French from Milan and the return of Lodovico Sforza interrupted his conquests, and he returned to Rome early in 1500. This year was a jubilee year, and crowds of pilgrims flocked to the city from all parts of the world, bringing money for the purchase of indulgences, so that Alexander was able to furnish Cesare with funds for his enterprise. In the north the pendulum swung back once more and the French reoccupied Milan in April, causing the downfall of the Sforza much to Alexander's gratification.

But there was no end to the Vatican tragedies, and in July the Duke of Bisceglie, whose existence was no longer advantageous, was murdered; this left Lucrezia free to contract another marriage. The Pope, ever in need of money, now created 12 new cardinals, from whom he received 120,000 ducats; and fresh conquests for Cesare were considered. But while a crusade was talked of, the real object was central Italy, and in the autumn Cesare, favoured by France and Venice, set forth with 10,000 men to complete his interrupted enterprise. On his return to Rome (June 1501) Cesare was created Duke of Romagna. Louis XII. now concluded a treaty with Spain for the division of the Neapolitan kingdom, which was ratified by the Pope on June 25, Frederick being formally deposed. The French army proceeded to invade Naples, and Alexander took the opportunity, with the help of the Orsini, to reduce the Colonna to obedience. In his absence he left Lucrezia as regent, offering the astounding spectacle of a Pope's natural daughter in charge of the Holy See. Shortly afterwards he induced Alphonso d'Este, son of the Duke of Ferrara, to marry her (Jan. 1502).

As France and Spain were quarrelling over the division of Naples and the Campagna barons were quiet, Cesare set out once more in search of conquests (see BORGIA, CESARE). As soon as Alexander heard the news of Cesare's successes (1502) he deposed Cardinal Orsini to the Vatican and cast him into a dungeon, where he died. His goods were confiscated, his aged mother was turned into the street, and numbers of other members of the clan in Rome were arrested, while Giuffrè Borgia led an expedition into the Campagna and seized their castles. Thus the two great houses of Orsini and Colonna, who had long fought for predominance in Rome, and often flouted the Pope's authority,

were subjugated. Three more high personages fell victims to the Borgias' greed this year, viz., Cardinal Michiel, who was poisoned in April, and J. da Santa Croce, who had helped to seize Cardinal Orsini and Troches or Troccio, one of the family's most faithful assassins; all these murders brought immense sums to the pope. About Cardinal Ferrari's death there is more doubt; he probably died of fever, but the Pope confiscated his goods.

The war between France and Spain for the possession of Naples dragged on, and Alexander was ever intriguing, ready to ally himself with whichever power promised at the moment most advantageous terms. Cesare was preparing for another expedition into central Italy in July 1503, when, in the midst of all these projects and negotiations both he and his father were taken ill with fever. The occurrence was, of course, attributed to poison, although it was merely the result of malaria, at that time very prevalent in Rome. On Aug. 18 Alexander died at the age of 72. His death was followed by scenes of wild disorder, and Cesare, being himself ill, sent Don Michelotto, his chief bravo, to seize the Pope's treasures before the demise was publicly announced. Alexander's successor on the chair of St. Peter was Francesco Todeschini-Piccolomini, who assumed the name of Pius III.

Alexander VI. has become almost a mythical character, and countless legends and traditions are attached to his name. His career shows no great political ideas, and his one thought was family aggrandizement. While it is unlikely that he meditated making the papacy hereditary in the house of Borgia, he certainly gave away its temporal estates to his children as though they belonged to him. The secularization of the church was carried to a pitch never before dreamed of, and it was clear to all Italy that he regarded the papacy as an instrument of worldly schemes with no thought of its religious aspect. During his pontificate the church was brought to its lowest level of degradation. The condition of his subjects was deplorable, and if Cesare's rule in Romagna was an improvement on that of the local tyrants, the people of Rome have seldom been more oppressed than under the Borgia. Alexander was not the only person responsible for the general unrest in Italy and the foreign invasions, but he was ever ready to profit by them. Even if we do not accept all the stories of his murders and poisonings and immoralities as true, there is no doubt that his greed and his essentially vicious nature led him to commit a great number of crimes. For many of the misdeeds attributed to him, Cesare was responsible, but of others the Pope cannot be acquitted. The one pleasing aspect of his life is his patronage of the arts, and in his days a new architectural era was initiated in Rome with the coming of Bramante. Raphael, Michelangelo and Pinturicchio all worked for him and a curious contrast, characteristic of the age, is afforded by the fact that a family so steeped in vice and crime could take pleasure in the most exquisite works of art.

BIBLIOGRAPHY.—The chief contemporary authorities for this reign are: the diary of Alexander's master of ceremonies, Johannes Burchardus, edited by L. Thuanus (Paris, 1883-84), which is characterized by accuracy and by a candour often amounting to gross indecency; the despatches of Giustiniani, the Venetian ambassador, edited by P. Villari (Florence, 1876), which are based on the most accurate information; and Paolo Cappelletti's "Diarii" in E. Alberi's *Relazioni*, series ii., iii. Among modern works the most important are: F. Gregorovius's *Geschichte der Stadt Rom* (3rd ed., Stuttgart, 1881), a work of immense research and admirable synthesis, giving a very unfavourable view of the Borgia; A. von Reumont's *Geschichte der Stadt Rom* (Berlin, 1867-70), also a valuable book; M. Creighton's *History of the Papacy* (London, 1897) is very learned and accurate, but the author is more lenient towards Alexander; F. Gregorovius's *Lucrezia Borgia* (Stuttgart, 1874) contains a great deal of information on the Borgia family; P. Villari's *Machiavelli* (English translation, new ed., 1892) deals with the subject at some length. Of the Catholic writers, L. Pastor, *Geschichte der Päpste* (Freiburg, i. B., 1886), should be consulted, for although the author tries to extenuate the pope to some extent, on the whole he is fair. See also Rafael Sabatini, *The Life of Cesare Borgia*; G. Portigliotti, *The Borgias*, trans. by Bernard Miall (1928).

ALEXANDER VII. (Fabio Chigi), Pope from 1655 to 1667; was born at Siena on Feb. 13, 1599. He was successively inquisitor at Malta, vice-legate at Ferrar and nuncio in Cologne (1630-51). Innocent X. subsequently made him cardinal-secretary of State. When Innocent died, Chigi, the candidate favoured by Spain, was

elected Pope on April 7, 1655. The Conclave believed he was strongly opposed to the nepotism then prevalent. In the first year of his reign Alexander VII. forbade his relations even to visit Rome; but in 1656 he gave them the best-paid civil and ecclesiastical offices, also palaces and princely estates. Alexander disliked business of State, preferring literature and philosophy; a collection of his Latin poems appeared at Paris in 1656 under the title *Philomathi Labores Iuveniles*. He also encouraged architecture, and in particular constructed the beautiful colonnade in the piazza of St. Peter's. He favoured the Jesuits, in their conflict with the Jansenists, forbade in 1661 the translation of the Roman Missal into French, and in 1665 canonized Francis of Sales. His pontificate was marked by protracted controversies with France and Portugal. He died on May 22, 1667.

ALEXANDER VIII. (Pietro Ottoboni), Pope from 1689 to 1691, was born in 1610 of a noble Venetian family, was created cardinal, and then successively bishop of Brescia and datary. The ambassador of Louis XIV. succeeded in procuring his election, Oct. 6, 1689, as successor to Innocent XI.; nevertheless, after months of negotiation Alexander finally condemned the declaration made in 1682 by the French clergy concerning the liberties of the Gallican church. Charities on a large scale and unbounded nepotism exhausted the papal treasury. He bought the books and manuscripts of Queen Christina of Sweden for the Vatican library. Alexander condemned in 1690 the doctrines of so-called philosophic sin, taught in the Jesuit schools. He died on Feb. 1, 1691.

ALEXANDER I. (ALEKSANDER PAVLOVICH) (1777-1825), emperor of Russia, son of the grand-duke Paul Petrovich, afterwards Paul I., and Maria Fedorovna, daughter of Frederick Eugene of Württemberg, was born on Dec. 28, 1777. The strange contradictions of his character make Alexander one of the most interesting as he is one of the most important figures in the history of the 19th century. Autocrat and "Jacobin," man of the world and mystic, he was to his contemporaries a riddle which each read according to his own temperament. Napoleon thought him a "shifty Byzantine." To Metternich he was a madman to be humoured. Castlereagh gave him credit for "grand qualities," but said that he was "suspicious and undecided." His complex nature was, in truth, the outcome of the complex character of his early education. Reared in the free-thinking atmosphere of the court of Catherine II. he had imbibed from his Swiss tutor, Frédéric César de Laharpe, the principles of Rousseau's gospel of humanity; from his military governor, General Soltikov, the traditions of Russian autocracy; while his father had inspired him with his own passion for military parade. These contradictory tendencies remained with him through life, revealed in the fluctuations of his policy and influencing through him the fate of the world. Another element in his character discovered itself when in 1801 he mounted the throne over the body of his murdered father; a mystic melancholy liable at any moment to issue in extravagant action. At first, indeed, this exercised but little influence on his life. Young, impressionable, well-meaning and egotistic, Alexander plunged with all the ardour of youth into the task of realizing his political ideals. While retaining for a time the old ministers who had served and overthrown the emperor Paul, one of the first acts of his reign was to appoint a secret committee, called ironically the "Comité du salut public," consisting of young and enthusiastic friends of his own—Victor Gavovich Kochubey, Nikolai Nikolaevich Novosiltsov, Paul Alexandrovich Strogonov and Adam Czartoryski—to draw up a scheme of



AFTER A 17TH CENTURY ITALIAN MEDAL IN METROPOLITAN MUSEUM OF ART
PROFILE OF POPE ALEXANDER VII. ON AN EARLY ITALIAN MEDAL. HE CONSTRUCTED THE BEAUTIFUL COLONNADE IN THE PIAZZA OF ST. PETER'S

internal reform. Their aims were far in advance of the possibilities of the time, and even after they had been raised to regular ministerial positions, but little of their programme could be realized. For Russia was not ripe for liberty; and Alexander, the disciple of the revolutionist Laharpe, was—as he himself said—but "a happy accident" on the throne of the tsars. He spoke, indeed, bitterly of "the state of barbarism in which the country had been left by the traffic in men." "Under Paul," he said, "three thousand peasants had been given away like a bag of diamonds. If civilization were more advanced, I would abolish this slavery, if it cost me my head."¹ But the universal corruption, he complained, had left him no men; and the filling up of the government offices, with Germans and other foreigners merely accentuated the sullen resistance of the "old Russians" to his reforms. That Alexander's reign, which began with so large a promise of amelioration, ended by riveting still tighter the chains of the Russian people was, however, mainly due to the defects of the tsar himself.

His love of liberty, though sincere, was in fact unreal. It flattered his vanity to pose before the world as the dispenser of benefits; but his theoretical liberalism was mated with an autocratic will which brooked no contradiction. "You always want to instruct me!" he exclaimed to Derzhavin, the minister of justice, "but I am the autocratic emperor, and I will this, and nothing else!" Moreover, with this masterful temper was joined an infirmity of purpose which ever let "I dare not wait upon I would," and seized upon any excuse for postponing measures the principles of which he had publicly approved. The codification of the laws initiated in 1801 was never carried out during his reign; nothing was done to improve the intolerable status of the Russian peasantry; the constitution drawn up by Speranski, and passed by the emperor, remained unsigned. Alexander, in fact, who, without being consciously tyrannical, possessed in full measure the tyrant's characteristic distrust of men of ability and independent judgment, lacked also the first requisite for a reforming sovereign, confidence in his people; and it was this want that vitiated such reforms as were actually realized. He experimented in the outlying provinces of his empire; and the Russians complained that, not content with governing through foreign instruments, he was conferring on Poland, Finland and the Baltic provinces benefits denied to themselves. In Russia, too, certain reforms were carried out; but they could not survive the suspicious interference of the autocrat and his officials. The newly created council of ministers, and the senate, endowed for the first time with certain theoretical powers, became in the end but the slavish instruments of the tsar and his favourites of the moment. The elaborate system of education, culminating in the reconstituted, or new-founded, universities of Dorpat, Vilna, Kazan and Kharkov, was strangled in the supposed interests of "order" and of orthodox piety; while the military colonies which Alexander proclaimed as a blessing to both soldiers and state were forced on the unwilling peasantry and army with pitiless cruelty. Even the Bible Society, through which the emperor in his later mood of evangelical zeal proposed to bless his people, was conducted on the same ruthless lines. The Roman archbishop and the Orthodox metropolitans were forced to serve on its committee side by side with Protestant pastors; and village popes were compelled to disseminate what they regarded as works of the devil.

Alexander's grandiose imagination was, however, more strongly attracted by the great questions of European politics than by attempts at domestic reform. On the morrow of his accession he had reversed the policy of Paul, denounced the League of Neutrals, made peace with England (April 1801), and opened negotiations with Austria. Soon afterwards, at Memel, he entered into a close alliance with Prussia. The development of this alliance was interrupted by the short-lived peace of Oct. 1801; and for a while it seemed as though France and Russia might come to an understanding. Carried away by the enthusiasm of Laharpe, who had returned to Russia from Paris, Alexander began openly to proclaim his admiration for French institutions and for the person of Bonaparte. Soon, however, came a change. Laharpe, after a new visit to Paris, presented to the tsar his *Reflexions on the*

¹Savary to Napoleon, Nov. 4, 1807. Tatischev, p. 226.

True Nature of the Consulship for Life, which, as Alexander said, tore the veil from his eyes, and revealed Bonaparte as "the most famous tyrant the world has produced." His disillusionment was completed by the murder of the duc d'Enghien, and diplomatic relations with Paris were broken off.

The tsar's attitude during the war that followed was pregnant with issues momentous for the world. In opposing Napoleon, "the oppressor of Europe and the disturber of the world's peace," Alexander already believed himself to be fulfilling a divine mission. In his instructions to Novosiltsov, his special envoy in London, he elaborated the motives of his policy in language which anticipated the exalted ideals of international policy which the Covenant of the League of Nations later sought to realize. The outcome of the war, Alexander argued, was not to be only the liberation of France, but the universal triumph of "the sacred rights of humanity." To attain this it would be necessary "after having attached the nations to their government by making these incapable of acting save in the greatest interests of their subjects, to fix the relations of the states amongst each other on more precise rules, and such as it is to their interest to respect." A general treaty was to become the basis of the relations of the states forming "the European confederation," which would attain some of its results if, at the conclusion of the general war, it were possible to establish on clear principles the prescriptions of the rights of nations. "Why could not one submit to it," the tsar continued, "the positive rights of nations, assure the privilege of neutrality, insert the obligation of never beginning war until all the resources which the mediation of a third party could offer have been exhausted, having by this means brought to light the respective grievances, and tried to remove them? It is on such principles as these that one could proceed to a general pacification, and give birth to a league of which the stipulations would form, so to speak, a new code of the law of nations, which, sanctioned by the greater part of the nations of Europe, would without difficulty become the immutable rule of the cabinets, while those who should try to infringe it would risk bringing upon themselves the forces of the new union."¹ Meanwhile Napoleon never gave up hope of detaching him from the coalition. He had no sooner entered Vienna in triumph than he opened negotiations with him; he resumed them after Austerlitz. Russia and France, he urged, were "geographical allies"; there was between them no true conflict of interests; together they might rule the world. But Alexander was still determined "to persist in the system of disinterestedness in respect of all the states of Europe which he had thus far followed," and he again allied himself with Prussia. The campaign of Jena and the battle of Eylau followed; and Napoleon, though still intent on the Russian alliance, stirred up Poles, Turks and Persians to break the obstinacy of the tsar. A party too in Russia itself was clamorous for peace; but Alexander, after a vain attempt to form a new coalition, summoned the Russian nation to a holy war against Napoleon as the enemy of the Orthodox faith. The outcome was the rout of Friedland (June 13 and 14, 1807). Napoleon saw his chance and seized it. Instead of making heavy terms, he offered to the chastened autocrat his alliance, and a partnership in his glory.

The two emperors met at Tilsit on June 25. Alexander, dazzled by Napoleon's genius, was completely won. Napoleon knew well how to appeal to the imagination of his new-found friend. He would divide with Alexander the empire of the world; as a first step he would leave him in possession of the Danubian principalities and give him a free hand to deal with Finland; and, afterwards, the emperors of the East and West would drive the Turks from Europe and march across Asia to the conquest of India. A programme so stupendous awoke in Alexander's impressionable mind an ambition to which he had hitherto been a stranger. The interests of Europe were forgotten. "What is Europe?" he exclaimed to the French ambassador. "Where is it, if it is not you and we?"²

These new visions did not, however, blind Alexander to the obligations of friendship; and he refused to retain the Danubian

principalities as the price for suffering a further dismemberment of Prussia. It was not long before the first enthusiasm of Tilsit began to wane. Napoleon promised much, and performed little. The French remained in Prussia, the Russians on the Danube; each accused the other of breach of faith. Meanwhile, however, the personal relations of Alexander and Napoleon were cordial; and it was hoped that a fresh meeting might adjust all their differences. The meeting took place at Erfurt in Oct. 1808, and resulted in a treaty which defined a common policy. But Alexander's relations with Napoleon none the less changed. He realized that Napoleon had never intended his proposed "grand enterprise" seriously, and had only used it to preoccupy the mind of the tsar while he consolidated his own power in central Europe. From this moment the French alliance was for Alexander also an affair of pure policy. He used it, in the first instance, to remove "the geographical enemy" from the gates of St. Petersburg by wresting Finland from the Swedes (1809); and he hoped by means of it to make the Danube the southern frontier of Russia. Events were in fact rapidly tending to the rupture of the Franco-Russian alliance. Alexander, indeed, assisted Napoleon in the war of 1809, but he declared that he would not allow Austria to be crushed; and Napoleon complained bitterly of the inactivity of the Russian troops during the campaign. The tsar in his turn protested against Napoleon's encouragement of the Poles. In the matter of the French alliance he knew himself to be practically isolated in Russia, and he declared that he could not sacrifice the interest of his people and empire to his affection for Napoleon. The treaty of Vienna, which added largely to the grand-duchy of Warsaw, he complained had "ill requited him for his loyalty," and he was only mollified for the time by Napoleon's public declaration that he had no intention of restoring Poland.

But if Alexander suspected Napoleon, Napoleon was no less suspicious of Alexander; and, partly to test his sincerity, he sent an almost peremptory request for the hand of the grand-duchess Anne, the tsar's youngest sister. After some little delay Alexander returned a polite refusal. Napoleon's answer was to refuse to ratify the convention of Jan. 4, and to announce his engagement to the archduchess Marie Louise. From this time the relation between the two emperors became more and more strained. The annexation of Oldenburg, of which the duke was the tsar's uncle, to France in Dec. 1810, added another to the personal grievances of Alexander against Napoleon; while the ruinous reaction of the "continental system" on Russian trade made it impossible for the tsar to maintain a policy which was Napoleon's chief motive for the alliance. An acid correspondence followed, and ill-concealed armaments, which culminated in the summer of 1812 in Napoleon's invasion of Russia. Yet, even after the French had passed the frontier, Alexander still protested that his personal sentiments towards the emperor were unaltered. It was the occupation of Moscow and the desecration of the Kremlin, the sacred centre of Holy Russia, that changed his sentiment into passionate hatred. In vain the French emperor, within eight days of his entry into Moscow, wrote him a letter, revealing the desperate straits of the Grand Army, and appealed to "any remnant of his former sentiments."¹ Alexander returned no answer to these "fanfaronnades." "No more peace with Napoleon!" he cried, "He or I, or I or he: we cannot longer reign together!"

The campaign of 1812 was the turning-point of Alexander's life. Its horrors, for which he felt himself largely responsible, overset still more a mind never too well balanced. At the burning of Moscow, he declared afterwards, his own soul had found illumination, and he had received the divine revelation of his mission as the peacemaker of Europe. He tried to calm the unrest of his conscience by correspondence with the leaders of the evangelical revival, and sought for guidance in texts of scripture. It was not, however, according to his own account, till he met the Baroness von Krüdener (q.v.) at Basle, in the autumn of 1813, that his soul found peace. From this time a mystic pietism influenced his policy. Madame von Krüdener, and her colleague, the evangelist Empaytaz, became the confidants of his most secret thoughts; and during the campaign that ended in the occupation

¹Instructions to M. Novosiltsov, Sept. 11, 1804. Tatischev, p. 82.

²Savary to Napoleon, Nov. 18, 1807. Tatischev, p. 232.

¹Alexander speaking to Colonel Michaud. Tatischev, p. 612.

of Paris the imperial prayer-meetings were the oracle on whose revelations hung the fate of the world.

Such was Alexander's mood when the downfall of Napoleon left him the most powerful sovereign in Europe. With the memory of Tilsit still fresh in men's minds, it was not unnatural that to cynical men of the world like Metternich he merely seemed to be disguising "under the language of evangelical abnegation" vast and perilous schemes of ambition. The puzzled powers were, in fact, the more inclined to be suspicious in view of other, and seemingly inconsistent, tendencies of the emperor, which yet seemed all to point to a like disquieting conclusion. For though Alexander had declared war against the revolution, Laharpe was once more at his elbow, and the catchwords of the gospel of humanity were still on his lips. The very proclamations which denounced Napoleon as "the genius of evil," denounced him in the name of "liberty," and of "enlightenment." A monstrous intrigue was suspected for the alliance of the eastern autocrat with the Jacobinism of all Europe, which would have issued in the substitution of an all-powerful Russia for an all-powerful France. At the congress of Vienna Alexander's attitude accentuated this distrust. Castlereagh, whose aim was the restoration of "a just equilibrium" in Europe, reproached the tsar to his face for a "conscience" which suffered him to imperil the concert of the powers by keeping his hold on Poland in violation of his treaty obligation.¹

Yet Alexander was sincere. Even the Holy Alliance, the pet offspring of his pietism, does not deserve the sinister reputation it has since obtained. To the other powers it seemed, at best "verbiage" and "exalted nonsense," at worst an effort of the tsar to establish the hegemony of Russia on the goodwill of the smaller signatory powers. To the Liberals, then and afterwards it was clearly a hypocritical conspiracy against freedom. Yet to Alexander himself it seemed the only means of placing the "confederation of Europe" on a firm basis of principle² and, so far from its being directed against liberty he declared roundly to all the signatory powers that "free constitutions were the logical outcome of its doctrines." Europe, in fact, owed much at this time to Alexander's exalted temper. During the period when his influence was supreme, the fateful years between the Moscow campaign and the close of the congress of Aix-la-Chapelle, it had been used largely in the interests of moderation and liberty. To him mainly it was due that France was saved from dismemberment, and received a constitution which, to use his own words, "united crown and representatives of the people in a sense of common interests."³ By this wise intervention Switzerland was saved from violent reaction. To his protection it was due that the weak beginnings of constitutional freedom in Germany were able for a while to defy the hatred of Austria. Lastly, whatever its ultimate outcome, the constitution of Poland was a genuine effort to respond to the appeal of the Poles for a national existence.

From the end of the year 1818 Alexander's views began to change. A revolutionary conspiracy among the officers of the guard, and a foolish plot to kidnap him on his way to the congress of Aix-la-Chapelle, are said to have shaken the foundations of his Liberalism. At Aix he came for the first time into intimate contact with Metternich, who was swift to take advantage of the psychological moment. From this time dates the ascendancy of Metternich over the mind of the Russian emperor and in the councils of Europe. It was, however, no case of sudden conversion. Though alarmed by the revolutionary agitation in Germany, which culminated in the murder of his agent, the dramatist Kotzebue (*q.v.*), Alexander approved of Castlereagh's protest against Metternich's policy of "the governments contracting an alliance against the peoples," as formulated in the Carlsbad decrees, 1819.⁴ He still declared his belief in "free institutions, though not in

such as are forced from feebleness, nor contracts ordered by popular leaders from their sovereigns." "Liberty," he maintained, "should be confined within just limits. And the limits of liberty are the principles of order."¹

It was the apparent triumph of the principles of disorder in the revolutions of Naples and Piedmont, combined with increasingly disquieting symptoms of discontent in France, Germany and among his own people, that completed Alexander's conversion. In the seclusion of the little town of Troppau, where in Oct. 1820 the powers met in conference, Metternich found an opportunity for cementing his influence over Alexander which had been wanting amid the turmoil and feminine intrigues of Vienna and Aix.² The issue was momentous. In January Alexander had still upheld the ideal of a free confederation of the European states, symbolized by the Holy Alliance; he had still protested against the claims of collective Europe to interfere in the internal concerns of the sovereign states. On Nov. 19 he signed the Troppau protocol, which consecrated the principle of intervention and wrecked the harmony of the concert (*see* TROPPAU, CONGRESS OF).

At Laibach, whither in the spring of 1821 the congress had been adjourned, Alexander first heard of the revolt of the Greeks. From this time until his death his mind was torn between his anxiety to realize his dream of a confederation of Europe and his traditional mission as leader of the Orthodox crusade against the Turks. At first, under the careful nursing of Metternich, the former motive prevailed. He struck the name of Alexander Ypsilanti from the Russian army list, and directed his foreign minister, Count Capo d'Istria, himself a Greek, to disavow all sympathy of Russia with his enterprise; and, next year, a deputation of the Greeks of the Morea on its way to the congress of Verona was turned back by his orders on the road. He made, indeed, some effort to reconcile the principles at conflict in his mind. He offered to surrender the claim that the affairs of the East were the "domestic concerns of Russia," and to march into Turkey, as Austria had marched into Naples, "as the mandatory of Europe."³ Metternich's opposition to this first opened his eyes to the true character of Austria's attitude towards his ideals. Once more in Russia, far from the fascination of Metternich's personality, the immemorial spirit of his people drew him back into itself; and when, in the autumn of 1825, he took his dying empress for change of air to the south of Russia, in order—as all Europe supposed—to place himself at the head of the great army concentrated near the Ottoman frontiers, his language was no longer that of "the peace-maker of Europe," but of the Orthodox tsar determined to take the interests of his people and of his religion "into his own hands." Before the momentous issue could be decided, however, Alexander died at Taganrog on Dec. 1 (Nov. 18, O.S.) 1825, "crushed," to use his own words, "beneath the terrible burden of a crown" which he had more than once declared his intention of resigning. A report, current at the time and often revived, affirmed that he did not in fact die. By some it was supposed that a mysterious hermit named Fomich, who lived at Tomsk until 1864 and was treated with peculiar deference by successive tsars, was none other than Alexander;⁴ but this legend is now discredited.⁵

Modern history knows no more tragic figure than that of Alexander. The brilliant promise of his early years; the haunting memory of the crime by which he had obtained the power to realize his ideals; and, in the end, the terrible legacy he left to Russia; a principle of government which, under lofty pretensions, veiled a tyranny supported by spies and secret police; an uncertain succession; an army permeated by organized disaffection; an armed Poland, whose hunger for liberty the tsar had whetted but not satisfied; the quarrel with Turkey, with its alternative of war or humiliation for Russia; an educational system rotten with official hypocrisy; a church in which conduct counted for nothing; orthodoxy and ceremonial observance for everything; economical

¹Castlereagh to Liverpool, Oct. 1814. F.O. papers, Vienna VII.

²Martens IV. part i., p. 49.

³*Etat des négociations actuelles*, etc., mem. prepared by order of the tsar, July 16, 1815, enclosed in Castlereagh to Liverpool, F. O. Cont. papers. Congress Paris, Castlereagh, 22.

⁴Despatch of Lieven, Nov. 30 (Dec. 12), 1819, and Russ. Circular of Jan. 27, 1820. Martens IV., part i., p. 270.

¹*Aperçu des idées de l'Empereur*, Martens IV., part i., p. 269.

²Metternich *Mem.*

³Martens IV., part i., pp. 307, etc.

⁴*See* W. Gasiorowski, *Tragic Russia*, translated by Viscount de Busancy (1908).

⁵*See* Waliszewski, *Le Règne d'Alexandre 1er.*

and financial conditions scarce recovering from the verge of ruin; and lastly, that curse of Russia—serfdom.

In private life Alexander displayed many lovable qualities. All authorities combine in praising his handsome presence and the charm of his address. His personal friendship, too, once bestowed, was never lightly withdrawn. By nature he was sociable and pleasure-loving, he proved himself a notable patron of the arts and he took a conspicuous part in all the gaieties of the congress of Vienna. In his later years, however, he fell into a mood of settled melancholy; and, though still accessible to all who chose to approach him with complaints or petitions, he withdrew from all but the most essential social functions, and lived a life of strenuous work and of Spartan simplicity. His gloom had been increased by domestic misfortune. He had been married, in 1793, without his wishes being consulted, to the beautiful and amiable Princess Maria Louisa of Baden (Elizabeth Feodorovna), a political match which proved the misfortune of both. The only child of the marriage, a little grandduchess, died on May 12, 1808; and their common sorrow drew husband and wife closer together. Towards the close of his life their reconciliation was completed by the wise charity of the empress in sympathizing deeply with him over the death of his daughter by Madame Narishkine.

See also EUROPE; RUSSIA; FRANCE; TURKEY; VIENNA, CONGRESS OF; NAPOLEON I.; METTERNICH-WINNEBURG, CLEMENS WENZEL LO-THAR; CAPO D'ISTRIA, GIOVANNI ANTONIO (JOANNES).

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ALEXANDER II. (1818-1881), emperor of Russia, eldest son of Nicholas I., was born on April 29, 1818. Up to the moment of his accession in 1855 no one ever imagined that he would be known to posterity as a great reformer. In so far as he had any decided political convictions he seemed to be animated with the reactionary spirit of his time. The moral atmosphere of St. Petersburg (Leningrad) was very unfavourable to the development of any originality of thought or character. It was a time of government on martinet principles, under which all freedom of thought and all private initiative were suppressed vigorously by the administration. Alexander Nicolaevich received the education commonly given to young Russians of good family at that time—a smattering of a great many subjects and a good practical acquaintance with the chief modern European languages. His ordinary life was that of an officer of the Guards, modified by the ceremonial duties incumbent on him as heir to the throne. His natural kindness and in disposition for a military life had been fostered by his tutor Zhukovskii, the amiable humanitarian poet, and they remained with him all through life. In 1841 he married the daughter of the grand duke Louis II. of Hesse, Maximilienne Wilhelmine Marie,

thenceforward known as Maria Alexandrovna, who bore him six sons and two daughters. He did not travel much abroad, for his father, in his desire to exclude from Holy Russia the subversive ideas current in Western Europe, disapproved of foreign tours and could not consistently encourage in his own family what he tried to prevent among the rest of his subjects. He visited England, however, in 1839, and in the years immediately preceding his accession he was entrusted with several missions to the courts of Berlin and Vienna. On March 2, 1855, during the Crimean War, he succeeded to the throne on the death of his father.

The first year of the new reign was devoted to the prosecution of the war and, after the fall of Sevastopol, to negotiations for peace. Then began a period of radical reforms, recommended by public opinion and carried out by the autocratic power. The rule of Nicholas, which had sacrificed all other interests to that of making Russia an irresistibly strong military power, had been tried by the Crimean War and found wanting. A new system had, therefore, to be adopted. All who had any pretensions to enlightenment declared loudly that the only way of restoring Russia to its proper position in Europe was to develop its natural resources and to reform thoroughly all branches of the administration. Fortunately for Russia the autocratic power was in the hands of a man who was impressionable enough to be deeply influenced by the spirit of the time, and who had sufficient prudence and practical common sense to prevent his being carried away by the prevailing excitement into the dangerous region of Utopian dreaming. At first he moved so slowly that many of the impatient, would-be reformers began to murmur. But important changes were made in the legislation concerning industry and commerce, and the new freedom thus accorded produced a large number of limited liability companies. At the same time plans were formed for constructing a great network of railways, partly for economic and partly for military purposes. Further progress was blocked by a great obstacle—the existence of serfage, and Alexander II. grappled boldly with the difficult and dangerous problem. Taking advantage of a petition presented by the Polish landed proprietors of the Lithuanian provinces, praying that their relations with the serfs might be regulated in a more satisfactory way, he authorized the formation of committees "for ameliorating the condition of the peasants" and laid down the principles on which the amelioration was to be effected. Without consulting his ordinary advisers, the tsar then ordered a copy of these instructions to be forwarded to the provincial governors of European Russia and suggested that perhaps the landed proprietors of other provinces might express a similar desire. In all provinces where serfage existed emancipation committees were formed. Emancipation involved very complicated problems affecting deeply the economic, social and political future of the nation. The main point at issue was whether the serfs should become agricultural labourers dependent economically and administratively on the landlords or be transformed into a class of independent communal proprietors. The emperor gave his support to the latter project, and the Russian peasantry accordingly acquired rights and privileges such as were enjoyed at that time by no other peasantry in Europe. In the numerous other questions submitted to him he began by consulting carefully the conflicting authorities, and while leaning as a rule rather to the side of those who were known as "Liberals" he never went so far as they desired and always sought some middle course by which conflicting interests might be reconciled. On March 3, 1861, the sixth anniversary of his accession, the emancipation law was signed and published. Other reforms followed in quick succession during the next five or six years: army and navy organization, a new judicial administration on the French model, a new penal code and a greatly simplified system of civil and criminal procedure, an elaborate scheme of local self-government for the rural districts and the large towns, with elective assemblies possessing a restricted right of taxation, and a new rural and municipal police under the direction of the minister of the interior. These new institutions were incomparably better than the old ones which they replaced, but they did not work such miracles as inexperienced enthusiasts expected. Comparisons were made, not with the past, but with an ideal state of things which never existed in Russia or elsewhere. Hence arose a general feeling of disappointment which acted on

different natures in different ways. Thus appeared in the educated classes two extreme groups: on the one hand, the discontented Conservatives, who recommended a return to a more severe disciplinarian *régime*; and on the other, the discontented Radicals, who would have been satisfied with nothing less than the adoption of a thoroughgoing socialistic programme. Between the two extremes stood the discontented Moderates, who indulged freely in grumbling without knowing how the unsatisfactory state of things was to be remedied. For some years the emperor, with his sound common sense and dislike of exaggeration, held the balance fairly between the two extremes; but when radicalism assumed more and more the form of secret societies and revolutionary agitation, he felt constrained to adopt severe repressive measures.

The revolutionary agitation was of a very peculiar kind. It was confined to a section of the educated classes and emanated from the universities and higher technical schools. At the beginning of the reform period there had been much enthusiasm for scientific as opposed to classical education. Russia required, it was said, not classical scholars, but practical scientific men capable of developing her natural resources. The government, in accordance with that view, had encouraged scientific studies until it discovered to its astonishment that there was some mysterious connection between natural science and revolutionary tendencies. Thus arose a struggle between the youthful, hot-headed partisans of revolutionary physical science and the zealous official guardians of political order—a struggle which has made the strange term Nihilism (*q.v.*) a familiar word not only in Russia but also in western Europe. The movement gradually assumed the form of terrorism and aimed at the assassination of prominent officials and even of the emperor himself, and the natural result was that the reactionary tendencies of the government were strengthened.

In foreign policy Alexander II. showed the same qualities of character as in internal affairs, ever trying prudently to steer a middle course. When he came to the throne the Crimean War was still going on, but he concluded peace with the allies as soon as he thought the national honour had been satisfied. Prince Gorchakov for fifteen years avoided foreign complications so that the internal strength of the country might be developed, while the national pride and ambition received a certain satisfaction by the expansion of Russian influence and domination in Asia. Twice, indeed, during that period the chancellor ran the risk of provoking war. The first occasion was in 1863, when the Western powers seemed inclined to interfere in the Polish question, and the Russian chancery declared categorically that no interference would be tolerated. The second occasion was during the Franco-German War of 1870–71, when the cabinet of St. Petersburg boldly declared that it considered itself no longer bound by the Black Sea clause of the Treaty of Paris. On both occasions hostilities were averted. Not so on the next occasion, when Russia abandoned her attitude of *recueillement*. When the Eastern question was raised in 1875 by the insurrection of Hercegovina, Alexander II. had no intention or wish to provoke a great European war. No doubt he was waiting for an opportunity of recovering the portion of Bessarabia which had been ceded by the treaty of Paris, and he perceived in the disturbed state of eastern Europe a possibility of obtaining the desired rectification of frontier, but he hoped to effect his purpose by diplomatic means in conjunction with Austria. At the same time he was anxious to obtain for the Christians of Turkey some amelioration of their condition, and to give thereby some satisfaction to his own subjects. As autocratic ruler of the nation which had long considered itself the defender of the Eastern Orthodox faith and the protector of the Slav nationalities, he could not remain inactive at such a crisis, and he gradually allowed himself to drift into a position from which he could not retreat without obtaining some tangible result. Supposing that the Porte would yield to diplomatic pressure and menace so far as to make some reasonable concessions, he delivered his famous Moscow speech, in which he declared that if Europe would not secure a better position for the oppressed Slavs he would act alone.

The diplomatic pressure failed and war became inevitable. During the campaign he displayed the same perseverance and the same moderation that he had shown in the emancipation of the serfs. To

those who began to despair of success, and advised him to conclude peace on almost any terms so as to avoid greater disasters, he turned a deaf ear; but when his more headstrong advisers urged him to insist on terms which would probably have produced a conflict with Great Britain and Austria, he resolved, after some hesitation, to make the requisite concessions. In this resolution he was influenced by the discovery that he could not rely on the expected support of Germany, and the discovery made him waver in his devotion to the German alliance, which had been the main pivot of his foreign policy; but his personal attachment to the emperor William prevented his adopting a hostile attitude towards the empire he had helped to create.

The patriotic excitement produced by the war did not weaken the revolutionary agitation. The struggle between the Terrorists and the police authorities became more and more intense, and attempts at assassination became more and more frequent. Alexander II. succumbed by degrees to the mental depression produced originally by the disappointments which he experienced in his home and foreign policy; and in 1880, when he had reigned twenty-five years, he entrusted to Count Loris-Melikov a large share of the executive power. In that year the empress died, and a few weeks afterwards he married secretly a Princess Dolgoruki, with whom he had entertained intimate relations for some years. Early in 1881, on the advice of Count Loris-Melikov, he determined to try the effect of some moderate liberal reforms on the revolutionary agitation, and for this purpose he caused a ukase to be prepared creating special commission, composed of high officials and private personages who should prepare reforms in various branches of the administration. On the very day on which this ukase was signed—March 13, 1881—he fell a victim to a Nihilist plot. When driving in one of the central streets of St. Petersburg, near the Winter Palace, he was mortally wounded by the explosion of some small bombs and died a few hours afterwards. (D. M. W.)

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ALEXANDER III. (1845–1894), emperor of Russia, second son of Alexander II., was born on March 10, 1845. In natural disposition he bore little resemblance to his soft-hearted, liberal-minded father, and still less to his refined, philosophic, sentimental, chivalrous, yet cunning grand-uncle, Alexander I. He rather gloried in the idea of being of the same rough texture as the great majority of his subjects. His straightforward, abrupt manner savoured sometimes of gruffness, while his direct, unadorned method of expressing himself harmonized well with his rough-hewn, immobile features and somewhat sluggish movements. His education was not fitted to soften these peculiarities. During the first 20 years of his life he had no prospect of succeeding to the throne, because he had an elder brother, Nicholas, who seemed of a fairly robust constitution. Alexander received only the perfunctory and inadequate training of an ordinary grand duke of that period, which did not go much beyond primary and secondary instruction, practical acquaintance with French, English and German, and a certain amount of drill. When he became heir-apparent by the death of his elder brother in 1865, he began to study the principles of law and administration under Prof. Pobedonostsev, who influenced the character of his reign by instilling into his mind the belief that zeal for Eastern Orthodoxy ought, as an essential factor of Russian patriotism, to be specially cultivated by every right-minded tsar. His elder brother, when on his deathbed, had expressed a wish that his affianced bride, Princess Dagmar of Denmark (see MARIE FEDOROVNA), should marry his successor. The marriage was celebrated on Nov. 9, 1866. The union proved a most happy one to the end. During those years when he was heir-apparent—1865 to 1881—he allowed it to become known that he had certain ideas of his own which did not coincide with the principles of the existing Government.

He deprecated undue foreign influence in general and German influence in particular. He desired to see a homogeneous Russia—homogeneous in language, administration and religion. His father, though a good patriot according to his lights, had strong German sympathies, often used the German language in his private relations; occasionally ridiculed the exaggerations of the Slavophiles and based his foreign policy on the Prussian alliance. The antagonism first appeared publicly during the Franco-German War, when the tsar supported the cabinet of Berlin and the cesarevitch did not conceal his sympathies with the French. It reappeared in an intermittent fashion during the years 1875-79, on the Eastern question. At first the cesarevitch was more Slavophil than the Government, but any of the prevalent popular illusions he may have imbibed were soon dispelled by personal observation in Bulgaria, where he commanded the left wing of the invading army. He did not, however, make himself conspicuous in any way during the campaign, but fulfilled his military duties in a conscientious and unobtrusive manner. After many mistakes and disappointments the army reached Constantinople, and the Treaty of San Stefano was signed; but much that had been obtained by that important document had to be sacrificed at the Congress of Berlin. Prince Bismarck failed to do what was confidently expected of him. In return for the Russian support, which had enabled him to create the German empire, it was thought that he would help Russia to solve the Eastern question in accordance with her own interests, but to the surprise and indignation of the cabinet of St. Petersburg he confined himself to acting the part of "honest broker" at the congress, and shortly afterwards he ostentatiously contracted an alliance with Austria for the express purpose of counteracting Russian designs in eastern Europe. The cesarevitch drew the practical conclusion that for Russia the best thing to do was to recover as quickly as possible from her temporary exhaustion and to prepare for future contingencies by a radical scheme of military and naval reorganization. In accordance with this conviction he called his father's attention to the grave disorders and corruption in the army. His representations were not favourably received. Alexander II. had lost much of the reforming zeal which distinguished the first decade of his reign, and had no longer the energy required to undertake drastic reforms. On March 13, 1881, Alexander II. was assassinated by a band of Nihilists, and the autocratic power passed to the hands of his son.

In the last years of his reign, Alexander II. had been much exercised by the spread of Nihilist doctrines and the increasing number of anarchist conspiracies. On the very day of his death he signed a ukase, creating a number of consultative commissions which might have been easily transformed into an assembly of notables. Alexander III. at once cancelled the ukase before it was published, and in the manifesto announcing his accession to the throne he let it be very clearly understood that he had no intention of limiting or weakening the autocratic power which he had inherited from his ancestors. Nor did he afterwards show any inclination to change his mind. All the internal reforms which he initiated were intended to correct what he considered as the too liberal tendencies of the previous reign. In his opinion Russia was to be saved from anarchical disorders and revolutionary agitation, not by the parliamentary institutions and so-called liberalism of western Europe, but by the three principles which the elder generation of the Slavophiles systematically recommended—nationality, Eastern Orthodoxy and autocracy. His political ideal was a nation containing only one nationality, one language, one religion and one form of administration; and he did his utmost to prepare for the realization of this ideal by imposing the Russian language and Russian schools on his German, Polish and Finnish subjects, by fostering Eastern Orthodoxy at the expense of other confessions, by persecuting the Jews and by destroying the remnants of German, Polish and Swedish institutions in the outlying provinces. In the other provinces he sought to counteract what he considered the excessive liberalism of his father's reign. For this purpose he clipped the feeble wings of the zemstvo, an elective local administration resembling the county and parish councils in England, and placed the auton-

omous administration of the peasant communes under the supervision of landed proprietors appointed by the Government. At the same time he sought to strengthen and centralize the imperial administration, and to bring it more under his personal control. In foreign affairs he was emphatically a man of peace, but not at all a partisan of the doctrine of peace at any price. Though indignant at the conduct of Prince Bismarck towards Russia, he avoided an open rupture with Germany, and even revived for a time the Three Emperors' alliance. It was only in the last years of his reign, when M. Katkov had acquired a certain influence over him, that he adopted towards the cabinet of Berlin a more hostile attitude, and even then he confined himself to keeping a large quantity of troops near the German frontier, and establishing cordial relations with France. With regard to Bulgaria he exercised similar self-control. The efforts of Prince Alexander and afterwards of Stambolov to destroy Russian influence in the principality excited his indignation, but he persistently vetoed all proposals to intervene by force of arms. In central Asian affairs he followed the traditional policy of gradually extending Russian domination without provoking a conflict with Great Britain, and he never allowed the bellicose partisans of a forward policy to get out of hand. As a whole his reign cannot be regarded as one of the eventful periods of Russian history; but it must be admitted that under his hard, unsympathetic rule the country made considerable progress. He died at Livadia on Nov. 1, 1894, and was succeeded by his eldest son, Nicholas II.

ALEXANDER I., king of Epirus about 342 B.C., brother of Olympias the mother of Alexander the Great, and son-in-law of Philip of Macedon, whose daughter Cleopatra he married (336). In 332 he crossed over to Italy to assist the Tarentines against the Lucanians, Brutians and Samnites. He gained considerable successes, and made an arrangement with the Romans for a joint attack upon the Samnites; but the Tarentines, suspecting him of the design of founding an independent kingdom, turned against him. Although the advantage at first rested with Alexander, he gradually lost it, and his supporters dwindled away. In 330 (or earlier) he was defeated at Pandosia, and slain by a Lucanian emigrant.

See Justin viii. 6, ix. 6, xii. 2; Livy viii. 3, 17, 24; Aulus Gellius xvii. 21; also article MACEDONIAN EMPIRE.

ALEXANDER II., king of Epirus (succeeded 272 B.C.). In 264 he invaded Macedonia but was driven out of that country and his own kingdom by Demetrius, son of Antigonus Gonatas. He was later restored to Epirus. He subsequently recovered his kingdom (Polybius ii. 45, ix. 34; Plutarch, *Pyrrhus*, 9; Justin xviii. 1, xxvi. 2, xxviii. 1).

See Thirlwall, *History of Greece*, vol. viii.; Droysen, *Hellenismus*; B. Niese, *Gesch. d. griech. u. maked. Staaten*; J. Beloch, *Griech. Gesch.*, vol. iii.

ALEXANDER (1893-1920), king of the Hellenes, second son of King Constantine and Queen Sophia, was born Aug. 1, 1893, and ascended the throne of Greece on the dethronement of his father, June 14, 1917. The Government itself was for the time in the hands of Venizelos, who had the confidence of the Allies; but the defeat of Germany, and Venizelos's diplomatic triumphs at the Peace Conference, seemed to breathe a new spirit into the young king. From the day of his triumphal entry into Adrianople, he took an active personal interest in the prospect of being the ruler of Greater Greece.

He died Oct. 25, 1920, by blood poisoning from the bite of a pet monkey. In Nov. 1919 King Alexander made a morganatic marriage with an Athenian lady, Aspasia Manos; and after his death a daughter was born to her in Paris on March 25, 1921. On Oct. 12, 1922, the marriage was declared valid by royal decree, so that Alexander's daughter became her father's legal heir, though she did not thereby acquire any rights in respect to the throne.

ALEXANDER III., known as **THE GREAT** (356-323 B.C.), king of Macedon, was the son of Philip II. of Macedon and Olympias, an Epirote princess. His father was pre-eminent for practical genius, his mother a woman of half-wild blood, weird, visionary and terrible; and Alexander himself is singular among men of action for the imaginative splendours which guided him.

and among romantic dreamers for the things he achieved. He was born at Pella in 356 B.C., about October (Hogarth, pp. 284 *seq.*). The court at which he grew up was the focus of great activities, for Philip, by war and diplomacy, was raising Macedonia to the headship of the Greek states, and the air was charged with great ideas. To unite the Greek race in a war against the Persian empire was set up as the ultimate mark for ambition, the theme of idealists. The great literary achievements of the Greeks in the 5th century lay already far enough behind to have become invested with a classical dignity; the meaning of Hellenic civilization had been made concrete in a way which might sustain enthusiasm for a body of ideal values, authoritative by tradition. And upon Alexander in his 14th year this sum of tradition was brought to bear through the person of the man who beyond all others had gathered it up into an organic whole: in 343-342 Aristotle (*q.v.*) came to Pella at Philip's bidding to direct the education of his son. We do not know what faculty the master-thinker may have had for captivating this ardent spirit; at any rate Alexander carried with him through life a passion for Homer, however he may have been disposed to greyer philosophic theory. But his education was not all from books. The coming and going of envoys from many states, Greek and Oriental, taught him something of the actual conditions of the world. He was early schooled in war. At the age of 16 he commanded in Macedonia during Philip's absence and quelled a rising of the hill-tribes on the northern border; in the following year (338) he headed the charge which broke the Sacred Band at Chaeronea. Then came family dissensions such as usually vex the polygamous courts of the East. In 337 Philip repudiated Olympias for another wife, Cleopatra. Alexander went with his mother to her home in Epirus, and, though he soon returned and an outward reconciliation between father and son was contrived, their hearts were estranged. The king's new wife was with child; her kinsmen were in the ascendant; the succession of Alexander was imperilled. Some negotiations which Pixodarus, the satrap of Caria, opened with the Macedonian court with a view to effecting a marriage alliance between his house and Philip's, brought Alexander into fresh broils. In 336 Philip was suddenly assassinated whilst celebrating at Aegae the marriage of his daughter to Alexander I. of Epirus in the presence of a great concourse from all the Greek world. It is certain that the hand of the assassin was prompted by someone in the background; suspicion could not fail to fall upon Alexander among others. But guilt of that sort would hardly be consistent with his character as it appears in those early days.

Accession.—Alexander was not the only claimant to the vacant throne, but, recognized by the army, he soon swept all rivals from his path. The newly born son of Philip by Cleopatra, and Alexander's cousin Amyntas, were put to death, and Alexander took up the interrupted work of his father. That work was on the point of opening its most brilliant chapter by an invasion of the great king's dominions; the army was concentrated and certain forces had already been sent on to occupy the opposite shore of the Hellespont. The assassination of Philip delayed the blow, for it immediately made the base, Macedonia, insecure; and in such an enterprise, plunging into the vast territories of the Persian empire, a secure base was everything. Philip's removal had made all the hill-peoples of the north and west raise their heads and set the Greek states free from their fears. A demonstration in Greece, led by the new king of Macedonia, momentarily checked the agitation, and at the diet at Corinth Alexander was recognized as captain-general (*ἡγεμὼν αὐτοκράτωρ*) of the Hellenes against the barbarians, in the place of his father Philip. In the spring of 335 he went out from Macedonia northwards, struck across the Balkans, by the Kojia or Shipka pass, frustrating the mountain warfare of its tribes by a precision of discipline which, probably, no other army of the time could have approached, and traversed the land of the Triballians (Rumelia) to the Danube. To gratify his own imagination or strike the imagination of the world he took his army over the Danube and burnt a settlement of the Getae upon the other side. Meanwhile the Illyrians had seized Pelion (Pliassa), which commanded the passes on the west of Macedonia, and from the Danube. Alexander marched straight

thither over the hills. He had hardly restored Macedonian prestige in this quarter when he heard that Greece was aflame. Thebes had taken up arms. By a forced march he took the Thebans completely by surprise, and in a few days the city, which a generation before had won the headship of Greece, was taken. There were to be no half-measures now; the city was wiped out of existence with the exception of its temples and the house which had been Pindar's. Greece might now be trusted to lie quiet for some time to come. The Panhellenic alliance (from which Sparta still stood aloof) against the barbarians was renewed. Athens, although known to be hostile at heart to the Macedonian power, Alexander treated all through with eager courtesy.

Invasion of Asia Minor.—In the spring of 334, Alexander crossed with an army of between 30,000 and 40,000 men, Macedonians, Illyrians, Thracians and the contingents of the Greek states, into Asia. The place of concentration was Arisbe on the Hellespont. Alexander himself first visited the site of Troy and there went through those dramatic acts of sacrifice to the Ilian Athena, assumption of the shield believed to be that of Achilles and offerings to the great Homeric dead, which are significant of the poetic glamour shed, in the young king's mind, over the whole enterprise, and which men will estimate differently according to the part they assign to imagination in human affairs. To meet the invader the great king had in Asia Minor an army certainly not much larger than Alexander's, if as large, gathered under the satraps of the western provinces at Zeleia. He had also, what was more serious, command of the Aegean. Alexander could communicate with his base only by the narrow line of the Hellespont, and ran the risk, if he went far from it, of being cut off altogether. To draw him after them, while avoiding a conflict, was sound strategy for the Persian generals. It was urged upon them by their colleague the Rhodian Memnon.

Granicus.—Strategic considerations were cancelled by the Persian barons' code of chivalry, and Alexander found them waiting for him on the banks of the Granicus. It was a cavalry mêlée, in which the common code of honour caused Macedonian and Persian chieftains to engage hand to hand, and at the end of the day the relics of the Persian army were in flight, leaving the high-roads of Asia Minor clear for the invader. Alexander could now accomplish the first part of the task belonging to him as captain-general to the Hellenes, that liberation of the Greek cities of Asia Minor, for which Panhellenic enthusiasts had cried out so long. He went to take possession of the old Lydian capital Sardis, the headquarters of the Persian government on this side of the Taurus, and the strong city surrendered without a blow. And now in all the Greek cities of Aeolis and Ionia the oligarchies or tyrants friendly to Persia fell, and democracies were established under the eye of Alexander's officers. Only where the cities were held by garrisons in the Persian service, garrisons composed mainly of Greek mercenaries, was the liberator likely to meet with any resistance. From Ephesus indeed the garrison fled upon the news of Granicus, but Miletus required a siege. The Persian fleet in vain endeavoured to relieve it, and Miletus did not long hold out against Alexander's attack. It was at Halicarnassus that Alexander first encountered the stubborn resistance, at Halicarnassus where Memnon and the satraps of Caria had rallied what land-forces yet belonged to Persia in the west. When winter fell, Alexander had captured the city itself, but the two citadels still held out against his blockade.

Meanwhile Alexander was making it plain that he had come not merely as captain-general for a war of reprisals, but to take the Persian's place as king of the land. The conquered provinces were organized under Macedonian governors and in Caria a de-throned princess of the native dynasty, Ada, was restored to power. In the winter, whilst Parmenio advanced upon the central plateau to make the occupation of Phrygia effective, Alexander himself passed along the coast to receive the submission of the Lycians and the adherents of the Greek cities of the Pamphylian sea-board. The hills inland were the domain of fighting tribes which the Persian government had never been able to subdue. To conquer them, indeed, Alexander had no time, but he stormed some of their fortresses to hold them in check, and marched

through their territory when he turned north from Pamphylia into the interior. The point of concentration for the following year's campaign had been fixed at Gordium, a meeting-place of roads in Northern Phrygia. The story of Alexander's cutting the fatal "Gordian knot" on the chariot of the ancient Phrygian king Gordius is connected with his stay in this place.

Extension of Alexander's Power.—Whilst Alexander had been grounding his power in Asia Minor, he had run a narrow risk of losing his base in Europe. He had after the siege of Miletus disbanded the Graeco-Macedonian fleet, surrendering for the time all attempts to challenge the command of the Aegean. Memnon the Rhodian, now in supreme command of the Persian fleet, saw the opportunity to detach the Greek island-states where discontent always smouldered in Alexander's rear. But Memnon died at the critical moment whilst laying siege to Mytilene and the great plan collapsed. A Persian fleet still held the sea, but it effected little, and presently fresh Graeco-Macedonian squadrons began to hold it in check. It was, however, the need to ensure command of the sea and free all lines of communication behind him that determined Alexander's plan for the next campaign. If he mastered the whole coast-line of the Levant, the enemy's fleet would find itself left in the air. The Syrian coast was accordingly his immediate objective when he broke up from Gordium for the campaign of 333. He was through the Cilician Gates before the Persian king, Darius III., had sent up a force adequate to hold them. His passage through Cilicia was marked by a violent fever that arrested him for a while in Tarsus, and meantime a Persian army was waiting for him in northern Syria under the command of Darius himself. In the knot of mountains which close in about the head of the Gulf of Alexandretta, Alexander, following hard by the coast, marched past the Persian army whilst it was crossing the Amanus chain more to the East.

Battle of Issus.—To cut Alexander's communications with the rear, Darius now committed the error of entangling his large force in the mountain defiles. Alexander turned, and near the town of Issus fought his second pitched battle, sending Darius and the relic of his army in wild flight back to the East.¹ It was an incident which did not modify Alexander's plan. He did not press the pursuit far, although the great king's camp with his harem fell into his hands. The chivalrous courtesy which he showed to the captive princesses was a favourite theme for later rhetoricians. He went on his way to occupy Syria and Phoenicia. It is now that we get definite evidence as to the scope of Alexander's designs; for Darius opened negotiations in which he ultimately went so far as to offer a partition of the empire, all west of the Euphrates, to be Alexander's. Alexander refused the bargain and definitely claimed the whole.² The conquest of the Phoenician coast was not to be altogether easy, for Tyre shut its gates and for seven months Alexander had to sit before it—one of those obstinate sieges which mark the history of the Semitic races. When it fell, Alexander had the old Tyrian people scattered to the winds, sold as slaves. Gaza offered a resistance equally heroic, lasting two months, and here too the old population was dispersed. The occupation of the rest of Syria and Palestine proceeded smoothly, and after the fall of Gaza Alexander's way lay open into Egypt.³ Egypt was the last of the Mediterranean provinces to be won, and here no defence was made. To the native Egyptians Alexander appeared as a deliverer from the Persian tyranny, and he sacrificed piously to the gods of Memphis. The winter (332-331) which Alexander spent in Egypt saw two memorable actions on his part. One was the expedition (problematic in its motive and details) to the oracle of Zeus Ammon (Oasis of Siwa), where Alexander was hailed by the priest as son of the god, a belief which the circle of Alexander, and perhaps Alexander himself, seem hereafter to have liked to play

with in that sort of semi-serious vein which still allowed him in the moments of every-day commonplace to be the son of Philip. The other action was the foundation of Alexandria at the Canopic mouth of the Nile, the place destined to be a new commercial centre for the eastern Mediterranean world which Alexander had now taken in possession, to rise to an importance which the founder, although obviously acting with intention, can hardly have foreseen. (E. Keller, *Alex. d. Grosse nach der Schlacht bei Issus*, 1904).

Invasion of Persia.—In the spring of 331 Alexander could at last leave the Mediterranean to strike into the heart of the



AFTER G. CURTIUS RUFUS, "ALEXANDRI MAGNI VITA," 1696

ALEXANDER DEFEATING DARIUS III., KING OF PERSIA IN 331 B.C.

The battle of Arbela (more properly Gaugamela) resulted in the destruction of the last army of Persia. After the victory there was no further organized resistance, and Alexander seized Susa and Babylon

Persian empire, for by his occupation of the coasts the Persian command of the sea had inevitably collapsed. Returning through Syria, and stopping at Tyre to make final arrangements for the conquered provinces, he traversed Mesopotamia and struck the Tigris some four marches above the site of Nineveh. It was near Nineveh that Darius was waiting with an army, stronger in cavalry than in infantry, mustered from all parts of the empire. The happy coincidence of a lunar eclipse gives us Sept. 20, 331, as the exact day upon which the Macedonian army crossed the Tigris.

Battle of Arbela.—Alexander came within sight of the Persian host without having met with any opposition since he quitted Tyre. He had now to settle the most serious problem which had yet faced him, for in the plains the Persian army was formidable by sheer bulk. But the day showed the Macedonian army equal to the task. The last army gathered by an Achaemenian king was shattered in the battle called popularly after the city of Arbela some 60m. distant, or more precisely after the village of Gaugamela hard by. Darius fled eastwards into Media and again Alexander waited till he had secured the provinces to the south. He followed the Tigris into Babylonia, the central seat of the empire and its richest region, and from Babylon went on to seize the fabulous riches which the Persian kings had amassed in their spring residence, Susa. Thence he at last ascended upon the Iranian plateau. The mountain tribes on the road (the Uxii, Persian *Huzha*), accustomed to exact blackmail even from the king's train, learnt by a bitter lesson that a stronger hand had come to wield the empire. Alexander entered Persis, the cradle of the Achaemenian house, and came upon fresh masses of treasure in the royal city, Persepolis. He destroyed the royal palace by fire, an act which has been variously estimated by historians. Ostensibly a solemn revenge for the burning of Greek temples by

¹See Bauer, "Die Schlacht bei Issus" in *Jahreshefte d. österr. archäol. Instit.* ii., pp. 105 f.; A. Janke, *Auf Alex. d. grossen Pfaden*; Gruhn, *Das Schlachtfeld von Issus*; Lammert in *Berl. Philol. Wochenschr.* (1905), col. 1,596 f.

²Pridik, *De Alex. Mag. epist. commercio* (Dorpat, 1893); Schwartz, art. "Curtius" in Pauly-Wissowa, col. 1,884.

³The story of Alexander's visit to Jerusalem rests on no better authority than a later Jewish romance.

Xerxes, it has been justified as a symbolical act calculated to impress usefully the imagination of the East, and condemned as a senseless and vainglorious work of destruction.

With the spring of 330 Alexander was prepared for further pursuit. Darius fled northwards from Ecbatana upon his approach. At Ecbatana new masses of treasure were seized, but when once the necessary measures which its disposal and the



THE DEATH OF ALEXANDER THE GREAT AT BABYLON IN 323 B.C.
Alexander's death, in his 33rd year, put an end to the Macedonian subjugation of the East and left his empire a prey to his ambitious generals.
From an 18th century Persian ms. in the Metropolitan Museum of Art

occupation of the Median capital entailed were taken, Alexander continued the pursuit. It was an exciting chase of king by king, in which each covered the ground by incredible exertions, shedding their slower-going followers as they went, past Rhagae (Rai) and the Caspian gates, till early one morning Alexander came in sight of the broken train which still clung to the fallen king. He had become a puppet in the hands of his cousin Bessus and the Persian magnates with him (see DARIUS III.), and at this extremity they stabbed him and allowed Alexander to become master only of his corpse (summer 330).

The pursuit had brought Alexander into that region of mountains to the south of the Caspian which connects western Iran with the provinces to the east of the great central desert. To conquer this remaining portion of the empire, Alexander now went on through the mountain belt, teaching the power of his arms to the hillsmen, Tapyri and Mardi, till he came, passing through Zadracarta (Asterabad), to Parthia and thence to Aria. In these farther provinces of Iran the Macedonian invader had for the first time to encounter a serious national opposition, for in the west the Iranian rule had been merely the supremacy of an alien power over native populations indifferent or hostile. Here the ruling race was at home. In Asia, Alexander learnt that Bessus had taken the diadem as Darius's successor in Bactria, but so soon as he marched against him Aria rose in his rear, and Alexander had to return in haste to subdue the revolt. Nor did he, when this was accomplished, again strike directly at Bactria, but made a wide turning movement through Seistan over Kandahar into the Kabul valley. It was on the way, in Seistan at Prophthasia (mod. *Farrah?*), that the alienation between Alexander and his Macedonian followers, which becomes sensible in the latter part of his career, first showed itself in an ugly form. Alexander had come to merge the characters of Macedonian king and Hellenic captain-general, with which he had set out, in that of Oriental despot (Spieker, *Hof u. Hofordnung Al. d. Gr.*, 1904).

He wore on occasions of state the Persian dress. (According to pseudo-Plutarch, *de fort. Al. i. 8*, it was the simpler *Persian* dress, not the Median.) A discontent began to work among the Macedonians, and at Prophthasia the commander of the Macedonian cavalry, Philotas, the son of Parmenio, and certain others were arraigned before the army on the charge of conspiring against the king's life. They were condemned and put to death. Not satisfied with procuring this, Alexander had Parmenio himself, who had been left in command in Media, put to death by secret orders. It is perhaps the worst crime, because the most cold-blooded and ungenerous, which can be laid to his charge. By the winter of 329-328 Alexander had reached the Kabul valley at the foot of the Paropamisadae (Hindu Kush).

The ordinarily received chronology makes Alexander reach the Kabul valley in the winter of 330-329. That to fit the actions and distances covered by Alexander into such a scheme, assuming that he went by Seistan and Kandahar, would involve physical impossibilities has been pointed out by Count Yorck v. Wartenburg and D. G. Hogarth.

Northern India.—In the spring of 328 Alexander crossed the Hindu Kush into Bactria and followed the retreat of Bessus across the Oxus and into Sogdiana (Bokhara). Here Bessus was at last caught and treated with the barbaric cruelty which the rule of the old Persian monarchy prescribed for rebels. Till the spring of 327 Alexander was moving to and fro in Bactria and Sogdiana, beating down the recurrent rebellions and planting Greek cities. Just as in 335 he had crossed the Danube, so he now made one raid across the frontier river, the Jaxartes (Sir Daria), to teach the fear of his name to the outlying peoples of the steppe (summer 328). And meanwhile the rift between Alexander and his European followers continued to show itself in dark incidents—the murder of Clitus at Maracanda (Samarkand), when Alexander struck down an old friend, both being hot with wine; the claim that Alexander should be approached with prostration (*proskynesis*), opposed somewhat strangely by the philosopher Callisthenes, Aristotle's nephew, who had come in the king's train and embroidered his history of the campaign with gross flatteries; the conspiracy of the pages in Bactria, which was made an occasion for putting Callisthenes to death. It was now that Alexander completed the conquest of the provinces north of the Hindu Kush by the reduction of the last mountain strongholds of the native princes. In one of them he captured Roxana, the daughter of Oxyartes, whom he made his wife. Before the summer of 327 he had once more crossed the Hindu Kush on his way to India (for the campaigns in the north-east see F. von Schwarz, *Alex. d. Grossen Feldzüge in Turkestan*, v. 1893).

Whilst the heavier troops moved down the Kabul valley to Peucelaotis (Chârsadda) under Perdicas and Hephaestion, Alexander with a body of lighter-armed troops and cavalry pushed up the valleys which join the Kabul from the north—through the regions now known as Bajour, Swat and Buner, inhabited by Indian hill peoples, as fierce then against the western intruder as their Pathan successors are against the British columns. The books give a number of their "cities" reduced by Alexander—walled mountain villages which can in some cases be identified more or less certainly with places where the clans are established to-day. The crowning exploit was the reduction of Aornus,¹ a stronghold perched on a precipitous summit above the Indus, which it was said that Heracles had failed to take. How much of the story of Alexander's discovery of the sacred mountain of the Nysa and the traces of Dionysus is due to the invention of Aristobulus and Clitarchus (Arrian did not find it in Ptolemy) we cannot say. Meantime Perdicas and Hephaestion had built a bridge over the Indus, and by this in the spring of 326 Alexander passed into the Punjab (at Ohind, 16m. above Attock, according to Foucher, *Notes sur la géogr. anc. du Gandhâra*, 1902). The country into which he came was dominated by three principalities, that of Ambhi (Gr. *Omphis*, Curt. viii. 12. 6) between the Indus and the Hydaspes (*Jhelum*, *Jehlam*), centred in the great city of Takkasila (Gr. *Taxila*), that of the Paurava rajah (Gr. *Porus*) be-

¹Sir Aurel Stein believes that he has discovered Aornus; see *Geographical Journal*, vol. 70, No. 6, pp. 515-540, 1927.

tween the Hydaspes and Acesines (*Chenab*), and that of Abhisara (Gr. *Abisares*) between the same two rivers higher up, on the confines of Kashmir (Stein, *Rajatarangini*, transl. bk. i. 180, v. 217). The king of Taxila and Porus were at enmity, and for this cause the invader could reckon upon Omphis as a firm ally. Porus was prepared to contest the passage of the Hydaspes with all his strength. Abisares preferred to play a double game and wait upon events. Alexander reached the Hydaspes shortly before the rains broke, when the river was already swollen. Porus held the opposite bank with a powerful army, including 200 elephants. Alexander succeeded in taking a part of his forces across the river higher up during a night of torrential rain, and then he fought the fourth and last of his pitched battles in Asia, the one which put to proof more shrewdly than any of the others the quality of the Macedonian army as an instrument of war, and yet again emerged victorious. Porus fell sorely wounded into his hands.¹ Porus had saved his honour, and now Alexander tried, and not in vain, to gain him as a friend. When he continued his progress eastwards across the Acesines, Porus was an active ally. Alexander moved along close under the hills. After crossing the *Hydraotes* (*Ravi*) he once more came into contact with hostile tribes, and the work of storming petty towns began again. Then the *Hyphasis* (*Beas*) was reached, and here the Macedonian army refused to go any farther. It was a bitter mortification to Alexander, who probably believed that he had not much farther to go to reach the ocean and the eastern limit of the inhabited world. For three days the will of king and people were locked in antagonism; then Alexander gave way; the long eastward movement was ended; the return began.

The Return.—Alexander left the conquered portion of India east of the Indus to be governed under Porus, Omphis of Taxila, and Abisares, the country west of the Indus under Macedonian governors, and set out to explore the great river to its mouth (for the organization of the Indian provinces, see especially Niese, vol. i., pp. 500). The fleet prepared on the Hydaspes sailed in Nov. 326, while a land army moved along the bank. The confluence of the Hydaspes and Acesines passed, the Macedonians were once more in a region of hostile tribes with towns to be stormed. It was at one of these, a town of the Malli, that a memorable incident occurred, such as characterized the personality of Alexander for all succeeding time. He leapt from the wall with only three companions into the hostile town, and, before the army behind him could effect an entrance, lay wounded almost to death.² He recovered and beat down the resistance of the tribes, leaving them annexed to the Macedonian satrapy west of the Indus. Below the confluence of the Punjab rivers into the single stream of the Indus the territory of loose tribes was succeeded by another group of regular principalities, under the rajahs called by the Greeks *Musicanus*, *Oxycanus* and *Sambus*. These opposed a national resistance to the Macedonians, the fires of which were fanned by the Brahmins, but still the strong arm of the western people prevailed. The rajah of Patala at the apex of the Indus delta abandoned his country and fled. It was the high summer of 325 when Alexander reached Patala. From there he explored both arms of the delta to the ocean, now seen by the Macedonians for the first time. He had determined that the Indus fleet should be used to explore this new world and try to find a waterway between the Indus and the Persian Gulf. A great part of the land-forces had been already sent off under Craterus in the earlier summer to return west by Kandahar and Seistan; the fleet was to sail under the Greek Nearchus from the Indus mouth with the winter monsoon; Alexander himself with the rest of the land-forces set out in Sept. 325, to go by the coast of Baluchistan, through the appalling sand-wastes of the Mekran.³

¹Beside V. Smith (cited below) see Schubert, "Die Porusschlacht," in *Rhein. Mus.* lvi., 1901, p. 543.

²There seems nothing to fix the exact spot of this town; the common identification with Multan is, according to Raverty and V. Smith, certainly wrong.

³For the Indian campaigns of Alexander see especially McCrindle, *Invasion of India by Alexander the Great* (1896); Vincent A. Smith, *Early History of India* (1904), and the references there given to the researches of Sir T. H. Holdich, Raverty and Foucher; A. Anspach, *De Alex. Magni expedit. ind.* (1903).

He would seem to have kept down to the coast until the headland of Ras Malan was reached, scattering before him the bands of Arabitae and Oritae who were the inhabitants of this well-provisioned tract. For the 150 miles between Ras Malan and Pasni, Alexander was compelled by the natural barriers to march inland, and it was here that his troops sank under the horrors of heat and thirst and sand. The coast once regained, the way was easy; no such desert had to be traversed, when Alexander again struck inland for the chief city of the Gedrosians (*Pura*), and thence made his way into Carmania. Here the spent troops rested; here the army of Craterus joined them, and Nearchus came to announce his safe arrival at the entrance of the Persian gulf.¹

The machine of empire had not functioned altogether smoothly while the king had been absent, and on Alexander's reappearance many incapables and rogues in high office had to be replaced by better men. In Carmania, in Persis, complaints from the provinces continued to reach him, as well as the news of disorders in Macedonia and Greece. New orders and appointments served to bring the empire into hand again, and at Susa in the spring of 324 Alexander rested, the task of conquering and compassing the Achaemenian realm achieved. The task of its internal reorganization now began to occupy him—changes, for instance, in the military system which tended to assimilate Macedonians and Orientals. The same policy of fusion was furthered by the great marriage festival at Susa, when Alexander took two more wives from the Persian royal house, married a number of his generals to Oriental princesses, and even induced as many as he could of the rank-and-file to take Asiatic wives. This policy did not allay the discontent of the Macedonian army, and when Alexander in the summer of 324 moved to the cooler region of Media, an actual mutiny of the Macedonians broke out on the way at Opis on the Tigris. It was occasioned by the discharge of the Macedonian veterans, and only the personal magnetism of Alexander and his threat to entrust himself altogether to the Orientals availed to quell it. At Ecbatana the death of Hephaestion for a time plunged Alexander into a passion of mourning. But by the winter (324-323) he was again active, bringing the hill-tribes on the south-west border of Media, the Cossaei, into subjection. In the spring of 323 he moved down to Babylon, receiving on the way embassies from lands as far as the confines of the known world, for the eyes of all nations were now turned with fear or wonder to the figure which had appeared with so superhuman an effect upon the world's stage. The embassy from Rome, however, is almost certainly a later, and an inevitable, invention. The exploration of the waterways round about the empire was Alexander's immediate concern, the discovery of the presumed connection of the Caspian with the Northern Ocean, the opening of a maritime route from Babylon to Egypt round Arabia. The latter enterprise Alexander designed to conduct in person; under his supervision was prepared in Babylon an immense fleet, a great basin dug out to contain 1,000 ships, and the water-communications of Babylonia taken in hand. Innovations were carried out in the tactical system of the army which were to modify considerably the methods of future battle-fields. At last all was ready; the 20th of the month Daesius (? June 5) was fixed for the king's setting forth. On the 15th and 16th Alexander caroused deep into the night at the house of the favourite Medius. On the 17th he developed fever; for a time he treated it as a momentary impediment to the expedition; but on the 27th his speech was gone, and the Macedonian army was suffered to pass, man by man, through his chamber to bid him farewell. On the 28th (June 13) Alexander died.²

His son by Roxana, the so-called ALEXANDER "AEGUS," was born a few months later. He and his uncle Philip, as joint kings, were placed under the guardianship of Perdikkas, Peithon and Antipater in succession. After the death of Antipater (319) Roxana fled with him to Epirus, and was afterwards taken back to Macedonia.

¹Tomaschek, "Topographische Erläuterung der Küstenfahrt Nearchs" in the *Sitzungsberichte der kaiserl. Akad. d. Wissensch.* of Vienna, (*Philosoph.-histor. Klasse*, vol. cxxi.); Major P. M. Sykes, *Ten Thousand Miles in Persia* (1902), pp. 166 et seq.

²For Alexander's funeral see F. Jacoby in *Rhein. Mus.* (1903), pp. 461 et seq.

donia, together with Olympias, by Polyperchon. All three fell into the hands of Cassander; Alexander and his mother were put to death in 310–309 by order of Cassander (*Justin* xiv. 6, xv. 2). The meaningless surname of *Aegus*, still given in some books to this Alexander, is perhaps derived from a modern misreading of the text of the Astronomical Canon, ΑΙΦΟΤ for ΑΑΑΟΤ.

Character and Policy.—Alexander the Great is one of the instances of the vanity of appealing from contemporary disputes to “the verdict of posterity”; his character and his policy are estimated to-day as variously as ever. Certain features—the high physical courage, the impulsive energy, the fervid imagination—stand out clear; beyond that disagreement begins. That he was a great master of war is admitted by most of those who judge his character unfavourably, but even this has been seriously questioned (*e.g.*, by Beloch, *Griech. Gesch.* iii. [i.], p. 66). There is a dispute as to his real designs. That he aimed at conquering the whole world and demanded to be worshipped as a god is the traditional view. Droysen denies the former, and Niese maintains that his ambition was limited by the bounds of the Persian empire and that the claim to divine honours is fabulous (*Historische Zeitsch.*, lxxix., 1897, 1 f.). It is true that our best authority, Arrian, fails to substantiate the traditional view satisfactorily; on the other hand those who maintain it urge that Arrian's interests were mainly military, and that the other authorities, if inferior in trustworthiness, are more complete in range of vision. Of those, again, who maintain the traditional view, some, like Niebuhr and Grote, regard it as convicting Alexander of mad ambition and vainglory; whilst to Kaerst, Alexander only incorporates ideas which were the timely fruit of a long historical development. The policy of fusing Greeks and Orientals again is diversely judged. To Droysen and Kaerst it accords with the historical conditions; to W. W. Tarn, whose chapters in the *Cambridge Modern History*, vol. vi., give an able survey of Alexander's career in the light of the most recent studies, it was one of Alexander's great contributions to history; to Grote and to Beloch it is a betrayal of the prerogative of Hellenism.

Some notion of the personal appearance of Alexander may be got from the literature and the surviving monuments. He is described as of an athletic frame, though not taller than the common, and a white and ruddy complexion. The expression of his eyes had something “liquid and melting” (τῶν ὀμμάτων τὴν διάχυσιν καὶ ὑγρότητα) and the hair which stood up over his forehead gave the suggestion of a lion. He had a way of carrying his head somewhat aslant. (See especially *Plut. Alex.* 4; *de Alex. fort.* ii. 2.) The greatest masters of the time executed portraits of him, Lysippus in sculpture, Apelles in painting and Pyrgoteles in graven gems. Among surviving monuments, we have no completely certified portraits except the Tivoli herm (now in the Louvre) and the coins struck by his successors. The herm is a dry work and the head upon the coins shows various degrees of idealization. There are, however, a considerable number of works which can make out a better or worse claim either to be portraits of Alexander or to reproduce his type, and a large field of discussion is therefore open as to their values and classification (*F. Kopp, Über das Bildnis Alexanders d. Grossen* [1892]; *K. J. Ujfalvy, Le Type physique d'Alexandre le Grand* [1902]; *T. Schreiber, Studien über das Bildnis Alexanders d. Grossen* [1903]; *J. J. Bernoulli, Die erhaltenen Darstellungen Alexanders d. Grossen* [1905]). Alexander shaved clean, and set the fashion in this respect for the Graeco-Roman world for the next 500 years.

The campaigns and life of Alexander did not lack contemporary historians, some of them eye-witnesses and even associates. They included the philosopher Callisthenes, put to death by Alexander in 327, whose history went up to the death of Darius, Alexander's general Ptolemy, afterwards king in Egypt; Nearchus, who commanded the fleet that sailed from the Indus to the Persian Gulf; Onesicritus, who served as pilot in the same fleet, and Aristobulus who was with Alexander in India. Clitarchus, whose highly coloured version of the life of Alexander became the popular authority for succeeding generations, is now believed to have written in the 3rd century A.D. Besides the historical narrative, there were works mainly geographical or topographical left by persons like Baeton and Diognetus, whom Alexander had employed (as *ἡγεμόνας*) to survey the roads over which he passed. All such original sources have now perished. The fragments are collected in the Didot edition of Arrian by Karl Müller. Not reckoning

scattered notices, we depend principally upon five later compositions, Diodorus, book xvii. (c. 20 B.C.), the work of Quintus Curtius (c. A.D. 42), Plutarch's (c. A.D. 45–125) *Life of Alexander*, Arrian's *Anabasis* and *Indica* (c. A.D. 150), and the relevant books of Justin's abridgement (2nd cent. A.D.) of the history of Troguus (c. 10 B.C.?). To these we may add the Latin *Itinerarium Alexandri*, a skeleton outline of Alexander's campaigns dedicated to the Emperor Constantius (A.D. 324–361), printed at the end of the Didot edition of Arrian, and the *Epitome Rerum Gestarum Alexandri magni*, an abridgement made in the 4th or 5th century of a lost Latin work of uncertain date, combining history with elements taken from the *Romance* (edited by O. Wagner, Leipzig, 1900). The relation of these works to the various original sources constitutes the critical problem before the modern historian in reference to the history of Alexander. A bibliography of modern literature bearing on Alexander will be found connected with Mr. W. W. Tarn's chapters in the *Cambridge Ancient History*, vol. vi. (E. R. B.)

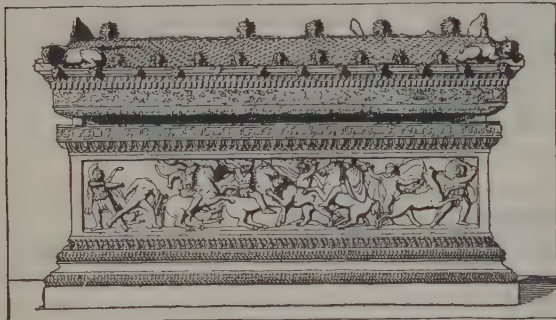
THE ROMANCE OF ALEXANDER

The figure of Alexander naturally impressed itself upon the imagination of the world which his career had shaken. The romance of Alexander is found written in the languages of nearly all peoples from the Indian Ocean to the Atlantic, but all these versions are derived, mediately or immediately, from the Greek original which circulated under the false name of Callisthenes. The Greek pseudo-Callisthenes (otherwise *Aisopos*) we possess in three recensions, based all upon a book produced in Egypt in the 2nd century A.D. But this book itself was a farrago of heterogeneous elements—pieces of genuine history, ancient stories once told in Babylon of Gilgamesh or Etanna; literary forgeries of the days soon after Alexander, like the oldest part of the “Testament of Alexander,” and variations according to the bent of different times and peoples. In the Persian version Alexander (*Iskander*) became a son of Darius; among the Mohammedans he turned into a prophet, hot against idols; the pen of Christian monks made him an ascetic saint.

The Alexander romance found its way into Europe through the Latin versions of the pseudo-Callisthenes, not from the more sober narrative of Quintus Curtius. The pseudo-Callisthenes, in a recension which has not been preserved, was translated into Latin by Julius Valerius about the end of the 3rd century, and an epitome of this translation, also in Latin, was made some time before the 9th century, and is introduced by Vincent de Beauvais into his *Speculum historiale*. The first book deals with his birth and early exploits. The trace of Alexandrian influence is to be found in the pretence that his actual father was Nectanebus, a fugitive king of Egypt. The latter was a great magician, able, by operating upon waxen figures of the armies and ships of his enemies, to obtain complete power over their real actions. Obligated, however, to flee to Pella in Macedonia, he established himself as an astrologer, and as such was consulted by the childless Olympias. Having promised that Zeus Ammon would visit her in the form of a dragon, he himself assumed the disguise. In due course Alexander was born, and Philip's suspicions were overcome by a second appearance of the dragon, which was held to prove the divine fatherhood. The child was small and somewhat deformed, but of great courage and intelligence. When he was twelve years old he was instructed in starcraft by Nectanebus, who was killed by a fall into a pit, into which he had been playfully pushed by Alexander. The first book also relates his conquests in Italy, Africa, Syria and Asia Minor; his return to Macedonia and the submission of Greece. The second book continues the history of his conquests, and the third contains the victory over Porus, the relations with the Brahmans, the letter to Aristotle on the wonders of India, the histories of Candace and the Amazons, the letter to Olympias on the marvels of Farther Asia and lastly the account of Alexander's death in Babylon.

The most widespread Latin version of the story, however, was the *Historia de proeliis*, printed at Strasbourg in 1486, which began to supersede the *Epitome* of Julius Valerius in general favour about the end of the 13th century. It is said to have been written in the 10th century by the Neapolitan arch-presbyter Leo. Auxiliary sources for the mediaeval romance-writers were: the opusculum (4th century) known as *Alexandri magni iter ad Paradisum*, a fable of Eastern origin directed against ambition;

the *Itinerarium Alexandri* (340), based partly on Julius Valerius and dedicated to Constans, son of the emperor Constantine; the letter of Alexander to Aristotle (*Epist. de situ et mirabilibus Indiae*) and the correspondence between Alexander and the king of the Brahmins, Dindimus, both of which are often contained in mss. of the *Epitome*; and the treatise (based on a lost history of Alexander by Onesicritus), *De gentibus Indiae et Bragmanibus*,



THE CENOTAPH OF ALEXANDER THE GREAT AT CONSTANTINOPLE

ascribed without certainty to Palladius (d. c. 430), successively bishop of Helenopolis and Aspona.

In the Ethiopic versions we find the Greek gods in the guise of Enoch, Elijah, etc., while Philip is a Christian martyr, and Alexander himself a great apostle, even a saint; quotations from the Bible are frequent. Syriac and Armenian versions were made in the 5th century. Persians and Arabs told the deeds of Iskander; and Firdousi made use of the story in the *Shāhnāma*. Another early Persian poet, Nizami, made the story specially his own. In the 11th century Simeon Seth, *protovestiarius* at the Byzantine court, translated the fabulous history from the Persian back into Greek.

The Alexander legend was the theme of poetry in all European languages; six or seven German poets dealt with the subject, and it may be read in French, English, Spanish, Danish, Swedish, Icelandic, Flemish and Bohemian.

French.—The principal extant French romances based on the Alexander legend are: (1) A fragment by Alberic of Besançon (more properly Briançon), 11th century; (2) *Li romans d'Alexandre*, 12th century, by Alexandre de Bernai and other poets, in rhymed verse; (3) *l'Histoire du noble et vaillant roy Alixandre le Grant* (1506), a prose romance taken from the *Historia de proeliis*; and the *Alexandreis* (c.1180) of Gaultier de l'Isle or de Châtellon, a Latin poem based on Quintus Curtius.

English Versions.—The letter from Alexander to Aristotle and his correspondence with Dindimus are found in Early English versions dating from the 11th century. The Monk in Chaucer's *Canterbury Tales* prefaces his account of Alexander with the statement that his story is so common—

That every wight that hath discrecioun
Hath herd somewhat or all of his fortune.

There exist fragments of an English alliterative romance on the subject written in the west midland dialect, dating from the second half of the 14th century. Another alliterative poem in the northern dialect, of 15th-century origin, is based on the *Historia de proeliis*. Earlier than any of these is the rhyming *Lyfe of Alisaunder* (c. 1330), which is printed in H. Weber's *Metrical Romances* (vol. i., 1810). The *Scots Buik of the most noble and vailyeand Conqueror Alexander the Great*, printed by Alexander Arbuthnot (d. 1585) about 1580, reprinted in 1831 for the Bannatyne Club, contains three episodes of the cycle, the "Forray of Gadderis" (not taken from the *Fuerre de Gadres*, but from the *Assaut de Tyr* in the *Romans d'Alexandre*), "The Avowes of Alexander" and "The Great Battell of Efesuson," taken from the *Voeux du paon*. A *Buke of the Conqueror Alexander the Great* by Sir Gilbert Hay (fl. 1456) is in ms. at Taysmouth Castle.

BIBLIOGRAPHY.—The best sketch of the Alexander romance literature is by Paul Meyer, *Alexandre le grand dans la littérature française*

au moyen âge (1886). The first volume contains some French texts, and the second a detailed discussion of the various versions from the pseudo-Callisthenes downwards. See also J. Zacher, *Pseudo-Callisthenes, Forschungen zur . . . Alexandersage* (Halle, 1867), and for Oriental versions, T. Nöldeke, "Beiträge zur Geschichte des Alexanderromans" (*Denkschriften der ksl. Akad. d. Wissenschaften, Phil.-hist. Klasse*, vol. 38: Vienna, 1890). For early printed versions see Brunet, *Manuel du libraire*, s.v. "Alexandre."

The text of the pseudo-Callisthenes was edited by C. W. Müller from three mss. in the Bibl. Nat. and printed in the Arrian of the Coll. Didot (Paris, 1846), and by H. Meusel (Leipzig, 1871) from a Leyden ms. A. Mai ed. Julius Valerius (Milan, 1817). *Itinerarium Alexandri* (Class. Auct. vol. vii.; Milan, 1835); J. Zacher, *Alex. iter ad Paradisum* (Regensburg, 1859); and the *Epitome* (Halle, 1867); the Oxford ms. of the *Epitome* was edited by G. Cilli (Strasbourg, 1905); G. Landgraf, *Die "Vita Alexandri" . . . des Archpresbyter Leo (Historia de proeliis)* (Erlangen, 1885); Alexander's letter to Aristotle and his correspondence with Dindimus are included in the Teubner edition of Julius Valerius (ed. B. Kübler, Leipzig, 1888). A newly discovered anonymous *Epitome* was edited by O. Wagner (Leipzig, 1900).

The fragment by Alberic was edited by P. Heyse (Berlin, 1856); Lamprecht's German text by H. Weissmann (Frankfurt, 1850) and by C. Kinzel (Halle, 1884); the *Alexandreis* of Gaultier de Lille, by F. A. Müldener (Leipzig, 1863); an Icelandic prose version (c. 1250) of the same, *Alexanders Saga*, by C. R. Unger (Christiania, 1848); *Li Romans d'Alexandre*, by H. Michelant (Stuttgart, 1846); the Ethiopic version by E. A. T. Wallis Budge (1896, with English translation); the Syriac text of pseudo-Callisthenes by Budge (Cambridge, 1880).

Besides the English editions quoted in the text, the alliterative English poems were partially edited by J. Stevenson for the Roxburghe Club (1849). There is a great deal of information on the various texts in H. L. Wood's *Catalogue of Romances in the British Museum* (1883, vol. i., pp. 94 et seq.). Among other works see E. Rohde, *Der griechische Roman* (2nd ed., Leipzig, 1900); F. Kampers, "Alex. d. Grosse und die Idee des Weltimperiums in Prophetie und Sage" (in H. Granert's *Studien*, etc., Freiburg, 1901); Adolf Ausfeld, *Der griechische Alexanderroman* (Leipzig, 1907), edited after the author's death by W. Kroll. (X.)

ALEXANDER (1461–1506), king of Poland, succeeded his brother John Albert in 1501. He carried on the hopeless struggle of the crown against the growing power of the Polish senate and nobles, who deprived him of financial control and curtailed his prerogative. For want of funds, Alexander was unable to assist the Grand Master of the Order of the Sword against Muscovite aggression, or prevent Tsar Ivan III. from ravaging Lithuania with the Tartars. The utmost the king could do was to garrison Smolensk and other fortresses and employ his wife Helena, the tsar's daughter, to mediate a truce between his father-in-law and himself. Only the death of Stephen, the great hospodar of Moldavia, enabled Poland still to hold her own on the Danube. The liberality of Pope Julius II., who granted Alexander Peter's Pence and other financial help, enabled the Polish king to restrain somewhat the arrogance of the Teutonic Order in the Prussian provinces. Alexander died on Aug. 5, 1506.

See V. Czerny, *The Reigns of John Albert and Alexander Jagiello* (Pol.) (Cracow, 1882).

ALEXANDER I. (c. 1078–1124), king of Scotland, was the fourth son of Malcolm Canmore by his wife Margaret. On the death of his brother Edgar in 1107 he became king of Scotland north of the Forth and Clyde, southern Scotland being reserved for his brother David. He founded many abbeys and bishoprics, among them Inchcolm and Scone. He died April 27, 1124 (see *SCOTLAND, History*).

ALEXANDER II. (1198–1249), king of Scotland, son of William the Lion, whom he succeeded in 1214. He joined the English barons in their struggle against King John, marched into England and besieged Norham Castle in 1215. In 1217 he again invaded England but eventually made peace with Henry III., and the understanding was strengthened by his marriage with Henry's sister, Joanna, in 1221.

Peace with England was broken over a claim by Henry for homage from the Scottish king, and again by a threat of invasion in 1243, but both disputes were amicably settled. Alexander attempted to reduce the Western Isles, which were dependent on Norway, as he had already reduced Argyll, but while on an expedition for the purpose he died at Kerrera July 8, 1249.

ALEXANDER III. (1241–1285), king of Scotland, son of Alexander II. by his second wife Mary de Coucy, succeeded to

the throne in 1249, at the age of eight. The years of his minority were marked by an embittered struggle for the control of affairs between two rival parties, the one led by Walter Comyn, earl of Menteith, the other by Alan Durward, the justiciar. At the marriage of Alexander to Margaret of England in 1251, Henry III. seized the opportunity to demand from his son-in-law homage for the Scottish kingdom, but the claim was refused.

On attaining his majority, Alexander laid formal claim before the Norwegian king Haakon for sovereignty over the Hebrides, where Scandinavians had settled since the 9th century. Haakon replied by a formidable expedition in 1263. Sailing round the west coast of Scotland he halted off Arran, where negotiations were opened. These were prolonged by Alexander until the autumn storms should begin. At length Haakon attacked only to encounter a terrific storm which greatly damaged his ships. The battle of Largs (Oct. 12, 1263) was indecisive. But even so Haakon's position was hopeless. Baffled he turned homewards, but died on the way.

In 1266 Haakon's successor concluded a treaty by which the Isle of Man and the Western Isles were ceded to Scotland in return for a sum of 4,000 marks in four yearly payments, Orkney and Shetland alone being retained for Norway. The marriage of Alexander's daughter, Margaret, to Eric, son of King Magnus, was also agreed. Towards the end of Alexander's reign, the death of all his three children within a few years made the question of the succession one of pressing importance.

In 1284 he induced the Estates to recognize as his heir-presumptive his grand-daughter Margaret, the "Maid of Norway," and next year the desire for a male heir led him to contract a second marriage. Alexander was killed by a fall from his horse in the dark while riding to visit the queen at Kinghorn on March 16, 1285. The "Lament for Alisaunder," cited by Wynton, written in praise of Alexander III., is one of the earliest Scottish poems extant.

ALEXANDER (ALEXANDER OBRENOVICH) (1876-1903), king of Serbia, was born on Aug. 14, 1876. On March 6, 1889, his father, King Milan, abdicated and proclaimed him king of Serbia under a regency until he should attain his majority at 18 years of age. King Alexander, on April 13, 1893, being then in his 17th year, proclaimed himself of full age, and took the royal authority into his own hands. His action was popular, and was rendered still more so by his appointment of a radical ministry.

In May 1894 King Alexander abolished the liberal constitution of 1889 and restored the conservative one of 1869. His attitude during the Turco-Greek war of 1897 was one of strict neutrality. In 1898 he appointed his father commander-in-chief of the Serbian Army, and from that time, or rather from his return to Serbia in 1894 until 1900, ex-King Milan was regarded as the *de facto* ruler of the country. But while, during the summer of 1900, Milan was at Carlsbad making arrangements to secure the hand of a German princess for his son, King Alexander suddenly announced his engagement to Mme. Draga Mashin, a widow, formerly a lady-in-waiting to Queen Natalie. Ex-King Milan gave up his post, the government resigned, and King Alexander had great difficulty in forming a new cabinet. But the Tsar Nicholas congratulated the king on his engagement and agreed to act as principal witness at the wedding. The marriage was celebrated on Aug. 5, 1900.

Alexander tried to reconcile political parties by granting on his own initiative a liberal constitution (April 6, 1901), introducing for the first time in the constitutional history of Serbia the system of two chambers (*skupština* and senate). This did not reconcile the army, which was alarmed by the rumour that one of the

two unpopular brothers of Queen Draga, Lieut. Nicodiye, was to be proclaimed heir-apparent. Meanwhile Alexander suspended (March 1903) the constitution for half an hour, time enough to publish the decrees by which the old senators and councillors of state were dismissed and replaced by new ones. This arbitrary act naturally increased the general discontent. It was thought that with a packed senate and a large government majority in the *skupština* King Alexander would not hesitate any longer to proclaim Queen Draga's brother as the heir to the throne. Ostensibly to prevent this, but in reality to replace Alexander Obrenovich by Peter Karagjorgjević, a military conspiracy was organized. The conspirators penetrated into the palace and savagely murdered King Alexander and Queen Draga in the early morning of June 11, 1903. (See SERBIA: *History*.)

ALEXANDER I., king of the Serbs, Croats and Slovenes (1888-1934), was born at Cetinje on Dec. 4, 1888, the second son of Prince Peter Karagjorgjević, later king of Serbia, and of Zorka, third daughter of Prince Nicholas of Montenegro. His mother died in 1890, and during his early years he shared the exile of his father at Geneva. In 1899 he was sent to St. Petersburg (Leningrad) to be educated, and in 1904 entered the *corps des pages* at the tsar's court. It was not till 1909, nearly six years after his father's election to the Serbian throne, that the young prince came to reside permanently in Serbia. Soon after his return his elder brother, Prince George, was obliged to renounce the succession (March 1909), owing to his unbalanced temperament, and various incidents that occurred during the Bosnian crisis; and Alexander was thereupon formally recognized as crown prince. On the outbreak of the Balkan war (1912) he assumed nominal command of the 1st Army and won his spurs at the battle of Kumanovo, subsequently serving with distinction in the campaigns against Turkey and Bulgaria.

On June 24, 1914 King Peter, whose health had completely broken down, appointed him prince regent, and he thus held the position of commander-in-chief when the World War broke out. He remained permanently at army headquarters, and shared with his soldiers all the privations of the retreat through Albania. On reaching the coast he fell ill and underwent a serious operation, but when already convalescent resolutely declined the proffered assistance of an Italian destroyer which had been sent to convey him across the Adriatic; he remained till all the refugees had been transported into safety, and eventually found his way on foot to Durazzo. After the exiled Serbian Government had established itself at Corfu, Prince Alexander and M. Pašić paid visits to Paris and London, where the prince was received with warm ovations. On April 5, 1916, on receiving an important deputation of British sympathizers (led by the archbishop of Canterbury, the lord mayor, Lord Milner and Sir Edward Carson), he publicly identified the dynasty with the cause of unity, expressing his conviction that in the final victory "our Yugoslav people, united in a single state, will have their part."

During the rest of the War he remained at Serbian headquarters and shared his army's victorious advance in Oct. 1918. On Dec. 1 delegates of the Yugoslav National Council in Zagreb formally recognized him as regent in all the Yugoslav provinces of the former dual monarchy, and he assumed the title of "prince-regent of the Serbs, Croats and Slovenes." The attempt made upon his life on June 29, 1921, after he had taken the oath the previous day to the new Yugoslav constitution, was the outcome, not of any personal unpopularity, but of the subversive aims of the Communists and other revolutionary groups, who hoped to create confusion in the new state, owing to the lack of a direct heir to the throne. On Aug. 16, 1921 Prince Alexander succeeded his father as king of Yugoslavia. On June 8, 1922 he married Marie, second daughter of King Ferdinand of Rumania, and on Sept. 6, 1923 an heir was born, who received the name of Peter, a second son being called after Tomislav, the first Croatian king.

King Alexander inherited from his father a respect for constitutional and parliamentary traditions, which was conspicuously lacking in his predecessors of the Obrenović dynasty;



FROM TYTLER, "SCOTTISH WORTHIES"
OBVERSE SIDE OF THE GREAT SEAL
OF ALEXANDER III., KING OF SCOT-
LAND, HONOURED BY HIS PEOPLE
AS THE LAST OF THE "KINGS OF
PEACE"

and his influence was repeatedly exercised behind the scenes to smooth down the acerbities of party strife. He was largely responsible for the reconciliation in 1925 between the Serbian Radicals under M. Pašić and the Croat Peasant party under M. Radić. On Oct. 9, 1934, while visiting France, King Alexander, together with M. Barthou, the French foreign minister, was killed by a Croat assassin at Marseilles. See YUGOSLAVIA. (R. W. S.-W.)

ALEXANDER (ALEXANDER OF BATTENBERG) (1857-1893), first prince of Bulgaria, born on April 5, 1857, was the second son of Prince Alexander of Hesse and the Rhine by hismorganatic marriage with Julia, Countess von Hauke, who received the title of princess of Battenberg. Prince Alexander was nephew of the Tsar Alexander II., who had married a sister of Prince Alexander of Hesse. In his boyhood and early youth he was frequently at St. Petersburg (now Leningrad), and he accompanied his uncle during the Bulgarian campaign of 1877. When Bulgaria under the Berlin Treaty was constituted an autonomous principality under the suzerainty of Turkey, Prince Alexander was elected prince of Bulgaria at the instance of the tsar. He was at that time serving in the guards at Potsdam. He travelled to Bulgaria via St. Petersburg, and took the oath to the new constitution at Trnovo on July 8, 1879. The new ruler was 22 years of age, and chose his advisers at first from the Russophil conservative side, and, finding the liberals irreconcilable, he suddenly (May 9, 1881) issued a proclamation demanding absolute power for himself for seven years and appointing a Russian general, Ernroth, as head of the administration. This edict was ratified by a Grand Sobranje summoned for the purpose. But Alexander found himself in reality under the tutelage of two Russian generals, Soboleff and Alexander Kaulbars, sent from St. Petersburg. He chafed under the restraint, joined hands with his subjects, and restored the constitution (Sept. 18, 1883). The consequent breach with Russia was widened in 1885 when Alexander, who had been forewarned of the *coup d'état* at Philippopolis which deposed the governor-general of Eastern Rumelia and proclaimed union with Bulgaria, entered Philippopolis on Sept. 21 and assumed the government.

The tsar struck his nephew's name off the Russian army list, and recalled the Russian officers. Alexander strengthened his position by his brilliant defence against the Serbian invasion and the victory at Slivnitsa, Nov. 16-19, and the capture of Pirot. The sultan, in 1886, agreed that Alexander should be governor-general of Eastern Rumelia for five years. The Bulgarians would have liked a more explicit arrangement, and on the night of Aug. 20, 1886, the prince was kidnapped, compelled to abdicate, and handed over to the Russians. In a fortnight he was back at Sofia, but an abject telegram to the tsar had destroyed his prestige with his subjects, and the hostility of the tsar and of Bismarck drove him to abdicate in earnest on Sept. 8, 1886.

He spent the rest of his life principally at Graz, where he died on Oct. 23 1893.

See especially E. G. Costi, *Fürst Alexander von Battenberg* (2nd ed. Vienna, 1928); also Koch, *Fürst Alexander von Bulgarien* (Darmstadt, 1887; English translation, 1887); Matveyev, *Bulgarien nach dem Berliner Congress* (Petersburg, 1887); Bouchier, "Prince Alexander of Battenberg," in *Fortnightly Review*, Jan. 1894.

ALEXANDER, despot of Pherae in Thessaly from 369 to 358 B.C. His tyranny caused the Aleuadae of Larissa to invoke the aid of Alexander II. of Macedon, but after his withdrawal Alexander treated his subjects as cruelly as before. The Thessalians now applied to Thebes; Pelopidas, who was sent to their assistance, was treacherously thrown into prison (368), and it was necessary to send Epaminondas with a large army to secure his release. Alexander's conduct caused renewed intervention; in 364 he was defeated by the Thebans at Cynoscephalae, where Pelopidas fell. Alexander was at last compelled by Thebes to acknowledge the freedom of the Thessalian cities, to limit his rule to Pherae, and to join the Boeotian league. He was murdered by his wife's brother at her instigation.

ALEXANDER, son of Numenius, Greek rhetorician, flourished in the first half of the second century A.D., author of a treatise on rhetoric (*Περὶ τῶν τῆς διανοίας καὶ τῆς λέξεως σχημάτων*), of which only an abridgment is extant; it was fol-

lowed as an authority by later writers. Later epitomes were made in Latin by Aquila Romanus and Julius Rufinianus under the title *De Figuris Sententiarum et Elocutionis*.

Text in Spengel, *Rhetores Graeci* (1856).

ALEXANDER, DE ALVA STANWOOD (1845-1925), American lawyer and political historian, was born in Richmond, Me., on July 17, 1845. He enlisted in the Union army in 1862 and served until the end of the Civil War. Following his graduation at Bowdoin college, Brunswick, Me., in 1870, he was editor of the *Daily Gazette*, Ft. Wayne, Ind., in 1871-74, and was secretary of the Indiana Republican State committee in 1874-78. He was admitted to the bar and practised law in Indianapolis, Ind., from 1877 to 1881, served in the U.S. Treasury department from 1881 to 1885, and then resumed law practice in Buffalo, New York. Engaging in politics, he was elected Republican representative in Congress for seven consecutive terms, 1897-1911. He died in Buffalo, N.Y., on Jan. 29, 1925.

He published a valuable *Political History of the State of New York* (1906-09); *History and Procedure of the House of Representatives* (Boston, 1916) and *Four Famous New Yorkers* (1923), a continuation of his *Political History*.

ALEXANDER, SIR GEORGE (1858-1918), English actor, whose family name was Samson, was born in Reading on June 19, 1858, and died on March 16, 1918. He made his first appearance on the London stage as Caleb Decie in *Two Roses* in 1881 with Irving at the Lyceum. In 1891 he became manager of the St. James's theatre. There he produced a number of successful plays by Oscar Wilde, Pinero, C. Haddon Chambers, H. A. Jones, Alfred Sutro and others, he himself taking the leading rôles. Sir George Alexander was the type of the successful actor-manager on the London stage in the beginning of the 20th century. In 1907 he was elected a member of the London County Council as a municipal reformer. He received a K.C.B. in 1911.

ALEXANDER, SIR JAMES EDWARD (1803-1885), British general and traveller, was born on Oct. 16, 1803, and died on April 2, 1885. He was largely responsible for the preservation and transfer to England of the obelisk, Cleopatra's Needle, in 1877.

His varied experiences provided material for a large number of books, among which were *Travels from India to England* (1827); *Transatlantic Sketches* (1833); *An Expedition of Discovery into the Interior of Africa* (1838).

ALEXANDER, JEROME (1876-), American chemist, was born in New York city, on Dec. 21, 1876. He graduated in 1896 from the College of the City of New York from which in 1899 he received the degree of master of science. He was an official and chief chemist for various companies from 1896 until 1921, when he began individual practice as consulting chemist and engineer. In connection with this work he specialized in the chemistry of colloids and was an early investigator in America with the ultramicroscope. He published *Colloid Chemistry* (1919) and, in collaboration with numerous scientists, *Colloid Chemistry, Theoretical and Applied* (1926). In 1909 he translated Richard Zsigmondy's *Colloids and the Ultramicroscope*. His writings include also the sections "Glue and Gelatin" and "Colloid Chemistry" in Roger's *Industrial Chemistry* (1942), the article "Albuminoids or Scleroproteins" in Allen's *Commercial Organic Analysis* (1913), and the chapter "Colloid Chemistry" in Liddell's *Handbook for Chemical Engineers* (1920).

ALEXANDER, JOHN WHITE (1856-1915), American painter, was born in Allegheny (Pa.), Oct. 7, 1856. He was left an orphan when very young, became an illustrator for *Harper's Magazine*, studied in Europe, became a pupil of the Royal Academy at Munich, and also worked in Venice, in Holland and in Paris, where he attracted much attention by his exhibition at the Salon of two female portraits entitled "Gris" and "Noir." He became a member of the Société Nationale des Beaux Arts (Paris), of the National Academy of Design (New York), of which he was president 1909-15, of the International Society (London), and of the Vienna and Munich societies of painters. In 1901 he was made a Chevalier of the Legion of Honour. He

executed decorative panels for the Congressional library, Washington (D.C.), and a large decoration for the Carnegie institute, Pittsburgh (Pa.), and his works include numerous portraits and subject pictures. He died in New York June 1, 1915.

ALEXANDER, WILLIAM (1824-1911), Protestant archbishop of Armagh and primate of all Ireland, was born at Londonderry on April 13, 1824, and educated at Tonbridge school and Brasenose college, Oxford. He was made bishop of Derry and Raphoe in 1867, and was elevated to the primacy in 1896. His poems were collected in 1887 under the title of *St. Augustine's Holiday, and other Poems*.

His wife, CECILE FRANCES HUMPHREYS (1818-1895), wrote some tracts in connection with the Oxford movement, but is famous as the author of "Jesus calls us o'er the tumult," "There is a green hill far away," and other well-known hymns (nearly 400 in all). A collection of her verse was published in 1896.

ALEXANDER, WILLIAM LINDSAY (1808-1884), Scottish divine, born at Leith, Aug. 24, 1808, and died Dec. 20, 1884. Educated at St. Andrews and Edinburgh, he was classical tutor at the Blackburn Theological Academy (1827), minister of North College street church, Edinburgh (1834), editor of Kitto's *Biblical Encyclopaedia* (1861), a member of the committee appointed to revise the Old Testament (1870), and principal of the Edinburgh Theological Hall (1877).

ALEXANDER AETOLUS, of Pleuron in Aetolia, Greek poet and man of letters, flourished about 280 B.C. He was commissioned by Ptolemy Philadelphus to arrange the tragedies and satyric dramas in the library of Alexandria; in 276 he went to the court of Antigonus Gonatas, king of Macedonia. He was one of the Alexandrian tragic Pleiad. We know the title of only one of his plays (*Astragalistae*). He also wrote short epics, epigrams, and elegies, the considerable fragments of which show learning and eloquence.

Meineke, *Analecta Alexandrina* (1853); Bergk, *Poetae Lyrici Graeci*; Couat, *La Poésie alexandrine* (1882).

ALEXANDER BALAS (i.e., "lord"), a native of Smyrna of humble origin, gave himself out to be the son of Antiochus IV. Epiphanes and heir to the Syrian throne. His claims were recognized by the Roman senate. At first unsuccessful, he finally defeated the reigning king Demetrius Soter in 150 B.C. and made himself king. But in 146 Demetrius' son, with the help of Alexander's father-in-law, Ptolemy Philometor, defeated him in a pitched battle near Antioch in Syria. He fled for refuge to a Nabataean prince, who murdered him.

See 1 Maccab. 10 et seq.; Justin xxxv. 1 and 2; Josephus, *Antiq.* xiii. 2; Appian, *Syr.* 67; Polybius xxxiii. 14.

ALEXANDER CORNELIUS, Greek grammarian surnamed POLYHISTOR from his great learning, born at Miletus, became a Roman citizen in 82 B.C., after being taken prisoner in the Mithridatic war. Of the extant fragments of his works (which were mainly historical and geographical) (Mueller, *Fragmenta Historicorum Graecorum*, iii.), those relating to the Jews are important as containing quotations from lost Jewish authors.

ALEXANDER JOHN, FIRST PRINCE OF RUMANIA: see CUZA, ALEXANDER JOHN.

ALEXANDER NEVSKI (1220-1263), Russian hero and saint, grand duke of Vladimir, spent the early years of his life in constant warfare with the Germans, Swedes and Lithuanians, who sought to rescue Novgorod and Pskov from Russia. He is called Nevski from his victory over the Swedish general, Birger Jarl, on the banks of the Neva (July 15, 1240). Two years later his defeat of the knights of the Teutonic Order on Lake Peipus (April 5) compelled them to renounce their conquests. In 1252 the grand khan appointed Alexander grand-duke of Vladimir in place of his elder brother Andrew. Alexander thenceforth did his best to prevent any possible pretext for a new Tatar invasion. In 1262 he obtained a mitigation of the tribute, and the abolition of the military service hitherto rendered by the Russians to the Tatars. The Orthodox Church canonized Alexander for his services to his country.

See Sergyei Mikhailovich Solovev, *History of Russia* (Russ. 2d ed. 1897, vol. iii.).

ALEXANDER OF APHRODISIAS, pupil of Aristocles of Messene, Greek commentator on the writings of Aristotle, and styled, by way of pre-eminence, *ὁ ἐξηγητής* ("the expositor"), was a native of Aphrodisias in Caria. He came to Athens towards the end of the 2nd century A.D., became head of the Lyceum and lectured on peripatetic philosophy. The object of his work was to free the doctrine from the syncretism of Ammonius and to reproduce the pure doctrine of Aristotle. Commentaries by Alexander on the following works of Aristotle are still extant: *The Analytica Priora*, i.; the *Topica*; the *Meteorologica*; the *De Sensu*; and the *Metaphysica*, i-v., together with an abridgment of what he wrote on the remaining books of the *Metaphysica*. The most important of Alexander's other extant works are *On Fate*, in which he argues against the Stoic doctrine of necessity; and *On the Soul*, in which he contends that the undeveloped reason in man is material (*νοῦς ὁλικός*) and inseparable from the body. He argued strongly against the doctrine of immortality. He identified the active intellect (*νοῦς ποιητικός*), through whose agency the potential intellect in man becomes actual, with God.

Several of Alexander's works were published in the Aldine edition of Aristotle (Venice, 1495-98); his *De Fato* and *De Anima* were printed along with the works of Themistius at Venice (1534); the former work, which has been translated into Latin by Grotius and also by Schulthess, was edited by J. C. Orelli (Zürich, 1824); and his commentaries on the *Metaphysica* by H. Bonitz (Berlin, 1847). J. Nourisson has treated of his doctrine of fate, *De la liberté et du hasard* (Paris, 1870).

See PERIPATETICS (*ad fin.*); ALEXANDRISTS; POMPONAZZI, PIETRO; also A. Apelt, "Die Schrift d. Alex. v. Aphr.," *Philologus*, xlv. (1886); C. Ruelle, "Alex. d'Aphr. et le prétendu Alex. d'Alexandrie," *Rev. des études grecques*, v. (1892); E. Zeller's *Outlines of Gk. Phil.* (Eng. trans. ed. 1905, p. 296).

ALEXANDER OF HALES (ALEXANDER HALENSIS), known as DOCTOR IRREFRAGABILIS, was one of the first English scholars and theologians to make his influence felt in Paris. Born c. 1175 in Gloucestershire, he went to study at Paris, where he became a master of arts sometime before 1210. About 1231 he entered the Friars Minor, and after his appointment as the first *magister regens* of the chair of theology held by his order in the university became celebrated as a teacher. John of Rochelle, Bonaventura and probably Roger Bacon were among his pupils. He died in 1245. Roger Bacon tells us that Alexander's *Summa Theologiae* weighed more than a horse and was not entirely of his own composition. The latter statement is well substantiated, and pending publication of the critical edition which is being made by the Franciscans of Quaracchi little can be said with certainty about Alexander's theories. We know that he attempted to correlate the predominating Augustinianism of his day with the newly introduced philosophy of Aristotle and the Arabians, and apart from the doctrines that were common to the scholastics (see SCHOLASTICISM) we find in him theories that were to become characteristic of the Franciscan school. He admits the plurality of forms, the independence of body and soul, the existence of an intelligible matter or potency in all spiritual creatures, and the Augustinian theory of Divine Illumination in knowledge. Alexander's *Summa Theologiae* (best edition, Venice 1576) was extensively utilized by Albert the Great, St. Thomas, and St. Bonaventura.

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ALEXANDER OF TRALLES (ALEXANDER TRALLIANUS), Greek physician, born at Tralles in Lydia, lived probably about the middle of the 6th century B.C. The Greek text of his *Βιβλία ἱατρικὰ* was printed at Paris in 1548 and his *De Lumbicis* at Venice in 1570.

See E. Milward, *Trallianus Reviviscens* (1734); M. Neuberger, *History of Medicine* vol. i. (1910); T. C. Allbutt, *Greek Medicine in Rome* (1921).

ALEXANDER SEVERUS (MARCUS AURELIUS SEVERUS ALEXANDER) (208-235), Roman emperor from A.D. 222 to 235, was born at Arca Caesarea, in Phoenicia, on Oct. 1, 208. He was the son of an imperial procurator. In 221 his grandmother, Julia Maesa, persuaded her nephew, the emperor Heliogabalus, to adopt him as successor and create him Caesar. In the next year, on

March 11, Heliogabalus was murdered, and Alexander was proclaimed emperor by the Praetorians and accepted by the senate. He was then a mere lad, amiable, well-meaning, but entirely under the dominion of his mother, Julia Mamaea, who surrounded him with wise counsellors, but who alienated the army by extreme parsimony, while neither she nor her son had a strong enough hand to keep tight the reins of military discipline. Mutinies became frequent in all parts of the empire; to one of them the life of the jurist and praetorian praefect, Ulpian, was sacrificed; another compelled the retirement of Dio Cassius from his command. On the whole, however, the reign of Alexander was prosperous till he was summoned to the East to face the new power of the Sassanians (see PERSIA: History). Of the war that followed we have very various accounts; Mommsen leans to that which is least favourable to the Romans. At all events, though the Persians were checked for the time, the conduct of the Roman army showed an extraordinary lack of discipline. The emperor returned to Rome and celebrated a triumph (233), but next year he was called to face German invaders in Gaul, where he was slain (on March 18 or 19, 235), together with his mother, in a mutiny which was probably led by, Maximinus, a Thracian legionary, and at any rate secured him the throne. Alexander was the last of the Syrian princes. His advisers were the famous jurist, Ulpian, the historian, Dio Cassius, and a select board of 16 senators; a municipal council of 14 assisted the city praefect in administering the affairs of the 14 districts of Rome. The luxury and extravagance that had formerly been so prevalent at the court were put down; the standard of the coinage was raised; taxes were lightened; literature, art and science were encouraged; the lot of the soldiers was improved; and, for the convenience of the people, loan offices were instituted for lending money at a moderate rate of interest. In religious matters Alexander preserved an open mind. In his private chapel he had busts of Orpheus, Abraham, Apollonius of Tyana and Jesus Christ.

See Lampridius, *Alexander Severus*; Dio Cassius lxxviii. 30, lxxix. 17, lxxx. 1; Herodian vi. 1-18; Porraeth, *Der Kaiser Alex. Sev.* (1876); Pauly-Wissowa, *Realencyklopädie*, ii. 2,526 seq. (Groebe); monograph by Sir Richard Hopkins, *Cambridge Historical Essays*, No. xiv. (1907). A. von Domaszewski "Die Daten der Scriptorum historiae Augustae von Severus Alexander bis Carus," *Sitzungsberichte der Heidelberger Akademie der Wissenschaften* (1917) for a different chronology. K. Hönn, *Quellenuntersuchungen zu den Viten des Heliogabalus und des Severus Alexander* (1911).

ALEXANDER THE PAPHLAGONIAN, a celebrated impostor and worker of false oracles, was born at Abonouteichos (see INEBOLI) in Paphlagonia in the early part of the 2nd century A.D. The vivid narrative of his career given by Lucian might be taken as fictitious but for the corroboration of certain coins of the emperors Lucius Verus and Marcus Aurelius (J. H. Eckhel, *Doctrina Nummorum Veterum*, ii., p. 383, 384) and of a statue of Alexander, said by Athenagoras (*Apology*, c. 26) to have stood in the forum of Parium. Alexander succeeded in establishing an oracle of Aesculapius at his native town. Having circulated a prophecy that the son of Apollo was to be born again, he contrived that there should be found in the foundations of the temple to Aesculapius, then in course of construction at Abonouteichos, an egg in which a small live snake had been placed. Alexander had little difficulty in convincing the Paphlagonians of the second coming of the god under the name of Glycon. A large tame snake with a false human head, wound round Alexander's body as he sat in a shrine in the temple, gave "autophones" or oracles unasked, but the usual methods practised were those of the numerous oracle-mongers of the time, of which Lucian gives a detailed account, the opening of sealed enquiries by heated needles, a neat plan of forging broken seals, and the giving of vague or meaningless replies to difficult questions. The reputation of the oracle spread, and Alexander set up an "intelligence bureau" in Rome, instituted mysteries like those of Eleusis, from which the Christians and Epicureans were alike excluded as "profane," and celebrated a mystic marriage between himself and the moon. Lucian's own close investigations into Alexander's methods of fraud led to a serious attempt on his life. The whole account gives a graphic description of the inner working of one among the many new

oracles that were springing up at this period. Alexander lived to be seventy and amassed great sums of money.

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ALEXANDER ARCHIPELAGO, a maze of about 1,100 islands and islets (area about 13,000 sq.mi.) lying close inland off the southwest coast of Alaska, U.S., situated between 54° 40' and 58° 30' N. Pop. (1950) about 18,000. They are the remnant of a submerged mountain system and rise 3,000 to 5,000 ft. above the sea with wooded tops and sheer sides scarred with marks of glacial action. In some respects the scenery is similar to that of Norway. Through the inner channels, sheltered from the Pacific by the island ramparts, runs the "inland passage," the tourist route northward from Seattle, Wash. The principal islands from northwest to southeast are Chicagof, Baranof, Admiralty, Kupreanof, Kuiu, Prince of Wales (the largest of the archipelago and of all the islands about Alaska, measuring about 140 mi. in length and 40 mi. in width), Etolin and Revillagigedo. Sitka, the former capital, is on the west coast of Baranof Island.

ALEXANDERS (botanical name, *Smyrniolum olusatrum* family Umbelliferae), a stout herbaceous plant with a furrowed, much-branched stem 1 to 3 ft. high, and large compound leaves with broad sheathing stalks, and broad, cut or lobed segments. The small yellow flowers are borne in compound umbels. The plant is a native of the Mediterranean region, and was formerly cultivated as a potherb. It is now found apparently wild in the British Isles.

In the United States the name is applied to the meadow parsnip (*Zizia*), as golden alexanders (*Z. aurea*).

ALEXANDERSBAD, a watering place, Bavaria, Germany, romantically situated in the Fichtelgebirge, near Wunsiedel, 1,900 ft. above the sea. Its waters are ferruginous and largely used in nervous and rheumatic disorders. In the neighbourhood is the Luisenburg (or Luxburg), a hill commanding a fine view of the whole Fichtelgebirge.

ALEXANDERSON, ERNST F. W. (1878-), Swedish-American electrical engineer and inventor, was born at Uppsala, Sweden, Jan. 25, 1878. The son of a university professor, he showed marked mechanical abilities as a boy. Alexandererson graduated from the Royal Institute of Technology at Stockholm and did graduate work in Berlin. In 1901 he went to the United States with an ambition to work with C. P. Steinmetz and the following year did start work under Steinmetz with the General Electric company at Schenectady, N.Y. During 45 active years with that company, he did pioneering work in railroad electrification, ship propulsion and electric motor control. His chief contributions, however, were in the field of radio communication. He invented and developed the Alexandererson alternator for transoceanic communication as well as antenna structures and radio-receiving and transmitting systems. In 1930 he demonstrated a complete television system, including projection of a large picture on a theatre screen.

The General Electric company loaned his services to the Radio Corporation of America to be its chief engineer for a few years following its organization in 1920. In that capacity he supervised the installation of powerful Alexandererson alternator radio transmitters in a number of foreign countries as well as several in the U.S.

He was elected a fellow of both the American Institute of Electrical Engineers and the Institute of Radio Engineers and served as a president of the latter.

Alexandererson was decorated by King Gustavus V of Sweden and received the Valdemar Poulsen, John Ericsson, Cedergren and Edison medals from learned societies. He also received honorary degrees from the University of Uppsala (Sweden) and Union college at Schenectady, N.Y.

He wrote numerous technical articles and had more than 300 patents to his credit.

(W. C. WH.)

ALEXANDRA (1844-1925), Queen Consort of Edward VII, King of Great Britain and Ireland, eldest daughter of Prince Christian of Gluecksburg, afterwards King Christian IX of

Denmark, and Louise, daughter of the Landgrave William of Hesse, was born at Copenhagen Dec. 1, 1844, her full name being Alexandra Caroline Maria Charlotte Louisa Julia. One of her sisters married the tsar of Russia and became the mother of the Tsar Nicholas II. As a child Alexandra was simply brought up and early evinced a love of music and of fairy tales, being encouraged in this by her parents' friendship with Hans Andersen. She was married to Albert Edward, Prince of Wales, afterwards Edward VII., March 10, 1863, and was crowned with him in Westminster Abbey, Aug. 9, 1902.

Her singular beauty and charm—first celebrated in Tennyson's *A Welcome to Alexandra* (1863) when she came to England as a bride—preserved even into old age, won her immense popularity, and her progress through the streets of London on Alexandra Day, or Rose Day, a yearly event inaugurated by her in 1912 to raise funds for the London hospitals by the selling of roses in the streets, attracted vast crowds. She had earlier shown her great interest in the care of the sick by giving her name to the Queen Alexandra's Imperial Nursing Service, organized in 1902 to supply nurses for naval and military hospitals, as well as by her gift to the London Hospital in 1899 of the first Finsen lamp for light treatment of skin diseases. Her love of country life, and especially of horses and dogs, endeared her to a nation, like herself, lovers of animals. Though she took her full share in all public ceremonials, she was happiest in her country home at Sandringham. There in Dec. 1924 she kept her 80th birthday, surrounded by her children and grandchildren, and there she died Nov. 20, 1925. She was buried beside King Edward in St. George's Chapel, Windsor.

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(J. E. C.)

ALEXANDRE, NOËL (NATALIS ALEXANDER) (1639–1724), French theologian and ecclesiastical historian, born at Rouen, Jan. 19, 1639, was professor of philosophy at the convent of Saint-Jacques in Paris. He became provincial of his order in 1706, but was banished to Châtellerault in 1709 for having subscribed to the *Cas de conscience* (1703). He died in Paris, Aug. 21, 1724.

The best known of his numerous works is the *Selecta historiae ecclesiasticae capita, et in loca ejusdem insignia dissertationes historicae, chronologicae, dogmaticae* (1676–86), which was placed on the Index by Innocent XI. on account of his bold defense of the Gallican claims.

See *Catalogue complet des oeuvres du Père Alexandre* (1716); Quétiif-Echard, *Scriptores ordinis praedicatorum* (1719–21), t. ii. p. 810; and full bibliography in A. Vacant, *Dict. de Théologie* (scholarly article by P. Mandouret, cols. 769–772). Of the numerous editions of Alexandre's ecclesiastical history the best is that of P. J. D. Mansi, which contains many valuable notes and additions (Lucca, 1749) and has been frequently reprinted.

ALEXANDRETTA, a city of Turkey, on the gulf of the same name. Pop. (1945) 18,612, two-thirds Moslem. Iskenderun (its Turkish name) preserves the name but probably not the exact site of the city founded to commemorate Alexander's victory over the Persians at Issus (333 B.C.). The name "little Alexandria" appears to date from the 4th century A.D. The city is surrounded by a girdle of hills, spurs of the Cilician Taurus. Its site on marshy, deltaic ground has made it notoriously unhealthy, as an early epithet, *scabiosa*, indicates, and the yellow hue of the natives reflects the constant prevalence of fever. Alexandretta was the main outlet for the old overland trade from Persia and India until the construction of the Suez canal. The British Levant (Turkey) company maintained an agency and factory there for 200 years till 1825 in spite of appalling mortality among its employees. Alexandretta became in 1919 part of Syria in French mandated territory and was the centre of a *sanjaq*, with regard to which the League council settled a Franco-Turkish dispute on Jan. 27, 1937. The *sanjaq* became a separate entity controlling its own internal affairs, with Syria responsible for its foreign policy; the official languages were to be Turkish and another language (presumably Arabic) selected by the League council. On June 23, 1939, the *sanjaq* was

incorporated into Turkey and was renamed Hatay.

See *Admiralty Handbook of Syria* (London, 1913); M. Khadduri, "The Alexandretta Dispute," *American Journal of International Law*, vol. xxxix, pp. 406–425 (1945).

ALEXANDRIA, a city and chief seaport of Egypt, and for over 1,000 years from its foundation the capital of the country, situated on the Mediterranean in 31° 12' N., 29° 15' E., and 129 mi. by rail N.W. of Cairo. The ancient Canopic mouth of the Nile (now dry) was 12 mi. E.

The Modern City.—The city is built on the strip of land which separates the Mediterranean from Lake Mareotis (Mariut),



A BAZAAR STREET IN THE NATIVE QUARTER OF ALEXANDRIA, EGYPT
Alexandria, an important trading centre of Egypt, still retains after 2,000 years the cosmopolitan spirit engendered by its founder, Alexander the Great. It numbers among its inhabitants Egyptians, Greeks, Jews and Europeans and has industries ranging from the ancient oriental art of rug weaving to paper manufacture

and on a T-shaped peninsula which forms harbours east and west. The stem of the T was originally a mole leading to an island (Pharos) which formed the crosspiece. In the course of centuries this mole has been silted up and is now an isthmus half a mile wide. On it a part of the modern city is built. The cape at the western end of the peninsula is Ras et-Tin (Cape of Figs); the eastern cape is known as Pharos or Kait Bey.

The customhouse and chief warehouses are by the western harbour, but the principal buildings of the city are in the east and southeast quarters. The Place Mohammed Ali, or Grand square, which is the centre of the life of the city and the starting point of the electric tramways, is an oblong open space, tree-lined, in the centre of which there is an equestrian statue of the prince after whom it is named. The square is faced with handsome buildings mainly in the Italian style, including the law courts, exchange, Ottoman bank, English church and the Abbas Hilmi theatre. A number of short streets lead from the square to the eastern harbour. There a sea wall, completed in 1905, provides a magnificent drive and promenade along the shore for a

distance of about 3 mi. From the south end of the square the Rue Sherif Pasha—in which are the principal shops—and the Rue Tewfik Pasha lead to the boulevard, or rue, de Rosette. In it are the Zizinia theatre and the municipal palace (containing the public library); the museum, containing an excellent collection of antiquities, lies up a short street to the north. The western end of the boulevard leads to the Place Ibrahim, often called Place Ste. Catherine, from the Roman Catholic church at its southeast side. In a street running south from the boulevard to the railway station is the mosque of Nebi Daniel, containing the tombs of Said Pasha and other members of the khedivial family.

The north quarter, thoroughly oriental in style, is mainly occupied by Egyptians and Levantines. This Arab quarter is traversed by the Rue Ras et-Tin, leading to the promontory of that name. There, overlooking the harbour, is the khedivial yacht club (built 1903) and the palace built by Mohammed Ali. In the district between the Grand square and the western harbour, one of the poorest quarters of the city, is an open space with Fort Caffarelli or Napoleon in the centre. This quarter has been pierced by several straight roads, one of which, crossing the Mahmudiya canal by the Pont Neuf, leads to Gabbari, the most westerly part of the city, an industrial and manufacturing region, possessing asphalt works and oil, rice and paper mills. On either side of the canal are the warehouses of wholesale dealers in cotton, wool, sugar, grain and other commodities. In the southern part of the city are the Arab cemetery, "Pompey's Pillar" and the catacombs. Pompey's Pillar (A.D. 302), which stands on the highest spot in Alexandria, is nearly 99 ft. high, including the pedestal. The shaft is of red granite and is beautifully polished. The catacombs, a short distance southwest of the pillar, are hewn from the rocky slope of a hill, and are an elaborate series of chambers adorned with pillars, statues, religious symbols and traces of painting.

The eastern bay is rocky, shallow and exposed, and is now used only by fishing craft, though a breakwater to protect its quays was completed in 1916. The harbour is on the west of Pharos and partly formed by a breakwater (built 1871-73 and prolonged 1906-07), 2 mi. long. The breakwater starts opposite the promontory of Ras et-Tin, on which is a lighthouse, 180 ft. above the sea, built by Mohammed Ali. Another breakwater starts from the Gabbari side, the opening between the two works being about half a mile. A number of scattered rocks lie across the entrance, but through them two fairways have been made, and the enclosed water is divided into an outer and inner harbour by a mole 1,000 yd. long, projecting northwest from the southern shore. The inner harbour covers 464 ac. It is lined for 2½ mi. by quays, affording accommodation for ships drawing up to 28 ft. The outer harbour (1,400 ac. water area) is furnished with a graving dock, 520 ft. long, and with quays and jetties along the Gabbari fore-shore.

Alexandria is linked by a network of railway and telegraph lines to the other towns of Egypt, and there is a trunk telephone line to Cairo. The city secured in 1906 a new and adequate water supply, modern drainage works having been completed the previous year. Being the great entrepôt for the trade of Egypt, the city is the headquarters of the British chamber of commerce and of most of the merchants and companies engaged in the development of the delta. More than 80% of the total exports and imports of the country pass through the port.

The population of the city, including the suburbs, in 1937 was 685,736. The foreigners numbered more than 100,000, of whom the majority were Greeks, Italians, Syrians, Armenians and other Levantines, though almost every European and oriental nation is represented. The labouring population is mainly Egyptian; the Greeks and Levantines are usually shopkeepers or petty traders.

The Ancient City.—The Greek Alexandria was divided into three regions: (1) the Jews' quarter, forming the northeast portion of the city; (2) Rhacotis, on the west, occupied chiefly by Egyptians; (3) Bruchium, the royal or Greek quarter, forming the most magnificent portion of the city. In Roman times Bruchium was enlarged by the addition of an official quarter, making up the number of four regions in all. The city was laid out as a gridiron of

parallel streets, each of which had an attendant subterranean canal; and the two main streets, lined with colonnades and said to have been each about 200 ft. wide, intersected in the centre of the city. The island of Pharos was joined to the mainland by a mole nearly a mile long, called the Heptastadium. The end of this abutted on the land at the head of the present Grand square, where rose the "Moon gate." All that now lies between that point and the modern Ras et-Tin quarter is built on the silt which gradually widened and obliterated this mole. The Ras et-Tin quarter represents all that is left of the island of Pharos, the site of the actual lighthouse having been weathered away by the sea. On the east of the mole was the great harbour, now an open bay; on the west lay the port of Eunostos, with its inner basin Kibotos, now vastly enlarged to form the modern harbour.

In Strabo's time (latter half of 1st century B.C.) the principal buildings were as follows, enumerated as they were to be seen from a ship entering the great harbour: (1) The royal palaces, filling the northeast angle of the town and occupying the promontory of Lochias, which shut in the great harbour on the east. Lochias, the modern Pharillon, has almost entirely disappeared into the sea, together with the palaces, the private port and the island of Antirrhodus. There has been a land subsidence there, as throughout the north delta and indeed all the northeast coast of Africa; and on calm days the foundations of buildings may be seen, running out far under sea, near the Pharillon. (2) The great theatre, on the modern Hospital hill near the Ramleh station. This was used by Caesar as a fortress, where he stood a siege from the city mob after the battle of Pharsalus. (3) The Poseidon or temple of the sea god, close to the theatre and in front of it. (4) The Timonium built by Antony. (5, 6, 7) The Emporium (exchange), Apostases (magazines) and Navalia (docks), lying west of (4), along the sea front as far as the mole. Behind the Emporium rose (8) the great Caesareum, by which stood the two obelisks, later known as "Cleopatra's Needles," and now removed to London and New York city. This temple became in time the Patriarchal church, some remains of which have been discovered; but the actual Caesareum, so far as not eroded by the waves, lies under the houses lining the modern sea wall. (9) The Gymnasium and (10) the Palaestra are both inland, near the great Canopic street (Boulevard de Rosette) in the eastern half of the town, but on sites not determined. (11) The temple of Saturn, site unknown. (12) The Mausolea of Alexander (Soma) and the Ptolemies in one ring fence, near the point of intersection of the two main streets. (13) The Museum with its library and theatre in the same region; but on a site not identified. (14) The Serapeum, the most famous of all Alexandrian temples. Strabo tells us that this stood in the west of the city; recent discoveries go far to place it near Pompey's Pillar (see above), which, however, was an independent monument erected to commemorate Diocletian's siege of the city. On the eastern point of the Pharos Island stood the great lighthouse, one of the Seven Wonders, reputed to be 400 ft. high. The first Ptolemy began it, and the second completed it, at a total cost of 800 talents. It is the prototype of all lighthouses in the world. A temple of Hephaestus also stood on Pharos at the head of the mole.

History.—Founded in 332 B.C. by Alexander the Great, Alexandria was intended to supersede Naucratis as a Greek centre in Egypt, and to be at once a secure naval base for his designs on Persia and a link between Macedonia and the rich Nile valley. If such a city was to be on the Egyptian coast, there was only one possible site, behind the screen of the Pharos Island and removed from the silt thrown out by Nile mouths. An Egyptian townlet, Rhacotis, already stood on the shore and was a resort of fishermen and pirates. Alexander occupied Pharos, and had a walled city marked out by Deinocrates on the mainland to include Rhacotis. A few months later he left Egypt for the east and never returned to his city; but his corpse was ultimately entombed there. His viceroy, Cleomenes, continued the creation of Alexandria. The Heptastadium, however, and the mainland quarters seem to have been mainly Ptolemaic work. Inheriting the trade of ruined Tyre and becoming the centre of the new commerce between Europe and the Arabian and Indian east, the city

grew in less than a century to be larger than Carthage; for some centuries more it had to acknowledge no superior but Rome. It was a centre not only of Hellenism but of Semitism, and the greatest Jewish city in the world. There the Septuagint was produced. The early Ptolemies kept it in order and fostered the development of its museum into the leading Greek university, and, as a free Greek city, it retained its own senate into Roman times. In 80 B.C., however, it passed formally under Roman jurisdiction according to the will of Ptolemy Alexander, though it had been under Roman influence for more than 100 years previously. There Julius Caesar dallied with Cleopatra in 47 B.C. and was mobbed by the rabble; there his example was followed by Antony, for whose favour the city paid dear to Octavian, who placed over it a prefect from the imperial household. Alexandria seems from this time to have regained its old prosperity, commanding, as it did, an important granary of Rome; in the Augustan age its free population was estimated at 300,000, in addition to an immense number of slaves. In A.D. 215 the emperor Caracalla visited the city, and, in order to repay some insulting satires that the inhabitants had made upon him, a general massacre was perpetrated. Notwithstanding this terrible disaster, Alexandria soon recovered its former splendour, and for some time longer was esteemed the first city of the world after Rome, while it now acquired fresh importance as a centre of Christian theology and church government. There Arianism was formulated and there Athanasius, the great opponent of both heresy and pagan reaction, worked and triumphed. As native influences, however, began to reassert themselves in the Nile valley, Alexandria gradually became an alien city, more and more detached from Egypt; and, losing much of its commerce as the peace of the empire broke up during the 3rd century A.D., it declined fast in population and splendour. In 616 it was taken by Chosroes II, king of Persia; and in 640 by the Arabians, under 'Amr, after a siege that lasted 14 months, during which Heraclius, the emperor of Constantinople, did not send a single ship to its assistance. Notwithstanding the losses that the city had sustained, 'Amr was able to write to his master, the caliph Omar, that he had taken a city containing "4,000 palaces, 4,000 baths, 12,000 dealers in fresh oil, 12,000 gardeners, 40,000 Jews who pay tribute, 400 theatres or places of amusement." The well-known tale of how the famous library was used for six months to supply the furnaces of the public baths is now regarded as doubtful, in view of the many calamities which the collection had already suffered. About the year 646 'Amr was deprived of his government by the caliph Othman. The Egyptians, by whom 'Amr was greatly beloved, were so much dissatisfied by this act, and even showed such a tendency to revolt, that the Greek emperor determined to make an effort to reduce Alexandria. The attempt proved perfectly successful. The caliph, perceiving his mistake, immediately restored 'Amr, who, on his arrival in Egypt, drove the Greeks within the walls of Alexandria, captured the city after a most obstinate resistance, and completely demolished its fortifications. Alexandria now rapidly declined in importance. The building of Cairo in 969, and, above all, the discovery of the route to the east by the Cape of Good Hope in 1498, nearly ruined its commerce; the canal, which supplied it with Nile water, became blocked; and although it remained a principal Egyptian port, it played no great part in history until Napoleon's Egyptian expedition thrust it into prominence.

Battle of 1801.—The French troops stormed the city on July 2, 1798, and it remained in their hands until the arrival of the British expedition of 1801. The battle of Alexandria, fought on March 21, 1801, between the French army under Gen. J. F. Menou and the British expeditionary corps under Sir Ralph Abercromby, took place near the ruins of Nicopolis, on the narrow spit of land between the sea and Lake Aboukir. The British position on the night of March 20 extended across the isthmus, the right resting upon the ruins of Nicopolis and the sea, the left on Lake Aboukir and the Alexandria canal. The line faced generally southwest toward the city, the reserve division under Maj. Gen. Sir John Moore on the right, the guards brigade in the centre and three other brigades on the left. The French attacked before dawn. The first shock was repulsed, but a French column penetrated in

the dark between two regiments of the British and a confused fight ensued in the ruins, in which the 42nd (Black Watch) captured a colour. The front and rear ranks of the 28th (Gloucestershires) were simultaneously engaged, and the conduct of the regiment won for it the distinction of wearing badges both at the front and at the back of their headdress. Other regiments which assisted in the overthrow of the French column were the 23rd, 40th and 58th. In a second attack Abercromby was engaged in personal conflict with some French dragoons, and about this time received a mortal wound, though he remained on the field and in command to the end. The attack on the centre was repulsed by the cool and steady fire of the guards, and the left wing maintained its position with ease, but the French cavalry for the second time came to close quarters with the reserve. About 8:30 the combat began to wane, and the last shots were fired at 10. The forces engaged were approximately 14,000 British to about 20,000 French, and the losses were: British, 1,468 killed, wounded and missing, including Abercromby (who died on March 28), Moore and three other generals wounded; French, 1,160 killed and (?) 3,000 wounded. The British subsequently advanced upon Alexandria, which surrendered on Aug. 31.

In the 19th Century.—By this time it had sunk to a small town of about 4,000 inhabitants; it owed its modern renaissance solely to Mohammed Ali, who wanted a deep port and naval station for his viceregal domain. He restored its water communication with the Nile by making the Mahmudiya canal, finished in 1820; and he established at Ras et-Tin his favourite residence. The old Eunostos harbour became the port, and a flourishing city arose on the old Pharos Island and the Heptastadium district, with outlying suburbs and villa residences along the coast eastward and the Mareotic shore. Being the starting point of the "overland route" to India, and the residence of the chief foreign consuls, it quickly acquired a European character. At Alexandria most of the negotiations between the Powers and Mohammed Ali were conducted; thence started the Egyptian naval expeditions to Crete, the Morea and Syria; and thither sailed the betrayed Ottoman fleet in 1839. It was twice threatened by hostile fleets, the Greek in 1827 and the combined British, French and Russian squadrons in 1828. It was connected with Cairo by railway in 1856, and remained the real capital of Egypt till Said Pasha died there in 1863 and Ismail came into power. Though this prince continued to develop the city, giving it a municipality in 1866 and new (but inadequate) harbour works in 1871-78, he developed Cairo still more; and the centre of gravity definitely shifted to the inland capital.

Bombardment of 1882.—Fate, however, again brought Alexandria to the front. After a mutiny of soldiers there in 1881, the town was greatly excited by the arrival of an Anglo-French fleet in May 1882, and on June 11 a terrible riot and massacre took place, resulting in the death of a large number of Europeans. Since satisfaction was not given for this and the forts were being strengthened at the instigation of Arabi Pasha, the British admiral, Sir Beauchamp Seymour (afterward Lord Alcester), sent an ultimatum on July 10 and demolished the forts the next day. As Arabi did not submit, a British military expedition landed at Alexandria on Aug. 10, the sequel being the British occupation of the whole country.

Antiquities.—Persistent efforts have been made to explore the antiquities of Alexandria. The authorities of the museum have been enabled from time to time to carry out systematic excavations when opportunity offered; D. G. Hogarth made tentative researches on behalf of the Egyptian Exploration fund and the Society for the Promotion of Hellenic Studies in 1895; and a German expedition worked for two years (1898-99). But the great and growing modern city stands right over the ancient one, making it almost impossible to find any considerable space in which to dig except at enormous cost, and the general subsidence of the coast has sunk the lower-lying parts of the ancient town under water. Unfortunately the spaces still most open are the low grounds to the northeast and southwest, where it is practically impossible to get below the Roman strata.

The most important results were those achieved by G. Botti,

former director of the museum, in the neighbourhood of Pompey's Pillar, where there is a good deal of open ground. There substructures of a large building or group of buildings have been exposed, which are perhaps part of the Serapeum. Close by immense catacombs and columbaria have been opened which may have been appendages of the temple. These contain one very remarkable vault with curious painted reliefs, now lighted by electricity and shown to visitors. The objects found in these researches are in the museum, the most notable being a great basalt bull, probably once an object of cult in the Serapeum. Other catacombs and tombs have been opened in Kom es-Shugafa Hadra (Roman) and Ras et-Tin (painted). The Germans found remains of a Ptolemaic colonnade and streets in the northeast of the city, but little else. Hogarth explored part of an immense brick structure under the mound of Kom ed-Dik, which may have been part of the Paneum, the Mausolea or a Roman fortress. The making of the new fore-shore led to the dredging up of remains of the Patriarchal church; and the foundations of modern buildings are seldom laid without some objects of antiquity being discovered. The wealth underground is doubtless immense, but, despite all efforts, there is not much for antiquarians to see in Alexandria outside the museum and the neighbourhood of Pompey's Pillar.

ALEXANDRIA, town in Bonhill civil parish, Dumbartonshire, Scot., on the right bank of the Leven, about 3 mi. N. of Dumbarton, served by the Scottish Region railway. It owes its origin largely to cotton printing and bleaching works based on an abundant supply of excellent water and contains a large Turkey-red dyeing establishment. Pop. (1931) 5,818. Alexandria is connected with Bonhill, on the opposite bank of the river, by a bridge which replaced in 1898 one bought three years earlier by the county council from the Smollett family, who have been closely associated with the district since the time of Sir James Smollett, the novelist's grandfather. Alexandria takes its name from a member of this family, Alexander Smollett. The industries of Bonhill are calico printing, dyeing and bleaching. Pop. (1931) of parish 15,565. Jamestown, in the parish about 1 mi. N.E. of Alexandria, with a station on the railway, contains some of the largest cotton printing works in Scotland. Pop. (1931) approximately 1,200.

ALEXANDRIA, a city of Louisiana, U.S., on the south bank of the Red river, in the centre of the state; the seat of Rapides parish. It is on federal highways 71, 167 and 165, and is served by the Texas and Pacific, the Rock Island, the Missouri Pacific, the Southern Pacific and the Louisiana and Arkansas railways. Pop. (1950) 34,685; (1940) 27,066.

The city is on a level plain in the centre of extensive forests of longleaf pine, interspersed with various hardwoods. Corn, cotton, sugar, alfalfa and vegetables are the principal crops raised in the vicinity. There are about 100 factories in and near the city, including sawmills, a creosoting plant, foundries and machine shops, cottonseed oil mills, brick yards, an oil refinery, broom-handle and talcum factories and railroad repair shops. The city has a large wholesale and retail trade. A free traffic bridge leads to the town of Pineville, on the north side of the river (pop. [1950] 6,396), where there is a national cemetery. A state hospital for the insane, Mid-State Charity hospital, Louisiana college (a Baptist coeducational institution which was opened in 1906), Camp Beauregard (8,000 ac.), a U.S. veterans' hospital, the state industrial school for girls and the state colony for the feeble-minded are also near by.

Alexandria (army) air base is located there, and a few miles south of town is the Louisiana State university school of vocational agriculture.

Alexandria was named after Alexander Fulton, on whose grant from Spain the first settlement was made in 1785. It was incorporated as a town in 1818 and received a city charter in 1882. In May 1863 and again in March 1864 it was occupied by Union forces under Adm. David D. Porter and Gen. N. P. Banks. When finally vacated, May 12-13, 1864, the city was almost entirely burned. The Union gunboats, which had passed up the river toward Shreveport at high tide, were caught above the falls at Alexandria, and saved by a splendid piece of engineering (a dam at the falls) by Lieut. Col. Joseph Bailey (1827-67).

ALEXANDRIA, a city and a port of entry in northern Virginia, U.S., on the west bank of the Potomac river, 6 mi. below Washington, D.C.; contiguous to, but independent of, Arlington county. It is served by the Atlantic Coast Line, the Chesapeake and Ohio, the Richmond, Fredericksburg and Potomac, the Southern and the Washington and Old Dominion (freight only) railways.

There is water transportation, and Washington's National airport is near by. It is on federal highway 1. The population was 61,604 in 1950 and 33,523 in 1940 by federal census.

Alexandria is a quaint old-fashioned city, with quiet, shady streets. Many buildings date back to the 18th century: Christ church (1773), in which George Washington and Robert E. Lee worshipped; Carlyle house (1752), where Gen. Edward Braddock made his headquarters while recruiting rangers for the ill-fated expedition to Fort Duquesne, and where, in the same year, the five royal governors met; Gadsby's tavern (1752), where Washington had his headquarters while recruiting rangers for the campaign of 1754; Alexandria academy (1785), first free school in northern Virginia; Friendship Engine house (1774); the home of "Light Horse Harry" Lee, father of Robert E. Lee; Presbyterian meeting-house (1774), housing the oldest pipe organ in America; Ramsay house (1748); and many others.

On the hill in the western part of the city is the George Washington Masonic National memorial, rising to a height of 337 ft.

Just over the western boundary line is the Protestant Episcopal seminary of Virginia, opened in 1823.



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OLD CHRIST CHURCH AT ALEXANDRIA, VA., IN WHICH GEORGE WASHINGTON SERVED AS ONE OF THE FIRST VESTRYMEN AND WHERE ROBERT E. LEE ALSO WORSHIPPED

Alexandria is the commercial centre for northern Virginia. A large plant for construction and repair of refrigerator cars is near the city. The products of the industrial plants in Alexandria include fertilizers, beverages, shirts, chemicals, sewer pipes and lumber products.

One of the largest car-icing stations is there. The *Alexandria Gazette* is the oldest daily newspaper in the United States, founded in 1784 and in continuous circulation since.

The first settlement was made in 1695. In 1731 Scottish merchants founded the village of Belhaven, which in 1749 was incorporated under the name of Alexandria in honour of John Alexander, who originally owned the land. The city of Alexandria soon became an important port for the products of northern Virginia, from which flour and tobacco were shipped to the West Indies and even to Europe. Improved roads were built for wagon trains, and "rolling roads" were constructed on which hogheads of tobacco were rolled down from the plantations to the port. This economic development was checked by the anomalous political history of the city. From 1790 to 1846 it was part of the District of Columbia, at first with a vague and uncertain status, and later overshadowed by the development of the capital. Hardly had it been ceded back to Virginia before the clouds of the Civil War

began to gather, and during the whole course of the war it was occupied by Union troops. After the erection of the state of West Virginia (1863), and until the close of the war, it was the seat of the "Alexandria government" (see VIRGINIA). In 1814 the city was threatened by a British fleet, but averted attack by a payment of about \$100,000. Alexandria was incorporated in 1779 and rechartered in 1852.

A council-manager form of government was adopted Sept. 1, 1922.

ALEXANDRIAN SCHOOL, a term applied to certain tendencies in literature, science and art which took their rise in Alexandria. That city, founded by Alexander the Great, was in every way admirably adapted for becoming the new centre of the world's activity and thought. Its situation brought it into commercial relations with all the nations lying around the Mediterranean, and at the same time rendered it the one communicating link with the wealth and civilization of the east. The great natural advantages it thus enjoyed were increased to an enormous extent by the care of the sovereigns of Egypt, the Ptolemies Soter (323-285), Philadelphus (285-247) and Euergetes (247-222). The first began to draw around him from various parts of Greece a circle of men eminent in literature and philosophy. To these he gave every facility for the prosecution of their learned researches. Under the inspiration of his friend Demetrius of Phalerum, the Athenian orator, statesman and philosopher, this Ptolemy laid the foundations of the great Alexandrian library. He also built, for the convenience of his men of letters, the Museum, which was in many respects not unlike a modern university. Philadelphus, whose librarian was the poet Callimachus, bought up all of Aristotle's library, and included in his collection some foreign works among which was the Pentateuch, the Greek translation of which (the Septuagint) dates from his time.

Euergetes largely increased the library by getting possession of the official Athenian copies of the dramatists, and by compelling all travellers who arrived in Alexandria to leave a copy of any work they possessed.

The intellectual movement so originated extended over a long period of years, 306 B.C.-A.D. 642, which falls into two divisions: 306-30 B.C., from the foundation of the Ptolemaic dynasty to its final subjugation by the Romans; and 30 B.C. to A.D. 642, when Alexandria was destroyed by the Arabs. In the first of the two periods the intellectual activity was of a purely literary and scientific nature. This was particularly noticeable under the early Ptolemies, Alexandria being then almost the only home in the world for pure literature. During the last century and a half before the Christian era, the school, as it might be called, began to break up and to lose its individuality. This was caused partly by the state of government under some of the later Ptolemies, partly by the formation of new literary circles in Rhodes, Syria and elsewhere, whose supporters, though retaining the Alexandrian peculiarities, could scarcely be included in the Alexandrian school. Under Roman sway the influence of the school was extended over the whole known world, but men of letters began to concentrate at Rome rather than at Alexandria. Meanwhile, Alexandria developed a new movement, which was not in the old direction—having, indeed, nothing in common with it. With its character largely determined by oriental gnosticism and containing Jewish and, later, Christian elements, this second Alexandrian school resulted in the speculative philosophy of the Neoplatonists and the religious philosophy of the Gnostics and early church fathers.

There appear, therefore, to be two Alexandrian schools, distinct both chronologically and in substance. The one is the earlier Alexandrian school of poetry and science, the other the later Alexandrian school of philosophy and theology. The term "school," however, has not the same meaning as when applied to the Academics or Peripatetics, the Stoics or Epicureans. These consisted of a company united by holding in common certain speculative principles, by having the same theory of things. There was nothing at all corresponding to this among the Alexandrians. In literature their activities were directed to the most diverse objects; they have in common only a certain spirit or form. There was among them no definite system of philosophy.

Even in later schools of philosophy proper there is found a community rather of tendency than of definite result or of fixed principles.

I. Literature.—The general character of the literature of the school appears as the necessary consequence of the state of affairs brought about by the fall of Greek nationality and independence. The great works of the Greek mind had formerly been the products of the free and active, yet not undisciplined atmosphere of the Greek city-state. But with the rise of Macedonia, the city-state vanished from practical politics, taking with it freedom as a Greek understood it, and in large measure, independence and originality of thought. A substitute for this originality was found by the Alexandrians in learned research, stimulated by a reverential interest in the works of the past (cf. CLASSICS). They studied criticism, grammar, prosody and metre, antiquities and mythology. The results of this study constantly appear in their productions. Their works are written by and for the learned; they appeal to a small public, little interested in political and military affairs of the time, courtly, as was natural, seeing that many were under the direct patronage of a king, full of literary and scientific interests of all kinds, but, as it happened, not including any writer of first-rate genius. Three tendencies are very marked; viz., (1) Interest in all branches of science, and in the statement of its results in literary form. (2) Interest in the technique of literary expression, particularly that of verse; prose was for some reason far less popular. (3) Preoccupation in what was then a comparatively new literary motif, since it dates only from Euripides, namely the psychology of love. Most of the great love stories date from this period, and almost for the first time, the heroine is apt to be the central figure. The chief literary forms were:—

(1) *Epic*.—This, against the advice and practice of the greatest literary authority, Callimachus, was attempted by several writers. The *Argonautica* of Apollonius Rhodius survives; it is a very learned work, showing immense knowledge of epic metre and diction, and many episodes (notably the central one, the loves of Jason and Medea) are full of merit; but as a whole, it is dull and lacks unity. Epic was also written by Rhianus, who produced a long poem, now lost, on the Messenian wars. Better and more characteristic was the *epyllion*, or little epic, in which some one episode was treated at length, the rest of the story being merely alluded to. Good examples are the two poems on Heracles and on the Dioscuri, in the Theocritean corpus; the most famous was the *Hecale* of Callimachus, of which fragments survive.

(2) *Didactic poetry*.—This was very popular, for it gave an opportunity to handle neatly and tastefully a subject interesting in itself. Prominent examples are the *Phaenomena* of Aratus, a versified handbook of astronomy and meteorology; the *Theriaca* of Nicander, on snake-bites and herbal remedies for them, is remarkable for its highly learned and obscure diction, a fault, or rather a deliberate affectation, of many Alexandrians. Many mythological poems, as the *Aetia* of Callimachus, approach didactic poetry in subject, since they profess to explain customs, rites and so forth.

(3) *Elegiac poems* were of many kinds. Most characteristic were those dealing with love; in this genre, which was not strictly new, since it had been handled long before by Mimnermus, for instance, the Alexandrians, with their new interest in psychology and *ethos*, excelled, to judge from the scanty fragments remaining, and the criticisms and imitations of Latin writers such as Propertius. The *Lyde* of Antimachus was the pioneer of this movement; the first Alexandrian writer of the erotic elegy was Philetas of Cos; Callimachus, Hermesianax, and others also won distinction therein. The elegy was also used for mythological narrative, sometimes lengthy, as in Callimachus' *Aetia*; the mythological works of Euphoriion, however, seem to have been mostly in hexameters. As an important offshoot of these compositions, we may notice the epigram (cf. ANTHOLOGY) which assumed a new importance among the Alexandrians.

(4) *Closet-drama*, including both tragedies and comedies. As the great age of drama was over, nothing first-rate was to be expected from the Pleiad, as the seven most admired authors in

this vein were called. The fragments which survive, and the Alexandra of Lycophron (in form a *rheis* or messenger's speech from a tragedy, and a byword for its extreme obscurity) do not whet our appetite for more.

(5) *The mime*, a short dialogue, or monologue dealing with everyday life. Besides anonymous fragments, we have several mimes of Herodas, a writer little appreciated in antiquity. They are artificial in language, for they are in the dialect and metre of the old Ionian writers of iambics; in content, they show keen and cynical observation of commonplace, and not always very reputable, men and women. A development of this kind of work, and of the earlier prose mimes of Sophron, was the pastoral, usually a dialogue in form, sketching, with or without idealization, country life, especially that of herdsmen. The great name here is that of Theocritus, among whose *Eidyllia* ("little scenes or pictures") are some of the most beautiful poems in any language. Several of his imitators, such as Bion, Moschus, and the unknown writer of the Eighth Idyll, are decidedly pretty, although artificial.

(6) *Prose*: here the characteristic form is rhetorical history, or at least history written with an eye to stylistic effect, although research was not absent. Timaeus and Theopompus (both lost) were among the most celebrated; Cleitarchus and others wrote on the exploits of Alexander, which became in their hands more and more mixed with sheer fable. Polybius' history is in large measure a counterblast to the rhetorical style; it remained an almost isolated attempt.

(7) *Lyric poetry* was but mediocre, for it was not an age of intense emotions freely expressed. However, numerous pieces were written in lyric metres, avoiding the great complication and variety of Pindar and his contemporaries and keeping to those forms of verse which are easily reducible to fixed rules. Here Sotades may be mentioned. He wrote a number of poems in a variety of Ionics called after him Sotadean; the subjects appear to have been highly indecent.

(8) *Parody and satire* flourished, for example the *Silloi* of Timon, mock epic verses abusing philosophers.

In *grammar and philology*, the work of the Alexandrian critics, although lacking the minute accuracy of the best modern scholarship, aided as that is by palaeography, comparative philology, and archaeology, was most meritorious. It was their aim to collect and preserve in a correct and intelligible form the literature of Greece, and to comment adequately on it, where necessary. Their methods (*διδασκαλία*, textual or lower criticism, with *ἀνάλυσις*, correct accentuation; *τέχνη* or syntactical study, *ἐξηγῆσις* or commentary, and *κρίσις* higher or literary criticism, differ little in principle from our own. (See CLASSICS; TEXTUAL CRITICISM.) Besides the great Aristarchus, and Zenodotus, whose labours on Homer were second only to Aristarchus' in value, may be named Aristophanes of Byzantium, Homeric critic and inventor of the signs for accents; Crates; and several of the most famous writers, as Apollonius Rhodius, Lycophron, and Callimachus. Many works were written on grammar (as by Dionysius Thrax, the first important Greek grammarian), chronology (Eratosthenes is the great name here, see CHRONOLOGY); (Callimachus wrote on the chronology of the drama), mythology (the *Bibliotheca* falsely ascribed to Apollodorus, and many scholia, epitomize much of this learning), geography (again Eratosthenes took a leading part), and astronomy (Hipparchus, and later Claudius Ptolemaeus, from whom the Ptolemaic system is named; see ASTRONOMY). Medicine was studied with much success (Herophilus and Erasistratus were great anatomists), and finally, the mathematicians of that age notably advanced this science; Archimedes and Apollonius of Perga are especially great names (see MATHEMATICS, HISTORY OF) while Euclides is still familiar as the "Euclid" but recently displaced as a text-book of geometry.

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II. Philosophy.—The mutual criticisms of the various philosophic schools, all of which continued to exist, had resulted in a general feeling of uncertainty and scepticism. As a result, any doc-

trine which claimed infallible certainty was sure of a hearing; and this was found in the various Eastern religions, notably Judaism. Hence arose that characteristic feature of Alexandrian thought which we may call *gnosticism*. A supposed revelation (*gnosis*) personal or derived from ancient writings, set forth with Greek logic and rhetoric, is the central feature of all the most characteristic Alexandrian philosophy (see NEOPYTHAGOREANISM; HERMES TRISMEGISTUS).

So far as the Jewish succession is concerned, the great name is that of Philo in the first century of our era. He took Greek metaphysical theories, and, by the allegorical method, read them into the Old Testament. He dealt with (a) human life as explained by the relative nature of Man and God, (b) the Divine nature and the existence of God, and (c) the great *Logos* doctrine as the explanation of the relation between God and the material universe. From these three arguments he developed an elaborate theosophy which was a syncretism of oriental mysticism and pure Greek metaphysics, and may be regarded as representing the climax of Jewish philosophy. Of pagan schools of philosophy, the first was Neopythagoreanism, the second and last Neoplatonism (q.v.). Their doctrines were a synthesis of Platonism, Stoicism and the later Aristotelianism with a leaven of oriental mysticism which gradually became more and more important. The world to which they spoke had begun to demand a doctrine of salvation to satisfy the human soul. They therefore devoted themselves to examining the nature of the soul, and taught that its freedom consists in communion with God, to be achieved by absorption in a sort of ecstatic trance. This doctrine reaches its height in Plotinus, after whom it degenerated into magic and theurgy in its unsuccessful combat with the victorious Christianity. Finally this pagan theosophy was driven from Alexandria back to Athens under Plutarch and Proclus, and occupied itself largely in purely historical work based mainly on the attempt to reorganize ancient philosophy in conformity with the system of Plotinus. This school ended under Damascius when Justinian closed the Athenian schools (A.D. 529). The influence of all this on some of the most enlightened Christians, as Clement and Origen, was enormous. They strove after a Christian *gnosis*. Side by side with them, a swarm of semi-Christian Gnostic sects arose. Such ideas are still present much later in Synesius, bishop of Ptolemais, and Neoplatonism, gradually absorbed into Christianity, profoundly and lastingly modified its theology.

See *Histories of Philosophy* by Zeller, Ueberweg, Windelband, etc., and bibliography of CHURCH HISTORY and the other special articles referred to above.

ALEXANDRIA TROAS, an ancient Greek city of the Troad, situated on the west coast at nearly its middle point, a little south of Tenedos. It was built by Antigonos, perhaps about 310 B.C., and was called by him Antigonía Troas. Early in the next century the name was changed by Lysimachus to Alexandria Troas, in honour of Alexander's memory. As the chief port of north-west Asia Minor, the place prospered greatly in Roman times, and the existing remains sufficiently attest its former importance. Thence St. Paul sailed for Europe for the first time, and there occurred later the episode of the raising of Eutychus (Acts xx. 5-12). The circuit of the old walls can be traced, and there are remains of some ancient buildings, including a bath and gymnasium and an aqueduct built by Trajan. The harbour had two large basins, now almost choked with sand.

ALEXANDRINA, LAKE, in South Australia, forms with Lake Albert and the curious boomerang-shaped Coorong a series of extensive and shallow lagoons about the outlet of the River Murray. (Lake Alexandrina: area, c. 220sq.m.; depth: 7-10ft.; L. Albert: c. 64sq.m.; 3-6ft.) A relic of a sea-gulf—analogue to Spencer and St. Vincent gulfs—which penetrated northwards into what is now the lower Murray basin, Lake Alexandrina was formed by a (geologically) recent elevation of the coast line, so that now the Murray, lacking a "mouth" in the ordinary sense, can only be approached by an entrance over a shifting sand-bar carrying some 7-12ft. of water and beset with breakers. Moreover the large water-surface which these lakes expose, coupled with a sub-arid climate (average annual temp. c. 61-62°; average annual rainfall c. 22 in.) leads to an evaporation which has been esti-

mated at 42,000 million cu.ft. per annum (Lakes Alexandrina and Albert). This loss, which has normally to be borne by the River Murray system, is particularly felt in dry seasons. An intake of sea-water may then occur and adversely affect pastoral and agricultural interests for some distance upstream. Associated with certain incidents in the history of Australian exploration—notably that of Sturt's voyage of discovery down the Murrumbidgee-Murray in 1830—Lake Alexandrina is now chiefly of interest as constituting one of Australia's national problems. The River Murray valley is of rapidly growing importance. Lack of a natural outlet by way of the mouth has encouraged, if it has not caused, the development of numerous railway lines which tap the river at various points along its course. The riparian States, and particularly the capitals of those States, have vested interests which militate against the construction of a river-mouth port. This project, however, is appealing ever more insistently as one of national importance. Various solutions—notably a port at Goolwa served by a connecting canal—have been proposed. After being referred to various commissions and expert investigations, the question was discussed by Sir George Buchanan (Report on Transport in Australia, vol. ii., 1927), and the matter was explicitly referred to by the Commonwealth Premier in a speech which was held by some to foreshadow action by the Commonwealth Government. Subsequently, the draining of Lake Albert was proposed, and the conversion of its bed into agricultural land.

ALEXANDRINE VERSE, a name given to the leading measure in French poetry. It is the heroic French verse, used in epic narrative, in tragedy, and in the higher comedy. There is some doubt as to the origin of the name; but most probably it is derived from a collection of romances, compiled in the 12th century, of which Alexander of Macedon was the hero. Before the publication of this work most of the *trouvère* romances appeared in octosyllabic verse. There is also a theory that the form was invented by a poet named Alexandre. The new work, which was henceforth to set the fashion to French literature, was written in lines of 12 syllables, but with a freedom of pause which was afterwards greatly curtailed. The new fashion, however, was not adopted all at once. The metre fell into disuse until the reign of Francis I., when it was revived by Jean Antoine de Baïf (1532–89), one of the seven poets known as the *Pléiade* (*q.v.*). Jodelle (1532–73) mingled episodic Alexandrines with the *vers communs* of his tragedies and so introduced them into drama. It was Ronsard, however, who made the verse popular and gave it vogue in France. From his time it became the recognized vehicle for all great poetry, and the regulation of its pauses became more strict. Two laws came to be established with regard to the pauses. The first is, that each line should be divided into two equal parts, the sixth syllable always ending with a word. In the earlier use of this metre, on the contrary, it frequently happened that the sixth and seventh syllables belonged to the same word. The other is that, except under the most stringent conditions, there should be none of what the French critics call *enjambement*, that is, the overlapping of the sense from one line on to the next. Ronsard completely ignored this rule, which was after his time settled by the authority of Malherbe. Later French poets have abandoned the rigidity of Malherbe, as a reference to a popular play like Rostand's *Cyrano de Bergerac* will show.

Michael Drayton, who was 22 years of age when Ronsard died, seemed to think that the Alexandrine might be as pleasing to English as it was to French ears, and in this metre he wrote a long poem called the *Polyolbion*. The metre, however, failed to catch the English ear. In English heroic verse it is but rarely introduced; but in the favourite narrative metre, known as the Spenserian, it comes in regularly as the concluding line of each stanza. In English usage, moreover, there is no fixed rule as to the position of the pause. Thus Thomson (*Castle of Indolence*, i. 42):—

And music lent new gladness to the morning air.

The danger in the use of the Alexandrine is that, in attempting to give dignity to his line, the poet may only produce heaviness, incurring the criticism of Pope:—

A needless Alexandrine ends the song,
That, like a wounded snake, drags its slow length along.

The Alexandrine was the dominant metre in Dutch poetry from the 16th to the middle of the 19th century, and about the time of its introduction to Holland it was accepted in Germany by the school of Opitz. In the course of the 17th century, after being used without rhyme by Seckendorf and others, it formed a transitional station on the route to German blank verse, and has since then been rarely employed, except occasionally in rhymed comedy.

ALEXANDRISTS, the name given to those philosophers of the Renaissance, who, in the great controversy on the subject of personal immortality, adopted the explanation of the *De Anima* given by Alexander of Aphrodisias. According to the orthodox Thomism of the Roman Catholic Church, Aristotle rightly regarded reason as a faculty of the individual soul. Against this, the Averroists, led by Agostino Nifo (*q.v.*), introduced the modifying theory that universal reason in a sense individualizes itself in each soul and then absorbs the active reason into itself again. These two theories respectively evolved the doctrine of individual and universal immortality, or the absorption of the individual into the eternal One. The Alexandrists, led by Pietro Pomponazzi, boldly assailed these beliefs and denied that either was rightly attributed to Aristotle. They held that Aristotle considered the soul as a material and therefore a mortal entity which operates during life only under the authority of universal reason. Hence the Alexandrists denied the possibility of immortality in every shape or form. Since the soul is organically connected with the body, the dissolution of the latter involves the extinction of the former.

ALEXANDRITE, a variety of chrysoberyl (*q.v.*) discovered in the Urals in 1833, on the day set apart for celebrating the majority of the Russian *cesarevich*, afterwards the tsar, Alexander II., in whose honour the stone was named. It is remarkable for being strongly dichroic, that is, exhibiting different colours according as viewed from different directions, generally appearing dark green by daylight and raspberry-red by candle-light, or by daylight transmitted through the stone. As red and green were the military colours of Russia, the mineral became highly popular as a gem-stone.

ALEXANDROV, TODOR (1882–1924), Macedonian leader, was born at Stip in Central Macedonia. As a youth he took part in the *comitadji* campaign against Turkey, becoming one of the most prominent leaders of the Bulgarian bands in Macedonia. After the treaties which concluded World War I had allotted his native district to Yugoslavia, he came to Sofia and began to reorganize the old I.M.R.O. (International Macedonian Revolutionary Organization) against Yugoslavia and Greece. Imprisoned by Stambolisky, he escaped through the connivance of his friends, retired to the mountains near Petritch, and there organized a power which was able not only to terrorize Serbian and Greek Macedonia, but also to defy the Bulgarian Government, against which he declared irrevocable hostility in 1923, after he had failed to persuade Stambolisky to support his cause. Alexandrov himself aimed at an autonomous Macedonia, with its capital at Salonika, and thus incurred the hostility of the more moderate group of "Federalists," who were on tolerable relations with the Yugoslav Government. He helped to bring about the fall and death of Stambolisky in June 1923, and under the Government of Tsankov was practically an independent ruler; but when this Government also disavowed the Macedonians, Alexandrov turned elsewhere for help, and entered into relations, first with Turkey, then with M. Radić, the Croat leader, and finally with the Third International. A treaty concluded in the summer of 1924 between the Macedonian Autonomists and the Third International was alleged to bear Alexandrov's signature, but afterwards repudiated by him. Violent dissensions broke out in his party over the advisability or not of accepting Russian help, and as a result of them, Alexandrov was murdered on Aug. 31, 1924.

Alexandrov was for years the uncrowned and absolute king of the Bulgarian Macedonians, who almost worshipped him. He was a very fine figure, tall, black-bearded and handsome, and as ruthless as he was brave. His courts knew only three verdicts: acquittal, a hundred stripes, or death, the last being inflicted for theft, insult to a woman, or political treachery. He must have

been responsible for many hundreds of deaths; withal, he was a man of personal probity and fanatical and selfless patriotism.

(C. A. M.)

ALEXANDROVSK, a town in Sakhalin Island in the Far Eastern area of the R.S.F.S.R. Lat. $51^{\circ} 10'$ N. Long. $142^{\circ} 5'$ E. Population 7,807. It is a port on the west coast in the coal and naphtha area and is the administrative centre for the Russian, part of the island.

ALEXANDROVSK, a town in the Ukrainian S.S.R., now called Zaporozhe (q.v.).

ALEXEYEV, MIKHAIL (1857-1918), Russian soldier, was born Nov. 3, 1857. Entering the army in 1876, he became a general in 1904. At the outbreak of the World War he was appointed chief of staff on the south-western front, and in that capacity was largely responsible for the Russian victory in Galicia in 1914. In March 1915 he took over command of the armies on the north-western front and by his energy and ability saved them from complete destruction. Appointed chief of the general staff in Aug. 1915, he had to give up this office in Nov. 1916 on account of ill health.

From March to May 1917 he commanded the army; recalled in September by Kerensky, he attempted to mediate between Kerensky and Kornilov. Failing in this, he went to S. Russia and there organized the "Volunteer" army. On the death of Kornilov in March 1918, the military command of the army was taken over by Denikin and Alexeyev became leader of the Government. On Sept. 25, 1918 he died of heart disease at Ekaterinodar.

ALEXIS, Greek comic poet of the Middle Comedy, was born at Thurii and taken early to Athens, where he became a citizen. He wrote during the latter half of the 4th century and perhaps the early part of the 5th. Plutarch says that he lived to the age of 106, and that he died on the stage while being crowned. According to Suidas, who calls him Menander's uncle, he wrote 245 comedies, of which about 130 titles are preserved. The fragments (about 1,000 lines) attest the wit and refinement of the author (Koch, *Comicorum Atticorum Fragmenta*).

ALEXIS, WILLIBALD, the pseudonym of GEORG WILHELM HEINRICH HÄRING (1798-1871), German historical novelist. He was born June 29, 1798 at Breslau, where his father, who came of a French refugee family, named Hareng, was an official. He attended the Werdersche Gymnasium in Berlin, and served as a volunteer in the campaign of 1815. On his return he studied law at the universities of Berlin and Breslau. Settling in Berlin, he edited, 1827-35, the *Berliner Konversationsblatt*, in which for the first two years he was assisted by Friedrich Christoph Förster (1791-1868). In 1852 he retired to Arnstadt in Thuringia, where after many years of broken health he died Dec. 16, 1871.

Alexis made his name as a writer by an idyll in hexameters, *Die Treibjagd* (1820), and several short stories in which the influence of Tieck is observable; but his reputation was first established by two historical romances, *Walladmor* (1823), and *Schloss Avalon* (1827), which, published as being "freely translated from the English of Sir Walter Scott, with a preface by Willibald Alexis," so closely imitated the style of the famous Scotsman as really to deceive even Scott's admirers. Alexis published a number of successful short stories (*Gesammelte Novellen*, 1830-31), some books of travel, and the novels *Das Haus Dusterweg* (1835) and *Zwölf Nächte* (1838).

In *Cabanis* (1832), a story of the time of Frederick the Great, he entered the field of patriotic-historical romance, in which he earned the name of "der Maerkische Walter Scott" (Walter Scott of the Mark). *Cabanis* is written in the first person, is rather clumsy in construction, and has the faults of excessive romanticism. From 1840 onwards he published at short intervals a series of romances, each dealing with some epoch in the history of Brandenburg. Among them may be noted *Der Roland von Berlin* (1840); *Der falsche Woldemar* (1842); *Die Hosen des Herrn von Bredow* (1846-48), in which room is found for many delightful folk and ghost stories; and *Ruhe ist die erste Bürgerpflicht* (1852). In 1842, in conjunction with the publicist Julius Eduard Hitzig (1780-1849), he began the publication of *Der neue Pitaval* (continued by A. Vollert, Leipzig, 1842-65; new edition Leipzig,

1866-91), a collection of criminal anecdotes culled from all nations and all times. This publication attained great popularity, and is to-day of psychological interest and value.

BIBLIOGRAPHY.—His *Gesammelte Werke* were published in Berlin (1874); the *Vaterländische Romane* in eight volumes (1881, 1884), and, since the expiration of the copyright in 1901, in many cheap reprints. Cf. *W. Alexis' Erinnerungen*, edited by M. Ewert (1900); and essays by Julian Schmidt, *Neue Bilder aus dem geistigen Leben unserer Zeit* (1873); G. Freytag, *Werke*, vol. xvi. and xxiii.; A. Stern, *Zur Literatur der Gegenwart* (1880); and T. Fontane, *Bayreuther Blätter*, vi. (1883).

ALEXISBAD, a spa of Anhalt, Germany, under the Harz mountains, 1,000 ft. above sea-level, noted for its medicinal waters, of which the Alexisbrunnen, a ferruginous spring, is used for drinking, while the Selkebrunnen supplies the baths, which are of use in feminine disorders. The place was founded in 1810 by Duke Alexius of Anhalt-Bernburg.

ALEXIUS I. (1048-1118), emperor of the East, was the third son of John Comnenus, nephew of Isaac Comnenus, emperor 1057-59. His father declined the throne on the abdication of Isaac, who was accordingly succeeded by four emperors of other families between that date and 1081. Under one of these emperors, Romanus Diogenes (1067-71), he served with distinction against the Seljuk Turks. Under Michael Parapinaces (1071-78) and Nicephorus Botaniates (1078-81) he was also employed, along with his elder brother Isaac, against rebels in Asia Minor, Thrace and in Epirus (1071). The success of the Comneni roused the jealousy of Botaniates and his ministers, and the Comneni were almost compelled to take up arms in self-defence. Botaniates was forced to abdicate and retire to a monastery, and Isaac declined the crown in favour of his younger brother Alexius, who then became emperor in the 33rd year of his age. His long reign of nearly 37 years was full of difficulties (see ROMAN EMPIRE, LATER). At the very outset he had to meet the formidable attack of the Normans (Robert Guiscard and his son Bohemund), who took Dyrrhachium and Corfu, and laid siege to Larissa in Thessaly. The Norman danger ended for the time with Robert Guiscard's death (1085) and the conquests were recovered. He had next to repel the invasions of Patzinaks (Petchenegs) and Kumans in Thrace, with whom the Manichaean sects of the Paulicians and Bogomilians made common cause; and thirdly, he had to cope with the fast-growing power of the Turks in Asia Minor. Above all he had to meet the difficulties caused by the arrival of the warriors of the first crusade, which had been in a great degree initiated owing to the representations of his own ambassadors, though the help which he wanted from the West was simply mercenary forces and not the immense hosts which arrived to his consternation and embarrassment. The first part, under Peter the Hermit, he got rid of by sending them on to Asia Minor, where they were massacred by the Turks (1096). The second and much more serious host of warriors, led by Godfrey of Bouillon, he conducted also into Asia, promising to supply them with provisions in return for an oath of homage, and by their victories recovered for the empire a number of important cities and islands—Nicaea, Chios, Rhodes, Smyrna, Ephesus, Philadelphia, Sardis, and in fact most of Asia Minor (1097-99). This is ascribed as a credit to his policy and diplomacy by his daughter, by the Latin historians of the crusade to his treachery and falseness. The last 20 years of his life were marked by persecution of the followers of the Paulician and Bogomilian heresies (one of his last acts was to burn Basilus, a Bogomilian leader, with whom he had engaged in a theological controversy), by renewed struggles with the Turks (1110-17), and by anxieties as to the succession, which his wife Irene wished to alter in favour of her daughter Anne's husband, Nicephorus Bryennius, for whose benefit the special title panhypersebastos (i.e. as it were *augustissimus si quis alius*) was created. This intrigue disturbed even his dying hours. He deserves the credit of having raised the empire from a condition of anarchy and decay at a time when it was threatened on all sides by new dangers. No emperor devoted himself more laboriously or with a greater sense of duty to the task of ruling.

BIBLIOGRAPHY.—Zonaras xviii. 27-29; Anna Comnena's *Life*; see also Du Cange, *Familiae Byzantinae*; Friedrich Wilken, *Rerum ab*

Alexio I., Joanne, Manuele et Alexio II. Comnenis Romanorum, Byzantinorum imperatoribus gestarum, libri iv. Commentatio (Heidelberg, 1811); Finlay, *History of Greece* (vol. iii., Oxford, 1877); Gibbon, *Decline and Fall of the Roman Empire*, edited with notes, etc., by Prof. J. B. Bury (1898) where further authorities are cited; F. Chalandon, *Essai sur le règne d'Alexis I^{er} Comnène* (1900).
(J. B. B.)

ALEXIOUS II. (COMNENUS) (1167–1183), emperor of the East, was the son of Manuel Comnenus and Maria, daughter of Raymund, prince of Antioch, and was born at Constantinople on Sept. 10, 1167. On Manuel's death, Maria, who had been immured in a convent under the name of Xene, had herself proclaimed regent (1179–80), and handing over her son to evil counsellors, who encouraged him in every vice, supported the government of Alexius the protosebastos (nephew of Manuel), who was supposed to be her lover. The young Alexius and his friends now tried to form a party against the empress mother and the protosebastos; and his sister Maria, wife of Caesar John, stirred up riots in the streets of the capital. Their party was defeated (May 2, 1182), but Andronicus Comnenus took advantage of these disorders to enter Constantinople, where he was received with almost divine honours, and overthrew the regents. His arrival was celebrated by a barbarous massacre of the Latins in Constantinople, which he made no attempt to stop. He allowed Alexius to be crowned, but forced him to consent to the death of all his friends, including his mother, his sister and the Caesar, and refused to allow him the smallest voice in public affairs.

Andronicus was now formally proclaimed as coemperor, and not long afterward, on the pretext that divided rule was injurious to the empire, he caused Alexius to be strangled with a bowstring, and subsequently married Alexius' widow, Agnes, the daughter of Louis VII of France.

(J. B. B.; X.)

ALEXIOUS III. (Angelus), emperor of the East, was the second son of Andronicus Angelus, nephew of Alexius I. In 1195, while his brother Isaac II. was away hunting in Thrace, he was proclaimed emperor by the troops; he captured Isaac at Stagira, in Macedonia, put out his eyes, and kept him henceforth a close prisoner, though he had been redeemed by him from captivity at Antioch and loaded with honours. To compensate for this crime and to confirm his position as emperor, he had to scatter money so lavishly as to empty his treasury, and to allow such licence to the officers of the army as to leave the empire practically defenceless. He consummated the financial ruin of the state. The empress Euphrosyne tried in vain to sustain his credit and his court; Vatatzes, the favourite instrument of her attempts at reform, was assassinated by the emperor's orders. Eastward the empire was overrun by the Turks; from the north Bulgarians and Vlachs descended unchecked to ravage the plains of Macedonia and Thrace; while Alexius squandered the public treasure on his palaces and gardens. Soon he was threatened by a new and yet more formidable danger. In 1202 the western princes assembled at Venice, bent on a new crusade. To them Alexius, son of the deposed Isaac, made appeal, promising as a crowning bribe to heal the schism of East and West if they would help him to depose his uncle. The crusaders, whose objective had been Egypt, were persuaded to set their course for Constantinople, before which they appeared in June 1203, proclaiming the emperor Alexius IV. and summoning the capital to depose his uncle. Alexius III., sunk in debauchery, took no efficient measures to resist. His son-in-law, Lascaris, who was the only one to do anything, was defeated at Scutari, and the siege of Constantinople began. On July 17 the crusaders, the aged doge Dandolo at their head, scaled the walls and took the city by storm. During the fighting and carnage that followed Alexius hid in the palace and finally, with one of his daughters, Irene, and such treasures as he could collect, got into a boat and escaped to Develtum in Thrace leaving his wife, his other daughters and his empire to the victors. Isaac, drawn from his prison and robbed once more in the imperial purple, received his son in state.

Shortly afterwards Alexius made an effort in conjunction with Murzuphlus (Alexius V.) to recover the throne. The attempt was unsuccessful and, after wandering about Greece, he surrendered with Euphrosyne, who had meanwhile joined him, to Boniface of

Montferrat, then master of a great part of the Balkan peninsula. Leaving his protection he sought shelter with Michael, despot of Epirus, and then repaired to Asia Minor, where his son-in-law, Lascaris, was holding his own against the Latins. Alexius, joined by the sultan of Iconium (Konia) now demanded the crown of Lascaris, and on his refusal marched against him. Lascaris, however, defeated and took him prisoner. Alexius was relegated to a monastery at Nicaea, where he died on some date unknown.

See the records of Nicetas Acominatus, George Acropolites, Nicephorus Gregoras; and the sources quoted for the Fourth Crusade in the article CRUSADES.
(J. B. B.)

ALEXIOUS IV. (d. 1204), Byzantine Emperor, 1203–04. When Isaac II. was dethroned and blinded by his brother Alexius III., his son Alexius escaped, in 1201, to Germany, where he persuaded his brother-in-law, Philip of Suabia, and Boniface of Montferrat, the leader of the crusaders, to divert the fourth crusade to Constantinople. By 1203 Isaac was restored, with Alexius as joint emperor, but they were unable to fulfil the promises made to the crusaders that they would contribute men and money to the expedition to Jerusalem and would force the East to conform to the Western Church. In Jan. 1204 quarrels broke out between the crusaders and the Greeks, who revolted under the leadership of Murzuphlus. An officer, Canabus, was put on the throne, but was imprisoned by Murzuphlus, who had Alexius strangled, while Isaac died of shock. At this the crusaders, in self-defence against the Greeks, stormed and captured Constantinople a second time and elected Baldwin of Flanders as Latin Emperor. (See CRUSADES; also DANDOLO.)

ALEXIOUS V., eastern Roman emperor, was proclaimed emperor Feb. 5, 1204, during the siege of Constantinople by the Latins (fourth crusade). His name was Alexius Ducas Murzuphlus, and he was a connection of the imperial house of the Angeli. His elevation was the result of a revolution in the city against Isaac II. and Alexius IV. He conducted the defence with great bravery till it became hopeless (April 12), whereupon he fled. He would then have made common cause with Alexius III. against the Latins, but was blinded by that ex-monarch and fell into the hands of the crusaders, who put him to death by casting him from the top of the Pillar of Theodosius as the murderer of Alexius IV.

ALEXIOUS MIKHAILOVICH (1629–1676), tsar of Muscovy, the son of Tsar Michael Romanov and Eudoxia Stryeshnevaya, was born on March 9, 1629. A youth at his father's death (1645), he was committed to the care of Boris Ivanovich Morozov, who recognized the needs of his country and was accessible to Western ideas. He secured the truce with Poland and avoided complications with the Porte. His domestic policy was equitable, and aimed at relieving the public burdens by limiting the privileges of foreign traders and abolishing many useless and expensive court offices. On Jan. 17, 1648, he procured the marriage of the tsar with Maria Miloslavskaya, and he himself married her sister Anna ten days later.

The Miloslavskis were typical self-seeking 17th century boyars, whose extortions made them generally detested. In May 1648 the people of Moscow rose against them, and the young tsar was compelled to dismiss both them and their patron Morozov. There were disquieting disturbances all over the tsardom culminating in dangerous rebellions at Pskov and Great Novgorod, with which the Government was so unable to cope that it surrendered, practically granting the malcontents their own terms. The metropolitan Nikon (q.v.), who had displayed tact and courage at Great Novgorod, in consequence became in 1651 the tsar's chief minister.

In 1653 the weakness and disorder of Poland, which had just emerged from the savage Cossack war, encouraged Alexius to attempt to recover from her secular rival the old Russian lands. The campaign of 1654 was an uninterrupted triumph, and scores of towns, including the important fortress of Smolensk, fell into the hands of the Muscovites. In Jan. 1655 the rout of Ochmatov arrested their progress; but in the summer of the same year, the sudden invasion by Charles X. of Sweden for the moment swept the Polish State out of existence; the Muscovites, unop-

posed, quickly appropriated nearly everything which was not already occupied by the Swedes, and when at last the Poles offered to negotiate, the whole grand-duchy of Lithuania was the least of the demands of Alexis.

Fortunately for Poland, the tsar and the king of Sweden now quarrelled over the spoil, and at the end of May 1656 Alexis declared war against him. Great things were expected of the Swedish war, but nothing came of it. Dorpat was taken, but countless multitudes were lost in vain before Riga. In the meantime Poland had so far recovered herself as to become much more dangerous than Sweden. The tsar rid himself of the Swedes by the peace of Kardis (July 2, 1661), whereby Muscovy retroceded all her conquests. The Polish war dragged on for six years longer and was then concluded by a truce, nominally for 13 years, which proved the most durable of treaties.

By the truce of Andruszovo (Feb. 11, 1667) Vitebsk, Polotsk and Polish Livonia were restored to Poland, but Smolensk and Kiev remained in the hands of the Muscovites, together with the whole eastern bank of the Dnieper. This truce was the achievement of Athanasius Orduin-Nashchokin, the first Russian chancellor and diplomatist in the modern sense, who after the disgrace of Nikon became the tsar's first minister till 1670, when he was superseded by Artamon Matveyev. Nikon had become too powerful for the tsar, and on the return of Alexis from the Polish war there arose a conflict over the question of ecclesiastical authority in the State, ending in Nikon's trial and deprivation in 1667.

Alexis had the art of discovering good advisers and the good sense to employ them. He was not a man of strong character, or he would not have submitted to the dictation of Nikon. He was naturally progressive, though in a timid way, or he would not have supported the reforms of Matveyev. He was learned in his own way, wrote verses and began a history of his own time. His last years were tranquil, in spite of the rebellion of Stenka Razin. By his first wife he had a large family, and by his second, Natalia Narushkina, two children, the tsarevich Peter and the tsarevna Natalia.

See Robert Nisbet Bain, *The First Romanovs* (London, 1905).

ALEXIUS PETROVICH (1690-1718), Russian tsarevich, the sole surviving son of Peter I. and Eudoxia Lopukhina, was born on Feb. 19, 1690. The young tsar married the *boyarina* Lopukhina at his mother's command. From the first, her society bored Peter unspeakingly, and, after the birth (Oct. 3, 1691) of their second short-lived son Alexander, he practically deserted her. The young Alexis was ignored by his father till he was nine years old, and was privately educated. In 1703 he was ordered to the field as a private in a bombardier regiment in the army. In 1704 he was present at the capture of Narva.

In 1708 Peter sent Alexis to Smolensk to collect provender and recruits, and thence to Moscow to fortify it against Charles XII. At the end of 1709 he went to Dresden for 12 months for finishing lessons in French and German, mathematics and fortification, and, his education completed, he was married on Oct. 14, 1711, greatly against his will, to the Princess Charlotte of Brunswick-Wolfenbüttel. Three weeks later the bridegroom was hurried away by his father to Thorn to superintend the provisioning of the Russian troops in Poland. For the next 12 months Alexis was kept constantly on the move. His wife joined him at Thorn in December, but in April 1712 a peremptory ukase ordered him off to the Army in Pomerania, and in the autumn of the same year he was forced to accompany his father on a tour of inspection through Finland. Immediately on his return from Finland, Alexis was despatched by his father to Staraya Rusya and Ladoga to see to the building of new ships. This was the last commission entrusted to him. On his return to the capital, Peter, in order to see what progress his son had made in mechanics and mathematics, asked him to draw something of a technical nature for his inspection. Alexis, in order to escape such an ordeal, disabled his right hand by a pistol-shot. In no other way could the tsarevich have offended his father so deeply. He had behaved like a cowardly recruit who mutilates himself to escape military service. After this, Peter employed him no more. He

no longer pressed him to attend public functions. Alexis rejoiced at this welcome change, but he had cause rather to fear it.

On Oct. 22, 1715, Alexis's consort, the Princess Charlotte, died, after giving birth to a son, the Grand-duke Peter, afterwards Peter II. On the day of the funeral, Peter addressed to Alexis a stern letter urging him no longer to resemble the slothful servant in the parable, and threatening to cut him off if he did not acquiesce in his father's plans. Alexis wrote a pitiful reply to his father, offering to renounce the succession in favour of his baby half-brother Peter, who had been born the day after the Princess Charlotte's funeral. In Jan. 1716 he wrote to his father for permission to become a monk. Still Peter did not despair. On Aug. 26, 1716, he wrote to Alexis from abroad urging him, if he desired to remain tsarevich, to join him and the Army without delay.

But Alexis fled to Vienna and placed himself under the protection of his brother-in-law, the Emperor Charles VI., who sent him for safety first to the Tyrolean fortress of Ahrenberg, and finally to the castle of San Elmo at Naples. He was accompanied throughout his journey by his mistress, the Finnish girl Afrosina. That the emperor sincerely sympathized with Alexis, and suspected Peter of harbouring murderous designs against his son, is plain from his confidential letter to George I. of England, whom he consulted.

Peter's agitation was extreme. The flight of the tsarevich was a reproach and a scandal. He must be recovered and brought back to Russia at all hazards. This task was accomplished by Count Peter Tolstoi, the most subtle and unscrupulous of Peter's servants; but terrorized though he was, Alexis would only consent to return on his father's solemnly swearing, "before God and His judgment seat," that if he came back he should not be punished, but cherished as a son and allowed to live quietly on his estates and marry Afrosina.

On Jan. 31, 1718, the tsarevich reached Moscow. On Feb. 18 a "confession" was extorted from Alexis which implicated most of his friends, and he then publicly renounced the succession to the throne in favour of the baby grand-duke Peter Petrovich. A reign of terror ensued, in the course of which the ex-tsaritsa Eudoxia was dragged from her monastery and publicly tried for alleged adultery, while all who had in any way befriended Alexis were impaled, broken on the wheel or otherwise done to death. In April 1718 fresh confessions were extorted from Alexis, now half idiotic with fright. Yet even now there were no actual facts to go upon. The worst that could be brought against him was that he had "wished" his father's death. In the eyes of Peter, his son was now a self-convicted and most dangerous traitor, whose life was forfeit. But there was no getting over the fact that his father had sworn "before the Almighty and His judgment seat" to pardon him and let him live in peace if he returned to Russia. But did the enormity of the tsarevich's crime absolve the tsar from the oath? This question was solemnly submitted by Peter to a grand council of prelates, senators, ministers and other dignitaries on June 13, 1718. The clergy left the matter to the tsar's own decision. The temporal dignitaries declared the evidence to be insufficient and suggested that Alexis should be examined by torture. Accordingly, on June 19, the weak and ailing tsarevich received 25 strokes with the knout (as then administered, nobody ever survived 30), and on the 24th 15 more. He expired two days later in the guard-house of the citadel of St. Petersburg, two days after the senate had condemned him to death for "imagining" rebellion against his father, and for "hoping" for the co-operation of the common people and the armed intervention of his brother-in-law, the emperor.

See R. N. Bain, *The First Romanovs* (London, 1905); Comte de Vogue, *Mazepa. Un changement de règne* (Paris, 1884).

ALFA or HALFA: see ESPARTO.

ALFALFA, LUCERNE or PURPLE MEDICK, known botanically as *Medicago sativa*, is a leguminous forage plant famed in the regions of its adaptation for its tolerance of drought, heat and cold; for the remarkable productivity and the quality of its herbage; and for its incidental value in soil improvement. It is grown primarily for hay, pasturage and silage. The plant is an

erect, long-lived, tap-rooted, perennial herb with numerous, thin, hollow and branching stems arising from a much-branched crown which is partially embedded in the surface layer of soil. As the plant develops, numerous stems bearing many trifoliate leaves, arise from the crown buds and attain lengths of from 1 to 5 ft. Racemes of small flowers arise from the upper axillary buds of the stems. The flowers of all commercial varieties are predominantly purple. This is particularly true of the types grown in Russian Turkistan and the regional strains of common alfalfa grown in North and South America. However, from 5 to 30% of variegated and yellow flowers occur in such well-known hardy commercial varieties as Grimm, Cossack, Ladak and Canadian variegated. These were derived from natural crosses between the purple *M. sativa* and the wild yellow-flowered species, *M. falcata*. With approaching maturity, coiled pods containing from two to eight or more seeds develop abundantly in regions with much sunshine, moderate heat and dry weather.

The primary root of alfalfa attains great depths. When 20 or more years of age this tap root may descend as much as 50 ft. or more, where the subsoil is porous. This accounts for the unusual ability of the plant to tolerate drought. The roots of seedling plants are known to penetrate the soil for 3 ft. when two months, and for 6 ft. with plants five months of age. Not infrequently, newly established fields of alfalfa survive severe summer drought and heat when stands of red, alsike and white clover, and other members of the genus *Trifolium* may succumb, partly because the roots are much shallower and more branching.

Alfalfa has remarkable capacity for rapid and abundant regeneration of dense growths of new stems and leaves following cutting. This makes possible from one to as many as 13 crops of hay in one growing season. The frequency of harvest and the total seasonal yields are dependent largely on the length of the growing season, the fertility of the soil, the abundance of sunshine, and especially the amount and distribution of rainfall or irrigation during the growing season. On nonirrigated lands yields of from two to four tons per acre are common, but with long growing seasons and with irrigation as much as ten tons of dry hay per acre are obtained. Green leafy alfalfa hay is very nutritious and palatable, containing about 16% proteins and 8% mineral constituents. In addition it is rich in vitamins A, E, D and G.

Although alfalfa is highly tolerant to drought and heat, it utilizes very large quantities of water to produce forage. A yield of three tons of dry herbage per acre requires the absorption by the roots from the soil of approximately 2,490 tons of water, the equivalent of about 22 in. of rainfall. Such heavy utilization of water greatly reduces the reserves of subsoil moisture and yields may decline markedly unless the moisture supply is replenished adequately by rainfall, surface irrigations or subirrigation. Most all water utilized for growth is lost in transpiration, being evaporated through the leaf pores or stomates after passage through the stems and the veins of the leaflets. In the course of growth, some of the water is combined with carbon dioxide in the synthesis of sugar and numerous other organic compounds, of which the dry matter of the plant is largely constituted.

Although a native of the old world, the acreage of alfalfa occurs primarily in the western hemisphere. Estimates vary, but in 1942 it is probable that 37,000,000 ac. of alfalfa were grown in the

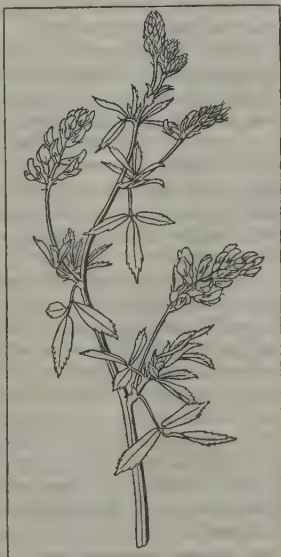
world of which not less than 50% was grown in Argentina and 43% in the United States. It is likely that alfalfa had its origin in the dry, hot regions east of the Mediterranean. It occurs in the wild state in the Transcaucasian mountains of southern Russia together with many other species of *Medicago*. Historically, alfalfa has been grown for a longer period for forage than any other plant. Incident to the invasion of Greece it was introduced into that country by Medes and Persians about 400 B.C. It was grown extensively in Italy in the 1st century and the Romans introduced it into other parts of Europe. It is probable that the Moors also introduced alfalfa into Spain. It was the Spaniards, who, coincident with their lure for gold, brought alfalfa to the new world, having introduced it into South America in the 16th century.

While alfalfa may have been introduced into southwestern United States from Mexico through Spanish influence, it was the discovery of gold in California in 1848 which gave alfalfa culture its great impetus in the western states. The gold seekers from the eastern states brought alfalfa from Chile to California in 1854 where it became known as "Chilean clover" and later as Spanish or common alfalfa. Subsequently, alfalfa culture spread through the west as this vast territory was settled by the migrations of settlers from the eastern states.

Alfalfa was introduced into eastern United States by the early colonists. George Washington and Thomas Jefferson attempted to grow it, but its culture met with but little success in this humid region with its leached and highly acid soils. In only a few areas of the eastern states, where soils derived from limestone were abundant in mineral residues, did the culture of alfalfa persist.

In the western states, with arid or semiarid climates, soils were high in mineral residues containing calcium, phosphorus and potassium compounds and other sources of nutrients which are requisites for successful alfalfa culture. In addition, the climate with its abundant sunshine and favourable winters was, in the main, ideal for alfalfa culture. It is not surprising, therefore, that alfalfa culture was predominantly a western enterprise for more than 70 years after its introduction into California in 1854. In 1899, 2,000,000 ac. of alfalfa were harvested for hay and 97% of this was grown in the 17 western states, Nebraska, California, Kansas, Idaho, Oregon, Washington, Nevada, Utah, Arizona, New Mexico, Colorado, Wyoming, Montana, North and South Dakota, Oklahoma and Texas. In 1929, the total acreage of alfalfa harvested for hay was 11,500,000 ac. of which 71% was grown in the aforementioned western states. By this time, however, extensive researches, demonstrations and experience had established clearly the significant fact that alfalfa could be grown successfully in the northern humid states by adjusting the soil environment with applications of various forms of lime and of phosphate and potash fertilizers. These practices, along with the development of artificial cultures for the inoculation of seed with nitrogen-fixing bacteria; the improvement of seeding techniques; the establishment of proper managerial practices; and the utilization of winter-hardy varieties such as Grimm, Canadian variegated, Cossack and Ladak instead of the less hardy regional strains of American common, presaged the remarkable eastward expansion of alfalfa culture. Minnesota, Wisconsin, Michigan, Iowa, Illinois, Indiana, Ohio, Kentucky and Missouri grew 45% of the total of the 16,000,000 ac. grown for hay in the United States in 1942 compared with 45% for the 17 western states and 10% for the remaining eastern and southern states. In the six-year period from 1937 to 1942, the only states which grew more than 1,000,000 ac. of alfalfa hay each were Minnesota, Wisconsin, Michigan and Iowa.

Like all crops, alfalfa is beset with hazards of climate, diseases and insects. Among the more serious of these are winterkilling, bacterial wilt disease, grasshoppers and leafhoppers. In the humid and in the irrigated areas, stands three or more years of age have often become badly thinned by the infections from the soil-borne bacterial wilt organism, *Phytophthora infestans*. Severe damage is caused periodically by winter manifestations of the humid areas such as enduring and contacting sheets of ice, or protracted



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LUCERNE OR ALFALFA (*MEDICAGO
SATIVA*)

periods of extremely cold weather without the insulation of snow or vegetative cover or both, or long periods of alternate freezing and thawing which on heavy, water-saturated soils lift or "heave" the plants, exposing the crown to harmful aerial temperatures and desiccation. Such losses are greatly reduced through the selection of soils with good surface and underdrainage; through managerial treatments; and by the use of winter-hardy and wilt-resistant varieties such as the new synthetic variety, Ranger. Orestan, Ladak and Cossack alfalfas are winter-hardy and moderately resistant to wilt but Grimm and Canadian variegated are winter-hardy but very susceptible to the wilt disease. Grasshoppers which defoliate alfalfa plants in dry weather are widely distributed but "outbreaks" of them are checked with poison bait. The tiny leafhoppers, *Empoasca fabae*, which cause stunting and yellowing of summer growths of alfalfa in warm humid areas may be controlled by cutting management under some conditions.

See F. B. Morrison, *Feeds and Feeding* (20th ed. 1936); Hayward, *The Structure of Economic Plants* (1938); *Climate and Man* (U.S. Dept. of Agriculture, yearbook of agriculture, 1941). (L. F. G.)

ALFALFA WEEVIL, a snout-beetle, or weevil (*Phytonomus posticus*) of Old World origin, which feeds upon alfalfa, or lucerne (*Medicago sativa*). Although widely distributed in Europe, where its host plant is extensively grown, it attracted little attention until it was accidentally introduced into the United States in the early years of the 20th century. It appeared suddenly in 1904 in the vicinity of Salt Lake City, a region where the alfalfa crop is of great importance, multiplied and spread rapidly, causing great alarm to the agricultural and livestock industries. It spread steadily at the rate of from 10 to 20 mi. a year, and in 1927 occurred in great numbers through the Great Basin and the Snake river watershed, in large areas of the Colorado and North Platte drainage basins, and in the territory of the Yellowstone and Sacramento rivers. It is a constant threat to the great alfalfa regions to the east, and its spread cannot be prevented by regulating the production and marketing of the crop, since it feeds on other leguminous plants, some of which are wild.

The adult weevil is dark brown in colour and about $\frac{1}{8}$ in. long. In this stage it passes the winter, usually in crevices in the ground. In the spring the adults begin feeding on the earliest growth of the plant, and lay their eggs either in old, dry stems or in the living stems. In warm weather these eggs hatch in from one to two weeks, and the young larvae begin to feed on the leaves, especially on the opening tips, rapidly skeletonizing them—so rapidly, in fact, that the plant is unable to outgrow the injury. When full grown, the greenish larvae spin loose cocoons from which adults emerge in the summer. The cocoons are found attached to the stems, in curled leaves or on the ground.

During the first nine years in America, the weevil spread rapidly and nearly destroyed the first crop of alfalfa each year. Since then there have been fluctuations in the amount of damage, probably because of climatic changes. Damage to alfalfa in 1938 by this insect was estimated to have been at least \$250,000. Systematic studies have been carried on by the federal bureau of entomology and by the official entomologists of Utah and the neighbouring states since the insect was first discovered. Ten species of parasites have been imported from Europe by the federal experts, and one of these (*Bathyplectes curculionis*) is thoroughly established and has spread throughout most of the infested territory. In some localities it has been known to kill 90% of the weevil larvae; but the rate of increase of the weevil is so rapid that even this percentage does not bring about control, and artificial remedial measures must be relied upon. Of the artificial measures, prompt cutting of the first crop as soon as it reaches prebloom stage, or spraying or dusting the first crop at just the proper time with powdered arsenate of calcium has been found to be the most effective, by which method it is still possible to grow alfalfa with profit, in spite of the weevil. See *Farmers' Bulletin*, No. 1,528, U.S. Department of Agriculture. (L. O. H.)

See C. L. Metcalf and W. P. Flint, *Destructive and Useful Insects*, 2nd ed. (1939).

ALFANO, FRANCO (1876–), Italian composer, was born at Posilippo, near Naples, March 8, 1876. He studied at Naples and Leipzig, wrote his first opera, *Miranda*, in 1896, and assumed a leading position among contemporary Italian composers with *Resurrezione* (Turin, 1904). Other successful operas included *L'ombra di Don Giovanni* (Milan, 1914), *Sacuntala* (Bologna, 1921), *Madonna Imperia* (Turin, 1927) and *Cyrano de Bergerac* (Buenos Aires, 1937). His operas combine successfully the lyrical and fully developed arias and ensemble numbers of the Italian school with Wagnerian orchestration

and chromatic harmonies. He also wrote two symphonies, two string quartets, and various other works for orchestra, chamber music combinations, piano and voice. From 1919 to 1923 he was director of the Liceo Musicale of Bologna, and after 1923 of the Liceo Musicale of Turin. In 1924 he was selected by the heirs of Giacomo Puccini to complete the master's unfinished opera, *Turandot*.

See Guido M. Gatti, "Franco Alfano," *Musical Times*, vol. 62 (London, 1921). (D. E.)

ALFELD, chief town of a subdivision of the district of Hildesheim, in the Prussian province of Hanover, on the river Leine, about 15 mi. S.S.W. of Hildesheim. Pop. (1933) 7,221. It has a church with twin spires. Its industries are papermaking, iron founding and the production of agricultural machinery.

ALFIERI, VITTORIO, COUNT (1749–1803), famous tragic dramatist of Italy, was born at Asti in Piedmont, of rich and noble parents. His father died when he was an infant and his mother married again, but an uncle took an interest in his education and sent him in his tenth year to the Academy of Turin. By the death of this uncle he was left, at the age of 14, to enjoy without control his vast paternal inheritance, augmented by the recent accession of his uncle's fortune; but for three more years he remained at the academy, though he seems to have learned very little there except contempt for his studies and for the life which he saw about him. Eager to escape from it, he obtained leave of the king to travel, and left Turin in 1766 under the care of an English tutor, from whom, however, he soon parted.

For nearly seven years he travelled about Europe, visiting most of the capitals, and indulging in a series of amorous adventures, of which he gives some account in his interesting autobiography; but although much of his time was wasted in dissipation, he found in England the political liberty which became his ideal, and in France the literature which seems to have influenced him most profoundly. He studied Voltaire, Rousseau and, above all, Montesquieu; and his reading confirmed in him that love of freedom and hatred of all tyranny which were henceforward his most marked characteristics.

In 1772 he returned to Turin, but two more years were wasted in yet another intrigue before he found in Plutarch's *Lives*—his "book of books," as he called it—a stimulus to literary composition, and, identifying himself with the love-sick Antony, wrote a play entitled *Cleopatra*, which was acted in 1775. Well aware of its defects, he persuaded the producer to withdraw it after the second performance; but its immediate success filled him with ambition to excel as a dramatist, and, since no great tragic poet had yet arisen in Italy, he determined to devote himself to the composition of tragedies.

As a Piedmontese who had spent so many years abroad, he was gravely handicapped by his ignorance of classical Italian, and indeed his first two tragedies, *Filippo* and *Polinice*, were conceived and written in French prose. Much hard study was required before he could translate them into Italian blank verse (for which Cesarotti's version of *Ossian* served him as a model), but he had at last found an object in life, and so ardently did he devote himself to its achievement that in eight years he had 14 tragedies to his credit, ten of which were published at Siena in 1783. During the same period he found time to write many translations and original lyrics, including five odes on American independence, as well as a treatise, *Della Tirannide*, which however was not published until many years later. His first series of tragedies culminated in *Saul*, which many critics besides himself have regarded as his best play, and when he wrote it he intended it to be his last.

Meanwhile, in 1777, he had found in the Countess of Albany (*q.v.*) a new love, to whom he remained faithful for the rest of his life; and, in order to be free to follow her, in 1778 he ended his allegiance to Piedmont by making over his estate there to his sister. One of his plays, *Maria Stuarda*, was dedicated to the countess, but it was not until she had left Italy to reside at Colmar in Alsace (1784) that he was able to see her freely, and thenceforward until his death he lived with her. Immediately after Vittorio Alfieri joined her he was moved to break his previous resolution and write five more tragedies, one of which, *Mirra*, has been preferred by some good judges even to *Saul*; and

it was at this time, too, that he completed his treatise *Del Principe e delle Lettere*, an exercise in the manner of Machiavelli, which was not published until 1801. From Alsace the lovers moved to Paris, and there in 1788-89 Alfieri supervised the printing of a complete edition of his tragedies by Didot.

When the Revolution began he hailed it with an ode on the taking of the Bastille; but the excesses of the populace could not fail to disgust a republican who, as Byron said of him, "was an aristocrat at heart." In 1792 he escaped with the Countess from France and settled in Florence, where they lived for the rest of his life. The property which he had left in France was confiscated, on the plea that he was an emigrant, and this fact helps to explain the hatred of all things French which found expression in his *Misogallo*, a collection of violent polemics in prose and verse, which was published in 1799, the year when the French troops first entered Florence. Although he never ceased to rage against tyranny—not only of kings and priests, but of revolutionaries as well—the last years of his life were undisturbed and he devoted them to quiet study, teaching himself Greek, and even trying to write comedies, for which he had no real gift. These, like his autobiography, his satires, and many of his lyric poems, were not published until after his death, which occurred at Florence, Oct. 8, 1803. He was buried in Santa Croce, and there the Countess of Albany caused a monument by Canova to be dedicated to his memory seven years later. A collected edition of his works was published at Florence in 22 volumes (1805-15).

Alfieri's literary reputation rests chiefly on his 19 tragedies, which were all strictly classical in form, adhering even more closely than their models to the unity of action or interest. Subordinate episodes and verbal ornaments were ruthlessly excluded from them, and no more than four principal characters were admitted on the stage.

But the genius of their author was essentially lyrical, and the situation which he treats most often and with most success—that of the hero defying tyranny—is one in which he was able to identify himself with the "splendid rebel," and use him as a mouthpiece for his passionate denunciation of tyrants or praises of freedom. For this his somewhat harsh style, *pensato e non cantato*, which was an offense to his contemporaries, is now recognized to be the most appropriate vehicle.

But plays written to serve as weapons for political warfare are rarely successful dramatically, and Alfieri too often sacrificed dramatic propriety to special pleading. It is as a precursor of the Risorgimento that he is specially honoured in Italy today, and it was in a section of the *Misogallo* that he first turned from generalizations about freedom to make a direct appeal to his countrymen to recover their own.

By that appeal and by many of his lyrics, which he claimed to have written as spurs to arouse the new generations and make them worthy of their Roman ancestors, he certainly helped to revive the national spirit and earned the title of *Vate d'Italia* by which he is honoured today.

See Antoine de Latour, *Mémoires de Victor Alfieri* (French trans. Paris, 1840); Sismondi, *De la lit. du midi de l'Europe*; J. C. Walker, *Historical Memoir on Italian Tragedy* (1799); *Giorn. de Pisa*, tom. lviii.; Centofanti, *Life of Alfieri* (1842); Emilio Teza, *Vita, Giornali, Lettere di Alfieri* (1861); Antonini and Cognetti, *Vittorio Alfieri* (1898).

ALFORD, HENRY (1810-1871), English divine and scholar, was born in London on Oct. 7, 1810, of a Somersetshire family which had given five consecutive generations of clergymen to the Church of England. He was a precocious lad who wrote Latin odes and a history of the Jews before he was ten. He graduated from Trinity college, Cambridge, in 1832, being 34th wrangler and 8th classic, and in 1834 became a fellow of his college.

Alford was vicar of Wymeswold (1835-53), preached at Quebec chapel in London (1853-57) and was dean of Canterbury from 1857 to his death on Jan. 12, 1871.

Dean Alford was a man of many and varied accomplishments. He published some volumes of verse, wrote some popular hymns, and was the first editor of the *Contemporary Review*. But his

chief fame rests upon his monumental edition of the New Testament in Greek, which occupied him from 1841 to 1861. In this work he first brought before English students a careful collation of the readings of the chief mss., and the researches of the ripest continental scholarship of his day.

Though more recent research, patristic and papyral, has largely changed the method of New Testament exegesis, Alford's work is still a quarry where the student can dig with a good deal of profit.

His *Life*, written by his widow, appeared in 1873 (Rivington).

ALFRED or AELFRED, known as **THE GREAT** (848?-900), king of England, was born at Wantage, and was the fifth son of King Aethelwulf and his first wife Osburh. He seems to have been a child of singular attractiveness and promise, and stories of his boyhood were remembered. At the age of five (853) he was sent to Rome, where he was confirmed by Leo IV, who is also stated to have "hallowed him as king." Later writers interpreted this as an anticipatory crowning in preparation for his ultimate succession to the throne of Wessex. That, however, could not have been foreseen in 853, as Alfred had three elder brothers living.

It is probably to be understood as investiture with the consular insignia, or possibly with some titular royalty such as that of the under-kingdom of Kent. In 855 Alfred again went to Rome with his father Aethelwulf, returning towards the end of 856. About two years later his father died.

During the short reigns of his two eldest brothers, Aethelbald and Aethelbert, nothing is heard of Alfred. But with the accession of the third brother Aethelred (866), the public life of Alfred begins, and he enters on his great work of delivering England from the Danes. It is in this reign that Asser applies to Alfred the unique title of *secundarius*, which seems to indicate a position analogous to that of the Celtic *tanist*, a recognized successor, closely associated with the reigning prince. It is probable that this arrangement was definitely sanctioned by the witenagemot, to guard against the danger of a disputed succession should Aethelred fall in battle. In 868 Alfred married Ealhswith, daughter of Aethelred Mucill, an ealdorman of the Gaini, an unidentified district.

The same year the two brothers made an unsuccessful attempt to relieve Mercia from the pressure of the Danes. For nearly two years Wessex had a respite. But at the end of 870 the storm burst; and the year which followed has been rightly called "Alfred's year of battles." Nine general engagements were fought with varying fortunes, though the place and date of two of them have not been recorded. A successful skirmish at Englefield, Berkshire (Dec. 31, 870), was followed by a severe defeat at Reading (Jan. 4, 871), and this, four days later, by the brilliant victory of Ashdown, near Compton Beauchamp in Shrivensham Hundred. On Jan. 22, the English were again defeated at Basing, and on March 22, at Marton, Wiltshire, the two unidentified battles having perhaps occurred in the interval.

In April Aethelred died, and Alfred succeeded to the whole burden of the contest. While he was busied with his brother's funeral, the Danes defeated the English in his absence at an unnamed spot, and once more in his presence at Wilton in May. After this peace was made, and for the next five years the Danes were occupied in other parts of England, Alfred merely keeping a force of observation on the frontier. But in 876 part of the Danes managed to slip past him and occupied Wareham; whence, early in 877, under cover of treacherous negotiations, they made a dash westwards and seized Exeter. Here Alfred blockaded them, and a relieving fleet having been scattered by a storm, the Danes had to submit and withdrew to Mercia. But in Jan. 878 they made a sudden swoop on Chippenham, where Alfred had been keeping his Christmas, "and most of the people they reduced except the King Alfred, and he with a little band made his way . . . by wood and swamp, and after Easter he . . . made a fort at Athelney; and from that fort kept fighting against the foe" (*Chron.*). The idea that Alfred during his retreat at Athelney was a helpless fugitive rests upon the foolish legend of the cakes. In reality he was organizing victory.

By the middle of May his preparations were complete and he moved out of Athelney, being joined on the way by the levies of Somersetshire, Wiltshire and Hampshire. The Danes on their side moved out of Chippenham, and the two armies met at Edington in Wiltshire. The result was a decisive victory for Alfred. The Danes submitted. Guthrum, the Danish king, and 29 of his chief men accepted baptism. By the next year (879) not only Wessex, but Mercia west of Watling Street, was cleared of the invader.

This is the arrangement known as the peace of Wedmore (878), though no document embodying its provisions is in existence. And though for the present the northeastern half of England, including London, remained in the hands of the Danes, in reality the tide had turned, and western Europe was saved from the danger of becoming a heathen Scandinavian power.

For the next few years there was peace, the Danes being kept busy on the continent. A landing in Kent in 884 or 885¹, though successfully repelled, encouraged the East Anglian Danes to revolt. The measures taken by Alfred to repress this revolt culminated in the capture of London in 885 or 886, and the treaty known as Alfred and Guthrum's peace, whereby the boundaries of the treaty of Wedmore (with which this is often confused) were materially modified in Alfred's favour. Once more for a time there was a lull; but in the autumn of 892 (893) the final storm burst. The Danes amounting in the aggregate to 330 sail, crossed to England in two divisions, finding their position on the Continent becoming more and more precarious, and entrenched themselves, the larger body at Appledore and the lesser under Haesten at Milton in Kent. The fact that the new invaders brought their wives and children with them shows that this was no mere raid, but a deliberate attempt, in concert with the Northumbrian and East Anglian Danes, to conquer England. Alfred, 893 (894), took up a position whence he could observe both forces.

While he was negotiating with Haesten the Danes at Appledore broke out and struck northwestwards, but were overtaken by Alfred's eldest son, Edward, and defeated in a general engagement at Farnham, and driven to take refuge in Thorney Island in the Hertfordshire Colne, where they were blockaded and ultimately compelled to submit. They then fell back on Essex, and after suffering another defeat at Benfleet coalesced with Haesten's force at Shoebury. Alfred had been on his way to relieve his son at Thorney when he heard that the Northumbrian and East Anglian Danes were besieging Exeter and an unnamed fort on the coast of North Devon. Alfred at once hurried westwards and raised the siege of Exeter; the fate of the other place is not recorded.

Meanwhile the force under Haesten set out to march up the Thames valley, possibly with the idea of assisting their friends in the west. But they were met by a large force under the three great ealdormen of Mercia, Wiltshire and Somersetshire, and forced to head off to the northwest, being finally overtaken and blockaded at Buttington, which some identify with Buttington Tump at the mouth of the Wye, others with Buttington near Welshpool. An attempt to break through the English lines was defeated with loss; those who escaped retreated to Shoebury. Then after collecting reinforcements they made a sudden dash across England and occupied the ruined Roman walls of Chester. The English did not attempt a winter blockade, but contented themselves with destroying all the supplies in the neighbourhood. And early in 894 (895) want of food obliged the Danes to retire once more to Essex.

At the end of this year and early in 895 (896) the Danes drew their ships up the Thames and Lea and fortified themselves 20 miles above London. A direct attack on the Danish lines failed, but later in the year Alfred saw a means of obstructing the river so as to prevent the egress of the Danish ships. The Danes realized that they were out-manoeuvred. They struck off northwestwards and wintered at Bridgnorth. The next year, 896 (897)

they abandoned the struggle. Some retired to Northumbria, some to East Anglia; those who had no connections in England withdrew to the continent. The long campaign was over.

The result testifies to the confidence inspired by Alfred's character and generalship, and to the efficacy of the military reforms initiated by him. These were (1) the division of the *fyrð* or national militia into two parts, relieving each other at fixed intervals, so as to ensure continuity in military operations; (2) the establishment of fortified posts (burgs) and garrisons at certain points; (3) the enforcement of the obligations of thanehood on all owners of five hides of land thus giving the king a nucleus of highly equipped troops. After the final dispersal of the Danish invaders Alfred turned his attention to the increase of the navy, and ships were built according to the king's own designs, partly to repress the ravages of the Northumbrian and East Anglian Danes on the coasts of Wessex, partly to prevent the landing of fresh hordes. This is not, as often asserted, the beginning of the English navy. There had been earlier naval operations under Alfred. One naval engagement was certainly fought under Aethelwulf (851), and earlier ones, possibly in 833 and 840. Nor were new ships a great success, as we hear of them grounding in action and foundering in a storm.

Much, too, was needed in the way of civil re-organization, especially in the districts ravaged by the Danes. In the parts of Mercia acquired by Alfred, the shire system seems now to have been introduced for the first time. This is the one grain of truth in the legend that Alfred was the inventor of shires, hundreds and tithings. The finances also would need careful attention; but the subject is obscure, and we cannot accept Asser's description of Alfred's appropriation of his revenue as more than an ideal sketch. Alfred's care for the administration of justice is testified both by history and legend; and the title "protector of the poor" was his by unquestioned right.

Of the action of the *witenagemot* we do not hear very much under Alfred. That he was anxious to respect its rights is conclusively proved, but both the circumstances of the time and the character of the king would tend to throw more power into his hands. The legislation of Alfred probably belongs to the later part of the reign, after the pressure of the Danes had relaxed. The details of it cannot be discussed here.

Asser speaks grandiosely of Alfred's relations with foreign powers, but little definite information is available. He certainly corresponded with Elias III, the patriarch of Jerusalem, and probably sent a mission to India. Embassies to Rome conveying the English alms to the pope were fairly frequent; while Alfred's interest in foreign countries is shown by the insertions which he made in his translation of *Orosius*. His relations to the Celtic princes in the southern half of the island are clearer. Comparatively early in his reign the South Welsh princes, owing to the pressure on them of North Wales and Mercia, commended themselves to Alfred. Later in the reign the North Welsh followed their example, and the latter co-operated with the English in the campaign of 893 (894). The Celtic principality in Cornwall which seems to have survived at least till 926, must long have been practically dependent on Wessex. That Alfred sent alms to Irish as well as to continental monasteries may be accepted on Asser's authority; the visit of the three pilgrim "Scots" (*i.e.*, Irish) to Alfred in 891 is undoubtedly authentic; the story that he himself in his childhood was sent to Ireland to be healed by St. Modwenna, though mythical, may point to Alfred's interest in that island.

The history of the church under Alfred is most obscure. The Danish inroads had told heavily upon it; the monasteries had been special points of attack, and though Alfred founded two or three monasteries and imported foreign monks, there was no general revival of monasticism under him. To the ruin of learning and education wrought by the Danes, and the practical extinction of the knowledge of Latin even among the clergy, the preface to Alfred's translation of Gregory's *Pastoral Care* bears eloquent testimony. It was to remedy these evils that he established a court school, after the example of Charles the Great; for this he imported scholars like Grimbald and John the Saxon from

¹Where alternative dates are given the later date is that of the *Saxon Chronicle*. But the evidence of the Continental Chronicles makes it probable that the *Saxon Chronicle* is a year in advance of the true chronology in this part.

the continent and Asser from South Wales; for this, above all, he put himself to school, and made the series of translations for the instruction of his clergy and people, most of which still survive. These belong unquestionably to the later part of his reign, not improbably to the last four years of it, during which the chronicles are almost silent.

Apart from the lost *Handboc* or *Encheiridion*, which seems to have been merely a commonplace-book kept by the king, the earliest work to be translated was the *Dialogues of Gregory*, a book enormously popular in the middle ages. In this case the translation was made by Alfred's great friend Werferth, bishop of Worcester, the king merely furnishing a preface.

The next work to be undertaken was Gregory's *Pastoral Care*, especially for the benefit of the clergy. In this Alfred keeps very close to his original; but the introduction which he prefixed to it is one of the most interesting documents of the reign, or indeed of English history.

The next two works taken in hand were historical, the *Universal History of Orosius* and Bede's *Ecclesiastical History of the English People*. The priority should probably be assigned to the *Orosius*, but the point has been much debated. In the *Orosius*, by omissions and additions, Alfred so remodels his original as to produce an almost new work; in the *Bede* the author's text is closely adhered to, no additions being made, though most of the documents and some other less interesting matters are omitted. Of late years doubts have been raised as to Alfred's authorship of the *Bede* translation. But the sceptics cannot be regarded as having proved their point.

We come now to what is in many ways the most interesting of Alfred's works, his translation of Boethius's *Consolation of Philosophy*, the most popular philosophical manual of the middle ages. Here again Alfred deals very freely with his original and though the late Dr. G. Schepss showed that many of the additions to the text are to be traced not to Alfred himself, but to the glosses and commentaries which he used, still there is much in the work which is solely Alfred's and highly characteristic of his genius. It is in the *Boethius* that the oft-quoted sentence occurs: "My will was to live worthily as long as I lived, and after my life to leave to them that should come after, my memory in good works." The book had come down to us in two mss. only. In one of these the poems with which the original is interspersed are rendered into prose, in the other into alliterating verse. The authorship of the latter has been much disputed; but probably they also are by Alfred. Of the authenticity of the work as a whole there has never been any doubt.

The last of Alfred's works is one to which he gave the title *Blostman*; i.e., "Blooms" or Anthology. The first half is based mainly on the *Soliloquies* of St. Augustine, the remainder is drawn from various sources, and contains much that is Alfred's own and highly characteristic of him. The last words of it may be quoted; they form a fitting epitaph for the noblest of English kings. "Therefore he seems to me a very foolish man, and very wretched, who will not increase his understanding while he is in the world, and ever wish and long to reach that endless life where all shall be made clear." Besides these works of Alfred's, the *Saxon Chronicle* almost certainly, and a *Saxon Martyrology*, of which fragments only exist, probably owe their inspiration to him. A prose version of the first 50 Psalms has been attributed to him; and the attribution, though not proved, is perfectly possible. How Alfred passed to "the life where all things are made clear" we do not know. The very year is uncertain. The arguments on the whole are in favour of 900. The day was Oct. 26. Alike for what he did and for what he was, there is none to equal Alfred in the whole line of English sovereigns, and no monarch in history ever deserved more truly the epithet of Great.

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ALFRED ERNEST ALBERT (1844-1900), Duke of Saxe-Coburg and Gotha, and Duke of Edinburgh, second son and fourth child of Queen Victoria, was born at Windsor Castle on Aug. 6, 1844. He passed a most creditable examination for midshipman in Aug. 1858, and being appointed to the "Euryalus," at once began to work hard at the practical part of his profession. In July 1860, while on this ship, he paid an official visit to the Cape. On the abdication of Otto, king of Greece, in 1862, the crown was offered to Prince Alfred, but political conventions of long standing rendered it impossible for the British government to agree to the proposal. The prince therefore remained in the navy, and was promoted to the rank of captain Feb. 23, 1866, being then appointed to the command of the "Galatea." On attaining his majority in 1865, the prince was created Duke of Edinburgh and Earl of Ulster, with an annuity of £15,000 granted by parliament. While still in command of the "Galatea," the duke started from Plymouth on Jan. 24, 1867, for a voyage round the world and visited Australia and India, being received everywhere with enthusiasm. An attempt on his life at Sydney by an Irishman named O'Farrell was the only unfortunate incident. After an absence of 17 months, he returned to England.

The duke married on Jan. 23, 1874, the Grand Duchess Marie Alexandrovna, only daughter of Alexander II, emperor of Russia. He continued his naval duties after his marriage, and held successive high commands until 1893 when he received his baton as admiral of the fleet.

On the death of his uncle, Ernest II, Duke of Saxe-Coburg and Gotha, on Aug. 22, 1893, the vacant duchy fell to the Duke of Edinburgh, for the Prince of Wales had renounced his right to the succession. At first regarded with some coldness as a "foreigner," he gradually gained popularity, and by the time of his death, on July 30, 1900, he had completely won the good opinion of his subjects. The duke was exceedingly fond of music and an excellent violinist, and took a prominent part in establishing the Royal College of Music. He was also a keen collector of glass and ceramic ware, and his collection, valued at 500,000 marks, was presented by his widow to the "Veste Coburg," near Coburg. When he became Duke of Saxe-Coburg he surrendered his English allowance of £15,000 a year, but the £10,000 granted in addition by parliament on his marriage he retained in order to keep up Clarence House. The duke had one son, who died unmarried on Feb. 6, 1899, and four daughters: Marie (queen of Roumania); Victoria Melita (Grand Duchess Cyril of Russia); Beatrice, who married Don Alphonso of Spain; and Princess Alexandra Louisa Olga Victoria of Hohenlohe-Langenburg.

ALFRED OF BEVERLEY, Alredus, Alured or Aluredus, was sacristan of the church of Beverley in the first half of the

12th century. He wrote, apparently about the year 1143, a chronicle entitled *Annales sive Historia de gestis regum Britanniae*, in nine books, which begins with the legend of Brutus and carries the history of England down to 1129. This work was edited by T. Hearne (Oxford, 1716). Geoffrey of Monmouth and Simeon of Durham are Alfred's chief sources. Among the Cottonian mss. there is a collection of records relating to Beverley, *Libertates Ecclesiae S. Iohannis de Beverlae*, which is attributed to Alfred, but on no good authority.

ALFRED, a village in Allegany county, N.Y., U.S.A., on the Erie railroad about 75 mi. S.E. of Buffalo. It is situated among rugged hills, at the intersection of two valleys. The population was 2,043 in 1950 and 694 in 1940.

On the west slope of Pine hill, 1,800 ft. above sea level, is Alfred university (coeducational), which embraces a college (nonsectarian) and a theological seminary (Seventh-Day Baptist). On grounds adjacent to the college campus, and administered by the university trustees, are the New York State College of Ceramics (established 1900), a unique institution which confers degrees in ceramic engineering and in applied art, and New York State Agricultural and Technical institute (established 1908). Alfred university traces its history to a "select school" organized in 1836, which developed into Alfred academy, chartered 1843. Three buildings were erected on the present campus in 1846, and in 1857 a university charter was secured.

Alfred lies within the territory purchased by Robert Norris in 1791, and is said to have been named after Alfred the Great. The first settlement was made in 1807. Most of the early settlers were Seventh-Day Baptists.

The village was chartered in 1887.

ALFRETON, urban district, Derbyshire, England, 14 mi. N. E. of Derby, on the L.M.S. Ry. Pop. (1938) 21,850. Area 8.09 sq.mi. It lies above a small tributary of the Derwent. The church of St. Martin is Early English and later. The neighbourhood abounds in ironworks, collieries, quarries and potteries, and is thickly populated. To the northeast of Alfreton are South Normanton (population 6,988 in 1931), Blackwell (4,857) and Tibshelf (3,500); to the north Shirland, to the south Ironville, and other busy industrial villages.

The foundation of Alfreton is traditionally ascribed to King Alfred.

ALFURS, a general name given to tribes of low culture and mixed origin inhabiting parts of the eastern islands of the Indonesian archipelago, Halmahera, Ceram, Timorlaut and Timor and the adjacent islets. They are probably of Proto-Malay and Indonesian extraction with a strong admixture of Papuan elements; and in Ceram in particular seem to have decided affinities with the dolichocephalic people of Oceania. Generally speaking they use bark belts and thigh-cloths, chew betel (tobacco is not used in Ceram), cultivate sago rather than rice, are exogamous, patrilineal and ancestor-worshippers, laying out their dead in trees, but there is a good deal of variation between different groups. Thus the head-hunting (*q.v.*) cult, which is strong in Ceram, takes the form of cannibalism in Timorlaut. In Ceram the women only are tattooed; in Timorlaut both sexes. In Ceram a quasi-secret society is formed for the administration of justice, a tree spirit is invoked for aid in war, and the skull of an enemy or slave is put under the posts of buildings, while head-hunters warn victims of hostile intentions by raiding their gardens and damaging the fruit trees. In Timorlaut warriors swallow a butterfly to obtain courage (*see* METEMPYCHOSIS), and trial by ordeal of battle is practised. A bamboo-headed spear is still used in Ceram.

ALGAE. Algae are primitive chlorophyll-containing plants without true leaves, stems or roots. The reproductive organs are simple. In most algae they are one-celled and in algae where they are composed of more than one cell every cell is fertile.

Familiar examples of algae are the pond scums and "water mosses" of fresh waters and the seaweeds of the ocean. Marine algae include all algae growing in the ocean and in brackish coastal waters. Fresh-water algae include all non-marine algae irrespective of whether they grow submerged in water or in

habitats where they are not submerged. The distinction between marine and fresh-water algae is ecologically sound because each of the 18,000 species of algae normally is exclusively marine or exclusively fresh-water. Taken together the marine and fresh-water algae exhibit a diversity of form not found in any other group of plants, ranging from one-celled organisms through manifold colonial forms to simple or branched rows of cells (filaments) and onwards to elaborate massive plants comparable in size with the flowering plants. As a general rule, fresh-water algae are minute and can only be distinguished one from another with the help of a microscope. On the other hand, the great majority of species of marine algae are of macroscopic size, distinctive shape, and readily recognizable when found growing *in situ* or cast ashore on the beach.

For a long time all algae were placed in a single sub-division of the division (Thallophyta) considered the lowest in the plant kingdom. In a series of articles appearing between 1914 and 1921 A. Pascher pointed out that the algae constitute a heterogeneous assemblage and one in which the various phylogenetic series probably arose independently. He proposed abandonment of the division Thallophyta and elevation of its sub-division Algae into seven separate divisions (*see Classification of Algae*, p. 598). Most specialists on the algae have adopted his proposals; botanists other than phycologists have been more conservative and a majority of them still retain the division Thallophyta with its two sub-divisions, Algae and Fungi.

GEOGRAPHICAL DISTRIBUTION AND OCCURRENCE OF FRESH-WATER ALGAE

One of the striking features of the fresh-water algal flora is its cosmopolitanism. Many species are found in all parts of the world, from the tropics to the polar regions, and in a variety of habitats. Other species are restricted to particular habitats, but even these may be found at stations thousands of miles apart.

Some of the fresh-water algae, such as *Trentepohlia* and *Pithophora*, are more abundant in the tropics than in temperate regions, and a few genera are never found in colder regions. The best known of the latter are *Cephaleuros*, a green alga parasitic on leaves of several flowering plants, and *Compsopogon*, a red alga found in the southern part of the United States, the West Indies, and in Central America.

The only group of fresh-water algae in which there is striking evidence of endemism is that of the desmids (*fig. 1, E-1, G*). A specialist shown a collection rich in species of desmids, but not told the source of the collection, would be able to tell whether it came from Europe, Australia, the Indo-Malay region or the Americas.

Aquatic Fresh-water Algae.—These include all algae growing permanently submerged and either attached (benthos) or free-floating (plankton). Filamentous grass-green and blue-green algae predominate in the benthos and they grow attached to stones, twigs, aquatic seed plants or other algae. The chief habitats of benthonic algae are flowing waters, ponds and lakes, pools and ditches, bogs and swamps. Each of the foregoing types of habitat has characteristic species but the composition varies from lake to lake or from bog to bog.

Members of the plankton are chiefly unicellular or non-filamentous colonial algae and are found in lakes, ponds or slowly flowing streams. Many of the plankton algae are structurally adapted to a free-floating life. Examples of this are the algae where the colony is a flat plate (*e.g.*, *Pediastrum*, *fig. 1, D*, *Merismopedia*, *fig. 4, G*) or where, as in *Golenkinia*, the cell bears numerous bristles. As a general rule, soft-water lakes are rich in species but the total number of individuals is small. The reverse condition is true of hard-water lakes. Here the algae may suddenly become so numerous as to make the water appear coloured and to cause what is known as a "water bloom." Diatoms, blue-green algae and grass-green algae predominate in the plankton; golden brown algae (Chrysophyceae) and dinoflagellates are present in smaller numbers.

Aerial Fresh-water Algae.—Aerial algae are frequently defined as algae that obtain their water wholly or in large part

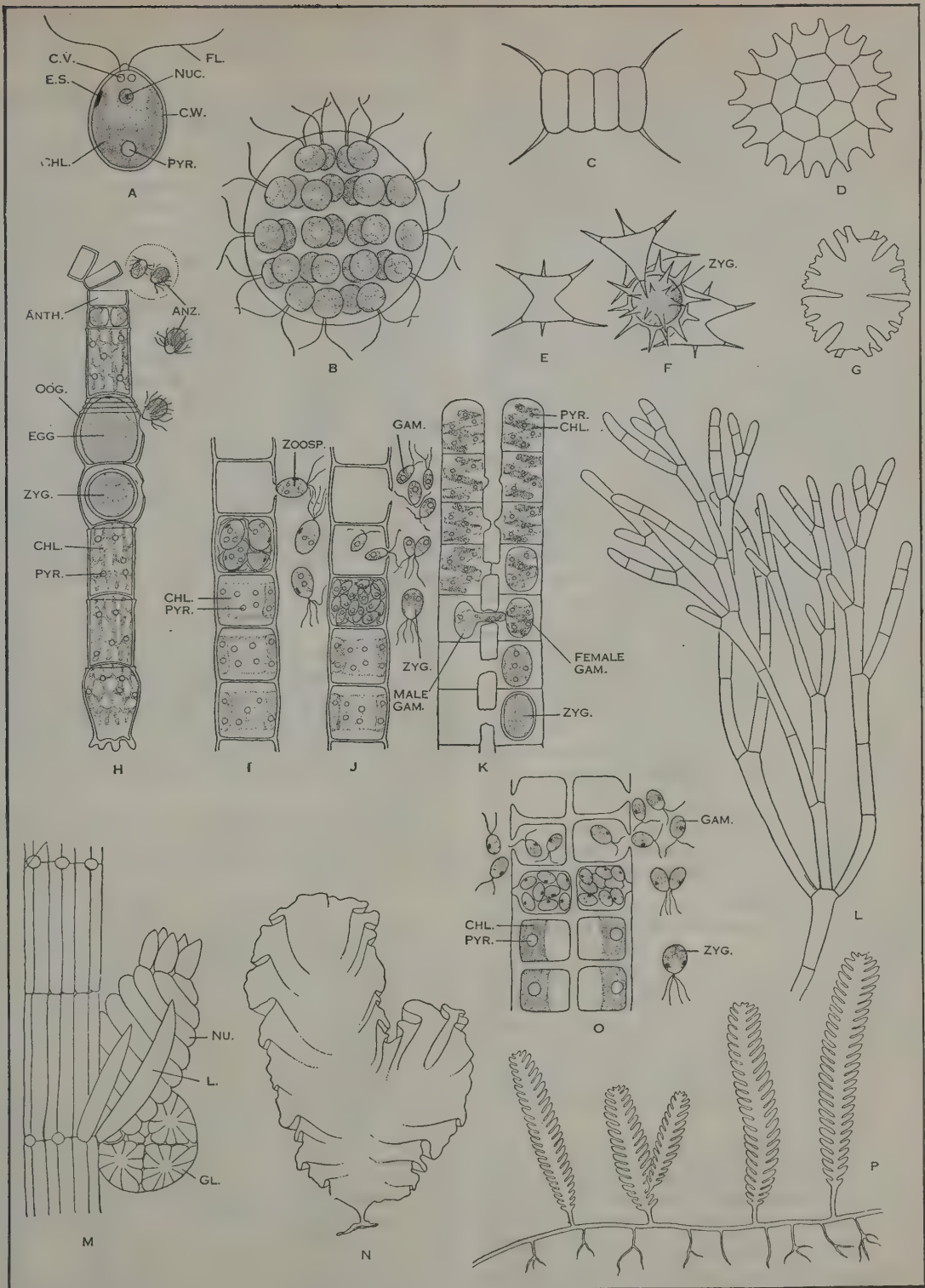


FIG. 1.—GRASS-GREEN ALGAE

A, Chlamydomonas; B, Eudorina; C, Scenedesmus; D, Pediatrum; E-F, Staurastrum; G, Micrasterias; H, Oedogonium; I-J, Ulothrix; K, Spirogyra; L, Cladophora; M, Chara; N-O, Ulva; P, Caulerpa. Anth., antheridium; Anz., antherozoid; Chl., chloroplast; C.V., contractile vacuole; C.W., cell wall; E.S., eye spot; FL., flagellum; Gam., gamete; Gl., globule; L., "leaf"; Nu., nucleole; Nuc., nucleus; Oög., Oögonium; Pyr., pyrenoid; Zoosp., zoospore; Zyg., zygote. All except N and P highly magnified

from moisture in the air. However, it is difficult to draw precise limits between aerial algae that obtain all their water from moisture in the air and terrestrial algae that obtain their moisture partly from the air and partly from the ground water. The primary feature distinguishing aerial from aquatic algae is their ability to endure drought without entering upon special resting stages and this, in turn, depends more upon the water-retaining than upon the water-absorbing capacity of the cells. Strictly aerial algae are found on the bark and leaves of trees, woodwork, stones and rocky cliffs. A familiar example is the greenish encrustation on the shaded side of tree trunks. Aerial algae are more abundant in tropical than in temperate regions and in humid tropical areas filamentous grass-green and blue-green algae form a felty coating on every stone and tree trunk.

Soil-inhabiting algae are more nearly aerial than aquatic but all of them obtain a part of their moisture from the ground water. Terrestrial algae may grow on the surface of the soil or a few feet below the surface. Those growing at the soil's surface may form a powdery or felty encrustation an acre or more in extent. Grass-green and blue-green algae predominate in this flora and the particular species present at any given locality are in large part dependent upon the soil's texture and chemical composition. The length of time that soil algae can withstand desiccation is remarkable, and some of them are able to resume growth after drying for more than 50 years. Terrestrial algae play an important role in the colonization of bare surface by plants. They aid in erosion of exposed surfaces; their decay affords the first available supply of humus; and they afford a moisture-retaining substratum for spores and seeds of more advanced plants.

Fresh-water Algae of Unusual Habitats.—There is a surprisingly long list of algae restricted to unusual environmental conditions or to particular substrata. Certain of them are adapted to extraordinary conditions of temperature. Several species grow in the snow and ice of polar regions or of high mountain peaks. These algae are found both in regions of perpetual snow and in snow fields at the top of mountains where the snow melts every summer. Most of them are grass-green algae and they may be present in sufficient abundance to colour the snow. This colour is usually red because practically all snow-inhabiting green algae have the green colouring matter (chlorophyll) masked by a red pigment (haematochrome). The algae growing in hot springs are in an environment directly antithetical to that of snow algae. Such algae are found in various parts of the world including Iceland, New Zealand and the United States. The best known and most spectacular of all hot springs are those in Yellowstone National park. Here the algae have been found growing and multiplying where the temperature of the water is 187° F. With a few exceptions all of the hundred or more algae recorded from hot springs are blue-greens.

The "brine lakes" found in arid regions of the United States and other countries represent another unusual type of environment with a distinctive algal flora. Most of the species in these lakes belong to the grass-green algae and, strange as it may seem, algae closely related to them are found in fresh waters instead of in the ocean. The ability of these algae to live in a salt solution 2-15 times stronger than that in the ocean seems to rest upon a different permeability to salts as compared with that of other fresh-water or marine algae.

There are many fresh-water algae found only in association with specific plants or animals. Most of the animals bearing particular algae live in or about the water but there are a few land animals regularly harbouring algae. The most striking of the latter is the three-toed sloth, where a *Protococcus*-like algae growing upon the hairs gives the animal a distinctly greenish colouration. Algae associated with aquatic animals may grow upon the surface of them, as is true of the filamentous green alga (*Bacillaria*) found only on the backs of turtles; or the alga may grow within the tissues of the animal, as is the case with the unicellular green alga (*Chlorella*) found within *Hydra*. Algae associated with specific plants may grow upon their surfaces or within their tissues. Those growing within tissues may be space endophytes or true parasites. The *Nostoc* growing within the

liverwort *Anthoceros* is an example of a space endophyte. The best known of the parasites is *Cephaleuros* which at times causes serious damage to certain cultivated tropical plants, notably tea and pepper.

GEOGRAPHICAL DISTRIBUTION AND OCCURRENCE OF MARINE ALGAE

The marine algal flora differs from the fresh-water flora in that more than 95% of the benthic species are red or brown algae. Red algae predominate in warmer waters of the oceans, brown algae in the colder waters. Each ocean has its distinctive flora and a very large percentage of the species in any one of the oceans is not found in other oceans. This is well illustrated by the fact that of the algae found along the shores of the United States less than 10% are found along both the Atlantic and the Pacific coasts. There is also a rather definite geographical distribution of species of a particular ocean and this distribution is correlated with average water temperatures during the warmest month of the year. When this temperature difference between two portions of the shore is 10° F. there are marked differences in composition of the flora. On the Pacific coast of North America the differences in temperature produce four distinct flora: the *boreal*, extending from Alaska to Puget sound; the *temperate*, extending from Puget sound to Point Conception, California; the *sub-tropical*, from Point Conception to Magdalena bay, Mexico; and the *tropical*, from Magdalena bay to the Isthmus of Panama.

At a given place along the shore of any ocean there is a distinct vertical distribution of benthic algae, especially of those growing between the high tide and low tide levels. The number of species growing at or just below high tide level is small because relatively few marine algae are able to withstand the severe wilting produced by several hours exposure to air. The number of species increases progressively to extreme low tide level because of the progressive shortening of the period of intertidal exposure. Other factors, especially penetration of water by sunlight, affect the vertical distribution. The maximum depth at which algae grow is primarily dependent upon penetration of light into the water. In high latitudes the lowest depth at which algae occur is 150-180 ft. In tropical and subtropical seas, where the sun's rays are more nearly vertical, algae may grow at a depth of 300-600 ft.

Plankton algae of the ocean are either diatoms or dinoflagellates but the number of strictly planktonic species is large. Most species are restricted to a single ocean and in many cases the distribution within an ocean is quite definite.

UTILIZATION OF ALGAE

Several marine algae are used as food by man. The amount consumed in Europe and America is insignificant and is chiefly the utilization of the seaweed known as Irish moss, in making blancmange and other puddings. In the orient, on the other hand, certain algae are highly esteemed as foodstuffs and are used both in the making of soups and as condiments. The most widely used for such purposes is the red alga *Porphyra*. Most of the *Porphyra* eaten in the orient comes from Japan and in 1938 the market value of the year's crop was slightly more than 15,000,000 yen (\$7,500,000 at normal exchange). Some of the crop is sold fresh, but most of it is sun-dried before reaching the consumer. The supply is obtained almost exclusively from plants cultivated on suitable tidelands and the annual return from a good "*Porphyra* farm" may run as high as \$150. Tidelands are prepared for cultivation by implanting numerous bundles of bamboo or brush in mud where the water is 15-25 ft. deep. The bundles afford a lodgment for spores of *Porphyra* floating through the water and the spores grow into plants with blades several inches in diameter. Kombu, a product made from various kelps, is one of the standard foods of Japan. Kelps harvested by fishermen are dried and then sent to manufacturers for conversion into kombu. The manufacturer boils the dried algae for a few minutes and then spreads them out one by one in flat wooden presses where the whole mass is compressed as tightly as possible, dried, and then shredded or powdered for the market. In 1929 the half

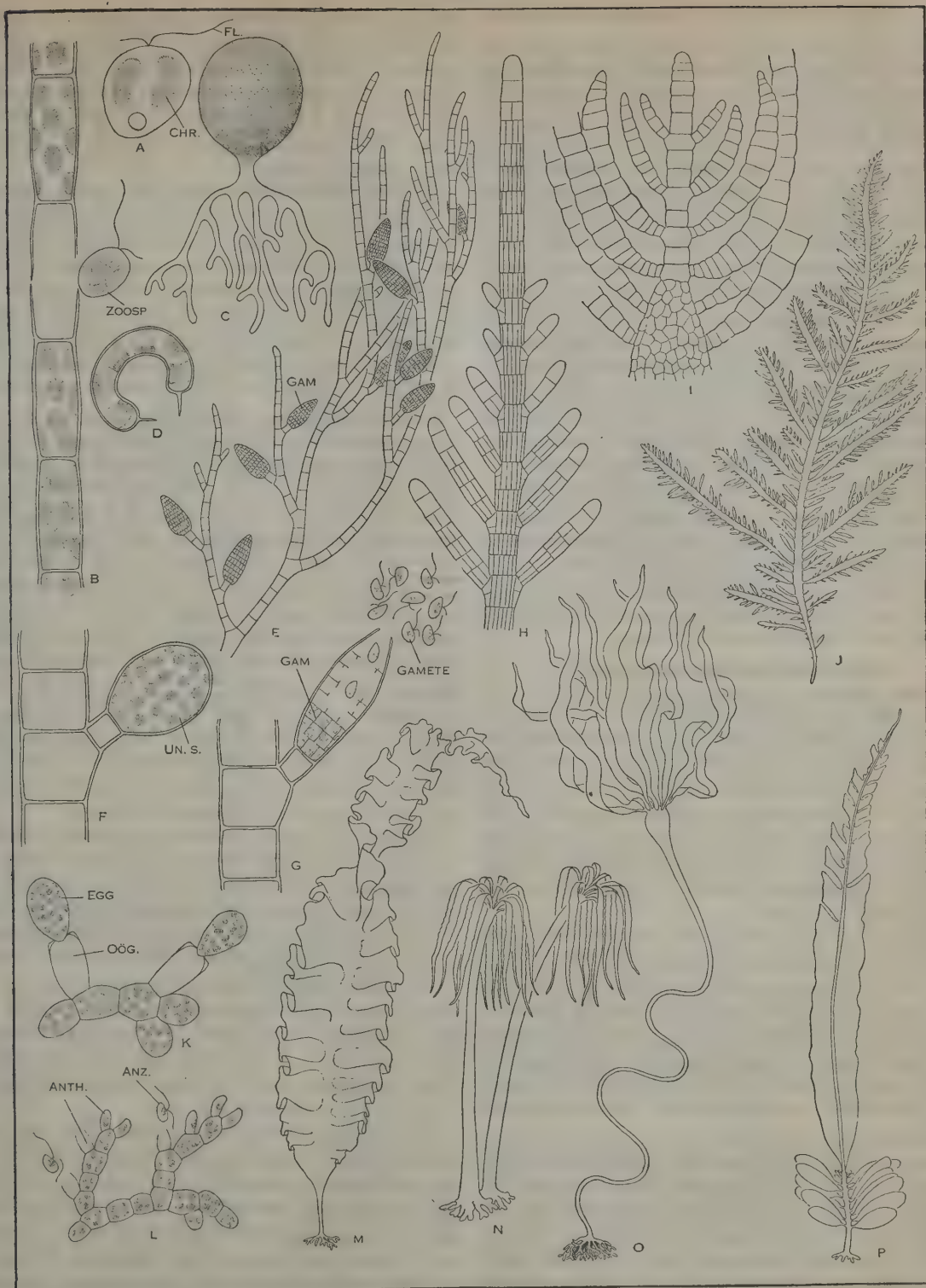


FIG. 2.—A-D. YELLOW-GREEN ALGAE; E-P. BROWN ALGAE

A, *Chlorochromonas*; B, *Tribonema*; C, *Botrydium*; D, *Ophiocytium*; E-G, *Ectocarpus*; H, *Sphacelaria*; I-J, *Desmarestia*; K-M, *Laminaria*; K, female gametophyte, L, male gametophyte, M, sporophyte; N, *Postelsia*; O, *Nereocystis*; P, *Alaria*. Anth., antheridium; Anz., anthero-

zoid; Chr., chromatophore; FL., flagellum; Gam., gametangium; Oög., oögonium; Un. S., unilocular sporangium; Zoosp., zoospore. All except J and M-P highly magnified

million pounds of kombu manufactured in Japan sold for 2,000,000 yen.

Products from marine algae have a wide variety of industrial uses. At one time kelps and rockweeds were of considerable importance as sources of potassium and iodine. The discovery of mineral deposits containing these elements has, however, made their recovery from algae unprofitable. Agar-agar is a gelatinous substance obtained from the red alga *Gelidium* by a rather involved process of extraction. Most of the agar-agar sold in world markets comes from Japan and in 1935 that country produced about 5,000,000 lb. of it. Under normal conditions the United States imports about 500,000 lb. Until 1939 the amount produced in the United States was insignificant, but since then it has increased greatly and in 1942 there was a production of 150,000 lb. valued at \$450,000. The best-known use is that of a solidifying agent in culture media in bacteriological laboratories. It is also used as a stiffening agent in certain food products; as a sizing material; and in clarifying liquids. The red alga *Chondrus crispus* and *Gigartina mamillosa*, both known as Irish moss or carrageen, are a source of a gelatinous substance widely used in industry. The algae are dried and bleached before being sold to manufacturers. Manufacturers use Irish moss as an agent that helps keep substances in suspension. Examples of this are various pharmaceutical preparations, especially hand lotions; and the chocolate milk sold by milk dealers. Irish moss is also used by brewers to clarify and to give body to beer. Alginates, salts of alginic acid, are jelly-like substances obtained from the brown algae known as kelps. All alginates sold in the United States are extracted from a giant kelp, *Macrocystis*, which grows in extensive stands along the coast of southern California. One widespread use of alginates is in the manufacture of ice cream. Alginates have also replaced the use of agar and of Irish moss in a considerable number of manufactured products.

STRUCTURE AND REPRODUCTION

The Cell.—Cells of algae (except Cyanophyta, see below) are essentially like those of more advanced plants. There is a distinct wall and the protoplasm within the wall is differentiated into cytoplasm and nucleus. The chlorophyll and other pigments that give different algae their distinctive colours are localized in chromatophores which are of distinctive size and shape from genus to genus. The chromatophores usually lie in the portion of the cytoplasm just within the cell wall (figs. 1, A; 1, H; 1, I) but they may lie at the centre of the cell. Chromatophores of grass-green algae contain one or more rounded bodies, the pyrenoids (figs. 1, A; 1, H) which are intimately concerned with the formation of platelets of starch.

The Plant Body.—The simplest algae are one-celled and the most primitive of these have thread-like extrusions (flagella) protruding through the cell wall. Flagella (fig. 1, A) are motile organs which, by lashing backward and forward, propel the cell through the water. Non-motile unicellular algae are usually of microscopic size and globose or angular. Certain unicellular algae are of macroscopic size and variously branched. The most highly differentiated of all macroscopic unicellular algae is *Caulerpa* (fig. 1, P), an alga differentiated into leaf-, stem- and root-like branches superficially resembling the leaf, stem and root of a seed plant.

If the plant body is composed of more than one cell the cells may not have a definite orientation with respect to one another (*Gloeocapsa*) or the cells may be joined end to end in branched or unbranched filaments (*Ulothrix*, fig. 1, I; *Ectocarpus*, fig. 2, E). Branched filamentous algae may have the various branches free from one another, or have them compacted to form a plant body of characteristic macroscopic form. The great majority of red algae (e.g., *Chondrus*, fig. 4, A) are of the compacted type and the plant body thus formed may be a foot or more in height. The largest and most complex plant bodies among algae are those of the kelps. These brown algae have a root-like holdfast, a stem-like stalk, and one or more leaf-like blades. Kelps of the Atlantic ocean are rarely more than 5 ft. tall, but certain kelps found along the Pacific coast of North America

and in the Antarctic ocean attain a length of more than a hundred feet. Kelps also have the highest differentiation of tissues found in any algae. Here the blades, the stipe, and the branches of the holdfast are each internally differentiated into cortex and medulla. The cortex is composed of approximately cubical cells with chromatophores; the medulla is composed of colourless interwoven filaments and in a few genera, as *Nereocystis* and *Macrocystis*, certain of the filaments develop into sieve tubes similar to those found in flowering plants.

Asexual Reproduction.—Algae may multiply vegetatively by fragmenting into two or more parts, but in most cases they reproduce asexually by means of spores formed within and liberated from ordinary vegetative cells or from special cells (sporangia). Spores of red algae are of types peculiar to that group (see *Rhodophyta*, below); those produced by other algae are either flagellated self-propelling zoospores or non-flagellated passively transported aplanospores. Zoospores and aplanospores may be formed singly, in multiples of two, or in indefinite numbers within a cell or a sporangium. Liberation of the spores may be by rupture or gelatinization of the surrounding wall, or through a pore in the wall.

Sexual Reproduction.—Sexual reproduction is effected by a fusion in pairs of special reproductive bodies (gametes) produced within ordinary vegetative cells or within special modified cells (gametangia). Gametic union (sexual reproduction) is of frequent occurrence among grass-green, brown, and red algae; it occurs very infrequently among yellow-green and golden brown algae; and not at all among blue-green algae. The most primitive type of gametic union is where both gametes of a fusing pair are motile and of equal size. More advanced than such an isogamous union of gametes is that where both are motile but one small and active, the other large and sluggish. In such an anisogamous union of gametes the smaller gamete is male and the larger is female. Anisogamy, in turn, leads to the condition of oogamy where there is a union of a small flagellated male gamete (antherozoid) with a large non-flagellated immobile gamete (egg). In oogamous algae the male gametangium (antheridium) is usually much smaller than the female gametangium (oögonium). Antherozoids of oogamous algae may swim into the oögonium and unite with the egg or eggs within it; or the eggs may be discharged from an oögonium and the antherozoids swim to and unite with the eggs floating passively in the water.

Fusing gametes (whether isogamous, anisogamous or oogamous) are devoid of a membrane but the resultant zygote soon secretes a wall. In most grass-green algae the zygote enters upon a dormant period and secretes a thick wall; in a few grass-green algae and in all brown algae there is no dormant period and the wall is always thin. A feature of deeper significance in the formation of a zygote is the union into a single nucleus of the two nuclei derived from the two gametes.

Life Cycle.—All plants more advanced than algae have a life cycle with two distinct phases or generations and one in which sexual (gametophytic) and asexual (sporophytic) generations follow one another in alternate succession. Sexually reproducing algae have or have not such an alternation of generations depending on whether there is or is not a reduction division (see *CYTOLOGY*) of the zygote nucleus.

Zygotes of most grass-green algae secrete a thick wall and do not germinate until they have undergone a ripening period lasting weeks or months. All such algae have a reduction division of the zygote nucleus and, consequently, the development of a gamete-producing generation (gametophyte) when the zygote germinates. The life cycle of these algae consists of a succession of gametophytic generations with a one-celled phase, the zygote, intervening between successive generations. Many algae with this type of a life cycle have the gametophyte also producing zoospores or aplanospores. This results in a life cycle where there is a reduplication of the gametophytic generation and not one where there is an alternation of gametophytic and sporophytic generations.

A few grass-green algae and all brown algae except *Fucales* have an immediate germination of the zygote, no reduction di-



FIG. 3.—A-I, BROWN ALGAE; J-N, RED ALGAE

A-C, *Dictyota*, A, thallus, B, section of gametophyte, C, section of sporophyte; D-H, *Fucus*, D, thallus, E, antheridium, F, section through conceptacle, G, liberation of eggs, H, fertilization; I, *Sargassum*; J-K, *Nemalion*, J, thallus, K, section of thallus; L-N, *Agardhiella*, L, female gametophyte, M, section through sporophyte, N, section through female gametophyte. A.C., auxiliary cell; Anth., antheridium; Anz., anthero-

zoid; Apl., aplanospore; Cono., conceptacle; Cpgn., carpogonium; Cps., carposporangium; Gon., gonimoblast; Oöbl., oöblast; Oög., oögonium; Sp., sporangium; Spg., spermatangium; Spm., spermatium; Tr., trichogyne; Ts., tetraspore; Tsp., tetrasporangium. All except A, D, I-J, and L highly magnified

vision of the zygote nucleus, and the production of a generation in which each cell has the same number of chromosomes as a zygote. This generation is strictly asexual (sporophytic) and there is a reduction division of nuclei in the cells producing zoospores or aplanospores. These spores develop into sexual (gametophytic) plants. In these algae with an alternation of generations in the life cycle the two generations may be identical in size, shape, and vegetative structure, or the two may be markedly unlike. Certain algae (as *Dictyota* and *Laminaria*) have the two alternating generations following each other in regular sequence; other algae (as *Ectocarpus*) may have the regular alternation interrupted by a reduplication of either the sporophytic or gametophytic generations.

All red algae except Bangiales have an alternation of generations but here there may be three generations in the life cycle, one gametophytic, the other two sporophytic.

CLASSIFICATION OF ALGAE

Algae fall into seven groups, each with distinctive pigments in the chromatophores, distinctive food reserves, and distinctive reproductive cells. The groups are sufficiently distinct from one another to be placed in separate divisions at the bottom of the plant kingdom. These divisions are the Chlorophyta, Euglenophyta, Pyrrophyta, Chrysophyta, Phaeophyta, Cyanophyta, Rhodophyta.

Chlorophyta.—Chromatophores of Chlorophyta are green and with the same pigments as vascular plants. The chief food reserve is starch. All flagella of a motile reproductive cell are the same length and the number of flagella is usually two or four. There are two classes: the Chlorophyceae (grass-green algae) and the Charophyceae (stoneworts).

The plant body of members of the Chlorophyceae never grows by means of an apical cell and the reproductive organs are always one-celled and without a sheath of vegetative cells. There are approximately 350 genera and 5,500 species of Chlorophyceae. Arrangement of the genera in major groups (orders) is primarily on the basis of cell structure, organization of the plant body, and structure of reproductive cells.

The most primitive order (Volvocales) includes all Chlorophyceae with motile vegetative cells. Most genera are fresh-water and either unicellular (*Chlamydomonas*, fig. 1, A) or colonial. The number of cells in a colony is a multiple of two and usually less than 128 (as in *Eudorina*, fig. 1, B) but as in *Volvox* it may be several thousand. Colonies with a small number of cells have all cells fertile; those with a large number of cells have reproduction restricted to a few greatly enlarged cells.

Somewhat advanced over the Volvocales are the Tetrasporales in which the cells are irregularly distributed through a colourless jelly. Vegetative cells of Tetrasporales may develop flagella at any time and temporarily live in the manner of a *Chlamydomonas* cell. The number of species in the order is about 100 and most of them are found in fresh waters.

Members of the Ulotrichales have uninucleate cells with a single band-shaped chromatophore and the cells are united end to end in filaments. There are approximately 80 genera and 450 species. Most genera are exclusively fresh-water; a few are exclusively marine or have both marine and fresh-water species. The filaments may be unbranched, as in *Ulothrix* (fig. 1, I), or branched. Genera with branched filaments may have the branches standing free from one another (*Stigeoclonium*) or have the branches laterally compacted to form a solid disk (*Coleochaete*). A considerable number of genera are of microscopic size and epiphytic on coarse filamentous fresh-water algae or endophytic within tissues of marine algae.

Ulvaes have cells resembling those of Ulotrichales but have the cells laterally adjoined in flat sheets or in hollow tubes. The plant body is macroscopic and often several inches tall. There are approximately 100 species and the majority of them are strictly marine. Two genera, *Ulva* (fig. 1, N; 1, O) and *Enteromorpha*, are abundant in all oceans. These two genera have an alternation of generations; certain other genera (as *Monostroma*) do not have this type of life cycle.

The Schizogoniales include three genera where the plant body is either filamentous or sheet-like. These genera differ from other Chlorophyceae in structure of chromatophore, lack of sexual reproduction, and in reproducing exclusively by aplanospores. *Prasiola*, the most widely distributed genus, usually grows only where the substratum is rich in soluble nitrogenous compounds and marine species of the genus are restricted to the high tide level of rocks covered with droppings from sea birds.

The Cladophorales have cylindrical multinucleate cells joined end to end in branched or unbranched filaments. The most widely distributed of the dozen genera is *Cladophora* (fig. 1, L), a genus with more than 150 species. It is one of the branched genera and is a common alga in both fresh and salt waters.

Oedogoniales are exclusively fresh-water and are the only filamentous Chlorophyceae in which flagella of zoospores are numerous and arranged in a ring near one end. Sexual reproduction is oogamous and the antherozoids resemble the zoospores. There are 3 genera and approximately 350 species. *Oedogonium* (fig. 1, H) the genus with the largest number of species is one of the commonest filamentous algae of pools and ditches.

The Zygnematales have a distinctive sexual reproduction and one where a cross connection established between two cells affords a pathway for a union of two amoeboid gametes. The order includes approximately 40 genera and 3,000 species; all fresh-water and a large majority strictly aquatic. Some genera have the cells permanently united in unbranched filaments; other genera are unicellular or have the cells temporarily united in filaments. *Spirogyra* (fig. 1, K), the most widely distributed genus of all fresh-water algae, is representative of the permanently filamentous genera. The unicellular genera have cells constricted into two symmetrical halves (*Staurastrum*, fig. 1, E; 1, F; *Microsterias*, fig. 1, G). These algae, the desmids, have long been favourites of microscopists because of their symmetrical shapes.

Chlorococcales have approximately isodiametric cells that do not divide vegetatively and are algae in which all increase in number of cells is brought about by production of spores or gametes. The order is a large one and most of the species are fresh-water. Some genera, as *Chlorella* and *Golenkinia* are unicellular; other genera (*Scenedesmus*, fig. 1, C; *Pediastrum*, fig. 1, D) have the cells united in non-filamentous colonies in which there is no increase in number of cells once a colony has been formed.

The Siphonales are unicellular, multinucleate branched tubes capable of indefinite elongation. Most of the 50 genera are marine and found in tropical or subtropical seas. *Vaucheria*, the genus most frequently encountered in fresh waters, has a small and sparingly branched plant body (cell). Many marine Siphonales are of macroscopic size, freely branched, with the branches of different shape and free from one another (*Caulerpa*, fig. 1, P), or with the branches alike and densely interwoven (*Pentacillus*, *Codium*). Reproduction of many Siphonales is exclusively sexual and frequently anisogamous.

The Siphonocladiales are like Siphonales when young but when older they become partitioned into a number of multinucleate segments. The order is exclusively marine and a large majority of the 120 species are found only in tropical waters. The mermaid's wineglass (*Acetabularia*) is one of the most striking of all Siphonocladiales.

The Charophyceae (stoneworts) have a multicellular plant body differentiated into nodes and internodes, and one in which terminal growth is initiated by an apical cell. The sex organs (antheridia and oogonia) are surrounded by envelopes of sterile cells. The six genera of the class are placed in a single order (Charales) and all of the 200 species grow submerged in fresh or brackish water.

The plant body consists of a slender cylindrical axis bearing whorls of short branches ("leaves") separated at regular intervals by relatively long internodes. The plant surface is frequently encrusted with lime, hence the popular name stonewort.

Asexual reproduction is exclusively vegetative and usually by a shedding of special reproductive branches. Sexual organs are produced one above the other at the nodes, as in *Chara* (fig. 1, M). The oogonium with its covering of five spirally twisted cells



FIG. 4.—A-F, RED ALGAE; G-L, BLUE-GREEN ALGAE

A, Chondrus; B, Gelidium; C, Callithamnion; D, Polysiphonia; E, Membranoptera; F, Ptilota; G, Merismopedia; H, Nostoc; I, Oscillatoria; J, Anabaena; K, Tolypothrix; L, Stigonema. All except A-B and E-F highly magnified

crowned by 5 or 10 small cells comprise the nucle. The antheridia are united in a branching filament and several antheridial filaments are surrounded by a globose envelope composed of 8 shield-shaped cells. The mass of antheridial filaments and the envelope surrounding them jointly constitute the globule. When the globule is mature the shield cells separate from one another and the antherozoids escape from the exposed antheridial filaments. They swim down through the apex of the nucle and unite with the egg. The zygote formed within the nucle develops a thick wall and ripens for several weeks before germinating to form a new plant.

Euglenophyta.—The Euglenophyta have grass-green chromatophores with a pigmentation similar to that of Chlorophyta. The food reserves are either paramylum (an insoluble carbohydrate related to starch) or fats. Flagella differ from those of other major groups (divisions) in that they are inserted in a small interior chamber at the anterior end of a cell. Reproduction is by cell division but several genera are known to form thick-walled resting stages. Sexual reproduction is not definitely known for any species.

There is but one class, the Euglenophyceae, and most genera of this class are naked motile unicellular organisms similar to *Euglena* so frequently present in stagnant fresh waters. All genera with motile cells are placed in a single order, the Euglenales. One genus (*Colacium*) has non-flagellate cells organized in dendroid colonies similar to those of certain Tetrasporales. It is the sole member of the order Colaciales.

Pyrrophyta.—Members of this division are the only algae with yellowish to brownish chromatophores that store reserve foods as starch or starch-like compounds. Motile cells are biflagellate, usually with the flagella unequal in length and movement. For a long time all known members of the group were unicellular biflagellate organisms but in 1912 five non-motile genera were discovered and the list of truly algal genera has been increased since then. The division has three classes (Cryptophyceae, Desmokontae, Dinophyceae) primarily distinguishable by the structure of the flagella.

The Cryptophyceae (cryptomonads) include 12 genera; 10 unicellular and motile; 2 with a colonial organization similar to that of *Tetraspora*. Cells of Cryptophyceae have one or two brownish-yellow chromatophores and granules of starch. Motile vegetative cells and zoospores are biflagellate with the two flagella alike except for slight differences in length. The commonest genus is *Cryptomonas*, an inhabitant of fresh waters rich in organic and nitrogenous materials.

Desmokontae differ from other Pyrrophyta in having a cell wall vertically divided into two homogeneous halves (valves). Motile cells have two apically inserted flattened flagella that differ from each other in type of movement. All members of the class are rare organisms and most of them are marine.

Cells of most Dinophyceae have numerous golden-brown to chocolate brown chromatophores, but cells of certain species lack chromatophores. Motile cells and zoospores are encircled by a transverse groove—the girdle. The two flagella are inserted in or near the girdle; one of them encircles the girdle, the other extends vertically backwards. The class includes about 120 genera and 950 species, almost all of which are marine and restricted to the plankton. Ninety per cent of the genera are unicellular and motile; the remainder are either unicellular and immobile, or *Tetraspora*-like, or filamentous. Motile genera are placed in three orders: one (Gymnodiniales) without a wall, the other two (Peridinales and Dinophysidales) with a wall and with one made up of a definite number of plates. The Peridinales, as in *Glenodinium*, have a wall that is not longitudinally divided into two halves; the Dinophysidales have a wall longitudinally divided into two halves. Immobile genera have the cells regularly producing one or more *Gymnodinium*-like zoospores. According to organization of the plant body they are placed in the following orders: Dinocapsales, with nonflagellate cells irregularly distributed through a gelatinous matrix; Dinotrichales, with nonflagellate cells joined end to end in filaments; Dinococcales, with solitary nonflagellate sessile or free-floating cells. These three

orders correspond, respectively, to the Tetrasporales, Ulotrichales, and Chlorococcales of the Chlorophyceae.

Chrysophyta.—The Chrysophyta have yellowish-green to yellowish-brown chromatophores in which there is a preponderance of carotinoid pigments. The chief food reserves are leucosin (an insoluble carbohydrate of unknown composition) and oils. Cell walls are usually composed of two overlapping halves and are frequently impregnated with silica. Various types of spores are formed and sexual reproduction, when present, is by an isogamous fusion of zoogametes or aplanogametes. There are approximately 300 genera and 5,700 species, three-quarters of which are fresh-water. The division has three classes—Xanthophyceae, Crysiophyceae, Bacillariophyceae.

The Xanthophyceae (Heterokontae), familiarly known as yellow-green algae, are almost exclusively fresh-water. They have yellowish-green chromatophores and store foods as leucosin or as oils, never as starch. Motile stages are regularly biflagellate and with the two flagella markedly unequal in length (fig. 2, A). Asexual reproduction by zoospores or aplanospores is of frequent occurrence; sexual reproduction very rarely occurs and is definitely established for only one genus. Although the number of genera and species (about 75 and 200) is much smaller than in Chlorophyceae, the Xanthophyceae exhibit much the same range in form, and most orders of Chlorophyceae have their counterpart among the Xanthophyceae.

The nine genera with motile vegetative cells are placed in the Heterochloridales and all genera are unicellular. The Rhizochloridales with naked amoeboid cells united in colonies comprise an order without counterpart among the Chlorophyceae. All of the seven genera are exceedingly rare and most of them are fresh-water. The Heterocapsales include a few rare fresh-water genera with colonies similar to those of Tetrasporales. The Heterotrichales have cylindrical cells joined end to end in branched or unbranched filaments. *Tribonema* (fig. 2, B), with unbranched filaments composed of cells surrounded by walls with two overlapping halves, is very common in fresh-water pools during the spring months.

Similar to Chlorococcales, the Heterococcales have no vegetative cell division and are unicellular or with the cells united in nonfilamentous colonies. This is the largest order and all but a couple of the 45 genera are fresh-water. *Ophiocytium* (fig. 2, D) is the most frequently encountered genus of the order, but it is never found in abundance. The Heterosiphonales, an order corresponding to the Siphonales, have but one genus—*Botrydium* (fig. 2, C). It is terrestrial, with a greenish vesicular aerial portion and a colourless tubular subterranean portion. *Botrydium* grows on firm damp soil and the cells may be so densely crowded that they completely cover the ground.

Typical Chrysophyceae have golden-brown chromatophores and a storage of reserve foods as leucosin or fats. They form a distinctive type of spore, the endospore. For a long time the only known members of the class were motile organisms (chrysiomonads) but since 1900 several immobile coccoid and filamentous genera with a truly algal organization have been discovered.

About half of the 65 genera belong to the Chrysiomonadales, the only order in which the vegetative cells are motile. Cells of Chrysiomonadales may be uni- or bi-flagellate and solitary or in colonies. The Rhizochrysidales have immobile amoeboid cells that may be naked or may have a wall-like envelope (*lorica*). All 12 genera of the order are fresh-water; some are unicellular, others colonial. Members of the Chrysocapsales are colonial and with cells irregularly distributed through a colourless jelly as in Tetrasporales. There are 10 genera, of which the most widely distributed is *Hydrurus*, an inhabitant of swiftly flowing cold-water streams.

The Chrysotrichales have cells united end to end in branched or unbranched filaments. Some of the branched genera have the branches standing free from one another; others, as *Thallochrysis*, have the branches laterally united. The five genera of the order are rare algae and are found in fresh water. The Chrysococcales correspond to the Chlorococcales of the Chlorophyceae. All six genera referred to the order are imperfectly known; and all, as

Chrysosphaera, are found in fresh water.

The Bacillariophyceae (diatoms [*q.v.*]) have cell walls composed of two overlapping halves and a bilateral or radially symmetrical ornamentation of the wall. These algae are dealt with in a separate article.

Phaeophyta.—Phaeophyta (brown algae) have chromatophores with the green pigments masked by a brown pigment (fucoxanthin). The chief food reserve is a carbohydrate, laminarin, dissolved in the cell sap. Motile reproductive cells, whether zoospores or gametes, have two laterally inserted flagella of unequal length.

All but 3 of the 900 species are strictly marine. Brown algae predominate in the algal flora of colder seas, but certain brown algae, notably Dictyotales and *Sargassum*, are found only in tropical or subtropical waters. Marine Phaeophyta grow along rocky ocean shores and usually where the water is less than 50 ft. deep. All of the brown algae are multicellular and either filamentous or with a more complex plant body. In all except the Fucales there is an alternation of two free-living generations, but the gametophyte and sporophyte may be vegetatively similar or dissimilar. Gametophytes usually produce multicellular gametangia in which each cell contains a gamete but they may produce unicellular gametangia containing a single gamete. Gametic union ranges from isogamy to oogamy. The sporophyte produces unicellular sporangia containing spores in multiples of two (usually 64 or 128). In addition to unicellular sporangia, a sporophyte may also produce multicellular sporangia indistinguishable in appearance from gametangia. The reduction division of nuclei within a unicellular sporangium and the lack of this in a multicellular sporangium is of fundamental significance since it determines whether a plant growing from a spore is to be gametophytic or sporophytic.

The primary difference between the three classes of the Phaeophyta is in the life history. These differences are: the alternation of similar generations in Isogeneratae, the alternation of dissimilar generations in Heterogeneratae, and the lack of a gametophytic generation in the Cyclosporeae.

The simplest Isogeneratae, the Ectocarpales, have a filamentous plant body. The type genus, *Ectocarpus* (fig. 2, E-2, G) is a common epiphyte on other marine algae. Its plant body is freely branched and it grows by division of cells a short distance back from each branch tip. The gametophyte produces multicellular gametangia and union of gametes may be isogamous or anisogamous. Sporophytes developing from a zygote typically produce unicellular sporangia and have the zoospores released from them developing into gametophytes. However, a sporophyte may also produce multicellular sporangia whose zoospores reduplicate the sporophytic generation.

Sphacelariales have a branched thread-like plant body in which the cells are regularly arranged in transverse tiers. Growth of each branch is initiated by an apical cell (fig. 2, H). Reproductive organs resemble those of Ectocarpales and the life cycle is similar. The order has 10 genera and 60 species, most of which are restricted to the Atlantic ocean. Tilopteridales have a freely branched plant body in which the lower portions are similar to *Sphacelaria*, and the upper portions of the branches are *Ectocarpus*-like. The Cutleriales include two anomalous genera with filaments laterally compacted to form a blade- or disk-like plant body. Gametophytes have multicellular gametangia borne in groups and gametic union is markedly anisogamous. Sporophytes produce unicellular sporangia only; hence there is a regular alternation of generations.

Members of the Dictyotales are branched ribbon- or fan-like algae (fig. 3, A) with growth initiated by solitary or laterally adjoined apical cells. There are some 18 genera and 100 species. Dictyotales are the predominant brown algae of tropical seas and many of them grow in abundance. The gametophytes produce sex organs in patches (*sori*): female gametangia (oögonia) are one-celled (fig. 3, B) and the male gametangia (antheridia) are many-celled. Unicellular sporangia of sporophytes are unique for brown algae both in the small number of spores (4 or 8) and in the absence of flagella on the spores (fig. 3, C).

Gametophytes of Heterogeneratae are always irregularly branched filaments; sporophytes may be filamentous, or of a modified filamentous construction, or non-filamentous. Genera with a filamentous organization are placed in the subclass Haplostichineae; those with a non-filamentous organization in the subclass Polystichineae. The Haplostichineae are grouped in three orders (Chordariales, Sporocnales, Desmarestiales) differing in organization of the sporophyte. Sporophytes of Chordariales and Sporocnales are obviously filamentous; those of Desmarestiales (fig. 2, I; 2, J) are obscurely so because the branches become covered with irregularly arranged cells. Gametophytes of Chordariales resemble irregularly branched gametophytes of *Ectocarpus*; those of the other two orders are oogamous and with both antheridia and oögonia one-celled.

The Polystichineae are also divided into three orders; two (Punctariales and Dictyosiphonales) without internal differentiation of tissues in the sporophyte; the third (Laminariales) with an internal differentiation of tissues. Sporophytes of Punctariales are of medium size and usually blade-like or saccate; those of Dictyosiphonales are profusely branched and thread-like. Sporophytes of Laminariales (kelps; fig. 3, M-3, P) vary from one to more than a hundred feet in height. Most of the 30 genera of Laminariales are restricted to the North Pacific ocean but certain genera, as *Laminaria* (fig. 2, M) are found in all oceans. The sporophyte of *Laminaria*, which is rarely more than 6 ft. tall, has a root-like holdfast, a stem-like portion, and a single blade terminating the stem. Many Pacific ocean kelps are notable for their complexity of external form and for their size. These "giant kelps" have numerous blades borne either at the apex of a branched stem (*Nereocystis*, fig. 3, D), or at regular intervals along a branched stem (*Macrocystis*). Giant kelps grow where the water is 20-40 ft. deep and attain a length of 20-150 ft. Some are perennial; one is an annual that grows to a length of more than 100 ft. in a single season. Sporophytes of all kelps produce unicellular sporangia on the blade portion of the plant and have the sporangia grouped in sori. The gametophytes are microscopic irregularly branched filaments that rarely have more than 50 cells. Male gametophytes (fig. 2, L) bear many antheridia, each containing a single antherozoid; female gametophytes (fig. 2, K) have 1-6 oögonia, each containing a single egg.

The Cyclosporeae have a sporophytic plant body whose spores function as gametes instead of developing into gametophytes. Cyclosporeae differ from other brown algae in that the reproductive organs are borne in round cavities (conceptacles) within tips of the plant body. The single order, the Fucales, contains approximately 32 genera and 325 species. Fucales are world-wide in distribution but most genera are restricted to oceans of the northern or the southern hemispheres. Those growing on rocks high in the intertidal zone are often called "rockweeds" and of them *Fucus* (fig. 3, D) is a common rockweed along seacoasts of temperate regions. Its leathery, repeatedly forked, ribbon-shaped plant body is anchored to rocks by a disk-shaped holdfast. Growth occurs at the free end of each branch and is initiated by a single apical cell. Conceptacles are produced in abundance on somewhat inflated tips of branches. There are two kinds of sporangia: megasporangia (fig. 3, F) with 8 large nonflagellate megaspores, and microsporangia (fig. 3, E) with 64 small biflagellate microspores. In some species the two kinds of sporangia are borne in the same conceptacle, in other species the two kinds are in separate conceptacles; in still others they are borne on separate plants. There is a reduction division of nuclei in both the mega- and microsporangia. When the spores are liberated from the sporangia the megaspores function as eggs and the microspores as antherozoids. The zygote produced by their union immediately begins to develop into a new plant. *Sargassum* is the commonest genus in warmer portions of the oceans. Its plant body (fig. 3, I) is differentiated into stemlike and leaflike branches. Many branches terminate in small air-filled bladders; and if a plant becomes detached, it floats freely. Gametic union is similar to that of *Fucus*. Some species, as the two growing free-floating in the Gulf Stream and the Sargasso sea, multiply exclusively by fragmentation.

Rhodophyta.—The Rhodophyta (red algae) have chromatophores in which the photosynthetic pigments are masked by a red pigment (phycoerythrin); sometimes there is also a blue pigment (phycocyanin). The chief food reserve is an insoluble carbohydrate, floridean starch. Sexual reproduction is unique in that non-flagellate male gametes (spermatia) are passively transported to female sex organs. Red algae also differ from all other except the blue-green algae in lacking flagellated asexual spores. All Rhodophyta are placed in a single class, the Rhodophyceae, with some 340 genera and 2,500 species. About 50 species, belonging to a dozen genera, are fresh-water; all others are marine.

Rhodophyceae predominate in the algal flora of tropical seas but they are present in all seas, including those of polar regions. Almost all marine species grow attached and the great majority of them grow at or a few feet below the intertidal levels. In northern portions of the Atlantic and Pacific oceans red algae rarely grow in water more than 100 ft. deep; in portions of these oceans nearer the equator they have been dredged from a depth of 500 ft. Species growing in fresh water, as *Bairachiospermum*, are usually restricted to clear, cool, swiftly flowing streams.

The plant body is usually a simple blade, a much-divided blade (fig. 4, E); or more complex and differentiated into stem- and blade-like portions (fig. 4, A). None of the red algae attain a size comparable to that of the larger brown algae. The coralline red algae have their plant bodies heavily impregnated with lime. They have been shown to be of greater importance than coral animals in the formation of "coral" reefs and atolls.

The Rhodophyceae are divided into two subclasses, Bangioideae and Florideae. The Bangioideae have two distinctive characters: (a) cell division may take place anywhere in the plant body and (b) the direct division of the zygote into carpospores. The single order (Bangiales) includes about 15 genera and 60 species. A few species are fresh-water, the remainder are marine. The most conspicuous and abundant of the marine genera is *Porphyra*. Its plant body is a tough leathery blade one or two cells in thickness. *Porphyra* usually grows on rocks in the intertidal zone and its blades may be more than a foot in length.

All Florideae have a filamentous plant body but in the majority of genera this is not obvious because the filaments are laterally compacted to form a structure of definite macroscopic form. Cell division is restricted to terminal cells of the branches. In Florideae the male sex organ (spermatangium) is unicellular and contains a single non-flagellate spermatum (fig. 3, K). A spermatum liberated from a spermatangium floats to and lodges against a hair-like prolongation (trichogyne) of the one-celled female sex organ (carpogonium) (fig. 3, K) borne at the apex of a carpogonial filament. Gametic union is followed by a development of special filaments (gonimoblast filaments) that bear sporangia (carposporangia) containing carpospores (fig. 3, K). In some Florideae the gonimoblast filaments grow directly from the base of a carpogonium. In other Florideae fertilization is followed by growth of a delicate tube (oöblast) (fig. 3, N) from the carpogonium to another cell of the plant. The zygote nucleus migrates to this auxiliary cell and then gonimoblast filaments grow from the auxiliary cell. The mass of gonimoblast filaments and carposporangia, whether growing from a carpogonium or an auxiliary cell, jointly constitute the cystocarp or "fruit" of the sexual plant. Many phycologists interpret the cystocarp as a small asexual generation, the carposporophyte, that grows parasitically on the sexual plant (gametophyte). Each carposporangium of the carposporophyte liberates a single spore. Primitive Florideae have a reduction division of the zygote nucleus and have the carpospores developing into gametophytes. More advanced Florideae have no reduction division of the zygote nucleus and produce carpospores in which the chromosome number is the same as that of the zygote. Carpospores of these Florideae develop into free-living asexual plants of the same size and vegetative structure as gametophytes. This asexual plant, the tetrasporophyte, bears sporangia (tetrasporangia) in which the single nucleus divides reductionally before the sporangial contents divide to form four tetraspores (fig. 3, M). Tetraspores liberated from a tetrasporangium develop into gametophytes.

Classification of Florideae into orders is based on mode of development of the carposporophyte and on the presence or absence of a tetrasporophyte. The Nemalionales, the most primitive order, have no tetrasporophyte and usually have gonimoblast filaments developing from the carposporangium. There are approximately 35 genera in the order. All other orders have tetrasporophytes and of these the Gelidiales, a small order with some six genera, are the only ones where gonimoblast filaments grow directly from the carpogonium. All other orders with tetrasporophytes have the gonimoblast filaments growing from an auxiliary cell. In Cryptonemiales, an order with 85 or more genera, the auxiliary cell is borne in a special filament resembling a carpogonial filament. In the 70 genera placed in the Gigartinales the cell functioning as an auxiliary cell is an ordinary vegetative cell of the plant body. The two remaining orders, Rhodymeniales and Ceramiales, have a special auxiliary cell borne adjacent to the base of a carpogonial filament. Rhodymeniales have this cell developing before fertilization; Ceramiales have it formed after fertilization. The two orders contain, respectively, approximately 25 and 160 genera.

Cyanophyta.—The Cyanophyta (blue-green algae) are the only algae in which photosynthetic pigments are not localized in definite chromatophores and in which the nuclear substances are not localized in definite nuclei. The photosynthetic pigments are evenly distributed through the cytoplasm and are masked by a blue pigment (phycocyanin); sometimes there is also a red pigment resembling phycoerythrin of Rhodophyta. Cyanophyta have no motile flagellated cells, either vegetative or reproductive, and no members of the division reproduce sexually. There are about 150 genera and 1,400 species, more than 80% of which are fresh-water and either aquatic or terrestrial.

The division contains but one class, the Myxophyceae (Cyanophyceae). All members of the class are of microscopic size but in some cases (e.g., *Nostoc*, fig. 4, H) many plants may be aggregated to form a macroscopic mass of definite shape. Some genera are unicellular; the majority are multicellular and either filamentous or non-filamentous. The most primitive order, the Chroococcales, has solitary cells or has them united in non-filamentous colonies (fig. 4, G). Some of the species occasionally produce spores but the usual method of reproduction is by vegetative division of cells and fragmentation of colonies. The order includes some 35 genera and 250 species, almost all of which are fresh-water. Members of the Chamaesiphonales regularly have the contents of a cell dividing into a number of minute non-motile endospores. The plant body is usually unicellular and epiphytic on other algae. There are about 30 genera and 130 species, most of which are marine. The Hormogoneales have their cells united end to end in filaments. There are approximately 90 genera and 1,000 species, the great majority of which are fresh-water. The filaments may be unbranched (figs. 4, H-4, J) or branched (fig. 4, L). Some genera have the filaments breaking at certain points and the ends growing out at the point of rupture. This results in a "false branching" of a filament (fig. 4, K). Practically all genera multiply by fragmentation of a filament into short parts, each composed of a few cells. These hormogones then develop into long filaments. Many filamentous genera form special thick-walled cells with transparent contents. These cells, the heterocysts (figs. 4, H; 4, J-4, L), are spore-like in nature but rarely germinate to form new plants. Filaments of some species regularly break into shorter filaments at points next to the heterocysts; those of other species do not. Genera with heterocysts also produce large spores (akinetes, fig. 4, J) densely filled with protoplasm rich in reserve foods. Akinetes regularly germinate into new filaments.

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ALGARDI, ALESSANDRO (1602-1654), Italian sculptor, was born at Bologna in 1602, and attended the school of the Caracci. The turning point in Algardi's fortune was the accession

of Innocent X., of the Bolognese house of Panfili, to the papal throne in 1644. He was employed by Camillo Panfili, nephew of the pontiff, to design the Villa Doria Panfili outside the San Pancrazio gate. The most important of Algardi's other works were the monument of Leo XI., a bronze statue of Innocent X. for the capitol, and, above all, *La Fuga d'Attila* an alto-relievo in which the two principal figures are about 10 ft. high. In 1650 Algardi met Velasquez, who obtained some orders for his Italian companion in Spain. Thus there are four chimneys by Algardi in the palace of Aranjuez, where also the figures on the fountain of Neptune were executed by him. The Augustine monastery at Salamanca contains the tomb of the count and countess of Monterey, which was also the work of Algardi. He was most successful in his portrait-statues and groups of children, where he was obliged to follow nature most closely. He died in Rome on June 10, 1654.

See *Le arti di Bologna disegnate da A. Caracci ed intagliate da S. Giulini, con assistenza d'Alessandro A. Algardi* (1740).

ALGAROTH, POWDER OF, a basic chloride of antimony. It was known to Basil Valentine, and was used medicinally by the Veronese physician Victor Algarotus about the end of the 16th century. It may be prepared by the addition of much water to a solution of antimony chloride, a bulky amorphous precipitate being formed, which, on standing, gradually becomes crystalline. It is soluble in hydrochloric acid and tartaric acid, but insoluble in alcohol; its possible composition is represented by $\text{Sb}_4\text{O}_5\text{Cl}_2$.

ALGAROTTI, FRANCESCO, COUNT (1712–1764), Italian philosopher and writer on art, was born on Dec. 11, 1712, at Venice and died at Pisa on May 3, 1764. He studied at Rome and Bologna, and at the age of 20 went to Paris, where he enjoyed the friendship of Voltaire and produced his *Neutonianismo per le dame*, a work on optics. Voltaire called him his *cher cygne de Padoue*. Frederick the Great made him a count of Prussia (1740) and court chamberlain (1747). Augustus III. of Poland honoured him with the title of councillor. In 1754, after seven years' residence partly in Berlin and partly in Dresden, he returned to Italy, living at Venice and then at Pisa. He was a man of wide knowledge, a connoisseur in art and music, and the friend of most of the leading authors of his time. His chief work on art is the *Saggi sopra le belle arti* ("Essays on the Fine Arts").

The best complete edition with biography was published by D. Michelessi (1791–94).

ALGARVE or the **ALGARVES**, ancient kingdom and province in the extreme south of Portugal, corresponding with the modern administrative district of Faro, and bounded on the north by Alentejo, east by the Spanish province of Huelva, and south and west by the Atlantic ocean. Population (1940) 317,628; area 1,958 square miles. The province is about 85 mi. from east to west; 22 m. from north to south. The Serra de Malhão and the Serra de Monchique extend in the form of a crescent across the northern part of the province, and sweep round to the lofty promontory of Cape St. Vincent, the south-west extremity of Europe. This headland is famous as the scene of many sea-fights, notably the defeat of the Spanish fleet by the British in Feb. 1797. The coast is fringed for 30 m. from Quarteira to Tavira, with long sandy islands, through which there are six passages, the most important being the Barra Nova, between Faro and Olhão. The navigable estuary of the Guadiana divides Algarve from Huelva, and its tributaries water the western districts. From the Serra de Malhão flow the Silves and Odelouca, which unite and enter the Atlantic below the ancient town of Silves. The level country along the southern coast produces grapes, figs, oranges, lemons, olives, almonds, aloes, and even plantains and dates. The principal exports are dried fruit, wine, salt, tunny, sardines and anchovies. The only railway is the Lisbon-Faro main line, which passes north-eastward from Faro, between the Monchique and Malhão ranges. The name of Algarve is derived from the Arabic, and signifies a land lying to the west. The title "king of Algarve," held by the kings of Portugal, was first assumed by Alphonso III., who captured Algarve from the Moors in 1253.

ALGÄU or **ALLGÄU**, a small district in south-west Bavaria, belonging to the province of Suabia and Neuburg. The

name formerly applied to a much larger territory, extending to the Danube on the north, the Inn on the south and the Lech on the west. The Algäu Alps contain several lofty peaks, e.g., Mädelegabel (8,681 ft.). The district is celebrated for cattle, milk, butter and cheese.

ALGEBRA, according to present English usage that branch of mathematics which considers primarily the representation of numbers by means of letters. Speaking more precisely, that part of mathematics which considers the relations and properties of numbers by the aid of general symbols, usually letters ($a, b, c, \dots$), x, y, z and signs of operation ($+, -, \times, \dots$) and relation ($=, >, <, \dots$). For example, the statement that the area of a rectangle is equal to the product of the number of units of length in the base multiplied by the number of units in the height, is algebraically expressed by the symbols $A = bh$, where A stands for the number of square units of area; b , for the number of linear units in the base; and h , for the number of linear units in the height. Similarly, the expression $x^2 + 5x = 14$ states that there is a number (represented by x) such that its square, plus five times itself, is equal to 14. Algebraic symbolism and operations enter into nearly all branches of science, including the various subdivisions of mathematics. In certain cases, however, as in vector analysis ($q.v.$), the letters are not restricted to the representation of numbers. In its broader sense algebra treats of equations, polynomials, continued fractions, series, number sequences, forms, determinants, and new types of numbers. These topics will be found discussed in separate articles. It considers the fundamental theorem that every integral equation $f(x)$ with real coefficients has at least one real or complex root (see EQUATIONS), indeterminate equations (see DIOPHANTINE EQUATIONS), general algebraic equations of the third and fourth degrees, numerical higher equations (see EQUATIONS), and it enters into such important branches as the calculus, trigonometry and the theory of functions ($q.v.$). As a preparation for all this work, however, there is the elementary part of the subject. It is the purpose of this present article to discuss a number of topics which will show to the general reader the nature of algebra in its initial stage, and to show the teacher why algebra is taught in the schools. This discussion will be supplemented by references to treatises which will enable the student to find the underlying philosophical principles of the science.

Changes in Scope.—If by the word *algebra* we mean that branch of mathematics by which we learn how to solve the equation $x^2 + 5x = 14$, written in this way, the science begins in the 17th century. If we allow the equation to be written with other and less convenient symbols, it may be considered as beginning at least as early as the 3rd century. If we permit it to be stated in words and solved, for simple cases of positive roots, by the aid of geometric figures, the science was known to Euclid and others of the Alexandrian school as early as 300 B.C. If we permit of more or less scientific guessing in achieving a solution, algebra may be said to have been known nearly 2000 years B.C., and it had probably attracted the attention of the intellectual class much earlier. The scope of all early algebra was limited to a study of equations or to the solution of problems which at present would be solved by their aid. In the 16th century, after the advent of the printed book in Europe, the field was enlarged through the efforts of men like Christoff Rudolff (*Die Coss*, 1525; 2nd ed. by Michael Stifel, Königsberg, 1553, 1554), Robert Recorde (*Whetstone of witte*, London, 1557), Rafael Bombelli (*L'Algebra parte maggiore dell'arimetica*, Bologna, 1572) and Christopher Clavius (*Algebra*, Rome, 1608), becoming more of a generalized arithmetic, the fundamental operations with numbers being duplicated with rather crude algebraic symbols. The perfecting of symbolism in the 17th century greatly extended the domain of algebra and rendered possible the development of the higher branches of the subject.

Changes in Name.—The name "algebra" is quite fortuitous. When Mohammed ibn Mūsā al-Khawārizmī (Mohammed, son of Moses, the Khwarezmite), a native of Khwarezm (Khwarezm), wrote in Baghdad (c. 825), he gave to one of his works the name *Al-jabr w'al-muqābalah*. The title is sometimes translated as "restoration and equation," but the meaning was not clear even to the later Arab writers. Of late it has been thought that al-jabr is

Arabic, while *muqābala* is from the Persian, and that each meant or referred to an equation. At any rate, al-Khwarizmi's work was the first to bear the title "algebra," and the treatise was so important as to cause the name to be adopted, often with strange variations in spelling, by later writers. Various other names have been given to the science, such as *arithmetica* (see ARITHMETIC), *Bija Ganita* (Brahmagupta's Hindu treatise, c. 628, the term meaning calculation with primitive elements), *T'ien-yuen* (Chinese, "celestial element"), *Kigen seihō* (one of the Japanese names, referring to "revealing unknowns"), *Fakhrī* (al-Karkhi, c. 1020, who gave this name to his algebra in honour of his patron, Fakhr al-Mulk), *Regola de la cosa* (Rule of the *cosa*, Lat. *causa*, Fr. *chose*, the unknown quantity), *Ars magna* ("great art," used by Cardan in 1545), the German *Die Coss* and English *Cossike arte* (both in the 16th century). Most of these names referred to the science of the equation, and this is the meaning assigned to elementary algebra in certain European languages at present, the fundamental operations with literal expressions being then included under the term "arithmetic."

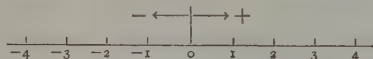
Summary of the Changes in Meaning.—We may, therefore, summarize the leading steps in the growth of algebra as follows: (1) The period of the puzzle problem relating to numbers, with little or no symbolism, c. 1800 B.C. to A.D. 275; (2) The inclusion of the geometric problem of completing the square, thus leading to the finding of a line that would be represented by x in a modern quadratic equation; (3) The development of a systematic although a crude symbolism, applied to the theory of numbers, as in the *Arithmetica* of Diophantus (c. 275), this theory including certain indeterminate equations; (4) A more critical study of equations with some approach to scientific treatment, as in the period of Muslim ascendancy, c. 800–c. 1200; (5) The rise of the theory of equations, beginning with the solution of the cubic and the biquadratic in the 16th century (see CARDAN; TARTAGLIA); (6) The development of a convenient symbolism, chiefly in the century 1550–1650, changing algebra from a crude theory of equations to an analytic subject concerned with algebraic numbers and polynomials; and (7) The modern development of higher algebra.

ARTIFICIAL NUMBERS

"The numbers used in counting objects have long been known as *natural numbers*. Numbers that are not naturally used in counting objects are commonly called *artificial numbers*, a term that is open to certain objections. From various points of view the number $\frac{2}{3}$ is as natural as 2, and $\sqrt{5}$ as naturally comes into use as 5, although we cannot look at an object $\frac{2}{3}$ of a time nor can we pick up a book $\sqrt{5}$ times. The term is convenient, however, even though it may be as inappropriate as "imaginary" in connection with $\sqrt{-3}$, or "fraction" (in its primitive sense) in connection with $\frac{2}{3}$, $\frac{5}{2}$, $\frac{1}{2}\frac{2}{3}$. The preceding discussion

leads to a much larger and more important question as to the meaning of number itself. (See NUMBER; NUMBERS, THEORY OF; COMPLEX NUMBERS.)

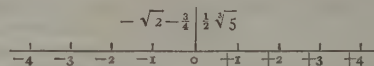
Algebraic Scale.—If we construct a scale of integers,



1, 2, 3, 4, ..., and count backwards (to the left) by repeatedly subtracting 1, we have ... 4, 3, 2, 1, 0. The next count on the scale carries us beyond the point marked 0 on the scale, to 1, 2, 3, 4, ... in the opposite direction, just as we count 1, 2, 3, 4, ... below zero on a thermometer. For obvious reasons we find it convenient to speak of these symbols on the other side of zero as representing numbers, even though we cannot look at an object "three-less-than-zero" or "three-on-the-other-side-of-zero" times. We were led to these particular artificial numbers by subtracting as we went down the scale, and so we come to designate them a minus sign, thus giving to this sign the qualitative meaning (say "negativeness") instead of the operative one (subtraction). Such numbers are imaginary in some senses and natural in others. If

we wish to emphasize the positive nature of 1, 2, ..., we may write them as $+1$, $+2$, ..., although even without any sign they are considered positive.

Further, on the algebraic scale we can represent such fractions as $\frac{1}{2}$ and $-\frac{2}{3}$, and such surd numbers as $-\sqrt{2}$ and $\sqrt[3]{5}$, so these



are as real in certain situations as the integers themselves.

If the expression a/b , in which a and b are natural numbers, does not denote a natural number, it is called a *fraction*, but since division by 0 has no meaning, the case in which $b=0$ is excluded. Integers and fractions are classified as *rational numbers*. More generally speaking, a rational algebraic fraction is the quotient of any integral function by any other integral function. Certain numbers such as $\sqrt{2}$ and $\sqrt[3]{7}$ do not come within the definition of rational numbers, and are called *irrational numbers*. In elementary algebra we also meet with certain numbers represented by the symbol $a\sqrt{-1}$, and these are called *imaginary numbers*. Numbers like $a+b\sqrt{-1}$, are called *complex numbers*. (See NUMBER; COMPLEX NUMBERS; FRACTIONS; NUMBERS, THEORY OF.)

Algebraic Expressions.—An expression consisting of a single letter, or made up either of letters or of letters and numerals, combined so as to represent some or all of the operations of addition, subtraction, multiplication, division, involution (the finding of powers) and evolution (the finding of roots), is an *algebraic expression*. If it does not involve addition or subtraction, it is a monomial; but in the expression $a-(b+c)$, $-(b+c)$ is considered as a monomial, and so in other similar cases involving signs of aggregation (parentheses, brackets, etc.). If an algebraic expression is not a monomial, it is a *polynomial*, the binomial (two-term) and trinomial (three-term) being special types. In algebra, the letters of an expression represent numbers of some kind. In the monomial ab , a and b are *factors* of the expression. If the value of either factor, say a , is known and is to remain the same throughout the discussion of the expression, it is called a *constant*; but if it may have any value we please to give it and change from one value to another, it is called a *variable*. Constants are often represented by the first letters of the alphabet (a , b , c , ...), and variables by the last letters (... x , y , z), but this is not a universal rule especially in physical formulas. In an equation, say $2a-x=4$, x usually represents a number to be found—"the unknown quantity"—the first letters of the alphabet representing numbers supposed to be known. In the monomial $2ax^2$, we may speak of any factor as the *coefficient* of the rest of the expression, but it is customary to speak of 2 as a numerical coefficient, and of $2a$ as the coefficient of x^2 , the coefficient being the first factor or factors. For example, in the expression $\frac{1}{2}(a+b)x^2y^3$, $\frac{1}{2}$ is the coefficient of $(a+b)x^2y^3$, and $\frac{1}{2}(a+b)$ is the coefficient of x^2y^3 , and it is also allowable to speak of $\frac{1}{2}(a+b)x^2$ as the coefficient of y^3 , and so on. In the expression x^3 , 3 is the *exponent* of x , and similarly in the case of x^m . In the expression mx , the coefficient m (if it be an integer) represents the number of times that x is taken as an addend; while in the expression x^m , m (if it be an integer) represents the number of times that x is taken as a factor. In each case the meaning is later extended to permit of m being any kind of number (fractional, surd, imaginary, etc.).

Function.—An expression like $2x+5$ is called a *function* of x and is said to "depend upon" x for its value. Similarly, $2x+y^3$ is a function of x and of y . For brevity we may, in any discussion, write $f(x)$ for the function of x , and $f(x, y)$ for the function of x and y , and so on for other variables. We may then, in discussing $x-3$, for example, say that $f(1)=1-3=-2$, $f(7)=7-3=4$, $f(-2)=-2-3=-5$, $f(0)=0-3=-3$, and so on, according to the value of x which we substitute in $x-3$.

The Elementary Operations.—From the standpoint of actual use, whether in the natural sciences or in pure mathematics, there is little need for the ordinary operations involving polynomials, therefore a brief treatment of the four fundamental operations, limited chiefly to binomial operators, with a slight reference to the theory of roots, is all that is essential to the further study

of the science of algebra. The operations upon algebraic fractions were adapted from arithmetic after the introduction of the improved symbolism of the 17th century. They later became more complicated owing to the doctrine of formal discipline, the result leading to an expenditure of time quite out of proportion to the use made of them. In the 19th century the time consumed in reducing artificial fractions to lowest terms, and in operations involving polynomials was excessive.

Ratio.—In practical work a ratio is considered simply as a fraction, although fundamentally the ratio of the circumference to the diameter of a circle is a transcendental number and not a fraction, as we define the term. Practical work in a laboratory or workshop is not concerned with irrationals as such; it seeks for precision within certain designated limits, recognizing that all measurement is approximate. On this account and because of the immaturity of the pupils, elementary algebra looks upon a proportion as a fractional equation, and deals with all ratios as simple fractions, ignoring the distinction between algebraic and arithmetical fractions, and the fact that the ratio may be irrational.

Uses of Irrational Numbers.—In the solution of quadratic equations, excepting those artificially constructed to give only integral values of the unknown quantity, the roots are generally irrational, not being expressible as the quotient of a/b , where a and b are integers. This is seen in the simple quadratic $x^2=2$, where $x=\pm\sqrt{2}$. Since early arithmetic was concerned largely with rational numbers, the irrational ones were generally assigned to algebra, the branch of mathematics in which they were needed. The purpose in placing them there was soon obscured, however, the result being a much more extensive treatment of the subject than was warranted by any practical considerations. If, in a physical problem, there is need for solving the equation $x^2=243$, it is important to find the value of x to a definite degree of approximation. If it is stated that $x=\pm\sqrt{243}$, nothing is gained by writing this result as $\pm 9\sqrt{3}$. An expression like $\sqrt{2}$ and $\sqrt[3]{17}$, but (for no very good reason) not like $\sqrt{3+\sqrt{2}}$, is known as a *surd*, from a mediaeval Latin translation of an Arabic rendering of the Greek ἄλογος (*al'ogōs*, irrational). Until recently the finding of the square root of a binomial surd, as of $7-4\sqrt{3}$ or of $12+2\sqrt{35}$, was a familiar operation in elementary algebra, and there is still good cause for complaint that the work in surds is excessive. With the properties of such transcendental numbers as e and π , elementary algebra is little concerned. (See NUMBER.)

Factors.—The factorizing of polynomials has a place in the theory of equations and in the advanced study of polynomials, but its value in elementary algebra is slight. In the algebra that the pupil will use in the sciences or in the mechanical arts its legitimate place is not large. The needs of the pupil are usually met by the cases of monomial factors, and of the binomial factors of expressions of the type $x^2+(a+b)x+ab$ and x^2-y^2 .

The original idea, carried over from arithmetic, was that factors should be integral and rational. In practical use, however, it is often necessary to enlarge this conception, and to speak of $x^2-\frac{1}{a^2}$ as having the factors $x+\frac{1}{a}$ and $x-\frac{1}{a}$; of $x+\sqrt{a}$ and $x-2\sqrt{b}$ as factors of $x^2+x(\sqrt{a}-2\sqrt{b})-2\sqrt{ab}$; and of $\sqrt{a}$, $\sqrt{b}$, and $\sqrt{c}$, as factors of $\sqrt{abc}$.

The Equation.—Expressions of equality are of several types. For our present purposes it is necessary to consider only three: (1) $2+3=5$ or, after the operation has been performed, $5=5$; (2) $a+a=2a$; (3) $x+2=5$. The first is a numerical relation between known numbers, and does not represent an algebraic equation; the second represents a relationship that is true for all values of a , and hence is called an *identity*, another example being $(a+b)^2=a^2+2ab+b^2$; the third is an algebraic equation, true in this case for one and only one value of x , this value being known as the *root* of the equation. An identity is often indicated by the symbol $\equiv$ instead of $=$. In the present discussion we consider only elementary algebraic equations with rational and integral terms. The general treatment with a consideration of the existence of a root is given in the article on EQUATIONS, THEORY OF.

Linear Equations.—Considerations of analytic geometry (*q.v.*) have led to the use of the term *linear equation* to mean an equation of the first degree having any number of variables. The oldest part of elementary algebra, so far as known, relates to the solution of linear equations in one unknown, the type form reducing, through the final stage (in modern symbols) of $px=q$, to $x=k$. This type of equation is found in the Ahmes (Rhind) Papyrus (*c.* 1700–1600 B.C.) and is the one found most frequently for a period of more than 3,500 years, varying merely in the language and symbols employed. Such number puzzles have been used by substantially all writers on algebra, and in modern times they have found a wide range of practical applications in the sciences, in industry and in commerce.

Linear equations of the type $ax+by+c=0$ and $a'x+b'y+c'=0$ generally have common values for x and y ; that is, they are *simultaneous*. For example, the two equations $x+3y-1=0$ and $2x+9y+1=0$ have in common the roots $x=4$, $y=-1$. Each equation is, by itself, *indeterminate*, having an infinite number of roots. For example, the first of these equations, $x+3y-1=0$, is satisfied by $x=0$, $y=\frac{1}{3}$, and similarly by the pairs of values $(1, 0)$, $(2, -\frac{1}{3})$, $(3, -\frac{2}{3})$, $(4, -1)$, and so on; but there is only one pair which satisfies both of the equations. In modern textbooks this is made clearer by means of graphs, each equation being represented by a straight line, and these lines having, in general, one point in common. This introduction of the elements of analytic geometry into elementary algebra is helpful in understanding the meaning of roots. For example, the two equations $3x-7y=6$ and $2x-4\frac{2}{3}y=4$ are satisfied by any number of pairs of values, their graphs being coincident; while $3x-7y=6$ and $2x-4\frac{2}{3}y=5$ cannot be satisfied by any pair of values, their graphs being parallel. (See ANALYTIC GEOMETRY.)

Simultaneous linear equations are solved by several methods, the equations as given in the textbooks being artificially constructed so as to illustrate each. These methods are sufficiently discussed in such works. If, however, only a single method is to be given for solving a pair of simultaneous equations, this method being made mechanical by much practice, that of substitution is the most satisfactory in cases that actually arise in science or industry. This method consists in finding in either equation the value of one unknown in terms of the other, and then in substituting this value in the other equation. For advanced classes the method of determinants (*q.v.*) is interesting and valuable.

Simultaneous linear equations with more than two unknown quantities have an interest as puzzles and some value in developing skill in manipulating algebraic expressions, and they also have value in certain technical fields and in certain commercial problems. During the centuries there have been developed various devices for solving specially constructed types, but such devices and types lack generality and hence they have little value except as recreations. In actual practice with real problems the method of determinants is the best. The question of the possibility of solution of given sets should be considered, as in the case of simultaneous equations with two unknowns.

Quadratic Equations.—An equation of the type $ax^2+bx+c=0$ in which b and c may have any finite numerical values, and a may have any finite value except zero, is a *quadratic equation* (from the Latin *quadratus*, a square). Such equations are frequently needed in solving scientific problems. There are several methods of solving such an equation, including the following: (1) Reducing to the form $ax^2+bx+c=0$; resolving into factors $(px+q)(p'x+q')=0$; equating each factor to zero; and solving the two resulting linear equations; (2) Completing the square; (3) Using a general formula, usually developed by the second method. Of these, (1) is too difficult in a practical case like $1.47x^2-0.36x+14.02=0$, however easy it may be in an artificial one like $x^2-5x+6=0$; (2) is a traditional method, essentially due to the Alexandrian school (*c.* 300 B.C.); it requires the memorizing of a process—the completion of the square; and it is arithmetically difficult in practical cases; (3) requires the memorizing of a formula, but in problems that are practical it is usually the easiest of the three.

Simultaneous quadratic equations can be solved by elementary

algebra (the biquadratic not being there given) only in cases artificially constructed to admit of easy solution. The analytic explanations given in textbooks may profitably be supplemented by the use of the graph. This will serve to show the difference between a case like $2x-3y=5$, $x^2+3y^2=7$, and a case like $x^2+y=7$, $x+y^2=11$. In the former substitution reduces the problem to the solution of a quadratic; in the latter case, to the solution of an equation of the fourth degree. The nature of such equations may profitably be shown by the aid of graphs.

Ratio and Proportion.—As already stated, this subject is best treated in connection with fractional equations. Since in elementary algebra the letters represent numbers, and since it is necessary to assume at this stage that operations with irrational numbers are subject to the ordinary laws that obtain with integers, the subject offers no new features. The range of application to outdoor measurement and to simple physical problems is extensive. With this method of treatment such special names as *antecedent*, *consequent*, *means*, and *extremes* lose their importance in practical problems. Moreover, the old notation, $a:b::c:d$, may profitably give place to the more familiar and more easily understood symbols representing a fractional equation.

Variation.—The subject of variation, which formerly had a symbolism of its own, is more conveniently and clearly treated as a topic under ratio and proportion or, what is substantially the same, by the ordinary method of equations; that is, variation may be expressed by the aid of the equation $x=ky$ (direct variation) or by $xy=k$ (inverse variation).

TRIGONOMETRY, SERIES, APPLICATIONS

A movement is taking place among teachers of mathematics to encourage the consideration of the simple trigonometry of the right-angled triangle as a special chapter of algebra, following the topics of ratio and proportion. (See TRIGONOMETRY; LOGARITHMS.)

Elementary Series.—Amongst those inheritances from mediaeval arithmetic which found their way into the early textbooks in algebra, was the topic of progressions. This term usually covered the rules for the summation of simple types of arithmetical and geometric series, and sometimes a brief discussion of harmonic series. With the improved symbolism came the formulae relating to these sequences, and in recent years the special name *progression* has tended to give place to *series*. The subject, together with the related Binomial Theorem, is sufficiently treated in current textbooks. (See SERIES; NUMBER SEQUENCES; LIMIT; BINOMIAL FORMULA.) Elementary algebra contains many practical applications of equations, and modern textbooks are using these to supplement or replace the less valuable inheritances. It would be unfortunate if any attempt should be made to abolish all of this traditional material; it could never have held its place through the centuries if it had not possessed such an interest for young people as to insure the degree of permanence which we see. It has often been from the study of the interesting but impractical that the most practical mathematicians as well as the leaders in pure mathematics have been made. The most important application of elementary algebra is found in the formula. This is the part of algebra which the pupil will use most frequently in science, in mensuration, in technical work of all kinds, and in such parts of more advanced mathematics as series, determinants, trigonometry, analytic geometry, and the calculus. To the formula, therefore, it is desirable that increased attention should be given.

FUNDAMENTAL PRINCIPLES ASSUMED

There are certain axioms which are often set forth in textbooks, as the statement "If $ab=p$, then $a=p/b$," but others, equally important from the standpoint of logic are properly assumed tacitly. Such for example, are the statements that $a+b=b+a$, the commutative law of addition; that $ab=ba$, the commutative law of multiplication; that $a+b+c=(a+b)+c=a+(b+c)$, the associative law of addition; that $abc=(ab)c=a(bc)$, the associative law of multiplication; and that $a(b+c)=ab+ac$, the distributive law. Such axioms and laws seem so evidently true to the mind of the child that any exhaustive discussion of them in

the early years is profitless. They may or may not be universally true; in fact, some of them are not; but they are true in the immediate and limited field of the beginner's study.

Laws of Equations.—As stated above, the axiom "If $ab=p$, then $a=p/b$ " is often set forth in elementary textbooks, but it ceases to have any meaning for the pupil if $b=0$. Similarly the statement "If $a>b$, then $ma>nb$ " ceases to be true if n is 0 or negative; and the statement "If $a=b$, then $\sqrt[n]{a}=\sqrt[n]{b}$ " also fails unless it is understood which of the n th roots in each case is to be taken, requiring a limitation upon the meaning of the symbol $\sqrt$. These laws are usually stated as axioms, with a statement of the limitations to be placed upon them in the elementary field. (See MATHEMATICS, FOUNDATIONS OF.)

Validity of Definitions.—Just as laws of operation which appear axiomatic to the beginner are seen to be wanting in universal validity as mathematics broadens, and as the laws of equations which are true in the early stages need close scrutiny when we leave the domain of the positive integers $+1, +2, \dots, +n$ (finite), so the definitions of the early years of instruction soon cease to have meaning, even before the pupil leaves the elementary stage. For example, ab does not mean that b is taken a times unless a is a positive integer; "minus a times" has no meaning unless and until the primitive use of "times" is changed, and similarly when a is equal to $\frac{3}{2}$, to $\sqrt{2}$, to $\log 7$ or to $\sqrt{-3}$; and a^n does not mean that a is taken n times as a factor when n ceases to be a positive integer. For this reason rigid definitions are not desirable.

Growth Imposes Consideration of Limitations.—The teacher of elementary algebra should early recognize that, as the science grows or as the pupil's knowledge increases, the early laws, axioms, definitions, postulates and significance of symbols constantly require further consideration of their limitations. For example, the statement that $a^m \div a^n = a^{m-n}$ must have the limitation imposed that m and n are positive integers and that $m>n$, unless negative and fractional exponents are admitted.

It is desirable that even the beginners in the study of algebra should see the necessity for maintaining the fundamental laws as the meaning of terms and symbols is broadened. For example, it would be unfortunate if a fractional or a negative exponent were to be so defined that $a^m a^n$ would cease to be equal to a^{m+n} , or that multiplication were to be given such a meaning that ab should not be equal to ba . As the pupil progresses in his study of mathematics he will meet with branches in which some of these laws cease to be valid, but his maturity will then permit of the necessary modifications.

HISTORY OF ALGEBRA

The earliest known treatise containing problems which would at present be called algebraic is the Ahmes Papyrus (also called, from the name of its former owner, the Rhind Papyrus) now in the British Museum, and written c. 1700-1600 B.C. The first of these problems reads as follows: "Ahe (or hau, transliterated by Egyptologists as 'h'w, meaning *heap, mass or quantity*), its whole, its seventh, it makes 19,"—that is, $x+\frac{1}{7}x=19$. The method of solving was by estimating the result and then correcting the error



FIG. 1.—HIEROGLYPHICS EXPRESSING THE EQUATION $x\left(3+\frac{1}{2}+\frac{1}{7}+1\right)=37$

by repeated trials. The Greek mathematicians were primarily geometers, and they made various kinds of geometric constructions by which they found a line segment corresponding to the root of an equation. Euclid (c. 300 B.C.), for example, solved problems equivalent to $xy=k^2$, $x+y=a$, and to $xy=k^2$, $x^2-y^2=a^2$. The only Greek to write extensively on algebra was Diophantus (c. 275). He was also the first writer to introduce any algebraic symbols of special significance, these including a character to represent the unknown quantity, a symbol for subtraction, the use of initial letters for equality, square and cube, and a scheme of combinations for other powers. In the Orient there is evidence of an early interest in problems which would now be solved by

algebra, and the Chinese were able to solve the quadratic equation before the Christian era. The Hindu works of Brahmagupta (c. 628), Mahāvīra (c. 850) and Bhāskara (c. 1150) contain a large number of problems solved by algebraic methods, and show considerable ability in analysis. In the Muslim world, and particularly at Baghdad in the time of the caliphs, two lines of mathematical thought converged, the first from Greek sources and the second from India. The result was the preparation of such textbooks as those of Mohammed ibn Mūsā al-Khawārizmī (c. 825), Abu Kamil (c. 900) and al-Karkhī (c. 1100). Of these, the algebra of al-Khawārizmī had the greatest influence upon European mathematics, being translated by Robert of Chester (c. 1140) and other mediaeval scholars. The Oriental writers mentioned were able to solve the quadratic equation, but whether their method originated in the East or was suggested by the Greeks is uncertain.

The beginning of printing in Europe found algebraists possessed of no convenient symbolism but, as already stated, able to solve the quadratic. Italy was the centre of learning and her scholars devoted much attention to solving the cubic equation. The latter solution was finally effected, with substantial completeness, by Tartaglia (q.v., 1535) being published by Cardan (q.v.) in his *Ars Magna* (1545). The biquadratic was solved by Ferrari (1540), a pupil of Cardan's, and was also published by the latter in the same work. The needed improvements in symbolism were generally made outside of Italy by such writers as Vieta (q.v., c. 1590), Harriot (q.v., c. 1600) and Descartes (q.v., 1637), with the notable extension of the exponential notation by John Wallis (q.v., 1655). The proof of the insolubility of the general equation of the fifth degree by algebraic methods is due to the investigations of Ruffini (1803, 1805), Abel (q.v., 1824) and Galois (q.v., 1831; posthumous publication, 1846). Elementary algebra may be said to have been substantially completed by the close of the 17th century, by which time higher algebra, especially through the

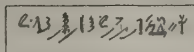


FIG. 2.—AFTER THE AHMES PAPYRUS WRITTEN ABOUT 1550 B.C.

The equation of fig. 1 in hieratics, the priestly writings of the ancient Egyptians

LIMIT; LINEAR ALGEBRAS; LOGARITHMS; MATHEMATICS, FOUNDATIONS OF; MAXIMA AND MINIMA; NUMBER; NUMBER SEQUENCES; NUMBERS, THEORY OF; POLYNOMIAL; PROBABILITY AND ERROR; QUATERNIONS, section, *Ausdehnungslehre*; SERIES; STATISTICS; TRIGONOMETRY.

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ALGEBRAIC FORMS. An algebraic form is a polynomial, all of whose terms are of the same degree in two or more variables. Thus $ax^2 + by + c$ is not a form, but $ax^2 + byz + cz^2$, of order two in three variables x, y, z is a quadratic ternary form. A form is also called a *quantic*, this general name resembling cubic, quartic or quintic. If its order is n , it is called an n -ic. Forms in two variables are called *binary*; in four variables, *quaternary*. Forms are interesting principally because they occur in equations for unknown quantities, and, since the time of Descartes (1637), in equations of geometric loci, such as curves, surfaces, families of lines or systems of circles. Their homogeneity is closely related to the modern development of projective geometry, in which the region known as "infinity" in the older geometry has no special treatment, but is like an extra axis or plane of co-ordinates, where the ratio of two co-ordinates becomes infinite or zero. Ratios take the place of measured distances. To equations in one unknown there will correspond binary forms; to those in two metric variables, ternary forms, and so on. Further, just as in geometry one considers often not single loci, but simply or doubly infinite systems of curves or surfaces, so algebraic forms may contain more than one set of variables; and the sets need not all occur to the same order, nor need two sets be composed of equal numbers of variables. A problem may arise, too, calling for the use of two, three or more forms at the same time; these are then termed a *simultaneous* system.

LINEAR TRANSFORMATIONS

For one set of variables it is often useful to substitute expressions containing a second, different set. An example of this is the change of axes, or planes, of reference in analytic geometry. Those expressions are most often linear (i.e., of the order one) in the new system, and the change is called a *linear transformation*. For some reason, however, expressions of the second or higher order may be used; this case is less frequent and less simple, and can be treated as a linear transformation in an increased number of variables, plus the inclusion of an additional locus in the system under discussion. By any linear transformation, if the new variables are given the same names as the old, the old form is changed into a new one. Two forms so derivable one from the other are called *equivalent under the transformation*. By this definition, any form is equivalent to all that can be derived from it by linear transformations. Consider a binary quadric:—

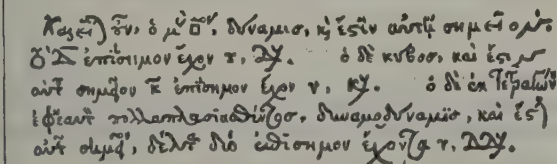
$$f(x) = x_1^2 - x_2^2.$$

Let the transformations be

$$\begin{aligned} x_1 &= 5y_1 + 6y_2, \\ x_2 &= 3y_1 + 10y_2, \end{aligned}$$

then

$$\begin{aligned} f(x) &= (5y_1 + 6y_2)^2 - (3y_1 + 10y_2)^2, \\ &= 16y_1^2 - 64y_2^2. \end{aligned}$$



AN EXTRACT FROM A 14TH CENTURY MS. SHOWING THE SYMBOLISM THEN IN USE AND SUPPOSED TO BE A TRANSLATION OF "ARITHMETICA," WRITTEN BY THE GREEK ALGEBRAIST, DIOPHANTUS, ABOUT 300 A.D. DIOPHANTUS WAS THE FIRST TO USE EXPRESSIONS FOR KNOWN AND UNKNOWN QUANTITIES

progress made in the study of equations, symmetric functions, and series, had already begun to rank as a special branch of mathematics.

HIGHER ALGEBRA

Much that is elementary in the sense of elemental, is not so in the sense of being adapted to the pre-university schools. Higher algebra of a sort is taught in these schools, and higher algebra of an entirely different sort is taught in the universities. In the pre-university schools the work serves as an introduction to the theory of equations, algebraic numbers, determinants, certain series, inequalities, limits and logarithms, and the simpler features of analytic trigonometry, analytic geometry and the differential calculus. In the universities it includes work in the theory of equations, the study of polynomials, combinatorial analysis, probability, matrices and various other fields. For the more important of these topics see AGGREGATES; ANALYSIS; ANALYTIC GEOMETRY; BARYCENTRIC CALCULUS; BINOMIAL FORMULA; TENSOR ANALYSIS; CALCULUS OF DIFFERENCES; COMBINATORIAL ANALYSIS; COMPLEX NUMBERS; DETERMINANT; EQUATIONS; DIFFERENTIAL FORMS. ALGEBRAIC FORMS; GRAPHIC METHODS; GROUPS;

Call this new form $F(y)$, then

$$F(x) = 16x_1^2 - 64x_2^2,$$

and $F(x)$ is equivalent to $f(x)$. Such a transformation may be represented, between two binary forms, by means of indeterminate coefficients or parameters $\alpha_1, \alpha_2, \beta_1, \beta_2$, thus:—

$$\begin{aligned} x &= \alpha_1 y_1 + \beta_1 y_2, \\ x_2 &= \alpha_2 y_1 + \beta_2 y_2, \end{aligned}$$

and it is reversible without ambiguity if the determinant $(\alpha_1\beta_2 - \alpha_2\beta_1)$ is not zero, for then these two equations can be solved for y_1 and y_2 .

Groups.—One reason for the employment of linear transformations is that all such form a group. (See GROUPS.) That is, if two linear transformations are made in succession, variables (x) into functions of (y) , and the (y) into functions of variables (z) , then the (x) are linear functions of the (z) . The linearity is unchanged by compounding two or more linear transformations. One speaks often of equivalence under the *linear group*, meaning to exclude transformations whose determinant is zero; then the equivalence is a mutual relation. There are groups of linear transformations that do not include all such substitutions; just as there are in geometry rotations of a plane about one fixed centre, leaving a system of concentric circles unaltered. For some purposes, the group of linear substitutions whose determinant is 1 are applied; or the group of real transformations, excluding all that have any imaginary parameters. If imaginary substitutions are admitted, a quaternary quadric $x_1^2 + x_2^2 + x_3^2 - x_4^2$ is equivalent to another $x_1^2 + x_2^2 - x_3^2 - x_4^2$; not, however, if the group is that of *real* linear transformations. Two systems of forms in any number of sets of variables are equivalent under the group if the members of one system can be transformed into those of the other system by means of separate linear substitutions on all the different sets of variables involved. Two sets of variables that are subject to the same transformation are *cogredient*.

Equivalence of Quantics.—What happens to the coefficients of the various terms in a form, or quantic, when it is transformed into an equivalent quantic? It is seen, on trial, that the new coefficients contain the old in the first degree, but the parameters of the transformation to higher degrees, *each form to a degree equal to its order in the variables*. Under linear transformation of its variables, every form undergoes also a reverse linear transformation of its coefficients, determined or *induced* by that of the variables. These need not be described more minutely here; they require for precise statement the definition of *polars*. (See POLE and POLAR.) While the two forms are called equivalent when the equations that transform variables are given, to make the statement algebraically exact the coefficients of similar terms in the two forms must be equated, and these equations constitute the induced substitution. But two forms may be given with numerical coefficients. By what means may their equivalence be tested? This is the first major problem in algebraic form theory. The answer is far from complete. Sufficient conditions can be stated, but many of them are certainly redundant. The minimum set of necessary conditions is known in only a few particular cases. To find explicitly the parameters of a linear substitution from the equations of the induced substitution on the coefficients would require the solving of equations whose degree in the parameters is equal to that of the given forms in the proper variables. That calls for extraction of roots or other irrational operations. Naturally an answer is preferred which should demand only rational operations in proving equivalence or non-equivalence. Hence comes a re-formulation of the question: When two forms (or systems of forms) are equivalent, what rational functions of the coefficients, or coefficients and variables, will have the same numerical value for both forms? What rational functions of coefficients and variables retain the same value, remain invariant, under the group of linear substitutions? This question can be answered. As an exercise, the reader might verify that two binary cubics are generally equivalent, but not always two binary quartics, taken at random.

Invariant and Covariant.—An invariant or covariant (a comitant) of a given form or system is any function of the coefficients, or coefficients and variables, which is identically equal to the same function of the corresponding coefficients and variables in every equivalent form or system—equal, that is, save for a multiplicative constant depending on the parameters of the transformation. Such a constant, it can be proved, is always some power of the determinant of the substitution. These are relative invariants, but if the multiplicative constant is unity, the invariant is absolute.

BINARY FORMS

The rational invariants of a single binary form of order less than ten have been thoroughly studied and tabulated. First to be noticed was naturally the discriminant or determinant of a quadric form, for it was known to vanish when the quadric has two equal factors; and their equality could not be altered by linear transformations, therefore the determinant after transformation must be a multiple of that before the transformation. To verify this, take the quadric $ax_1^2 + 2bx_1x_2 + cx_2^2$, the discriminant of which is $D = 4b^2 - 4ac$. The transformation is given by the equations:—

$$x_1 = \alpha_1 y_1 + \beta_1 y_2, \quad x_2 = \alpha_2 y_1 + \beta_2 y_2.$$

The transformed quadric is

$$\begin{aligned} &(a\alpha_1^2 + 2b\alpha_1\alpha_2 + c\alpha_2^2)y_1^2 \\ &+ 2(a\alpha_1\beta_1 + b(\alpha_1\beta_2 + \alpha_2\beta_1) + c\alpha_2\beta_2)y_1y_2 \\ &+ (a\beta_1^2 + 2b\beta_1\beta_2 + c\beta_2^2)y_2^2. \end{aligned}$$

The new coefficients are, therefore,

$$\begin{aligned} a' &= a\alpha_1^2 + 2b\alpha_1\alpha_2 + c\alpha_2^2, \\ b' &= a\alpha_1\beta_1 + b(\alpha_1\beta_2 + \beta_1\alpha_2) + c\alpha_2\beta_2, \\ c' &= a\beta_1^2 + 2b\beta_1\beta_2 + c\beta_2^2. \end{aligned}$$

For the discriminant after the transformation we find

$$\begin{aligned} D' &= 4b'^2 - 4a'c' \\ &= (\alpha_1\beta_2 - \alpha_2\beta_1)^2 \cdot D. \end{aligned}$$

This invariant D is the only one that the quadric has. The binary cubic and quartic have covariants as well as invariants, easily discovered without an elaborate notation. First, it should be observed that symbols of differentiation, $\frac{\partial}{\partial x_1}$ and $\frac{\partial}{\partial x_2}$, undergo a so-called *transposed* substitution, thus:—

$$\begin{aligned} \frac{\partial}{\partial x_1} &= \frac{1}{\Delta} \left(\beta_2 \frac{\partial}{\partial y_1} - \alpha_2 \frac{\partial}{\partial y_2} \right) \\ \frac{\partial}{\partial x_2} &= \frac{1}{\Delta} \left(-\beta_1 \frac{\partial}{\partial y_1} + \alpha_1 \frac{\partial}{\partial y_2} \right), \quad \Delta = (\alpha_1\beta_2 - \alpha_2\beta_1). \end{aligned}$$

(See DETERMINANT.) The law for multiplication of determinants shows then a factoring, if ϕ and ψ denote any two forms:

$$\begin{vmatrix} \frac{\partial \phi}{\partial x_1} & \frac{\partial \phi}{\partial x_2} \\ \frac{\partial \psi}{\partial x_1} & \frac{\partial \psi}{\partial x_2} \end{vmatrix} = \frac{1}{\Delta^2} \begin{vmatrix} \beta_2 & -\alpha_2 \\ -\beta_1 & \alpha_1 \end{vmatrix} \begin{vmatrix} \frac{\partial \phi}{\partial y_1} & \frac{\partial \phi}{\partial y_2} \\ \frac{\partial \psi}{\partial y_1} & \frac{\partial \psi}{\partial y_2} \end{vmatrix} = \frac{1}{\Delta} \begin{vmatrix} \frac{\partial \phi}{\partial y_1} & \frac{\partial \phi}{\partial y_2} \\ \frac{\partial \psi}{\partial y_1} & \frac{\partial \psi}{\partial y_2} \end{vmatrix}.$$

This shows that the Jacobian of any two forms is a covariant.

But the two forms may be $\frac{\partial f}{\partial x_1}$ and $\frac{\partial f}{\partial x_2}$. Then the covariant is termed the *Hessian* of the form f : $f = ax_1^3 + 3bx_1x_2 + 3cx_1x_2^2 + dx_2^3$

$$H = \frac{1}{36} \begin{vmatrix} \frac{\partial^2 f}{\partial x_1^2} & \frac{\partial^2 f}{\partial x_1 \partial x_2} \\ \frac{\partial^2 f}{\partial x_2 \partial x_1} & \frac{\partial^2 f}{\partial x_2^2} \end{vmatrix} = (ac - b^2)x_1^2 + (ad - bc)x_1x_2 + (bd - c^2)x_2^2.$$

The Jacobian of f and H is also covariant, of order three:—

$$Q = \frac{1}{6} \begin{vmatrix} \frac{\partial f}{\partial x_1} & \frac{\partial f}{\partial x_2} \\ \frac{\partial H}{\partial x_1} & \frac{\partial H}{\partial x_2} \end{vmatrix} = (a^2d - 3abc + 2b^3)x_1^3 + \text{etc.}$$

These four functions, all well known in the theory of equations, are connected by an identical relation or *syzygy*: $Q^2 + 4H^3 + Rf^2 = 0$. This shows that $Q + f\sqrt{-R}$ and $Q - f\sqrt{-R}$ are perfect third powers of the factors of H .

The Binary Quartic, $f = ax_1^4 + 4bx_1^3x_2 + 6cx_1^2x_2^2 + 4dx_1x_2^3 + ex_2^4$ is more interesting and not too complicated. It has one absolute invariant, which is the ratio of two relative invariants, i and j , and two covariants, H and T .

Their explicit formulae are:—

$$i = ae - 4bd + 3c^2, \quad j = \begin{vmatrix} a & b & c \\ b & c & d \\ c & d & e \end{vmatrix},$$

$$H = \frac{1}{144} \begin{vmatrix} \frac{\partial^2 f}{\partial x_1^2} & \frac{\partial^2 f}{\partial x_1 \partial x_2} \\ \frac{\partial^2 f}{\partial x_1 \partial x_2} & \frac{\partial^2 f}{\partial x_2^2} \end{vmatrix}, \quad T = \frac{1}{8} \begin{vmatrix} \frac{\partial f}{\partial x_1} & \frac{\partial f}{\partial x_2} \\ \frac{\partial H}{\partial x_1} & \frac{\partial H}{\partial x_2} \end{vmatrix}.$$

These five forms are connected by an identity or *syzygy*,

$$T^2 + 4H^3 - iHj^2 + jf^3 = 0.$$

From this comes an important factorization, if the cubic equation, $4x^3 - ix^2 + j = 0$, has three roots m_1, m_2, m_3 , namely:—

$$T^2 = -4(H - m_1f)(H - m_2f)(H - m_3f),$$

the factors on the right are perfect squares, a fact which aids in solving the quartic equation. The discriminant R is expressible in terms of i and j : $R = i^3 - j^2$. When $R = 0$, f and H have each a double factor, while T has one five-fold factor. If further i and j are both zero, the quartic f has a triple factor, and that factor occurs in H to the fourth power. Were H to vanish identically, f must be a perfect fourth power. (If H' is formed from H as H is from f , and T' from H and H' as T is from f and H , then T' differs from T only by an invariant factor.)

These details show that, for forms of higher order and in more than two variables, invariants would be unwieldy if written out in full. An abbreviated notation is a necessity for the development of the theory. The most generally used are the hyperdeterminant notation of Arthur Cayley, the Clebsch-Aronhold notation, which is practically the same, and modifications of either. Aronhold, R. F. A. Clebsch and Gordan use the following, some slight improvements having been made by E. Study.

TERNARY FORMS

If three ternary linear forms vanish for the same values of the variables, not all zero, *i.e.*, if

$$\begin{aligned} a_1x_1 + a_2x_2 + a_3x_3 &= 0 \\ b_1x_1 + b_2x_2 + b_3x_3 &= 0 \\ c_1x_1 + c_2x_2 + c_3x_3 &= 0, \end{aligned}$$

then their determinant, denoted by $(a_1b_2c_3)$ or merely (abc) , is zero. No linear transformation will disturb this relation, hence (abc) is an invariant of the three linear forms. It is the type of all invariant combinations of symbols. If the forms are abbreviated to (ax) , (bx) and (cx) respectively, and written with different sets of variables, *e.g.*, (ax) , (by) , (cz) , then (abc) is, in another expression:—

$$\begin{vmatrix} \frac{\partial}{\partial x_1} & \frac{\partial}{\partial x_2} & \frac{\partial}{\partial x_3} \\ \frac{\partial}{\partial y_1} & \frac{\partial}{\partial y_2} & \frac{\partial}{\partial y_3} \\ \frac{\partial}{\partial z_1} & \frac{\partial}{\partial z_2} & \frac{\partial}{\partial z_3} \end{vmatrix} (ax)(by)(cz).$$

This suggests that if ternary forms of higher order are expressed symbolically as powers of linear forms, operators of this same type, denoted by $\left(\frac{\partial}{\partial x} \frac{\partial}{\partial y} \frac{\partial}{\partial z}\right)$, acting on a collection of

such forms would produce invariants. The property of invariance is now located in the elementary operator. A single form may be represented by several symbols in the same problem; a ternary quadric, by $(ax)^2$, $(bx)^2$ and $(cx)^2$ indifferently. Then the operation $\left(\frac{\partial}{\partial x} \frac{\partial}{\partial y} \frac{\partial}{\partial z}\right)^2 (ax)^2 (by)^2 (cx)^2$ will yield, when explicated,

$$2 \begin{vmatrix} a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \\ c_1 & c_2 & c_3 \end{vmatrix}^2 \quad \text{or} \quad 2(abc)^2.$$

This result, if not identically equal to zero, is an invariant of the ternary quadric; in fact, its discriminant. An invariant so symbolized can be translated into terms of the actual coefficients of the quadric if we agree that $(ax)^2$ shall mean

$$\sum_i a_{ii} x_i^2 + \sum_{i,k=1, i \neq k}^3 a_{ik} x_i x_k$$

and that $a_{ik} = a_{ki}$. Further, any symbolic product a_1a_2 means a_{12} , and a_x^2 means a_{xx} . Similar conventions yield, for a ternary cubic $(ax)^3$, $(bx)^3$, $(cx)^3$ or $(dx)^3$, the invariant:— $(abc)(abd)(acd)(bcd)$, which is one of the two well-known invariants of the cubic. It is obvious also that $(abc)^2(ax)(bx)(cx)$ will be a symbol of a covariant of the cubic form; it is commonly called the *Hessian* of the cubic.

Such a structure might, however, prove to signify identically zero when symbols are translated into actual coefficients. Such cases are $(abc)^3$ and $(abc)^2(ade)(bde)(cde)$. Again, the difference of two supposed invariant forms may be a zero form, in which case the expressions, apparently distinct, signify actually the same invariant. Ambiguity of expression results from the existence of zero forms, and these in turn from a few elementary identities which are essentially alike. For binary covariants containing not more than two sets of variables; these identities are combinations of the following three:—

$$\begin{aligned} (ab)(cx) - (ac)(bx) + (bc)(ax) &= 0, \\ (ab)(xy) - (ax)(by) + (bx)(ay) &= 0, \\ (ab)(cd) - (ac)(bd) + (bc)(ad) &= 0, \end{aligned}$$

whatever the symbols may represent.

Equally recognizable is the possible ambiguity of symbolic formulae in invariants of ternary forms. The typical identity is this:—

$$(abc)(dx) - (abd)(cx) + (acd)(bx) - (bcd)(ax) = 0,$$

or this:—

$$(abc)(def) - (abd)(cef) + (abe)(cdf) - (abf)(cde) = 0.$$

Geometric Considerations.—For geometric uses variables of a second kind are considered. These are line co-ordinates $(u_1u_2u_3)$, subject to *contragredient* linear transformations so adjusted to those of the *point co-ordinates* $(x_1x_2x_3)$ that, if the latter are expressed in terms of $(y_1y_2y_3)$, and the former in terms of $(v_1v_2v_3)$, then identically

$$(ux) = u_1x_1 + u_2x_2 + u_3x_3 = v_1y_1 + v_2y_2 + v_3y_3 = (vy).$$

The combination (ux) is called the identical covariant. Symbols a_1b_1 etc. are cogredient with the u 's. When variables u and variables x are present in the same covariant expression, the above zero form may be

$$(abc)(ux) - (abu)(cx) + (acu)(bx) - (bcu)(ax) = 0,$$

$$\text{or} \quad (abc)(deu) - (abd)(ceu) + (abe)(cdu) - (abu)(cde) = 0.$$

GENERAL LAWS OF STRUCTURE

The first major problem in the theory of forms is the determination of general laws for structure of invariants. For *binary*

forms containing one set of variables it is proved that invariant forms consist of a finite number of terms composed of symbolic factors like (ab) and (ax) . For a ternary form structure of invariant forms, invariant comitants in one set of variables (x) and one set of contragredient variables (u) , every invariant concomitant consists solely of terms containing symbolic factors of these types: (ux) , (abc) , (ax) , (abu) . Equivalent symbolic representations of any one invariant form differ by a form containing in each term one or more of the above listed zero factors. Starting from more than one fundamental form, more types of symbolic factors would be admitted; so also if a fundamental form contains both kinds of variables, x 's and u 's.

Set of Three Quadrics.—Among ternary forms, after quadrics and systems of two quadrics, the next in point of simplicity and geometric interest is the set of three quadrics, or, what is closely related to such a set, the ternary cubic. If all invariants, covariants and contravariants are considered, together with mixed comitants containing both sets of variables, $(x_1 x_2 x_3)$ and $(u_1 u_2 u_3)$, then 34 distinct forms constitute a complete system for the rational expression of all others. The best known of these are, for the cubic f , written symbolically $f = (ax)^3, (bx)^3, (cx)^3$, etc.:—

Hessian covariant, $H = (abc)^2 (ax)(bx)(cx)$;
invariant, $S = (abc)(abd)(acd)(bcd)$;
invariant, $T = (abc)^2 (ade)(bdf)(cef)(def)$;
contravariant $\Sigma = (abc)(abu)(acu)(bcu)$, ("Cayleyan");
contravariant $T = (abc)^2 (ade)(bdu)(ceu)(deu)$;
discriminant $(T^2 - \frac{1}{3} S^3)$;
mixed form $\Theta = (abu)^2 (ax)(bx)$;
doubly apolar contravariant, $\Pi = 6T\Sigma - 4ST$.

This contravariant Π is noteworthy as being strictly dual to f itself; i.e., if variables (u) and (x) are exchanged, and invariants and contravariants derived from the altered Π , as from f , then the new Π altered by the same exchange of variables would be a multiple of the old f . The discriminant of H contains as a factor the discriminant of f . This has led to the discovery of closed systems among the comitants of the system,—closed with respect to the action of an operator δ , the "Aronhold operation." Denote in actual coefficients the two cubics—

$$f = \sum_{i+j+k=3} a_{ijk} x_1^i x_2^j x_3^k, \quad H = \sum_{i+j+k=3} \alpha_{ijk} x_1^i x_2^j x_3^k,$$

then the operation δ is defined thus (for this particular theory),

$$\delta = \Sigma \left(\alpha_{ijk} \frac{\partial}{\partial a_{ijk}} \right); \text{ i. e., } \delta f = H.$$

Then it is found that

$$\begin{aligned} \delta H &= \frac{1}{2} S \cdot f \\ \delta S &= 4T, & \delta T &= S^2, \\ \delta \Sigma &= 3T, & \delta T &= \frac{2}{3} S \cdot \Sigma, \end{aligned}$$

and connections are discovered among mixed forms of like orders.

For a ternary form of order four, the minimum number of covariant forms in a basis has not been determined; one author, Miss E. Noether, has progressed so far in approximations as to prove that it is above 300. For simultaneous systems of a small number of quadrics such work has been carried to a finish; but for higher orders it would be sport rather than science. Connections are soonest found among forms of low degrees.

Irrational Invariants are such as satisfy equations, algebraic, differential or functional, with invariant or covariant coefficients. Forms apolar to a given form satisfy an equation linear in their coefficients; e.g., the doubly apolar cubics f and Π mentioned above, so Hilbert's form $\phi = (ax)^3$, irrationally covariant to a cubic $(ax)^3$, satisfies an equation $(ab\alpha)^2(ax)(bx) = M(\alpha x)^3$, a relation discussed in vol. i of the *Transactions of the American Mathematical Society*. "Binary quartics which are multiples of their own Hessian covariants are the squares of quadrics." Combinants and semicombinants furnish another illustration. A

combinant of two forms of like order, $(ax)^n$ and $(Ax)^n$ is any simultaneous covariant of the two which is unchanged, save for a factor, when the first two are replaced by $m_1(ax)^n + M_1(Ax)^n$ and $m_2(ax)^n + M_2(Ax)^n$, m_1 and m_2 , M_1 and M_2 denoting any constants. One such is their Jacobian, and all others are comitants of that Jacobian, $(Aa)(Ax)^{n-1}(ax)^{n-1}$. A semicombinant of two forms of different orders is unchanged when the form of higher order is replaced by a homogeneous combination; e.g., when binary $(ax)^4$ and $(Ax)^3$ are replaced by $(ax)^4 + (m_1 x_1 + m_2 x_2)(Ax)^3$ and $(Ax)^3$. These are conjectured to be useful in discussing intersections of plane curves, or of surfaces, of different orders.

Classification.—Degree and order give a two-way arrangement, order being the number of variable factors in every term of the homogeneous covariant; degree, the number of factors which are coefficients of the fundamental form. One problem is, to enumerate the different invariant forms of a specified order and degree, counting as one any two whose difference is a zero-form. This counting gives a result that increases rapidly with the degree. But invariants of lower degree can be combined, in rational integral aggregates, into such of higher degree. This indicates a reduction at each stage of the enumeration by discarding those rational and integral in lower stages. Will the final result be zero at and beyond some finite degree? It proves to be so for all forms of low order in the binary field, and for systems of two or three ternary quadrics. The third major problem is, then, that of the finiteness of reduced systems of invariant comitants.

ORDERLY PRODUCTION AND ENUMERATION

The second major problem is that of orderly production and enumeration. The internal structure of all invariant forms is known; and all that involve a given fundamental form or system, in a given degree, and one or more sets of variables to specified orders, can be written down mechanically. There will be some ambiguity, i.e., repetitions, owing to the zero forms. The third great problem concerning the totality of such invariants is commonly called Gordan's problem; from Paul Gordan who in 1869 was the first to solve it for binary forms. The question arises, is there a finite basis for the entire system $F_1, F_2, \dots, F_i$ in terms of which all others can be represented linearly? If F is any invariant not in that basis, is there an identical equation

$$F = q_1 F_1 + q_2 F_2 + \dots + q_{l-1} F_{l-1} + q_l F_l$$

with coefficients $q_1, q_2, \dots, q_{l-1}, q_l$ polynomials in the variables x_1, x_2 ? Gordan's various proofs, that this basis must always exist, appeared first in 1869, later, revised, in 1871, and subsequently. His proof was based on the nature of certain elementary operations which build up and knit together those invariant forms; more precisely, on the Gordan series developing a form in terms of polars and Cayleyan operations. This is given in somewhat improved form by Grace and Young (*The Algebra of Invariants*, 1903). As Jacques Deruyts has gone further, treating the enumeration problem for forms in any number of variables, and as the question of finite systems is treated with greater generality by Hilbert, the earlier methods need not be exhibited. Deruyts's method is generalized from that for binary forms used by Arthur Cayley, James J. Sylvester and Fabian Franklin; Hilbert's was entirely novel.

Semi-invariants as Sources of Invariant Forms.—Semi-invariant had been defined by Cayley and Sylvester, for binary forms, as a polynomial in coefficients and variables of one or more fundamental forms, whose specific property it is to remain unaltered (identically) when the variables undergo the substitution

$$\begin{aligned} x_1 &= y_1 + \lambda y_2, \\ x_2 &= y_2, \end{aligned}$$

and the coefficients undergo the corresponding linear transformation, the variables (y) being replaced afterwards by (x) . Deruyts applies the same term to functions in more than two variables, unaltered by any substitution whose determinant lacks all con-

stituents below the principal diagonal. For quaternary forms such a substitution is this:—

$$\begin{aligned}x_1 &= y_1 + \alpha y_2 + \beta y_3 + \gamma y_4 \\x_2 &= \quad \quad y_2 + \delta y_3 + \epsilon y_4 \\x_3 &= \quad \quad \quad y_3 + \theta y_4 \\x_4 &= \quad \quad \quad \quad y_4.\end{aligned}$$

Like Alfredo Capelli, he considers for a quaternary system, covariants which may contain three sets of cogredient variables ($x_1 x_2 x_3 x_4$), ($y_1 \dots y_4$), ($z_1 \dots z_4$). Clebsch and Gordan had employed instead three unlike sets, two mutually contragredient, the other intermediate, its substitution like that of two-rowed determinants in either of the first two sets. If a covariant contains, when written in Clebsch-Aronhold symbols, π determinant factors in every term, and is of orders m_1 in the (x), m_2 in the (y), m_3 in the (z), (where $m_1 \geq m_2 \geq m_3$), its weights are called $\pi_1 = \pi + m_1$, $\pi_2 = \pi + m_2$, $\pi_3 = \pi + m_3$, $\pi_4 = \pi$; then it is shown that every primary covariant can be derived uniquely from a semi-invariant as source, which contains in every term

$$\begin{aligned}\pi_4 & \text{ 4-rowed symbolic determinant factors like } (a_1 b_2 c_3 d_4); \\ \pi_3 - \pi_4 & \text{ 3-rowed determinant factors with subscripts 1, 2, 3, like } (a_1 b_2 c_3); \\ \pi_2 - \pi_3 & \text{ 2-rowed determinant factors with subscripts 1, 2, like } (a_1 b_2); \\ \pi_1 - \pi_2 & \text{ monomial factors like } a_1, b_1, \text{ etc.}\end{aligned}$$

The number of such sources that can be written for a given set of weights $\pi_1, \pi_2, \pi_3, \pi_4$, may be denoted by $\{\pi_1, \pi_2, \pi_3, \pi_4\}$ but is subject to reduction.

This precisely defined structure of a semi-invariant is the clue to the problem: how many semi-invariants of given weights $\pi_1, \pi_2, \pi_3, \pi_4$ are linearly independent? For it is possible to count, directly or by formulae, the number of different monomial expressions, rational and entire in the coefficients, which have the prescribed weights. As they are expressed in actual coefficients (not symbolic merely) they are linearly independent. Next, they are required to satisfy the three differential equations expressing invariance under the one-way substitutions (21), (32), (43), which change the weights respectively to $(\pi_1 + 1, \pi_2 - 1, \pi_3, \pi_4)$, $(\pi_1, \pi_2 + 1, \pi_3 - 1, \pi_4)$, $(\pi_1, \pi_2, \pi_3 + 1, \pi_4 - 1)$. These involve as many conditions as there are terms of such weights; hence their number is to be subtracted from the first estimate. Then the overlapping conditions must be considered, etc. In all, the enumeration calls for as many items, additive and subtractive, as there are terms in a four-rowed determinant. This statement is for forms homogeneous in four variables. Were the forms binary, only two weights and two types of factors in semi-invariants would occur, and the results would be those of Sylvester and Franklin. For invariants (free from variables) of forms in any number of variables, the weights for the first distribution are all equal, and the calculation therefore slightly easier. But whatever the orders in variables, after the enumeration for linearly independent comitants comes the reduction for those composed of rational factors, factors which are themselves covariants of the same or lower orders. This is the "tamisage" of Sylvester and Franklin.

FINITENESS OF SYSTEM OF INVARIANTS: HILBERT'S EXTENSIONS

The third major problem is concerned with the finiteness of reduced systems of invariant comitants. Reduction by tamisage may show that, for degrees and orders proposed, all covariants are reducible, i.e., rationally expressible in terms of those of lower degrees. Beyond certain upper limits this must always occur. While Gordan and others proved this for binary forms, Hilbert established it for any finite number of forms in any finite number of variables. His widely inclusive principal theorem relates to algebraic forms, homogeneous, rational and integral

in the elements of any number of independent systems. Now invariants, as here defined, are so constructed from one or more sets of variables strictly so called, and from the coefficients of one fundamental form or from those of several independent forms. The theorem states, "If a series of forms be given, rational and integral and homogeneous in a domain of a finite number of finite sets of elements (variables or parameters), then it is always possible to find a finite basis, or set of forms among those given, such that every other form in the given (finite or infinite) series shall be expressible linearly in terms of those basal forms, with coefficients rational and integral in the same domain." The proof is by mathematical induction, from forms in n variables to forms in $n + 1$ variables, with starting-point in the obvious truth of the statement when a single variable x is concerned. It proceeds upon the lemma that a linear function of linear functions of several variables is itself a linear function of those variables.

According to this theorem of Hilbert's, if the given series of invariants be denoted by $A_1, A_2, \dots$ arranged in ascending degrees in sets of parameters concerned, then among the A 's is contained a basal set $B_1, B_2, \dots, B_k$, such that every A is expressible thus:—

$$A_i = M_{i1}B_1 + M_{i2}B_2 + \dots + M_{ik}B_k,$$

the M 's being rational in the same domain as the given A 's. But more than this is true: the M 's, if not invariants, can be replaced by invariants, which in turn are either B 's, or expressible in the B 's just as the A 's which include them. To turn the M 's into invariants while leaving A 's and B 's unchanged is an operation most neatly carried out by Mertens' device, as follows (confining the treatment to ternary forms, for brevity):—

Assume any linear transformation of the variables involved, say x_1, x_2, x_3 , and cogredient sets, with indeterminate parameters $\alpha_1, \alpha_2, \alpha_3, \beta_1, \dots, \gamma_1, \dots, \gamma_3$, viz.,

$$\begin{aligned}x_1 &= \alpha_1 y_1 + \beta_1 y_2 + \gamma_1 y_3 \\ x_2 &= \alpha_2 y_1 + \beta_2 y_2 + \gamma_2 y_3 \\ x_3 &= \alpha_3 y_1 + \beta_3 y_2 + \gamma_3 y_3.\end{aligned}$$

Calculate the induced transformations, resulting from this, upon the coefficients of the one or more fundamental forms. Those will give the old set of coefficients rationally in terms of the new, with denominators some powers of the determinant $(\alpha_1 \beta_2 \gamma_3)$ or Δ . Every M is thereby expressed as a form in the given domain and in the parameters $(\alpha), (\beta), (\gamma)$; so also the B 's, and these become merely powers of Δ multiplied into functions of quantities exclusive of the $(\alpha), (\beta)$ and (γ) . Now perform on every A_i, B_k and M_{ik} the operation P^*

$$P = \begin{vmatrix} \frac{\partial}{\partial \alpha_1} & \frac{\partial}{\partial \alpha_2} & \frac{\partial}{\partial \alpha_3} \\ \frac{\partial}{\partial \beta_1} & \frac{\partial}{\partial \beta_2} & \frac{\partial}{\partial \beta_3} \\ \frac{\partial}{\partial \gamma_1} & \frac{\partial}{\partial \gamma_2} & \frac{\partial}{\partial \gamma_3} \end{vmatrix}$$

where π_i is the weight of the invariant A_i . Every A_i and B_k reappears multiplied by a numerical constant (some power of 6); every M_{ik} yields an invariant and a numerical factor, and the identity is undisturbed. Accordingly, by repetitions if necessary, every A_i is expressible in terms of products of B 's with purely numerical coefficients.

Powers and products of powers of the B ; constitute a subset among the A . The same argument applies to them, giving a second theorem due to Hilbert. There exist an unlimited series of identities among the products of powers of the basal invariants of a system, identically true when all are explicit in the original variables and coefficients of given forms. These identities are called *syzygies*, and when all significant terms are brought to one side of the identity, that side (as a function of the B_k) is a *syzygant* of the first kind among the invariants B_k . Among the syzygants of the first kind there exist then syzygants of the second

kind, etc. But by a third theorem of Hilbert's the number of kinds of syzygants upon a given system of invariants is itself a finite number. Little has been done in concrete illustration of these theorems, or in the substitution of precise limits for the "finite" numbers involved; though Hilbert himself fixed an upper bound for the number of kinds of syzygies when m is the number of independent forms in the basis of the modulus or system, and worked out details for the system of three quadric surfaces defining a twisted cubic curve.

APOLARITY

For geometry, co-ordinates or variables all of one kind are not sufficient. The theory of duality demands, in a plane, point co-ordinates and line co-ordinates; and, in three-space, points and planes are dual, while lines, dual to lines, require a third kind of co-ordinates. A polarity of two forms is then an important relation. Ternary forms in contragredient sets of variables (x) and (u) are defined as apolar by the aid of an operator

$$\left(\frac{\partial}{\partial x_1} \cdot \frac{\partial}{\partial u_1} + \frac{\partial}{\partial x_2} \cdot \frac{\partial}{\partial u_2} + \frac{\partial}{\partial x_3} \cdot \frac{\partial}{\partial u_3} \right), \text{ or } \left(\frac{\partial^2}{\partial x \partial u} \right).$$

In binary forms, if $(x_1: x_2)$ and $(y_1: y_2)$ are cogredient, then $(x_1: x_2)$ and $(-y_2: y_1)$ are contragredient sets, and the operator

for apolarity is $\left(\frac{\partial}{\partial x_1} \frac{\partial}{\partial y_2} - \frac{\partial}{\partial x_2} \frac{\partial}{\partial y_1} \right)$. Two forms $(ax)^n$, $(uA)^n$

of like order are simply, doubly, etc. apolar if

$$(aA)^n = 0, \text{ i.e. } \left(\frac{\partial^2}{\partial x \partial u} \right)^n (ax)^n (uA)^n = 0,$$

or if $(aA)^{n-1} (ax) (uA) = 0$, i.e. $\left(\frac{\partial^2}{\partial x \partial u} \right)^{n-1} (ax)^n (uA)^n = 0$

(for all x and u).

Important applications of this notion to binary forms are connected with canonical or normal forms of quantics of odd order, and with a special kind of quantic of even order. A binary quantic of even order $(ax)^{2n}$, is equivalent to a sum of n perfect $2n$ th powers of linear forms if its catalecticant vanishes. A $(2n+1)$ -ic is reducible to the sum of $n+1$ perfect $(2n+1)$ th powers of linear forms, the linear factors of the canonizant. As to the latter, if the given form is

$$f(x_1, x_2) = (ax)^{2n+1} = \sum_1^{n+1} p_i (\alpha_{i1} x_1 + \alpha_{i2} x_2)^{2n+1},$$

and the canonizant

$$(Ax)^{n+1} = \prod_1^{n+1} (\alpha_{i1} x + \alpha_{i2} x_2),$$

then the transvectant

$$\frac{n!}{(2n+1)!} (Aa)^{n+1} (ay)^n = \sum p_i (\alpha_i y)^n \prod_1^{n+1} (\alpha_{i1} \alpha_{k_2} - \alpha_{k1} \alpha_{i2}) = 0$$

is identically $= 0$ on account of $n+1$ zero factors in which $i=k$. From the $n+1$ implied equations of condition, and from $(Ax)^{n+1} = 0$, elimination of the $n+2$ coefficients of $(Ax)^{n+1}$ yields the canonizant in the form of a determinant. This must be resolved into its linear factors, which must all be distinct, and then the $n+1$ coefficients p_i can be determined from linear equations.

For a binary form of even order, $(ax)^{2n}$, similar reasoning shows that it is reducible to the sum of $n+1$ perfect $2n$ th powers of linear forms, one of them an arbitrary linear form; or to the sum of n such powers if a determinant of n rows, the *catalecticant*, is equal to zero.

The so-called typical representation of binary forms expresses forms of odd order in terms of any two linear covariants, with coefficients automatically invariant. The symbolic identity $(\alpha\beta)(ax)^n = [(\alpha\beta)(ax) - (\alpha\alpha)(\beta x)]^n$ exhibits this, when (αx)

and (βx) are the selected covariants. For a binary form of even order three quadric covariants are needed, and these can be found if the order is foregoing four; call them $(\alpha x)^2$, $(\beta x)^2$, $(\gamma x)^2$, and the form $(ax)^{2n}$. Then the expansion of a four-rowed determinant gives an identity in the symbol $(\alpha x)^2$, and an n th power yields the desired typical representation:—

$$\begin{vmatrix} (ax)^2 & \alpha_1^2 & \alpha_1 \alpha_2 & \alpha_2^2 \\ (\alpha x)^2 & \alpha_1^2 & \alpha_1 \alpha_2 & \alpha_2^2 \\ (\beta x)^2 & \beta_1^2 & \beta_1 \beta_2 & \beta_2^2 \\ (\gamma x)^2 & \gamma_1^2 & \gamma_1 \gamma_2 & \gamma_2^2 \end{vmatrix} = A(ax)^2 - \{B(\alpha x)^2 + C(\beta x)^2 + D(\gamma x)^2\}, \\ \equiv 0$$

whence $A^n(ax)^{2n} = \{B \cdot (\alpha x)^2 + C \cdot (\beta x)^2 + D \cdot (\gamma x)^2\}^n$.

The linear covariants constitute a most interesting meeting point of geometry and algebra. (F. Morley in *Math. Ann.* vol. 49.)

The foregoing example of an even form and quadric covariants is also an example of geometric picturing of a binary form and its comitants upon a rational algebraic curve in two or more dimensions,—in this case on a curve of the second order in a plane. For, if we set $\xi_1/(\alpha x)^2 = \xi_2/(\beta x)^2 = \xi_3/(\gamma x)^2$, elimination of $x_1: x_2$ gives the equation of a conic in $\xi_1: \xi_2: \xi_3$, while $(ax)^{2n}$ is transformed into a ternary n -ic, and this, equated to zero, cuts out, on that conic, a set of $2n$ points, the picture of the $2n$ zero points of $(ax)^{2n}$ in the binary domain. Further, a unique curve of order n , can be determined, cutting out those $2n$ points on the conic, and itself apolar to the conic. Some use has been made of this style of picturing both on the plane conic and on the *gauche* curve of order three in three-space. (F. Meyer, *Apolarität und rationale Curven*, Tübingen, 1883.)

A sample of the relations, more easily discoverable in such geometric pictures than in algebraic symbols, is this theorem on three binary quadrics. Any three linearly independent quadrics being given (no one of which is the Jacobian of the two others), every fourth quadric is linearly related to them, with constant coefficients. But there is a unique fourth quadric, determined by the requirement that its square shall be a linear combination of the squares of the first three, with constant coefficients. Then any three of these four quadrics, taken in pairs, determine three Jacobians or functional determinants, covariant quadrics, which are related to the fourth of the original set in the same way as are the first three. (Meyer, *Apolarität und rationale Curven*, p. 244.) That is, if we use f_1, f_2, f_3, f_4 to denote the four quadrics, and write J_{12} , for example, for the Jacobian of f_1 and f_2 ,—

$$J_{12} = \begin{vmatrix} \frac{\partial f_1}{\partial x_1} & \frac{\partial f_1}{\partial x_2} \\ \frac{\partial f_2}{\partial x_1} & \frac{\partial f_2}{\partial x_2} \end{vmatrix}$$

then if there is an identical relation

$$f_4^2 = m_1 f_1^2 + m_2 f_2^2 + m_3 f_3^2,$$

the m 's denoting numbers, then there will be also an identical relation

$$f_4^2 = k_1 J_{23}^2 + k_2 J_{31}^2 + k_3 J_{12}^2.$$

This is more interesting when it is noticed that the f 's are necessarily proportional to the Jacobians of the J 's:—

$$J(J_{12}, J_{23}) = J(J_{23}, J_{31}) = f_2: f_3, \text{ etc.,}$$

for then it exhibits connections in a finite closed system.

HISTORICAL NOTE

Prior to the year 1800 the study of algebraic forms was confined to questions of factors, multiples, powers, differentiation and elimination. Resultants, discriminants and in particular determinants were chief objects of interest. Early in the 19th century, however, the invention or formulation of projective geometry and the study of groups in the theory of equations drew attention to the operational character of mathematics as

distinguished from its static aspect. It cannot be regarded as purely accidental that algebra, with its abstract groups of transformations followed after and eventually outran geometry with its groups of projectivities and quadric inversions. Projective geometry had been systematized and largely created between 1813 and 1840 by Jean Victor Poncelet, Julius Plücker and Michel Chasles. In 1841 the germ of a new movement in algebra appeared when George Boole noticed that the discriminant of $q + \lambda Q$, a homogeneous form with one parameter, must be a multiple of the discriminant of the same after transformation $q' + \lambda Q'$; from this follows that the discriminant is an invariant. In the same year appeared an essay of C. G. J. Jacobi on functional determinants, emphasizing their invariance under linear substitutions. In 1842 George Boole announced the invariance of polars. Three years later Arthur Cayley subsumed what was already known and opened a new field of discovery in the publication of his calculus of hyperdeterminants. This was in his view simply an extension, to symbols, of the theorem on multiplication of determinants of like order whose constituents are actual numbers. This was in 1845; but in 1844 there had already been published Friedrich G. M. Eisenstein's development of the invariants of a binary cubic and quartic and Ludwig Hesse's first paper on the covariant (now universally known as the Hessian. Siegfried Aronhold (1849) found the invariants of the ternary cubic and their combination in the discriminant. J. J. Sylvester's 40 years' labour in this field opened in 1851, and within four years he had invented most of the technical terminology and tapped most of the rich veins of the mines of the theory of invariants. He had even then shown the invariance of resultants under substitutions of higher order and had given examples of combinants and had named the catalecticant.

Charles Hermite's contributions began in 1851 with his discovery of evectants, followed not long after by his law of reciprocity for invariants of binary forms and by explicit formulas for the transformations of a quadric form into itself. Several writers realized the value of the differential equations of invariance and covariance (at present perhaps the most emphasized point of departure for the entire theory); among these were Francesco Brioschi, Sylvester and Cayley. The reference of invariant forms to sources is found first in the work of M. Roberts (1861), who proved, for binary forms, that the source of a product of covariants is the product of their several sources. Non-Euclidean geometry was attached to the algebraic train by Cayley (1859).

Meantime the new algebra had become accessible to wider circles by G. Salmon's publication of his *Higher Plane Curves* (1852) and *Modern Higher Algebra* (1859). French and Italian translations were widely circulated. In Germany, it was Aronhold, who founded, in publications in 1858 and 1863, the symbolic notation which has been proved most effective for the explicit working out of invariants and their relations for particular forms and systems. It is, however, more to A. Clebsch, from 1861 on, that the completion of this fundamental work is owed. By its use P. Gordan (1868) proved the finiteness of the total system of covariants for any given binary forms and so gave a climax to the earlier period of this new branch of algebra. Invention and discoveries have been less notable since that date, except for the climactic work of Hilbert, already described, and the systematizing publications of E. Study, J. Deruyts and the school of Sylvester. Important applications have been many, but the apparent tendency is to embody this theory as a typical and well-developed part in the comprehensive theory of transformation-groups of Sophus Lie. The most nearly complete history of this theory is Franz Meyer's *Bericht*.

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ALGEBRAIC FUNCTIONS, a study of a class of functions associated with algebraic equations. (See **ELLIPTIC FUNCTIONS**; **FUNCTION**; **NUMBER**.)

ALGEBRAIC GEOMETRY, a study of the geometric properties of a figure by means of its algebraic representation. (See **ANALYTIC GEOMETRY**; **CURVE**; **CURVES, SPECIAL**; **GEOMETRY**; **SURFACE**.)

ALGEBRAIC NUMBERS: see **NUMBERS, THEORY OF**.

ALGECIRAS, or **ALGEZIRAS**, a seaport and railway terminus of southern Spain, in the province of Cádiz, 6 mi. W. of Gibraltar, on the opposite side of the Bay of Algeciras. Pop. (1940) 20,226 (mun., 25,671). The name (Arabic, "island") is derived from a small islet on one side of the harbour. The fine winter climate attracts invalid visitors, on whom the town largely depends. Early in the 20th century it became a fishing station, the Algeciras steam trawlers visiting the Moroccan coast as well as Spanish and neutral waters. Whale fisheries, with a floating factory and steam whalers operating off Algeciras, were started by Spanish and Norwegian capital in 1923–25.

Algeciras was perhaps the *Portus Albus* of the Romans, but it was probably refounded in 713 by the Moors, who retained possession of it until 1344. It was then taken by Alphonso XI of Castile after a celebrated siege of 20 months, which attracted crusaders from all parts of Europe, among them being the English earl of Derby, grandson of Edward III. It is said that during this siege gunpowder was first used by the Moors in the wars of Europe. The Moorish city was destroyed by Alphonso; it was first reoccupied by Spanish colonists from Gibraltar in 1704, and the modern town was erected in 1760 by King Charles III. During the siege of Gibraltar in 1780–82, Algeciras was the station of the Spanish fleet and floating batteries. On July 6, 1801, the English admiral Sir James Saumarez attacked a Franco-Spanish fleet off Algeciras and sustained a reverse; but on the 12th he again attacked the enemy, whose fleet was double his own strength, and inflicted on it a complete defeat. The important international conference on Moroccan affairs, which resulted in an agreement between France and Germany, was held at Algeciras from Jan. 16 to April 7, 1906. Algeciras was occupied by nationalist forces early in the civil war of 1936–39.

See O. Jürgens, *Die Spanischen Städte*, bibl. (Hamburg, 1926).

ALGECIRAS CONFERENCE. On Aug. 8, 1904, a treaty was concluded in London by which France accorded absolute liberty of action to Great Britain in Egypt in return for a similar acknowledgment of French interests in Morocco. By a subsequent treaty (Oct. 1904) France concluded a secret arrangement with Spain. Disturbed by these agreements and determined to "vindicate" German rights in North Africa, the emperor William II landed at Tangier on March 31, 1905. Under his influence the sultan rejected the French scheme of reforms and issued invitations to a conference of the powers. Serious friction between France and Germany followed, resulting in the fall of Théophile Delcassé and the triumph for the moment of German policy.

The conference met at Algeciras on Jan. 16, 1906. Germany was backed by Austria, but the French claims were stoutly supported by Great Britain. A scheme of reforms was drawn up (see **MOROCCO: History**) and duly ratified; but Germany's principal object—to place France upon the same level as the other powers—was unsuccessful, and France was able to uphold its claim to a privileged position in Morocco.

ALGER (OF LIEGE) (d. c. 1131), known also as **ALGER OF CLUNY** and **ALGERUS MAGISTER**, a learned French priest who lived in the first half of the 12th century. He was first a deacon of the church of St. Bartholomew at Liège, his native town, and was appointed (c. 1100) to the cathedral church of St. Lambert.

He declined many offers from German bishops and finally retired to the monastery of Cluny, where he died about 1131 at a great age and leaving a good reputation for piety and intelligence. His *History of the Church of Liège* and many of his other works are lost. The most important of those still extant are: (1) *De Misericordia et Justitia*, a collection of biblical and patristic extracts with a commentary (an important work for the history of church law and discipline), which is to be found in the *Anecdota* of Martène, vol. v; (2) *De Sacramentis Corporis et Sanguinis Domini*; a treatise, in three books, against the Berengarian heresy, highly commended by Peter of Cluny and Erasmus; (3) *De Gratia et Libero Arbitrio*; given in B. Pez's *Anecdota*, vol. iv; (4) *De Sacrificio Missae*; given in the *Collectio Scriptorum*. Vet. of Angelo Mai, vol. ix, p. 371.

See Migne, *Patrol. Ser. Lat.*, vol. cxxx, pp. 739-972; Herzog-Hauck, *Realencyk. für prot. Theol.*, art. by S. M. Deutsch.

ALGER, HORATIO (1834-1899), U.S. writer, born in Revere, Mass., Jan. 13, 1834. He graduated at Harvard college in 1852, became a teacher and journalist and in 1864 a Unitarian minister. He moved to New York city in 1866, and the experiences gained in his efforts to improve the condition of street boys there are reflected in many of his writings, which include more than 100 books, mostly juvenile fiction, of which many hundred thousand volumes have been sold. He died in Natick, Mass., 1899.

Besides contributing extensively to newspapers and periodicals, he published *Helen Ford* (1866), a novel; *Gran'her Baldwin's Thanksgiv'g, with Other Ballads and Poems* (1879); the popular "Luck and Pluck," "Ragged Dick" and "Tattered Tom" series. See Herbert R. Mayes, *Alger, a Biography without a Hero* (1928).

ALGER, RUSSELL ALEXANDER (1836-1907), U.S. soldier and politician, was born in Lafayette township, Medina Co., O., on Feb. 27, 1836. He was admitted to the bar in 1859 and began practice at Cleveland, O., but early in 1860 moved to Michigan, where he engaged in the lumber business. Enlisting in a Michigan cavalry regiment in Sept. 1861, he rose from captain to colonel, distinguished himself in the Gettysburg campaign, and under Maj. Gen. Philip Sheridan in the Shenandoah valley, and in 1864 and 1865, respectively, received the brevets of brigadier general and major general of volunteers. After the war he invested in pine lands in Michigan and accumulated a large fortune. He served as governor of Michigan on the Republican ticket from 1885 to 1887. In 1889-90 he was commander in chief of the Grand Army of the Republic. From 1897 to 1899 he was secretary of war in Pres. William McKinley's cabinet. His administration of the war department during the Spanish-American War was severely criticized for extravagance, for unpreparedness and for general inefficiency, charges which he answered in his *The Spanish-American War* (1901). The extent of his personal responsibility is uncertain. In 1902 he was appointed by the governor of Michigan, and in 1903 was elected by the state legislature, as United States senator to complete the unexpired term of James McMillan (1838-1902). He died at Washington, D.C., on Jan. 24, 1907.

ALGER (ALGIERS), the central department of Algeria (*q.v.*).

ALGERIA, a country in North Africa under French dominion, bounded west by Morocco, north by the Mediterranean, east by Tunisia and Libya and south by French West Africa. Area 846,124 sq.mi. Northern Algeria has an area of 80,966 sq.mi. between lat. 37° and 34° N. and long. 2° 10' and 8° 50' E.; it is 683.5 mi. long east to west and 185-250 mi. north to south and so has the form of a narrow rectangle. The Saharan areas adjacent to Algeria were set up as a separate administrative unit, the Southern Territories, in 1902; their area is 765,158 sq.mi. The southernmost point in these Southern Territories, Tin Zaouaten, lat. 20° N., is 1,085 mi. from Algiers, while the distance from the ocean to Tripolitania is about 1,120 mi. The immense area is, however, almost empty and poor in resources.

Physical Geography and Divisions.—The fundamental units, based mainly on climate, are the Tell, an area of trees and cultivation, the High Plains, with grasses and pastoral life, and the Sahara, without water or trees save in oasis centres of irrigation. These are not continuous zones of constant breadth; there are wooded and cultivable patches in the High Plains and arid

patches in the Tell. One crosses mountains to either the Mediterranean or the Sahara from the high interior, formed of mountain ridges and masses and of high plains with mild undulations. The highest points are Chélia (7,638 ft.) in the Aurès and Lalla Kredidja (7,572 ft.) in Kabylia, but the average elevation is about 3,100 ft. and 68% of the area lies between 2,625 and 5,250 ft. Low plains cover only small areas near the coast in a few spots, but the coast generally is closely dominated by mountain lines, usually southwest-northeast. The slopes are usually very sharp, except in the west and in the east. A few semicircular gulfs—Mers-el-Kebir, Arzeu, Algiers, Bougie, Philippeville and Bona (Bône)—end westward against mountain masses while eastward are shore deposits caused by currents from the west.

Archæan and Palæozoic rocks occupy little space save near the coast east of Algiers, where they are accompanied by volcanic extrusions. Secondary rocks, usually calcareous or marly, form the main skeleton of the Atlas chains from the sea to the Sahara.



BY COURTESY OF THE CANADIAN PACIFIC STEAMSHIPS

AN ANCIENT STREET IN ALGIERS

Tertiary rocks are also highly developed and include limestones, marls, sandstones, clays. Those of Oligocene or later date include fluvialite and lacustrine, as well as marine, deposits.

The Algerian chains show two series of foldings, the Tell Atlas and the Saharan Atlas, separated by a zone which narrows from west to east and is folded hardly at all.

West of a line drawn from Biskra to a point about 37 mi. W. of Algiers the natural regions lie parallel to the sea. The Tell Atlas chain comprises coastal massifs (Trara, the Sahel of Oran, Dahra and the mountains of Miliana) and also inland ranges (the Tessala, Beni Chougran and Ouarsenis mountains) which, by their marked folding, make a contrast with the undulating plateaus of Tlemcen, Saïda and Frenda. The chain is interrupted by the coastal plains of Oran, of the Macta and of the Chélif and by the Sidi-bel-Abbès and Mascara basins. In the south the Tell Atlas chain is bounded by the High Plains (2,500-3,750 ft.), which con-

sist of steppe with alfa grass and compact basins. To the south again, the High Plains rise to the Ksour, Amour, Ouled Nail and Ziban mountains of the Saharan Atlas.

In eastern Algeria the Tell Atlas mountains are more massive, higher and better watered than in the west: except for the Wadi Soummam depression, streams going through them form gorges (Isser, Bou Sellam, Rhumel, Seybouse). The calcareous ridges of the Jurjura (Djurdjura) and Babor mountains and the Numidian chain dominate the outcrops of ancient rock and the markedly folded deposits of Cretaceous and Tertiary. The only plains are that of Bona and the Mitidja of Algiers. To the south, the Hodna (5,500–6,000 ft.), the solid massif of the Aurès and the Nememcha mountains dominate the semidesert basin of Hodna and the Lower Sahara (Ziban and the Shott region). Around Constantine the High Plains (2,750–3,500 ft.) are dotted with mountains and less arid than the western steppe, being to some extent drained toward the sea.

The North Sahara is built very simply. The Ahaggar, or central Tuareg massif, is made up of crystalline rocks surmounted by extinct volcanoes (Ilamane, 9,262 ft.). Around it are the sandstone plateaus called the Tazili of the Azjer and the Muidir-Ahnet. A great aureole of calcareous Cretaceous plateaus (Tademait, El-Goléa, M'zab) separates the northward-sloping Igharghar basin from that of the Saoura, which slopes southward. The first has the oases of Warqia (Ouarglu), Wadi Righ and the Zibans; the second, those of Gurara, Tuat and Tidikelt. Vast dunes, the eastern and western Erg, complete the symmetry.

Climate and Hydrography.—In winter, westerly and northern winds with rains come in from the west Mediterranean regions of low pressure. In summer the winds are from the east and northeast, and the air moves toward the superheated Sahara and is dry. The sirocco is a south wind that dries up the country. On the coast the winter temperature averages 50°–54° F., the summer temperature 75°–79°; but the long duration of unvarying summer heat, accompanied by moist atmosphere, makes the summer very trying. Away from the sea continental conditions are very marked, with strong radiation in a dry atmosphere. Average winter temperature there is 39°–43°, with much frost; summer temperature averages 79°–83° with average maxima near 95° or even 105° in the Sahara. Rainfall diminishes from January to August and increases from September to December. From June to September little falls. It diminishes toward the south, the Sahara being virtually rainless. A zone from Dellys to the Tunisian frontier with coastal massifs gets more than 800 mm. (31.5 in.) of rain (Bougie, 97.2 mm. [37.9 in.]). A zone along the coast from Ténès to Dellys and thence inland south of the previous one gets 600–800 mm. (24–31.5 in.) (Algiers, 762 mm. [29.7 in.]). The Oran coast west of Ténès and the remainder of the Tell get 400–600 mm. (16–24 in.) (Constantine, 594 mm. [23.2 in.]). The High Plains and the pre-Saharan Atlas get 200–400 mm. (8–16 in.), save on a few heights (Djelfa, 308 mm. [12 in.]). The Saharan slope of the Atlas gets less than 200 mm. (8 in.), irregularly (e.g., Biskra, 156 mm. [5.1 in.]).

Most Algerian streams are periodic, with the rains, and many diminish from their sources downward and many lose themselves in inland basins or in the Sahara. The Chélif is the chief river, more than 435 mi. long, with an outflow varying from 30–15 cu.m. during the rains to a few hundred litres in the dry season. The lacustrine hollows, shotts or sebkhas are occupied by salt deposits where evaporation has reduced them. On the Saharan slopes oasis irrigation and hot sands absorb the streams as soon as they leave the mountains. The Zousfana, helped by the Guir, occasionally reaches Fom-el-Kheneg. Wadi Mia and Wadi Igharghar are dead rivers—fossils, in fact.

Flora and Fauna.—In northern Algeria the flora is largely Mediterranean. Of 3,500 species only 500 are peculiar to the country. Evergreen trees and shrubs predominate and the olive is the characteristic tree. The barberry fig (*Opuntia ficus indica*), the agave (*Agave americana*) and the widespread eucalyptus are imported types. On the highlands one finds either central European or mountain Mediterranean plants. The woods include oaks (cork oak, evergreen oak, deciduous oak) and conifers

(cedars, Aleppo pines, thuja, juniper). Regions with less than 13.8 in. of rain are steppes with alfa (*Stipa tenacissima*), chih (*Artemisia herba alba*), esparto grass and drinn. The limit of the steppe runs approximately through Sebdu, Saïda, Frenda, Tiaret, Boghari and the Hodna, Aurès and Tebessa mountains. The Saharan region has a poor xerophilous flora of peculiar species, some of which grow very rapidly after rain; the oases are characterized by the date palm; the sand dunes and ergs have a fair number of plants; the regions of clay and boulders, less; and the regions of rock, least of all.

The fauna is similar to that of other Mediterranean countries. The greatest variety is in the mountains of eastern Algeria. The lion has become extinct; the panther and hyena are rare. A single variety of monkey (*Pithecius inuus*) occurs. Jackal and wild boar are very abundant where there is cover and there are various antelopes (gazelles). The Saharan fauna is highly specialized; horned vipers and scorpions are fairly common. Five of the 31 varieties of fresh-water fish are peculiar to Algeria.

History.—The history of Algeria, which constitutes the central part of Barbary or Maghreb, has almost always been bound up with that of Morocco and Tunisia, which are respectively the western and the eastern parts of that great natural region. The actual name of Algeria, or rather of the regency of Algiers, does not appear until the 16th century, when Turkish rule was established in the central Maghreb.

Northern Africa has from the most ancient times been a meeting ground for different races. The original Hamitic population is represented by the Berbers (*q.v.*), Berber dialects being still spoken in Algeria by approximately one-quarter of the native population. The history of Algeria is the history of successive conquests: the Carthaginian, the Roman, the Vandal, the Byzantine, the Arabian, the Turkish and the French. Since there was no one natural centre for the whole country, political divisions were constantly changing. The Berber tribes were split up like the land which they inhabited; each small settlement and each tribe had a history of its own.

Carthage and Rome.—The Phoenician colonization marks the beginning of the historical age in North Africa. As early as the 12th century B.C. the Phoenicians founded settlements on the African coast. In the 8th century Carthage supplanted the earlier metropolis and imposed its suzerainty on the Phoenicians of the east. During the seven centuries for which it endured, the Punic civilization penetrated more or less deeply into the Berber districts, and the Punic tongue long continued to be spoken.

After the fall of Carthage (146 B.C.) Rome governed the country through native kings. The Roman occupation was at first limited and extended itself only little by little. Complete annexation took place only under Caligula (A.D. 40). Algeria constituted the provinces of Numidia and Mauritania Caesarea. Even at its height, Roman domination did not extend over the whole of modern Algeria; the frontier passed south of the Aurès, but then turned north, leaving out the steppe zone of the modern *départements* of Algiers and Oran.

Roman colonization of the country was effected by three methods: (1) introduction of colonists; (2) intermarriage between Romans and natives; and (3) the transformation of natives into Romans. By the middle of the 2nd century A.D., Latinized Africans were to be found throughout the empire. The most famous authors produced by Latin Africa were Apuleius of Madaura among the pagans and St. Augustine of Thagasta among the Christians. Numerous and wealthy cities sprang up and roads were constructed. It was a period of great material prosperity, based mainly on agriculture. The wealthiest province was Constantine, which was much more completely Romanized than the rest of Algeria. The main crops cultivated were wheat and olives.

For two centuries (A.D. 40–238) Roman Africa enjoyed a period of complete peace, until this was destroyed by religious disturbances, native revolts and, finally, the Vandal invasion, which was followed by a brief restoration of Byzantine rule.

The Middle Ages: Arabs and Berbers.—In the 12th century what remained of Roman civilization in North Africa was finally destroyed by the Arab invasion. Algeria was thus detached from

the Latin world and absorbed into that of Islam. The first Arab invasion, which took place in the 7th century, was the beginning of an era of anarchy and incessant warfare. The Berbers resisted at first and then embraced the heretical Kharijite form of Mohammedanism. The next Arab invasion of North Africa, carried out in the 11th century by the Hilal and Soleim tribes from the Hejaz, completed the ruin of the country. The ethnographical character of the population was not, however, so profoundly affected by the invasion as was at one time believed. The invaders almost everywhere became amalgamated with the native population; the latter were, however, uprooted and thrown into confusion, and many of them took refuge in the mountainous districts or in the Sahara. In the towns and in the plains the Arabs gradually imposed their language and religion.

The Berbers nevertheless set up large and powerful empires during the middle ages. Two dynasties of a religious and reforming character were founded, that of the Almoravides and that of the Almohades, the former by the nomads of the Sahara and the latter by the Berbers of the Moroccan Atlas. Their rule extended not only to the whole of North Africa but also to Spain, and the civilizing influence of the latter country made itself felt upon them.

Three kingdoms were founded in the 13th century on the ruins of the Almohade empire: that of the Merinids of Fez, that of the Abd-el-Wadites of Tlemcen and that of the Hafsites of Tunis, corresponding approximately to modern Morocco, Algeria and Tunisia. Their history was a series of incessant struggles between dynasties, chronic insurrections and disturbances, raids and the sacking of towns. By the beginning of the 16th century anarchy was at its most widespread. From that time onward North Africa was contested by the two dominant foreign influences in the Mediterranean: that of the Spaniards and Portuguese and that of the Ottoman Turks.

The Turkish Period (1518-1830).—Once they had reconquered the Iberian peninsula the Spaniards and Portuguese continued the struggle against the Moslems. Oran was captured in 1509 and Algiers in 1510; on a small island in the harbour of Algiers the victors built a fortress, the Peñon, the guns of which could sweep the town from a distance of 300 yd. Spain was soon mistress of a large part of the coast of Algeria.

*Algerians, wishing to be delivered from the Spaniards, called in two Graeco-Turkish corsairs, the brothers Barbarossa. The first, Arouj, captured Algiers and Tenes, and destroyed the dynasty of the Abd-el-Wadites of Tlemcen. His brother, Khair ud-Din, succeeded him, and was the real founder of the regency of Algiers. He did homage for the conquered country to the sultan of Constantinople, who conferred on him the title of *beylerbey* (bey of beys) and authorized Turks to serve under his banner. In 1529 Khair ud-Din captured the Peñon and built a mole to connect it with the mainland, thus forming the famous harbour which until 1830 was the impregnable stronghold of the corsairs. Charles V attacked Algiers in 1541 but failed lamentably. The Spaniards retained only Oran, which was taken by the Turks in 1708, recaptured by the Spaniards in 1732 and finally abandoned in 1791.

The first period of the Turkish rule in North Africa (1518-87) ended with the reign of Euldj-Ali, the last and the most notable of the African *beylerbeys*. It was followed by the period of the triennial pashas (1587-1659) and then by that of the deys (1659-1830), all three marking greater independence from Constantinople. The real rulers of the "regency" were the *odjak* (militia), recruited in Asia Minor, and the *taïffe* of the *rais* (corporation of corsairs). The *rais* were mostly renegade Christians. The Turks and *kulughis* (of mixed Turkish and Berber blood) in these bodies governed themselves by intrigue and murder and set the native tribes one against the other, interfering but little provided that they paid taxes.

For 300 years the headquarters of Barbary pirates and sea robbers was at Algiers, despite many haphazard and ineffective bombardments and blockades of the city.

Under the French.—The settlement of the French in Algiers opened a new period in the history of North Africa. In the 16th century traders from Marseilles set up coral fisheries on the Barbary coast, at Bona, at La Calle and at the Bastion de France.

France had maintained more continuous relations with the regency than any other Christian nation. A dispute arose with the dey in connection with the wheat supplied to the Directory by two Jews of Algiers, Bakri and Busnach. In the course of the negotiations over the dispute, the dey Hussein struck Deval, the French consul, with a fly whisk (April 1827). The incident provided the occasion for armed intervention. After an unsuccessful blockade of Algiers for three years, an expedition was dispatched. The command of the army was entrusted to the comte de Ghaisne de Bourmont, and that of the fleet to Baron Duperré. A French force of 37,000 men landed at Sidi-Ferruch on June 14, 1830. Algiers capitulated on July 5.

The French found, however, that although they had put an end to Turkish rule in Algeria, they were far from being in possession of the country, which had to be wrested from the native population. The July Monarchy wavered for some years between conquering the country completely or occupying a part of it or evacuating it altogether. A section both of parliament and the press urged that Algiers should be given up. Other sections opposed this policy. It was not until July 22, 1834, that a decree was issued appointing a governor general of French possessions in North Africa. From 1834 to 1840 an attempt was made to confine the occupation to a few points on the coast, Algiers, Oran, Bougie and Bona, with the districts immediately surrounding them. There were frequent changes in the command of the army, and governors succeeded one another rapidly. The ablest of these early governors was Bertrand Clauzel, who favoured large-scale colonization and exploitation of the country.

Abd el-Kader and Bugeaud.—The resistance of the natives in the province of Constantine centred round the bey Ahmed, and in the rest of Algeria round Abd el-Kader. The conquest of Constantine was not achieved until 1837. The French at first tried to work with him, but a treaty of 1834 and that of Tafna (1837) greatly increased his prestige. Alleging that the taking of Constantine was a violation of the treaties, he declared a holy war. He had real administrative and military gifts and attempted to create a regular army and taxation but the natives would not unite under him.

In 1840 the government, in alarm, adopted the policy of total conquest. Gen. Thomas-Robert Bugeaud was sent out. His arrival put an end to the long period of vacillation and uncertainty. Bugeaud was a man of energy and persistence and a first-class soldier. He was the real creator of the African army. He abandoned the system of small forces in blockhouses, where they were decimated by sickness and by the boredom of inactivity, for the policy of sending out flying columns in all directions, burdened with the least possible baggage so that they could strike quickly and attack the material interests of the enemy by carrying off his cattle and his crops. The war against Abd el-Kader was long and wearisome. The principal events were the capture of Takdempt, Abd el-Kader's fortress (1841), the taking of the Smala by the duc d'Aumale (1842), Bugeaud's victory at Isly over a Moroccan army (1844) while the prince de Joinville was bombarding Tangier and Mogador. Abd el-Kader surrendered to Lamoricière in 1847.

Bugeaud also set up a department for native affairs and military *bureaux Arabes*, established by the ministerial order of Feb. 1, 1844. The department, which was staffed with officers well acquainted with the language, institutions and customs of the population, had to administer the country and supervise the native chiefs. Bugeaud regarded colonization as a necessary auxiliary to conquest and permanently settled 40,000 French colonists in Algeria. He had what his predecessors had lacked: time, full powers and an army of 100,000 men. By 1848 the conquest of Algeria was virtually completed.

The fall of the July Monarchy and the advent of the second republic in 1848 led to important changes in the organization of Algeria. It was declared a French territory, and was divided into departments, which, although ten times larger than those of France, were each administered by a prefect. New colonists, largely recruited from the unemployed of Paris, were sent out with state subsidies. Algeria was included in the French customs system by the act of Jan. 11, 1851.

The Second Empire.—After the coup d'état, Gen. J. L. C. A. Randon (1851-57) was appointed governor general. He completed the conquest of Algeria by the subjection of Kabylia (1857). The policy of colonization was continued, and the first railways constructed.

In 1858 the governor generalship was abolished and replaced by a ministry of Algeria and the colonies. This office, however, had only a brief existence; it was held by Prince Jérôme Napoléon and the comte de Chasseloup-Laubat. The governor generalship was re-established by the order of Nov. 24, 1860. The new governor general was Marshall Aimable Pélissier, duc de Malakoff (1860-64), who was succeeded on his death by Marshal the comte de MacMahon, duc de Magenta (1864-70). The emperor Napoleon III had views of his own about Algeria, which he explained in two open letters in 1863 and 1865. He said that Algeria was an Arab kingdom, and he did not encourage colonization. In place of Bugeaud's policy of populating the country, he adopted the policy of economic development by great financial companies. These views were embodied in the senatorial decree of April 22, 1863, which gave the tribes ownership of the lands which they held by no matter what right. The senatorial decree of July 14, 1865, declared the natives French subjects and gave them facilities for acquiring rights of citizenship. Napoleon III's innovations were on the whole unpopular. State property in Algeria suffered, and colonization was hampered and discouraged.

The revolt of the Ouled-Sidi-Cheik (1861-83) in the south Oran district did not affect the rest of Algeria. Its long duration was the result of the fact that neighbouring Morocco was in a state of anarchy and that rebels found there both refuge and support.

The Third Republic.—The revolution of Sept. 4, 1870, was followed in Algeria by a period of agitation and disturbance which produced a deplorable effect upon the native population. A series of orders was promulgated which aimed at the complete assimilation of Algeria to France, in accordance with the demands put forward by the colonists and the plans to provide for new colonization. One of the decrees naturalized the Algerian Jews *en bloc*. The native insurrection which broke out in March 1871 and lasted until Jan. 1872 was not a rising of oppressed peoples against the oppressor or a national struggle for freedom, since no nation existed; still less was it a religious war. It was simply the result of the defeats which France had suffered and the ensuing anarchy. It was crushed and many tribal lands seized.

The governor generalship, which had been again abolished in 1870, was re-established in 1871 under the ministry of the interior, which, generally speaking, favoured colonization, instead of the ministry of war, which tended to protect the native. The post was entrusted to Louis-Henri de Gueydon, a broad-minded and energetic man and an excellent administrator. He was a strong partisan of colonization, which was energetically resumed. The act of 1873 which attacked communal ownership was intended to facilitate the acquisition of native lands by Europeans. The colonization policy was pursued under the governorship of Gen. A. E. A. Chanzy (1873-79). In 1881 the European population numbered 376,000, of whom 140,000 were settled on the land.

From 1881 to 1896 the policy of complete assimilation of Algeria to France once more prevailed. It has been estimated that the native inhabitants lost about 45% of their lands mainly by forced sales between 1881-89. The civil lands were greatly extended so as to cover the whole of the Tell and a large part of the High Plains. Districts that were almost entirely inhabited by natives were given the name of *communes mixtes*. Civilian administrators, instead of the officers of the Arab bureaus, were appointed to deal with them. Finally, by the *décrets de rattachement* of Aug. 26, 1881, Algerian affairs were allotted to the various ministries of France itself, whereby the governor became merely an agent for the transmission of instructions. The disadvantages of this system were not long in making themselves felt.

An order issued Dec. 31, 1896, revoked the orders of 1881 and restored the governor general's powers so that he again became the head of the administration of Algeria. Decentralization was completed by orders of Aug. 23, 1898. The powers of the governor were defined, the superior council was reorganized and, in ad-

dition to that body, which was composed of officials and elected members, there were set up a new assembly, nearly all of whose members were elected. This body, known as the *délégations financières*, had three sections providing separate representation for landowners, nonlandowners and natives. An act of Dec. 19, 1900, entrusted the two bodies mentioned above with the right of voting the budget, subject to the supervision of the home government and of parliament. A separate budget for Algeria was instituted, the expenditure being divided into obligatory and optional expenditure. Civil personality was conferred on the colony, and it was empowered to contract loans. The intention of these measures was to give the Algerians the opportunity of managing their own affairs. By an act of Dec. 24, 1902, the Southern Territories were transformed into an administrative unit distinct from northern Algeria and were also granted civil personality and a separate budget. This was desirable after the pacification of the central Sahara and the joining of North Africa and the Sudan.

The essentials of the country's administration remained stable after the reforms of 1898 and 1900. The governors general of Algeria after 1898 were either civil servants or members of parliament on mission. Many were able administrators but were hampered by bureaucratic control and political interference from Paris. The predominant political atmosphere was one of a strong economic, social and financial conservatism, directed largely at maintaining French primacy. Pressure for reforms by the native population, originating about 1926, led to various incidents, occasional riots and a few suggestions. The basic demands included closer assimilation of Algeria to France, politically and economically, including the right of natives to acquire French citizenship without loss of personal status under Islamic law. The demands were partially met in the proposals of Maurice Viollette in 1932 and 1936, which were dropped, however, after meeting violent opposition, largely from the French section of the population.

World War II.—After the defeat of France in June 1940, the Vichy government controlled Algeria until the Allied landings on Nov. 8, 1942 (see WORLD WAR II). Thereafter, up to the end of the war, all local institutions, including the French military, functioned as before—with, however, many personnel changes. Executive power was exercised in turn by Adm. Jean Darlan, who was assassinated on Dec. 24, 1942; Gen. Henri Giraud, who came to Algeria at the time of the landings; General Giraud jointly with Gen. Charles de Gaulle, who had come later from London with the national committee; and General de Gaulle with the committee and the consultative assembly which assumed legislative power. This committee later declared itself the provisional government of France. Algiers was the headquarters of Allied forces in the Mediterranean until the Italian campaign opened (1944) and also of Allied agencies controlling, with French colleagues, the trade of North Africa and much of its economy. In Aug. 1944 General de Gaulle and the Committee of National Liberation and the assembly moved to Paris.

On the day of the German surrender in Europe (May 8, 1945), violent rioting against the European population broke out in the *département* of Constantine. It was severely repressed, but afterward a more conciliatory spirit showed itself in French policy.

The Fourth Republic.—In Sept. 1947, a year after the inauguration of the fourth republic, the Statute of Algeria was granted by France (see *Administration*, below). But since the two newly created electoral colleges, the citizens' college and the noncitizens' college, though elected separately nevertheless voted together, it was clear that, since the statute allowed educated Moslems to become citizens without loss of their Islamic "personal status," the Moslems could be sure of an absolute majority in the assembly even if they had no more than one Moslem in the citizens' college. It was therefore decided that, while ordinary decisions of the assembly were to be taken by a majority vote, a two-thirds majority could be demanded either by the governor general or by the finance commission or by 30 members of the assembly.

At the first elections (April 4, 1948), the conduct of which was much criticized in the Paris press, the majority of Moslems actually elected to the assembly turned out to be moderates, inclined to support the French administration; and a similar result

attended the cantonal elections of March 20-27, 1949. Bitter attacks on the government were made by the autonomist Union Démocratique du Manifeste Algérien under Ferhat Abbas and by the nationalist Mouvement pour le Triomphe des Libertés Démocratiques under Messali Haj; but a plot organized by the latter party in May 1950 came to nothing. Defeated again in the elections of Feb. 1951, the U.D.M.A. and the M.T.L.D. joined the Communists and the religious movement of the *ulemas* in forming the Front Algérien de la Liberté (Aug. 5.)

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(F. C.; P. W. I.; S. E. C.)

Population.—In 1948 the population was 8,681,785. Of this total, 816,993 lived in the Southern Territories giving a density of about 1 per square mile. The indigenous element is Berber with Arab admixture physically assimilated. Physically diverse types are seen everywhere and their origins are little known. Arab invasions have had little influence on racial types but have spread Islam and the Arabic language; Berber dialects, however, survive in western Kabylia, in the Aurès mountains and their approaches, at certain oases and among the Tuareg. The Mozabites are not an orthodox Moslem people but belong to the Ibadite or Kharijite schism. Indigenous peoples number in all 7,721,678, including 800,000 in the Southern Territories. They increased rapidly under French rule, from less than 2,328,000 in 1856 and about 3,200,000 in 1886. Three-quarters of the indigenous population live in the Tell, and because of security and rain mountain lands are more peopled than the plains.

The urban element in the indigenous population comprises about 10%, much less, therefore, than in Tunisia or Morocco; but 12 localities have more than 25,000 agglomerated natives in each. Outside the towns four groups may be distinguished: (1) the old villagers, with houses and tree-plantations; (2) the new settlers, who grow cereals and live in hamlets of primitive shelters; (3) the semi-nomads, at once shepherds and farmers, who use both tents and a fixed dwelling; and (4) the shepherd nomads, who have only tents.

Europeans in 1948 numbered 960,107, of whom 12,593 were in the Southern Territories. Nearly all live on the coast and in the Tell, largely in towns, though there is an important rural element. One-quarter of all Europeans live in the vicinity of Algiers. The distribution by *départements* was: Oran—Europeans 371,392, natives 1,595,752; Algiers—Europeans 364,725, natives 2,364,064; Constantine—Europeans 173,562, natives 2,917,596.

From 1830 to 1856 the number of Europeans grew from 600 to 159,000 by immigration, but in that period deaths of Europeans were more numerous than births. After 1856 births were in excess, and there were 345,000 Europeans in 1876, 531,000 in 1891 and 752,000 in 1911. Of the Europeans in 1950 there were 867,100

French, chiefly from southern *départements* (Corsica, Bouches-du-Rhône, Gard, Hérault, Pyrénées-Orientales). After 1896 more of the French were Algerian-born than French-born. Spaniards are numerous in the *département* of Oran, south Italians in Constantine. Maltese are to be found in towns, notably Bona. Other Europeans are not numerous. There is no large half-caste population since there is little intermarriage of Europeans and natives. Up to 1889 French and non-French European elements were about equal. One must remember that many Frenchmen in Oran have married Spanish women, that any child born in Algeria is accounted as naturalized French unless he claims other nationality in the year of his majority, and that Jews, some of ancient settlement, others coming from Spain in the 16th and 17th centuries, were naturalized *en bloc* by the Crémieux decree (1870).

Algiers, the capital, had in 1948 a total population of 315,210, with a municipal population of 308,321 (179,546 Europeans and 128,775 natives). Oran had a total population of 256,661 (166,861 Europeans), Constantine 118,774 (37,249 Europeans), Bona 102,823 (44,541 Europeans), Sidi-bel-Abbès 61,355 (28,264 Europeans), Philippeville 62,860 (27,518 Europeans), Mascara 35,078, Mostaganem 53,464 (17,975 Europeans), Tlemcen 69,668 (12,899 Europeans) (q.v.), Sétif 51,674 (8,377 Europeans). The oases of the Sahara often have an urban character; e.g., Biskra (36,422), Tidikelt-Hoggar (17,431), Ghardaïa (17,581), El-Wad (13,489), Laghouat (11,336).

Administration.—Algeria is neither a colony in the usual sense, nor a simple aggregate of French *départements*; it has not complete autonomy, yet it is not entirely assimilated to France. According to the law of Sept. 20, 1947, called the Statute of Algeria, the country became a group of three *départements* (Algiers, Oran and Constantine). The governor general, aided by a secretary general, has wide powers and is responsible to the French minister of the interior. Algeria has had financial autonomy since 1900 (though soldiers' and sailors' pay is charged to the French budget). The Algerian assembly, which took the place of the *délégations financières*, votes the budget and has limited legislative powers. Since equality has been proclaimed between Moslems and Europeans, these two elements form two electoral colleges, which send equal numbers of representatives not only to the Algerian assembly but also to the national assembly, to the council of the republic and to the assembly of the French Union in Paris; so that a considerable assimilation took place. The three *départements*, which are divided into *arrondissements*, are gradually encroaching on the Southern Territories, which were previously under military administration. There the *communes mixtes*, which are almost entirely native-inhabited and are divided into *douars* under *caïds*, are administered by Frenchmen but are gradually giving way to *communes de plein exercice* run on French lines and to *communes rurales autonomes*. The fiscal system is like the French.

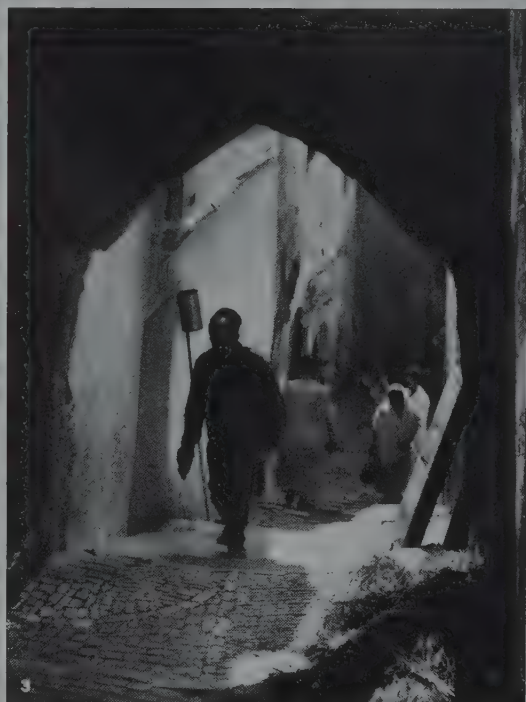
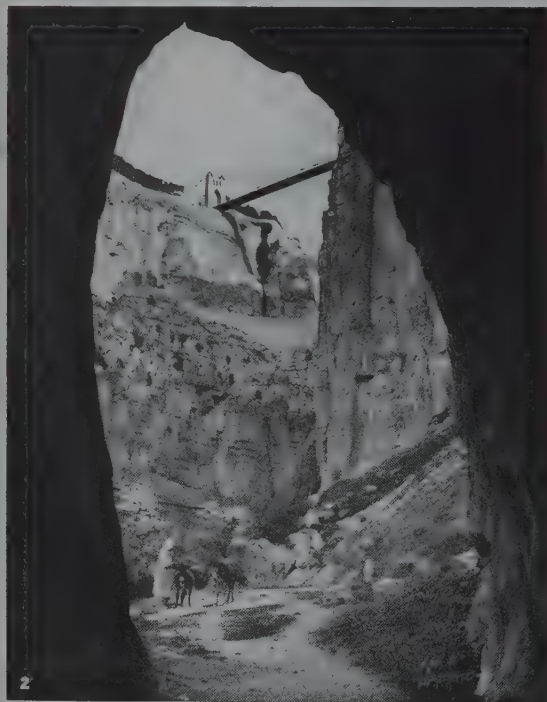
Algiers has a university with faculties of law, medicine, science and letters which have produced much research in science, history, archaeology, linguistics, law and medicine, especially relative to North Africa. Primary and secondary schools open to all are on French lines. Most natives do not go beyond the primary school but there are higher schools, called *medersas*, and, since 1950, Moslem *lycées* for Moslem functionaries. The knowledge and use of French has spread very widely among the natives.

Landed Property.—The absence of large empty areas and the rapid occupation of several reserves created problems. Land was distinguished as *melk*, private property often unenclosed, save in Kabylia and in the neighbourhood of towns, and *arch*, tribal land owned by the sovereign for the use of the tribe. In 1863 the tribes were declared proprietors of the lands that they had been using, and their delimitation and their division between the various *douars* were ordered with a view to division among individual members of these lesser groups. The last step was not taken and the Warner law of 1873 renewed the effort, but caused much hardship among the tribes. Another law was necessary in 1897, and still another one was passed on Aug. 4, 1926. In 1950 there were 13,600,000 ac. (mostly in the Tell) under the French system. Wherever crops can be grown, collective ownership recedes, since



URBAN AND COUNTRY SCENES IN ALGERIA

1. The ramps, Algiers, from port to city
2. Hamman Meskoutine, showing the famous rock terraces and boiling waterfalls
3. El Kantara, showing the palm fringed Oued and the gorge
4. The Algerian Sahara, showing the wastes of Amor-Kreddon



PHOTOGRAPHS, (1, 2) DONALD MCLEISH, (3) H. ARMSTRONG ROBERTS

ALGIERS AND CONSTANTINE

1. The inner harbour of Algiers, the capital and chief seaport of Algeria, showing the modern French city in the foreground, and the old Moorish citadel or Kasbah rising above it in the background
2. A natural archway over a road in Constantine
3. A typical street of steps in the Kasbah, the native quarter of Algiers, which climbs to 400 feet above sea level

the law of 1926 favours private ownership against it. European property covers 6,716,000 ac. (50% in the *département* of Oran).

Free grants of land, with obligatory residence, have been the rule save under the Second Empire. Four modes of transfer were recognized by the decree of Sept. 13, 1904; namely, (1) sale at a fixed price at a public office (the usual method); (2) sale by auction under public control; (3) sale by private treaty; and (4) free concession. A decree of Sept. 9, 1924, lengthened the period of obligatory residence from 10 to 20 yr. and the period during which the lands may be transferred only to French colonists from 20 to 40 yr. Official colonization has occupied about 4,200,000 ac., private colonization 2,470,000. Official colonization, however, has nearly come to an end and can do little more than develop communications and build new hamlets at spots reached by them.

Agriculture.—The chief crop is cereals, the annual average (1946–50) production being 1,630,000 short tons from about 7,785,000 ac. Europeans, by preparatory work, by scientific dry farming, including two-year rotation, and by the use of machinery, have greatly increased the yields over native production using primitive methods. The annual average yield (1946–50) of soft wheat was 261,820 tons; hard wheat, 644,200 tons; barley, 596,960 tons; oats, 123,400 tons. Maize and sorghum (*bechna*) are less important. The vine was the chief plant cultivated by Europeans after the *Phylloxera* ruined the vineyards of southern France and made the vinegrowers go to Algeria. Vines occupy (1950) 858,271 ac., half of this total being in the *département* of Oran. There are vineyards on the plains, on the hillsides and on the mountains and yields of wine vary greatly. *Phylloxera* also ravaged the Algerian vineyards, which were reconstituted with U.S. plants. Average annual production (1946–50) of wine is 258,094,700 gal., the chief market for which is France. The olive is widespread. Of 10,000,000 grafted olive trees 5,000,000 are in Kabylia. Six and one-half million belong to natives. The average production (1946–50) is 2,792,000 gal. of oil. Fig trees numbered 7,100,000 in 1950; citrus-fruit, trees 8,000,000 (more than 4,000,000 orange trees); and almonds and apricots are also grown in large quantities. The cultivation of early products owes much to the mildness of winter along the coast, and peas, beans, artichokes, tomatoes, potatoes and grapes are grown near the export harbours. Tobacco crops cover 68,000 ac. Production is 18,000 tons (1946–50), Kabylia being the chief centre of this development. About two-thirds of the tobacco belongs to natives; part is exported, part manufactured locally. Plants for perfumery are grown near Algiers. Experiments in cotton growing were made during the American Civil War (992 tons cotton) and resumed on several occasions when prices were high (9,753 ac. producing 870 tons in 1950). The irrigated crops depend for their rapid expansion on great dams and reservoirs, of which ten had been built by 1950. In the Southern Territories there are about 5,500,000 date palms in production. The digging of artesian wells is extending areas of cultivation and revivifying old oases.

Stock raising is important. In 1950 there were 4,540,000 sheep, 2,860,000 goats, 766,000 cattle, 216,000 horses, 326,000 asses, 230,000 mules, 160,000 pigs and 140,000 camels. The camel is used as a pack animal on the steppes and more especially for riding in the Sahara.

Forests occupy nearly 6,000,000 ac., but much of that is mere scrub. Fires and trespass of flocks are the great enemies of the forests. About 35,000 tons (1950) of cork are produced. Alfa covers 10,000,000 ac., which produce 180,000 tons for paper pulp. The dwarf palm yields 12,000 tons of fibre.

Minerals.—Algeria (Jebel-Kuif near Tebessa) with Morocco and Tunisia together lead the world for production of phosphates, yielding even more than the U.S. Algeria's share in 1950 was 685,400 tons. Iron ores (2,572,900 tons) are of good quality and are found near the Tunisian frontier (Wenza, Bou-Kadra), in the Miliana region (Zaccar) and on the Oran coast (Beni-Saf); they are mostly sent to England. Zinc and lead (19,100 tons) are found in several places. Constantine is the richest of the *départements* in mineral products. Prospecting for mineral oil goes on at several places. Production in 1950 amounted to 3,445 metric tons of crude petroleum. Kenadsa, in the southern Oranais,

yielded 250,250 metric tons of coal. Algeria exports its minerals in the crude state, but their extraction has caused railway developments, the growth of centres of population in districts previously empty and traffic at the ports.

Industry.—Native craftsmanship is of little importance but for certain art products (e.g., carpets). On the other hand, agricultural and commercial development have given rise to varied industries. After World War II there was a drive toward industrialization, to which the increase in the production of electricity contributed (586,500,000 kw.hr., including 130,600,000 from water power in 1950). In addition to the food industries (flour, wine, oil and preserved fruit and vegetables), there are the tobacco, cork, leather, textile and chemical industries (the last comprising fats, soap, glass and paper), some light engineering and a little ironworking, as well as the building trade.

Communications.—There were 2,797 mi. of railway in use in 1950, partly 1.44-m., partly 1.05-m. gauge. A central line goes from the Moroccan to the Tunisian frontier and has branches to the ports of Nemours, Beni-Saf, Oran, Arzeu, Mostaganem, Algiers, Bougie, Philippeville and Bona, as well as southward to Crampel, Kenadsa (478.5 mi. from Oran), Burdeau, Jelfa, Tuggurt (337.4 mi. from Philippeville), Khenchela and Tebessa. An excellent network of roads (7,150 mi. primary and 8,700 mi. secondary) supplements the railways, and motor transport includes regular passenger and freight lines across the Sahara.

The major port, Algiers, is practically the only one in its *département*. Imports in 1950 amounted to 1,503,600 metric tons; exports (ranging from wine, spring vegetables and fruit to iron), to 1,485,600. Oran is likewise the general port of its own *département* but is rivalled by Mostaganem (wines, spring vegetables and fruit), by Nemours (manganese and anthracite from eastern Morocco) and by Beni-Saf (iron). Its imports amounted to 950,000 metric tons in 1950; its exports (mainly wine; no ore), to 1,107,000. Bona, the great port for minerals (iron and phosphates), handled only 330,000 tons of imports but 2,645,000 of exports. Philippeville and Bougie are the other important ports of the *département* of Constantine. By a law of 1889 only French ships may trade between France and Algeria.

Lying between the Mediterranean and the Sahara, Algeria provides essential stations on the air routes between Europe and farther Africa and between America and the east. Its aerodromes counted 11,000 aircraft landed in 1950 (6,800 at Algiers).

Commerce.—Since 1867 there has been complete reciprocity in customs dues between Algeria and France. Overseas transactions amounted to 265,000,000,000 fr. in 1950. Of the imports (152,000,000,000 fr.; 2,537,000 metric tons), the greater part (35% of the total value) consisted of products required for industry (machinery, metal manufactures, transport, fuel), followed by food products (24%; sugar, dairy produce, oils, fats) and clothing (18%; mostly cotton goods). Of the exports (113,000,000,000 fr.; 5,860,000 tons), the most valuable were wines (45.5%), other agricultural and forest produce (30%; vegetables, fruits, tobacco, cork) and ores (mostly iron and phosphates).

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(P. W. I.; J.-J. Ds.)

ALGHERO, seaport and episcopal see, province of Sassari, West Sardinia, 21 mi. S.W. by rail from Sassari. Pop. (1936) town, 14,579; commune, 15,998. The cathedral is 12th century; the see dates from 1503. Founded by the Doria family of Genoa about 1102, it was occupied in 1354 by the house of Aragon, which held it until it fell to the house of Savoy with the rest of Sardinia in 1720. Catalanian is still spoken there. The district produces good wine. Seven miles northwest is the fine natural harbour of Porto Conte, secure in all weather, and on the west of that harbour is the Capo Caccia, with two stalactite grottoes.

The important prehistoric necropolis of Anghelu Ruju is $6\frac{1}{2}$ mi. N. of Alghero. Alghero was subjected to Allied bombing in World War II.

ALGIDUS MONS, the east part of the ridge of the larger crater of the Alban volcano (see ALBANUS MONS), traversed by a narrow opening (now called the Cava d'Aglio) used for the Via Latina. There was a temple to Diana, the site is unknown.

ALGIERS (ALGER), capital and chief seaport of Algeria, the seat of the governor general and of the Algerian assemblies, of the court of appeal, of the 19th army corps and of an archbishop. It is built on the west side of the bay of Algiers, $36^{\circ} 47' N.$, $3^{\circ} 4' E.$, on the slopes of the Sahel hills parallel to the coast and backing on to Mt. Buzareah (Bu Zarea). The growth of the town has been conditioned by the cliffs which approach the coast very closely and by military necessities. Turkish Algiers was triangular, with the Kasbah, or castle, at its apex and a line of rocky sea cliffs, now the Boulevard de la République, as the base. French Algiers grew piecemeal and haphazard. The city, in modern south European style, lies facing east, squeezed between high hills and a semicircular bay. The sea approach offers a view of "Algiers, the White" rising steep to heights topped by green. The older French town has many cool arcaded streets. The busiest through street to the port from west and south, the narrow, winding, steep Rue Michelet carries the main north-south city traffic and a streetcar line. Projected city planning includes accessory arteries. Many old picturesque Moorish buildings have given way to modernization. Wide, handsome boulevards skirt the harbour 45 ft. above the quays. The chief official and commercial buildings of Algiers are on these boulevards. The north end of the Boulevard de la République, the Place du Gouvernement, was long the centre of the town with the roads Bab-el-Oued, Bab-Azoun and la Marine starting from it. The suburb of Bab-el-Oued is peopled mainly by Spaniards and farther north is the suburb of St. Eugène dominated by the basilica of Notre Dame d'Afrique. West of the Place du Gouvernement a short street leads to the modern cathedral (1845-60) on the site of a mosque, the governor's winter palace and the old palace of the archbishops, the remains of the Jénina, or palace of the dey. Near by is the National library, in one of the finest Moorish houses of Algiers (1798). The area between the sea, the Rue de la Marine and the Rue Bab-el-Oued is the Algiers of the conquest and is full of old houses on narrow streets. The busy Rue Bab-Azoun leads to the Opera House square, the Rue Dumont d'Urville, the Rue d'Isly, the main Post Office parkway, the Rue Michelet and the university, the centre of the city.

The highest part of Algiers, on steeply scarped hills, has best preserved its native character, but it has been disfigured by the cutting of the Rue Randon and Rue Marengo.

The Kasbah, 387 ft. above sea level, belongs to the 16th century and was the residence of the two last deys, who left Jénina for it. There Dey Hussein struck the French consul with a fly whisk on April 30, 1827, whence followed the capture of Algiers and the end of Turkish rule.

Mustapha, once a suburb, but reunited to Algiers, grew very much after the fortifications between it and Algiers were demolished, and the two are continuous. The lower streets are populous and industrial; the upper ones have villas with fine sea views.

Khair-ed-Din created the old Turkish city by building a jetty from the mainland to an island, the Peñon of the Spaniards. In Arabic this was called "El-Jezair" (the islet), corrupted to Algiers. This islet retains the lighthouse, the admiralty, various structures of the Turkish and some of the Spanish period, and extends north and east of the shallow pool where fishing boats and pleasure boats are moored. To the south of this pool lies the modern port.

Algiers ranks next after Marseille among French ports for tonnage cleared, thanks to vessels calling for coal, and next after Marseille and Le Havre for number of ships. In 1950, 1,503,600 metric tons of merchandise were landed and 1,485,600 tons exported. Algiers imports vehicles, petroleum products, wheat, cement, metal products, cotton cloth, sugar and coffee, and exports wine, potatoes, vegetables, dried fruits, olives, vegetable fibre and phosphate. The regular service to Marseille involves a

voyage of 497 knots, or 26 hr., and Algiers is thus 40 hr. from Paris.

The total population (1948) was 315,210 with a municipal population of 308,321 (Europeans 179,546; natives 128,775). With the suburbs, which are continuous with Algiers (Bouzaréa 9,303; El Biar 25,010; Hussein Dey 43,271; St. Eugène 22,091; Maison-Carrée 41,195; Kouba 15,202; Birmandreïs 17,611), the greater city had nearly 490,000 inhabitants, about three-fourths of European stock.

History.—In Roman times a small town called Icosium existed where the marine quarter of the city is located. Roman cemeteries existed near the present streets of Bab-el-Oued and Bab-Azoun. Bishops of Icosium are mentioned as late as the 5th century. The present city was founded in 944 by Bulukkin b. Zeiri, the founder of the Zeirid-Sanhaja dynasty, which was overthrown by Roger II of Sicily in 1148. (See FATIMITES.) The Zeirids had before that date lost Algiers, which in 1159 was occupied by the Almohades, and in the 13th century came under the dominion of the Abd-el-Wahid, sultans of Tlemcen. Nominally part of the sultanate of Tlemcen, Algiers had a large measure of independence under amirs of its own, Oran being the chief seaport of the Abd-el-Wahid. The islet in front of the harbour, subsequently known as the Peñon, had been occupied by the Spaniards as early as 1302. Thereafter, a considerable trade grew up between Algiers and Spain. Algiers, however, continued of comparatively little importance until after the expulsion from Spain of the Moors, many of whom sought an asylum in the city. In 1510, following their occupation of Oran and other towns on the coast of Africa, the Spaniards fortified the Peñon. In 1516 the amir of Algiers, Selim b. Teumi, invited the brothers Arrouj and Khair-ed-Din Barbarossa to expel the Spaniards. Arrouj went to Algiers, caused Selim to be assassinated and seized the town. Khair-ed-Din, succeeding Arrouj, drove the Spaniards from the Peñon (1530) and was the founder of the pashalik, afterward deylik, of Algeria. Algiers from that time became the chief seat of the Barbary pirates. In Oct. 1541 the emperor Charles V sought to capture the city but was defeated thanks to a storm which destroyed his ships in the bay. Repeated vain attempts were later made by various nations to quell the pirates and in 1816 the British and Dutch burned the corsair fleet. But the piracy continued until 1830, when a French army captured the city.

From Nov. 1942 until Aug. 1944 the city was the headquarters of Allied forces against the axis in North Africa and the seat of the French Committee of National Liberation. (See ALGERIA.)

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ALGIN is the name given to sodium alginate and other water-soluble salts of alginic acid. The name is also sometimes applied to alginic acid itself. This acid occurs as a water-insoluble material in some species of seaweed, especially in those belonging to the brown algae. In California algin is made in large amounts from the giant kelp of the Pacific coast, *Macrocystis pyrifera*. It can also be made from *Fucus serratus*, *Laminaria saccharina* and other seaweeds growing in different parts of the world. In the manufacture of algin from *Macrocystis pyrifera*, the kelp is harvested and digested with a solution of sodium carbonate. This dissolves the alginic acid as sodium alginate. This algin solution is separated from the cellulose and other insoluble materials and bleached. Insoluble calcium alginate is then precipitated by addition of calcium chloride solution to the dilute algin solution. Free alginic acid is obtained from the calcium alginate by addition of hydrochloric acid. The free alginic acid may also be prepared by extracting the kelp with alcohol, water and dilute hydrochloric acid to remove soluble materials and then dissolving the alginic acid in sodium carbonate solution. The algin solution is separated from the insoluble material and the alginic acid is precipitated by addition of hydrochloric acid and alcohol.

Pure alginic acid is a white powder. It absorbs from 200 to 300 times its weight of water but is only slightly soluble in water

and is insoluble in alcohol. It dissolves in sodium carbonate solution to give algin, which is the most important commercial derivative of alginic acid. Algin is a hydrophilic colloid. It dissolves in water to give a viscous solution which has marked suspending and emulsifying properties. Alginic acid does not reduce Fehling's solution. On hydrolysis it gives only *d*-mannuronic acid. Alginic acid consists of a series of molecules of *d*-mannuronic acid combined with each other by glycosidic linkages.

Algin is extensively used in the food, cosmetic, pharmaceutical and textile industries wherever an emulsifying and suspending agent is required. It is nontoxic and is often used in the manufacture of ice cream, chocolate milk, salad dressings, pastry, tooth paste, shaving cream, as a sizing agent and for many other preparations where a hydrophilic colloid is required.

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ALGOA BAY, a wide, shallow bay between Capes Recife and Padrone, South Africa, formed by erosion of rocks of the Bokkeveld and Uitenhage series by the sea, which has left a belt of more resistant Table mountain sandstones projecting eastward, and forming the southwest border of the bay. In the bay are St. Croix Island, 33° 47' S., 25° 46' E., and Bird Island, the latter yielding guano. The shores are fringed with sand dunes, which contain abundant Strandlooper remains. In 1820 British emigrants landed there and founded Port Elizabeth. Vessels drawing up to 21 ft. can discharge cargo at the jetty in calm weather. Larger ships have to anchor in the bay, and discharge into tugs and lighters.

ALGOL, a well-known variable star, also designated β Persei. Its fluctuation of brightness was noticed by G. Montanari in 1669; but the Arabic name, which signifies the Demon, seems to hint that the behaviour may have been known in ancient times. The brightness varies regularly between magnitudes 2.1 and 3.2. In 1782 John Goodricke found that the variation of light was periodic and determined the period 2 days, 20 hr., 49 min.; he suggested that the variation might be caused by partial eclipses of the star by a dark body revolving round it. This hypothesis was generally accepted but it remained speculative until 1889, when H. C. Vogel demonstrated its truth in a way that can scarcely be doubted.

By spectroscopic measures of the velocity in the line of sight it was shown that the bright star was travelling round an orbit in the period named. Clearly there must be an unseen mass controlling its motion. Further, the reduced light occurs when the bright star is most remote from the earth; that is just the time when the dark companion passes between it and the bright star and is able to hide the star. About 1,000 variable stars of the Algol type, in which the change of light is caused by eclipses, are now known. It should, however, be understood that this is not the sole kind of stellar variability; and in fact the majority of variable stars have a different nature (*see* STAR).

Algol remains of almost constant brightness for 59 hrs.; the remaining 10 hrs. of the period are occupied by the eclipse, the light gradually decreasing to not much more than a third of its normal amount and then increasing again. The eclipse is partial. (In some variables a total eclipse occurs, totality being distinguished by a period of steady light at minimum.) The comparatively long duration of the eclipse shows that there are two stars whose dimensions are by no means small in comparison with the distance between them. Closer examination shows that the light is not absolutely constant during the 59 hr. The reason is that the dark component reflects (or reradiates) light from the bright star and thus goes through phases like the moon. Accordingly, after the eclipse is over, the total light still continues to increase a little because the "moon" is progressing from new to full. In the middle of the 59-hr. interval the light dips again because there is an "eclipse of the moon"; that is to say, the bright star is then hiding its companion. The whole phenomenon is beautifully shown in the light curve determined by J. Stebbins by means of selenium photometry.

In most eclipsing variables the dark companion means only comparatively dark, and the proper light of the eclipsing star is recognizable. But in Algol the companion is exceptionally dark, and it has not been possible to measure any light from it other than the reflected light above mentioned. On theoretical grounds the companion is believed to give out less than a hundredth of the light of the principal star; but it must be noticed that Algol itself is an exceptionally bright star and its companion is actually not much fainter than the earth's sun. From a study of the light curve, combined with the dimensions of the orbit of the principal star obtained from spectrographic measures, a great deal can be learned about the nature of the system; but to render the results definite, an additional constant is required to be known, and through ignorance of this the dimensions formerly given have turned out to be wide of the mark.

The required datum has been supplied by D. B. McLaughlin, who measured the radius of Algol by an ingenious method. Near the middle of the eclipse only a crescent of the bright star is showing; this crescent will be mainly on one side of the star just before the middle phase, and on the other side after it. Now the rotation of the star causes one side to approach the earth and the other to recede; so that if measurements of radial velocity are made shortly before and after mideclipse the speed of rotation can be determined, very much as the sun's speed of rotation is determined by measuring first on the east and then on the west side of its disk. Having found the equatorial speed of rotation, we multiply by the period of rotation, and the result is the circumference of the star. In Algol the two components are close together, and there can be no doubt that the huge tidal forces will make them keep the same faces turned toward each other, so that the period of rotation must be the same as the period of revolution; viz., 2 days, 21 hr. Knowing the circumference, one can at once find the radius.

The following dimensions of the Algol system have been deduced:

Distance between centres.....	10,200,000 km.
Radius of bright star.....	2,140,000 km.
Radius of faint star.....	2,450,000 km.
Mass of bright star.....	4.30 $\times$ sun's mass
Mass of faint star.....	0.86 $\times$ sun's mass
Density of bright star.....	0.16 (water=1)
Density of faint star.....	0.02
Luminosity of bright star.....	140 $\times$ sun
Distance of system.....	35 Parsecs (115 light years)

By spectroscopic measures it is found that Algol with its satellite is describing an orbit in 1.9 years; this indicates the existence of a third member of the system. It must be at a distance of 430,000,000 km. from Algol. It is intermediate in brightness between Algol and its close companion, giving about $\frac{1}{12}$ of the light of the former. It takes no part in the eclipses.

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ALGONKIN, a tribe, group and family of American Indians. The tribe lived on Gatineau river east of Ottawa. The name came gradually to include related tribes or bands in Quebec and Ontario, where they now number between 3,000 and 4,000. They were friends of the French, foes of the Iroquois and British. The name was finally applied to the whole of the linguistic family of which these tribes are part. This is one of the great stocks of native North America, perhaps the largest on the continent in point of area occupied, extending around latitude 55° continuously from the Atlantic ocean to the Rocky mountains, and to the south less regularly as far as Cape Hatteras and the Ohio river. This is essentially the natural region of northern woodland, whose coniferous forests the Algonkin tribes occupied almost exclusively, and the deciduous ones largely. Culturally the Algonkin lagged behind the Muskogee and Iroquois families of peoples. Where the archaeology of the northeastern part of the continent shows distinct horizons of types, as in New York, the simpler forms can generally be identified fairly closely with historic Algonkin culture. In this area, at least, they therefore preceded Mound Builders and Iroquois, and in part survived them. In general, the southern Algonkin tribes farmed; the northern ones were non-

agricultural. Three divisions drifted into the northern plains and became nomadic bison hunters: (1) the Arapaho and Gros Ventre; (2) the Blackfeet; and (3) the Cheyenne. The speech of the first two is highly specialized, indicating their separation for a long time; the Cheyenne are later comers in the plains. In recent generations some of the Cree and Ojibwa have begun to take on the Plains type of customs.

Apart from Arapaho, Blackfoot and Cheyenne, the Algonkin languages are relatively uniform. The principal divisions are: I, Arapaho; II, Blackfoot; III, Cheyenne, nearest to the next; IV, Central-Eastern: A, Central, comprising: (1) Ojibwa type: (a) Ojibwa, Pottawatomi, Ottawa, Algonkin proper; (b) Illinois (Peoria), Miami; (2) Cree type: (a) Cree, Montagnais, probably Naskopi; (b) Menominee; (c) Sauk, Fox, Kickapoo, Shawnee, nearest to next; (3) Delaware type: Delaware, Mohegan, Wappinger, Pequot; B, Eastern, comprising: (1) Abnaki type: (a) Micmac; (b) Abnaki; (c) Pennacook; (2) Massachusetts type: Massachusetts, Wampanoag, Narraganset, Montauk, Nipmuk. Position in the family uncertain: Powhatan, Nanticoke and other south Atlantic coast tribes. (T. Michelson, *Bur. Am. Ethn. Rep.*, xxviii, [1902].) The Algonkin languages are plastic, polysynthetic and elaborate in structure, and acquaintance with them unduly influenced early conceptions of the nature of American languages in general, many of which are much simpler. Of late it has seemed possible that the speech of the Beothuk of Newfoundland, of the Kootenay of British Columbia and of the Wiyot and Yurok of the coast of California may be remote branches of Algonkin. The majority of the population of tribes of admitted Algonkin affinity is believed to reside in Canada, with Ojibwa and Cree making up a full half of the total. (A. L. K.)

ALGORISM, a name applied in the middle ages to arithmetic employing the Indo-Arabic numerals. (See *ALGEBRA* for Mohammed ibn Mûsâ al-Khowârizmî, who wrote *Liber Algorism*, "the Book of al-Khowârizmî"). It appeared in mediæval French as *augrisme* and *augrime*, and was thence carried to England as *augrym* or *augrim*, as in Chaucer's *Astrolabe*, his *Testament of Love* and his *Clerk's Tale*. In Spanish it takes such forms as *al guarisma*. In the middle ages the abacists computed on the abacus (*q.v.*), while the algorists computed by algorism. Robert Recorde wrote in his *Ground of Artes* (c. 1542): "Some call it Arsetmetrick, and some Augrime. . . . Both names are corruptly written: Arsetmetrick for Arithmetick, as the Greeks call it, and Augrime for Algorisme, as the Arabians found it" (1646 edition). Early European writers thought that the word came from Albus, a king of India; thus in a manuscript of c. 1300: "There was a kyng of Inde the quich heyth Algor, he made this craft. And aft his name he called hit algyr." In modern mathematics, an algorism, or algorithm, is a set of operations reduced to a uniform procedure for solving a specific type of problem, for example, the algorism of continued fractions.

ALGUAZIL, a Spanish title often to be met in stories and plays, derived from the Arabic "*visir*" and the article "*al*." The alguazil among the early Spaniards was a judge, and sometimes the governor of a town or fortress. In later times he has gradually sunk down to the rank of an officer of the court, who is trusted with the service of writs and certain police duties. The title has also been given to inspectors of weights and measures in market-places, and similar officials.

ALGUM or **ALMUG TREE**. The Hebrew words *Algummin* or *Almuggim* are translated *Algum* or *Almug* trees in the authorized version of the Bible (see 1 Kings x: 11, 12; 2 Chron. ii: 8, and ix: 10, 11); *almug* is an erroneous form (see Max Müller, *Science of Language*). The wood of the tree was very precious, and was brought from Ophir (probably some part of India), along with gold and precious stones, by Hiram, and was used in the formation of pillars for the temple at Jerusalem, and for the king's house; also for the inlaying of stairs, as well as for harps and psalteries. It is probably the red sanders or red sandal-wood of India (*Pterocarpus santalinus*). This tree belongs to the large family Leguminosae, sub-order Papilionaceae. The wood is hard, heavy, close-grained and of a fine red colour. It is different from the white fragrant sandal-wood, which is the produce of *Santalum*

album, a tree belonging to another family, the Santalaceae.

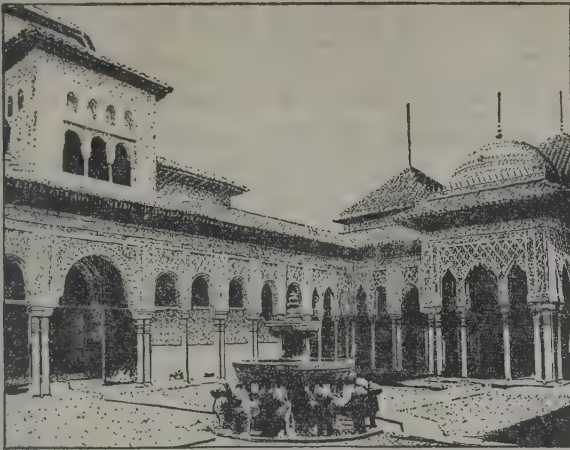
ALHAMA DE GRANADA, southern Spain, province of Granada, 24 mi. S.W. of Granada. Pop. (1940) 7,308 (mun., 9,849). Alhama is on a sloping shelf of limestone over a deep gorge of the river Marchan or Alhama; the rugged peaks (6,800 ft.) of the Sierra de Alhama rise behind it. On Christmas Day 1884 an earthquake destroyed fine terraces of Moorish houses and 800 people, and the town was rebuilt a little way from the old site. The baths (Arabic, *alhama*=bath) near the river, continuously used since Roman times, survived. The temperature of the hot sulphurous springs is about 112° F.; and visitors come in spring and autumn for the fine scenery and cures of rheumatism and dyspepsia. In the 15th century Alhama and the neighbouring fortress of Loja (*q.v.*), were the keys of Granada.

ALHAMBRA, THE, an ancient palace and fortress of the Moorish monarchs of Granada, in southern Spain, occupying a hilly terrace on the southeastern border of the city of Granada. This terrace or plateau, which measures about 2,430 ft. in length by 674 ft. at its greatest width, extends from W.N.W. to E.S.E., and covers an area of about 35 ac. It is enclosed by a strongly fortified wall, which is flanked by 13 towers. The river Darro, which foams through a deep ravine on the north, divides the plateau from the Albaicin district of Granada; the Assabica valley, containing the Alhambra park, on the west and south, and beyond this valley the almost parallel ridge of Monte Mauror, separate it from the Antequeruela district.

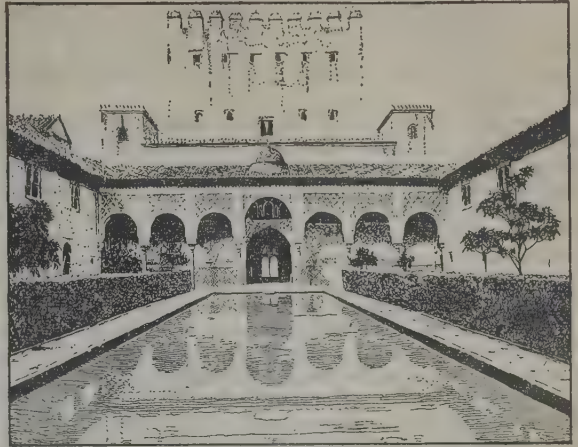
The name *Alhambra*, signifying in Arabic "the red," is probably derived from the colour of the sun-dried *tapia*, or bricks made of fine gravel and clay, of which the outer walls are built. Some authorities, however, hold that it commemorates the red flare of the torches by whose light the work of construction was carried on nightly for many years; others associate it with the name of the founder, Mohammed Ibn Al Ahmar; and others derive it from the Arabic Dar al Amra, "House of the Master." (For an account of the period to which the Alhambra belongs, see GRANADA [city].) The palace was built chiefly between 1248 and 1354, in the reigns of Al Ahmar and his successors; but even the names of the principal artists employed are either unknown or doubtful. The splendid decorations of the interior are ascribed to Yusef I, who died in 1354. Immediately after the expulsion of the Moors in 1492, their conquerors began, by successive acts of vandalism, to spoil the marvellous beauty of the Alhambra. The open work was filled up with whitewash, the painting and gilding effaced, the furniture soiled, torn or removed. Charles V (1516-1556) rebuilt portions in the modern style of the period, and destroyed the greater part of the winter palace to make room for a modern structure which has never been completed. Philip V (1700-1746) Italianized the rooms, and completed the degradation by running up partitions which blocked up whole apartments, gems of taste and patient ingenuity. In subsequent centuries the carelessness of the Spanish authorities permitted this masterpiece of Moorish art to be still further defaced; and in 1812 some of the towers were blown up by the French under Count Sebastiani, while the whole buildings narrowly escaped the same fate. In 1821 an earthquake caused further damage. The work of restoration undertaken in 1828 by the architect José Contreras was endowed in 1830 by Ferdinand VII; and after the death of Contreras in 1847 it was continued with fair success by his son Rafael (d. 1890) and his grandson Mariano.

The situation of the Alhambra is one of rare natural beauty; the plateau commands a wide view of the city and plain of Granada, towards the west and north, and of the heights of the Sierra Nevada, towards the east and south. The park (Alameda de la Alhambra), which in spring is overgrown with wild flowers and grass, was planted by the Moors with roses, oranges and myrtles; its most characteristic feature, however, is the dense wood of English elms taken there in 1812 by the duke of Wellington.

The Moorish portion of the Alhambra resembles many mediæval Christian strongholds in its threefold arrangement as a castle, a palace and a residential annex for subordinates. The Alcazaba or citadel, its oldest part, is built on the isolated and



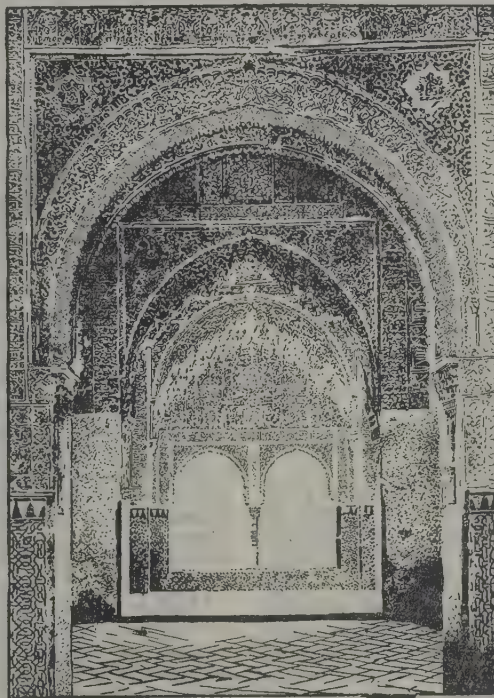
COURT OF THE LIONS



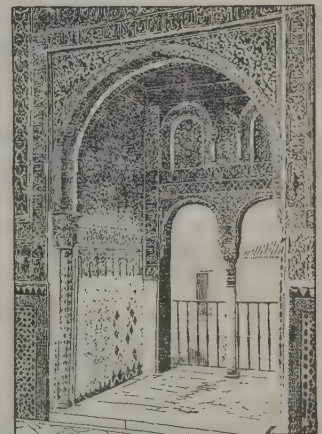
COURT OF THE MYRTLES AND COMARES TOWER



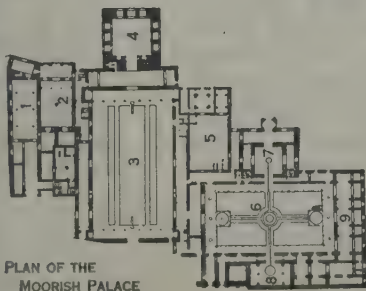
PAVILION OF PERISTYLE
COURT OF THE LIONS



WINDOWS "OF LINDARAJA"
HALL OF THE TWO SISTERS



DETAIL OF WINDOWS
HALL OF THE AMBASSADORS



PLAN OF THE
MOORISH PALACE

1. ORATORY
2. COURT OF THE MOSQUE
3. COURT OF THE MYRTLES
4. COMARES TOWER
5. HALL OF THE AMBASSADORS
6. BATHS
7. COURT OF THE LIONS
8. HALL OF THE TWO SISTERS
9. HALL OF THE ABENCERRAGES
10. HALL OF JUSTICE

- A. THE MOORISH PALACE
B. PALACE OF CHARLES V



GENERAL PLAN

COURT OF THE LIONS AND COURT OF THE MYRTLES FROM MAYER "ARCHITECTURE AND APPLIED ARTS IN OLD SPAIN" (DELPHIN VERLAG), PAVILION OF PERISTYLE, DETAIL OF WINDOWS AND WINDOWS OF LINDARAJA FROM SALADIN "L'ALHAMBRA DE GRANADE," BY PERMISSION OF ALBERT MORANGE

PLANS AND DRAWINGS, FROM PHOTOGRAPHS OF THE ALHAMBRA

To the black-and-white of the illustration must be added the gorgeous colour which decks the rich plaster work everywhere. The intricate arabesques glow with gold, bright blue, pure red and touches of deep green

precipitous foreland which terminates the plateau on the north-west. Only its massive outer walls, towers and ramparts are left. Beyond the Alcazaba is the palace of the Moorish kings, or Alhambra properly so-called, and beyond this, again, is the Alhambra Alta (Upper Alhambra), originally tenanted by officials and courtiers.

Access from the city to the Alhambra park is afforded by the Puerta de las Granadas (Gate of Pomegranates), a massive triumphal arch dating from the 15th century. A steep ascent leads past the Pillar of Charles V., a fountain erected in 1554, to the main entrance of the Alhambra. This is the Puerta Judiciaria (Gate of Judgment), a massive horseshoe archway, surmounted by a square tower, and used by the Moors as an informal court of justice.

The present entrance to the Palacio Arabe, or Casa Real, is by a small door from which a corridor conducts to the Patio de los Arrayanes (Court of the Myrtles), also called the Patio de la Alberca (Court of the Blessing or Court of the Pond). This court is 140ft. long by 74ft. broad, and in the centre there is a large pond set in the marble pavement, full of goldfish, and with myrtles growing along its sides. There are galleries on the north and south sides; that on the south 27ft. high, and supported by a marble colonnade. Underneath it, to the right, was the principal entrance, and over it are three elegant windows with arches and miniature pillars.

The Sala de los Embajadores (Hall of the Ambassadors) is the largest in the Alhambra, and occupies all the Torre de Comares. It is a square room, the sides being 37ft. in length, while the centre of the dome is 75ft. high. This was the grand reception room, and the throne of the sultan was placed opposite the entrance.

The celebrated Patio de los Leones (Court of the Lions) is an oblong court, 116ft. in length by 66ft. in breadth, surrounded by a low gallery supported on 124 white marble columns. A pavilion projects into the court at each extremity, with filigree walls and light domed roof, elaborately ornamented. The square is paved with coloured tiles, and the colonnade with white marble, while the walls are covered 5ft. up from the ground with blue and yellow tiles, with a border above and below enamelled blue and gold. In the centre of the court is the celebrated Fountain of Lions, a magnificent alabaster basin supported by the figures of twelve lions in white marble, not designed with sculptural accuracy, but as emblems of strength and courage.

The Sala de los Abencerrajes (Hall of the Abencerrages) derives its name from a legend according to which Boabdil, the last king of Granada, having invited the chiefs of that illustrious line to a banquet, massacred them here. This room is a perfect square, with a lofty dome and trellised windows at its base. The roof is exquisitely decorated in blue, brown, red and gold, and the columns supporting it spring out into the arch form in a remarkably beautiful manner. Opposite to this hall is the Sala de las Dos Hermanas (Hall of the two Sisters), so-called from two very beautiful white marble slabs laid as part of the pavement. There is a fountain in the middle of this hall, and the roof—a dome honeycombed with tiny cells, all different, and said to number 5,000—is a magnificent example of the so-called "stalactite vaulting" of the Moors.

The original furniture of the palace is represented by the celebrated vase of the Alhambra, a splendid specimen of Moorish ceramic art, dating from 1320, and belonging to the first period of Moorish porcelain.

Of the outlying buildings in connection with the Alhambra, the foremost in interest is the Palacio de Generalife or Ginalife (the Moorish *Jemāt al Arif*, "Garden of Arif," or "Garden of the Architect"). This villa probably dates from the end of the 13th century, but has been several times restored. The Villa de los Martires (Martyrs' Villa), on the summit of Monte Mauror, commemorates by its name the Christian slaves who were employed to build the Alhambra, and confined here in subterranean cells.

See *Plans, Elevation, Sections and Details of the Alhambra; from drawings taken on the spot by J. Gouly and Owen Jones; with a*

complete translation of the Arabic inscriptions and a historical notice of the Kings of Granada, by P. de Gayangos. These two magnificent folios, though first published in London between 1842 and 1845, give the best pictorial representation of the Alhambra; Rafael Contreras, *La Alhambra, El Alcázar, y la gran Mezquita de Occidente* (Madrid, 1885); *The Alhambra*, by Washington Irving, was written in 1832, and rewritten in 1857. A well-illustrated edition was published in London in 1896.

ALHAMBRA, a city of Los Angeles county, Calif., U.S., at the entrance to the San Gabriel valley; bounded by the cities of Los Angeles, South Pasadena and San Gabriel, and by the east side industrial area which adjoins Los Angeles. It is served by the Southern Pacific and the Pacific Electric railways, and is connected with Los Angeles by five boulevards. The population according to the federal census, was 51,284 in 1950; in 1940 it was 38,935 and in 1920, 9,096. Alhambra is primarily a residential city, but has an industrial district in which are a number of important plants. The principal manufactures are equipment for petroleum refineries, power apparatus, felt products, electrical goods, and beeswax and beekeepers' supplies. The city was incorporated in 1903, and adopted a commission-manager form of government in 1914. The name was given by Benjamin D. Wilson (after whom Mt. Wilson was named) when he set aside a tract for a city out of his vast ranch holdings; and the prevailing Spanish-Moorish type of architecture is in harmony with the name. On the outskirts of Alhambra is the San Gabriel mission (founded 1771 by the Franciscans).

ALHAZEN (âl-hah'zên) [ABU ALI AL-HASAN IBN ALHASAN], Arabian mathematician of the 11th century, was born at Basra and died at Cairo in 1038. He is to be distinguished from another Alhazen who translated Ptolemy's *Almagest* in the 10th century. Having boasted that he could construct a machine for regulating the inundations of the Nile, he was summoned to Egypt by the caliph Hakim; but, aware of the impracticability of his scheme, and fearing the caliph's anger, he feigned madness until Hakim's death in 1021.

Alhazen was the first great discoverer in optics after the time of Ptolemy. According to Giovanni Battista della Porta, he first explained the apparent increase of heavenly bodies near the horizon, although Bacon gives the credit of this discovery to Ptolemy. His treatise on optics was translated into Latin by Witelo (1270), and afterwards published by F. Risner in 1572, with the title *Opticæ thesaurus Alhazeni libri VII., cum ejusdem libro de crepusculis et nubium ascensionibus*. Works on geometrical subjects were found in the *Bibliothèque nationale de Paris* in 1834 by E. A. Sédillot; other manuscripts are preserved in the Bodleian Library at Oxford and in the library of Leyden.

BIBLIOGRAPHY.—See Casiri, *Bibl. Arab. Hisp. Escur.*; J. E. Montucla, *Histoire des mathématiques* (1758); and E. A. Sédillot, *Matériaux pour l'histoire des sciences mathématiques*.

'ALI, in full, 'ALI BEN ABU TALIB (c. 600–661), the fourth of the caliphs or successors of Mohammed, was born at Mecca about the year A.D. 600. His father, Abū Talib, was an uncle of the prophet, and 'Ali himself was adopted by Mohammed and educated under his care. As a mere boy he distinguished himself by being one of the first to declare his adhesion to the cause of Mohammed, who some years afterwards gave him his daughter Fatima in marriage. When Mohammed died without male issue, a few emigrants thought 'Ali to have the best claim to succeed him. Abu Bekr, Omar, and Othman, however, occupied this position before him, and it was not until A.D. 656, after the murder of Othman, that he assumed the title of caliph. Almost the first act of his reign was the suppression of a rebellion under Talha and Zobair, who were instigated by Ayesha, Mohammed's widow, a bitter enemy of 'Ali, and one of the chief hindrances to his advancement to the caliphate. The rebel army was defeated at the "Battle of the Camel," near Basra, the two generals being killed, and Ayesha taken prisoner. 'Ali soon afterwards made Kufa his capital. His next care was to get rid of the opposition of Moawiya, who had established himself in Syria at the head of a numerous army. A prolonged battle took place in July 657 in the plain of Siffin (Suffein), near the Euphrates; the fighting was at first, it is said, in favour of 'Ali, when suddenly a number of the enemy, fixing copies of the Koran to the points of their spears, exclaimed

that "the matter ought to be settled by reference to this book, which forbids Moslems to shed each other's blood." The superstitious soldiers of 'Ali refused to fight any longer, and demanded that the issue be referred to arbitration.

Abu Musa was appointed umpire on the part of 'Ali, and 'Amr ibn-el-Ass, a veteran diplomatist, on the part of Moawiya. It is said that 'Amr persuaded Abu Musa that it would be for the advantage of Islam that neither candidate should reign, and asked him to give his decision first. Abu Musa having proclaimed that he deposed both 'Ali and Moawiya, 'Amr declared that he also deposed 'Ali, and announced further that he invested Moawiya with the caliphate.

This decision (658) injured the cause of 'Ali, which was still further weakened by the loss of Egypt. After much indecisive fighting, 'Ali found his position so unsatisfactory that according to some historians he made an agreement with Moawiya by which each retained his own dominions unmolested. It chanced, however—according to a legend, the details of which are quite uncertain—that three of the fanatic sect of the Kharijites had made an agreement to assassinate 'Ali, Moawiya and 'Amr, as the authors of disastrous feuds among the faithful. The only victim of this plot was 'Ali, who died at Kufa Jan. 24, 661, of the wound inflicted by a poisoned weapon. A splendid mosque called Meshed 'Ali was afterwards erected near the city, but the place of his burial is unknown. He had eight wives after Fatima's death, and in all, it is said, thirty-three children, one of whom, Hassan, a son of Fatima, succeeded him in the caliphate. His descendants by Fatima are known as the Fatimites (*q.v.*; see also EGYPT: *History, Mohammedan period*). The question of 'Ali's right to succeed to the caliphate is an article of faith which divided the Mohammedan world into two great sects, the Sunnites and the Shiites, the former denying, and the latter affirming, his right. The Turks, consequently, hold his memory in abhorrence; whereas the Persians, who are generally Shi'as, venerate him as second only to the prophet, call him the "Lion of God" (Sher-i-Khudā), and celebrate the anniversary of his martyrdom. 'Ali is described as a bold, noble, and generous man, "the last and worthiest of the primitive Moslems, who imbibed his religious enthusiasm from companionship with the prophet himself, and who followed to the last the simplicity of his example." It is maintained, by the other school, that his motives were throughout those of ambition rather than piety, and that, apart from the tragedy of his death, he would have been an insignificant figure in history. (See CALIPHATE.)

BIBLIOGRAPHY.—In the eyes of the later Moslems he was remarkable for learning and wisdom, and there are extant collections (almost all certainly spurious) of proverbs and verses which bear his name: the *Sentences of 'Ali* (Eng. trans., William Yule, Edinburgh, 1832); H. L. Fleischer, *Ali's Hundert Sprüche* (Leipzig, 1837); the *Divan*, by G. Kuypert (Leyden, 1745, and at Bulak, 1835); C. Brockelmann, *Gesch. d. arabisch. Lit.* (vol. i., Weimar, 1899).

ALI, known as **ALI BEY** (1766–1818), the assumed name of DOMINGO BADIA Y LEBLICH, a Spanish traveller. Pretending to be a descendant of the Abbasids, Badia in 1803 set out on his travels. Under the name of Ali Bey el Abbassi, and in Muslim costume, he visited Morocco, Tripoli, Egypt, Arabia and Syria. He made the pilgrimage to Mecca, at that time in the possession of the Wahabites. In 1814, Badia published in Paris an account of his travels under the title of *Voyage d'Ali Bey en Asie et en Afrique*, etc. A few years later he set out again for Syria under the assumed name of Ali Othman and, it is said, accredited as a political agent by the French Government. He reached Aleppo, and there died, not without suspicion of having been poisoned.

An account of his Eastern adventures was published in London in 1816 entitled *Travels in Morocco, Tripoli, Cyprus, Egypt, Arabia, Syria and Turkey, between the years 1803 and 1807*.

ALI, known as **ALI PASHA** (1741–1822), Turkish pasha of Iannina, surnamed Arslan (the lion), was born at Tepeleni, Albania. His father, hereditary bey of Tepeleni, was killed by neighbouring chiefs when Ali was 14. His mother formed a brigand band to secure revenge and restitution. In the wild brigand school Ali proved an apt pupil, and recovered Tepeleni. He was then commissioned by the Turkish Government to chastise the

rebellious pasha of Scutari, whom he defeated and killed. He was then appointed lieutenant to the derwend-pasha of Rumelia, with a commission for the suppression of brigandage, and seized the opportunity to enrich himself by levying a tax on the brigands for immunity, at the same time securing indemnity for the malpractice by judicious bribes at Constantinople. In 1788 he was made pasha of Iannina.

By a combination of cunning and severity Ali made himself all-powerful in central Albania, and began to contemplate the establishment of a sea power including Albania, Greece and Thessaly which should rival in the eastern that of the dey of Algiers in the western Mediterranean. For a brief period in 1797–98 it seemed that this might be accomplished with the help of the French, who had occupied the Ionian islands, and gave Ali permission to suppress the "aristocratic" tribes of the coast. In the confused events which followed Ali abandoned his flirtation with France and French ideas, foreseeing the ultimate defeat of France. He retained the confidence of the sultan, who confirmed him in possession of the whole of Albania, and made him vali of Rumelia. In 1803 he was master of Epirus, Albania and Thessaly, while the pashaliks of Morea and Lepanto were in the hands of his sons Veli and Mukhtar. He held all the coastal towns which had once been Venetian, except Parga, which remained French in spite of a brief renewal of Ali's alliance with Napoleon in 1807. In 1814 the Pargiots rose against the French garrison, and handed it over to the British to save it from Ali, who had bought from the French commandant a promise of surrender. Ali now sent a mission to London, which was, in the end, successful. The Pargiots were compensated and removed to the Ionian islands, and the Turks took possession.

But Ali's fall was near. The Sultan Mahmud II. found a pretext in Ali's attempt to secure the murder of Pasha Bey in the precincts of the palace at Constantinople. Hurshid Pasha, the grand vizier, was entrusted with his deposition. After a polite interview with Hurshid, Ali was stabbed in the back as he left the tent.

Ali's court at Iannina was the centre of a sort of barbarous culture, in which astrologers, alchemists and Greek poets played their part, and was often visited by travellers. Amongst others, Byron came, and has left a record of his impressions in "Childe Harold's Pilgrimage," less interesting and vivid than the prose accounts of Pouqueville, T. S. Hughes and William M. Leake. Leake (iii. 259) reports a reproach addressed by Ali to the French renegade Ibrahim Effendi, who had ventured to remonstrate against some particular act of ferocity: "At present you are too young at my court to know how to comport yourself. . . . You are not yet acquainted with the Greeks and Albanians; when I hang up one of these wretches on the plane-tree, brother robs brother under the very branches: if I burn one of them alive, the son is ready to steal his father's ashes to sell them for money. They are destined to be ruled by me; and no one but Ali is able to restrain their evil propensities." This is perhaps as good an apology as could be made for his character and methods. To the wild people over whom he ruled, none was needed. He had their respect, if not their love; he is the hero of a thousand ballads; and his portrait still hangs among the *ikons* in the cottages of the Greek mountaineers.

BIBLIOGRAPHY.—Apart from the scattered references in the published and unpublished diplomatic correspondence of the period, contemporary journals and books of travel contain much interesting material for the life of Ali. Of these may especially be mentioned François C. H. L. Pouqueville, *Voyage en Morée, à Constantinople en Albanie, etc.* (1805), of which an English version by A. Plumptre was published in 1815; ib. *Voyage dans la Grèce* (1820, 1821). Pouqueville, who spent some time as French resident at Iannina, had special facilities for obtaining first-hand information, though his emotionalism makes his observations and deductions at times somewhat suspect. Very interesting also are Thomas Smart Hughes, *Travels in Greece and Albania* (2nd ed. 1830); John Cam Hobhouse (Lord Broughton), *A Journey through Albania, etc.* . . . during the years 1809–10 (1813 a new ed. 1855); William Martin Leake, *Travels in Northern Greece* (1845). See also Pouqueville's *Hist. de la régénération de la Grèce, 1740–1824* (1824, 3rd ed., 1825); R. A. Davenport, *Life of Ali Pasha, vizier of Epirus* (1861); and the chapter by W. Alison Phillips on "Greece and the Balkan Peninsula," vol. x. chap. vi. of *Cambridge Modern History*.

ALIAGA, a municipality of the province of Nueva Ecija, Luzon, Philippine Islands, almost due west from the capital, Cabanatuan, and about 70 mi. N. by W. of Manila. Pop. (1939), 15,149, of whom 7,579 were male, 7,570 female. The white population numbered one. Area, 32.7 sq.mi. The municipality is pleasantly situated in a large fertile valley about midway between the Pampanga Grande and Pampanga Chico rivers. In 1848 Aliaga, which had formed part of Pampanga province, was transferred to Nueva Ecija. Civil government under the United States was organized in 1901. There is an administrative centre and 18 barrios (wards). The principal products are corn, rice, sugar and tobacco. The vernaculars are Tagalog, Ilocano, Pampango and Pangasinan. Literacy, based on ages from 10 years up, was 61.7% in 1939. Of children of school age, 36.8% attended school. There were 2,758 parcels of land declared for taxation in 1938 with 1,635 owners thereof. The total area of agricultural lands in the municipality was 20,825 ac.

(C. S. L.)

ALIAS, a term used to connect the different names of a person who has passed under more than one, in order to conceal his identity or for other reasons, or to describe compendiously an adopted name.

ALIBI, in law, the defense resorted to in criminal prosecutions, where the person charged alleges that he was so far distant at the time from the place where the crime was committed that he could not have been guilty. An alibi, if substantiated, is the most conclusive proof of innocence. (See CRIMINAL LAW.)

ALICANTE, seaboard province, southeastern Spain, formed (1833) from parts of the provinces of Valencia and Murcia. Pop. (1940) 607,562; area, 2,264 sq.mi., density per sq.mi. 268.4. In the north and west there are extensive calcareous mountain ranges cut by deep ravines; farther south the land is more level with fertile valleys. On the coast, unhealthy salt marshes alternate with pleasant and productive *huertas* or gardens, such as those of Alicante and Denia. The Segura, the only large river, flows from the highlands of Albacete through Murcia and Orihuela. The scanty torrential rainfall makes irrigation from the Segura with its network of canals important. 40% of the area is cultivated, nearly a quarter being devoted to vines, the most important culture, producing wine and raisins from stocks immune against the phylloxera. The wine is famous in Spain and inferior kinds are sent to France to be mixed with claret. Cereals (barley first in importance, rice second) are profitable only in such irrigated lands as the Huerta de Orihuela; wheat and barley are imported from Algeria and maize from Argentina. Olives, almonds, oranges (especially in the Segura valley and on the coast), carobs and date palms are grown in large plantations. The fruit trees have been estimated to number 2,500,000. The almond is the characteristic fruit tree of Alicante. Oranges are sent ordinarily to England, Germany, Holland and Belgium, and other fruits to the interior of Spain. In sericulture, Alicante is second only to Murcia. Stock raising is not important, and the roads are mostly poor. Except in the Orihuela district, most of the land is in small properties; and fertility and skill in cultivation have made the population dense, even apart from Alicante and Alcoy.

Mineral products include superphosphates, salt and rock-salt. Hydrochloric, nitric and sulphuric acids are made in quantities. Fine cloths, silk, cotton and woollen fabrics, lace, paper, hats, leather, earthenware, soap, oil and brandy are made. Fisheries of tunny and anchovy are active. The dialect is a variety of the Valencian. The principal towns (separately described) are, with 1940 populations, Alicante, the capital (83,140), Crevillente (10,145), Denia (7,637), Elche (31,275), Novelda (8,798), Orihuela (11,983), and Villena (14,674).

During the rebellion of 1936-39, Loyalists retained control of the province until the end of the war.

ALICANTE, capital of the province of that name in southeastern Spain, episcopal see, rising in a crescent from the bay up the low surrounding hills with white flat-roofed houses ending in an old citadel on bare rock (400 ft.). Pop. (1940) 83,140 (mun., 96,729). A dry and equable climate makes it a health-resort, and large suburbs were built after 1905. The bays afford good anchorage, and large harbour works after 1902 improved what became one of the chief ports of Spain. The trade of Alicante consists in the manufacture of cotton, linen and woollen goods,

cigars, confectionery and castor oil; the importation of coal, iron, machinery, manures, timber, oak staves and fish; and the exportation of lead, fruit, farm produce and red wines, which are sent to France for blending with better vintages. Fine marble is procured in the island of Plana near the coast. Alicante was the Roman *Lucentum*; but, despite its antiquity, it has few Roman or Moorish remains. In 718, it was occupied by the



A CHARACTERISTIC OLD FARMHOUSE ON THE OUTSKIRTS OF ALICANTE. CAPITAL OF THE SPANISH PROVINCE OF THAT NAME. IN THE HEART OF THE DATE-RAISING COUNTRY OF SOUTHEASTERN SPAIN

Moors, who were only expelled in 1304, and made an unsuccessful attempt to recapture the city in 1331. Alicante was besieged by the French in 1709, and by the federalists of Cartagena in 1873. It was under loyalist control until the end of the civil war of 1936-39.

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ALICE MAUD MARY, Grand Duchess of Hesse-Darmstadt (1843-1878), second daughter and third child of Queen Victoria, was born at Buckingham palace on April 25, 1843. In the summer of 1860, at Windsor castle, Princess Alice first met her future husband, Prince Louis of Hesse. In the following year, the house of commons unanimously voted a dowry of £30,000 on her marriage and an annuity of £6,000 to the princess. In Dec. 1861, Princess Alice nursed her father with the utmost care during his short illness, and after his death devoted herself to comforting her mother. Her marriage took place at Osborne, on July 1, 1862.

The princess unconsciously wrote her own biography from this period in her constant letters to Queen Victoria, a selection of which, edited by Dr. Carl Sell, were printed in 1883. These letters give a complete picture of the daily life of the duke and duchess, and they also show the intense love of the latter for her husband, her mother and her native land. She visited England every year, and it was at her special request that when she died, her husband, who succeeded to the throne of the duchy in 1877, laid an English flag upon her coffin. In Nov. 1878 her children and her husband contracted diphtheria, and one of the children died. The duchess, worn with sorrow and anxiety, herself contracted the disease after the others had recovered, and died on Dec. 14. She left one son and four daughters: Ernest Louis, late reigning Grand Duke of Hesse (abdicated 1918); Victoria Alice, married Prince Louis of Battenberg, marquis of Milford Haven; Elizabeth Feodorovna, Grand Duchess Sergius of Russia, assassinated Sept. 1918; Irene, Princess Henry of Prussia; Alexandra Feodorovna, tsaritsa of Russia, killed July 16, 1918.

See Carl Sell, *Alice: Mittheilungen aus ihrem Leben und Briefen*, etc. (Darmstadt, 1883), with English translation by the Princess Christian, *Alice: biographical sketch and letters* (1884).

ALICE SPRINGS, a telegraph station on the overland telegraph line (Adelaide-Port Darwin) in the central southern portion of the Northern Territory, Australia. Situated near the centre of the Macdonnell ranges, 994 mi. from Adelaide and

1,105 mi. from Port Darwin, it lies virtually in the centre of the continent. Heavitree Gap, the largest and most conveniently situated of the characteristic gorge-like passes through the ranges, lies 4 mi. to the south, and upon this gap the telegraph line and a considerable stock-route traffic converge. Through this gap also passes the new railway line from Oodnadatta to Alice Springs which was completed in 1929. Alice Springs (alt. 1,926 ft.) stands on the central Australian platform (average elevation *c.* 2,000 ft.). The climate, hot in summer but fine and bracing in winter, suffers from the extremes associated with every continental position. (The rainfall [average annual: *c.* 11 in.] is erratic, variation 27.21–4.3 in.) In spite of such uncertainties of climate, and of its remoteness, Alice Springs is the centre of a pastoral area of about 100 mi. radius; and the mineral resources (gold, mica, etc.) of the region are probably considerable. The military road linking Alice Springs to the northern railway at Birdum was completed in 1941, though a trail serving the telegraph stations was in use since 1872. Pop. (1933) 467.

ALIDADE, or sight rule, a ruler provided with sights and used as an accessory with the plane-table employed for topographic survey. (See SURVEYING.)

ALIEN is defined by the British Nationality and Status of Aliens Act 1914–22 as a “person who is not a British subject.” He is one who either owes allegiance to a foreign sovereign or is stateless. *Calvin's Case* (1608) decided that natives of Scotland born before the union of the Crowns were aliens in England, but that, since allegiance is to the person of the king, those born subsequently (*post-nati*) were English subjects. But in *Isaacson v. Durant* (1886) the Court held that allegiance was due to the king, in his political and not in his personal character. Consequently, upon the separation of the Crowns of England and Hanover on the accession of Queen Victoria, Hanoverians ceased to owe allegiance to the British Crown and became aliens; and those born after the separation of the kingdoms were *a fortiori* in the same position.

Formerly, aliens in England suffered many disabilities. At common law an alien could not hold landed property, not even under lease. Until the reign of Edward I., when by charter aliens were permitted to rent houses, foreign merchants lived in lodgings. By 32 Hen. VIII. c. 16 alien artificers or handicraftsmen were forbidden to lease a dwelling house or shop. By the Naturalization Act, 1844, however, aliens were permitted to hold land or houses for residence or business for a term not exceeding 21 years, and also to take and hold personal property. They were incapable of inheriting real estate and of transmitting it by descent. By 11 & 12 William III. c. 6, natural-born subjects might derive title by descent through an alien ancestor. At common law an alien, whether the subject of a friendly or enemy state, possesses no legal right to enter British territory, but during his residence within the British dominions he owes a local allegiance to the Crown to the same extent as a British subject. Thus he is subject to British law, including that of treason. He was incapable, even when naturalized by the Act of Naturalization, of being a member of the Privy Council or of either House of Parliament, and this is still the law as to persons naturalized otherwise than under the Acts of 1870 and 1914. He was also incapable of holding any municipal office or of voting at parliamentary or municipal elections or of filling any office or place of trust, civil or military. Many of these disabilities were removed by the Naturalization Act 1870, the provisions of which were substantially re-enacted by the British Nationality and Status of Aliens Act 1914–22. By s.17 of this Act an alien may take, acquire, hold, and dispose of real and personal property as if he were a natural-born British subject; and a title to real and personal property may be derived through, from, or in succession to an alien in the same manner as through, from, or in succession to a natural-born British subject, provided that this section shall not operate so as to (1) confer any right on an alien to hold real property situated out of Great Britain; or (2) qualify an alien for any office or for any municipal, parliamentary, or other franchise; or (3) qualify an alien to be the owner of a British ship; or (4) entitle an alien to any right or privilege as a British subject, except such rights and privileges

in respect of property as are hereby expressly given to him; or (5) affect any estate or interest in real or personal property to which any person has or may be entitled, either mediately or immediately, in possession or expectancy, in pursuance of any disposition made before May 12, 1870, or in pursuance of any distribution by law on the death of any person dying before that day. But an alien may purchase a British ship, and if she is built in England to be delivered to him abroad, she is not a “British ship” within the Merchant Shipping Act 1894. By the Representation of the People Act 1918 an alien is not entitled to be registered or to vote as a parliamentary or local government elector. By s.18 of the Nationality Act of 1914 an alien is triable in the same manner as a natural-born British subject. By the Army Act 1881 an alien may with the consent of the Crown enlist in H.M. regular forces, but may not hold higher rank than that of a warrant or non-commissioned officer.

It seems to be a rule of general public law that an alien can be sent out of the realm by exercise of the Crown's prerogative; but in modern English practice, whenever it seems necessary to expel foreigners, a special Act of parliament has to be obtained for the purpose, unless the case falls within the Extradition Acts or the Aliens Act 1905.

The Acts of 1905, 1914 and 1919 prohibit the landing in Great Britain of undesirable alien steerage passengers, called in the Act “immigrants,” from ships carrying more than 20 alien steerage passengers, called in the Act “immigrant ships”; nor can alien immigrants be landed except at certain ports at which there is an “immigrant officer,” to whom power of prohibiting the landing is given, subject to a right of appeal to the immigration board of the port. The act contains a number of qualifications, and among these empowers the Secretary of State to exempt any immigrant ship from its provisions if he is satisfied that a proper system is maintained to prevent the immigration of undesirable persons. The principal test of undesirableness is not having or being in a position to obtain the means of supporting one's self and one's dependants, or appearing likely from disease or infirmity to become a charge on the rates, provided that the immigrant is not seeking to avoid prosecution or punishment on religious or political grounds, or persecution, involving danger of imprisonment or danger to life or limb, on account of religious belief.

The powers conferred by the Aliens Restriction Act 1914 for the exclusion, control, and deportation of aliens during a state of war or national emergency are by the Aliens Restriction (amendment) Act 1919 made permanent and further restrictions are imposed. Under the Act of 1914 by Order in Council aliens may be prohibited from landing or from embarking in Great Britain either generally or at certain places, may be deported, required to reside or remain, or forbidden to reside or remain in certain places, and required to comply with such provisions as to registration, change of abode, travelling, or otherwise as may be made by Order in Council. Under the Act of 1919 aliens inciting to sedition H.M. forces are liable on indictment to penal servitude or on summary conviction to imprisonment not exceeding three months, and for promoting industrial riot on summary conviction to imprisonment for a similar period. No alien may hold a pilotage certificate except certain certificates issued to masters or mates of French nationality. No alien may act as master, chief officer, or chief engineer of a British vessel or as skipper or second hand of a British fishing boat registered in Great Britain, except in the case of a vessel or boat employed habitually between ports outside Great Britain. Aliens certified by the Admiralty for good service are exempt from these restrictions. No alien may be employed in any capacity on board a British ship at a lower rate of pay for his rating than that current on British ships. Aliens, other than former enemy aliens habitually employed afloat in any capacity or in any climate for which they are specially fitted are exempt from the above restrictions except that relating to pay. No alien may be employed on a British ship registered in Great Britain unless he has produced satisfactory proof of his nationality. No alien may be appointed to any office or place in the Civil Service nor may he assume or use or continue the assumption or use of any name other than that by which he was ordinarily

known on Aug. 4, 1914, nor carry on business in any name other than that in which he carried on business at the said date without the consent of the Secretary of State. The Trading with the Enemy (Amendment) Act 1918 applies for a period of five years from the termination of the war . . . and thereafter until parliament otherwise determines.

By s. 2 no banking business may be carried on in Great Britain (a) by a company which is an enemy-controlled corporation within the meaning of the act, or (b) by a firm, or individual if the business carried on is with respect to which an order for the winding-up thereof could have been made under s. 1 of the Trading with the Enemy Act, 1916.

Enemy aliens during the time of war have no civil rights or privileges, unless they are here under the protection and by permission of the Crown. Thus an enemy alien who had registered under the Aliens Restriction Act 1914 as an enemy alien was held entitled to sue. And since an enemy alien can be sued here, he can appear and be heard in his defense, and if judgment proceed against him the appellate courts are as much open to him.

Formerly aliens acquired British nationality by special acts of parliament or became denizens by grants of letters of designation by the Crown; although both these processes are still available, aliens usually have since the Act of 1844 applied to the Home Secretary for certificates of naturalization. (H. H. L. B.)

See Pitt Cobbett, *Cases and Opinions on International Law*, vol. ii, 4th ed. (1922); J. A. Foote, *Private International Law*, 5th ed. (1925); L. F. L. Oppenheim, *International Law*, vol. ii, 4th ed. (1926).

In the United States state legislation has widely enabled aliens to hold real property by grant or devolution. Treaties have also been negotiated assuring aliens of the contracting parties reciprocal rights to hold land.

In instances, however, such as the Pacific Coast Japanese land legislation, state statutes have prohibited specific types of aliens from owning or leasing land. *Terrace v. Thompson*, 263 U.S. 197. Aliens are also entitled generally to the same protection that the law affords citizens, but discriminations between aliens and citizens can constitutionally be made wherever such differences of treatment are grounded upon a rational basis. Thus statutes forbidding the entry of aliens into certain trades and professions, prohibiting aliens from owning firearms, or distinguishing between aliens and citizens in the administration of fish and game laws, are common.

Statutes again may incapacitate aliens from holding public offices entitling them to public emoluments or to the right of suffrage. Distinctions are commonly drawn between declarants and non-declarants, *i.e.*, those aliens who have manifested their intention to become citizens and those merely resident in the country. Control over the naturalization of aliens is vested in the federal government though state agencies are employed concurrently with federal in the process of naturalizing aliens. Deportation and exclusion lies with the federal government.

(See NATIONALITY AND NATURALIZATION.) (J. M. LA.)

ALIENATION, the act or fact of being estranged, set apart or separated. In law the word is used for the act of transfer of property by voluntary deed and not by inheritance. In regard to church property the word has come to mean a transfer from religious to secular ownership.

See also INSANITY.

ALIEN CORPORATION, a corporation doing business in one country but having its organization and charter in another country, *e.g.*, a Canadian, English or French corporation doing business in the United States.

The various state statutes do not make any distinction between corporations incorporated in foreign countries and those incorporated in other states of the union, denominating all "foreign corporations" as distinguished from its own corporations known as "domestic corporations."

ALIENIST, one who specializes in the study and treatment of mental diseases, which are often included in the generic name "Alienation." (See INSANITY.)

ALIGARH, a city and district of British India in the Agra division of the United Provinces. The city (pop. 112,655 in 1941)

is also known as Koil-Aligarh. There are several flour-mills, cotton-presses and an important dairy farm. Aligarh fort, situated on the Grand Trunk road, consists of a regular polygon, surrounded by a very broad and deep ditch. It became a key fortress under Sindhia in 1759, and was the depot where he drilled and organized his battalions in the European fashion with the aid of De Boigne. It was captured from the Mahrattas by Lord Lake's army, in September 1803. In modern times the chief pride of Aligarh is its associations with Western education for Mohammedans. The enlightened pioneer was Sir Sayyid Ahmad Khan (d. 1898), who founded in 1864 an institute for the translation and study of Western literature. This he steadily, and in face of much orthodox opposition, developed into the Mohammedan Anglo-Oriental college and school. It attracted students from all over India and from outer Asia, and had a profound influence on the intellectual and political progress of Indian Mohammedans. In 1920 it was advanced to the status of a university.

The district of Aligarh has an area of 1,940 sq.mi., and a population (1941) of 1,372,641. It is nearly a level plain, but with a slight elevation in the centre, between the two great rivers the Ganges and Jumna. The only other important river is the Kali Nadi, which traverses the entire length of the district from north-east to south-west. The chief trading centre is Hathras, where there are several factories for ginning and pressing cotton.

ALIGNMENT or **ALINEMENT**, the way in which the line runs (from Fr. *à* and *ligne*, the Lat. *linea*, a line); an expression used in surveying, drawing, and in military arrangements, the alignment of a regiment or a camp meaning the situation when drawn up in line or the relative position of the tents. The alignment of a rifle has reference to the way of getting the sights into line with the object, so as to aim correctly.

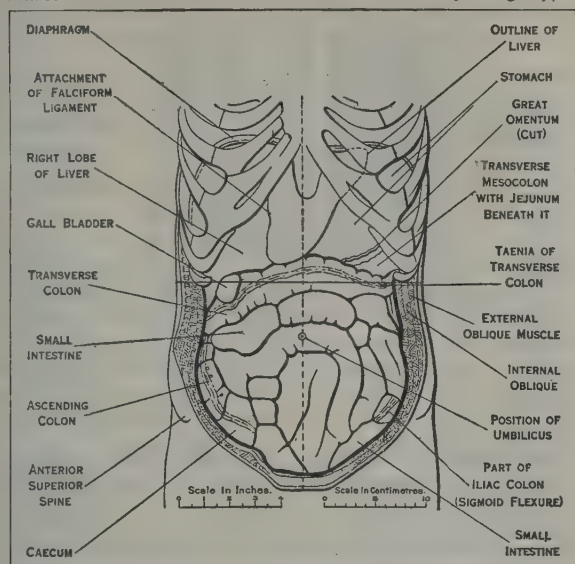
ALIMENT, a synonym for "food," literally or metaphorically. The word has also been used in the same legal sense as ALIMONY (*q.v.*). Aliment, in Scots law, is the sum paid or allowance given in respect of the reciprocal obligation of parents and children, husband and wife, grandparents and grandchildren, to contribute to each other's maintenance. The term is also used in regard to a similar obligation of other parties, as of a sequestered estate to aliment the bankrupt, the payments by parishes to paupers, etc. Alimentary funds, whether of the kind above mentioned, or set apart as such by the deed of a testator, are intended for the mere support of the recipient, and are not attachable by creditors.

ALIMENTARY CANAL, in anatomy. The alimentary canal is the digestive tract from the mouth to the anus. It is some 25 to 30 ft. long, and the food, in its passage, passes through the following parts one after the other: mouth, pharynx, oesophagus, stomach, small intestines, caecum, large intestines, rectum and anus. Into this tube at various points the salivary glands, liver and pancreas pour their secretions by special ducts. As the mouth (*q.v.*) and pharynx (*q.v.*) are separately described, the detailed description will here begin with the oesophagus or gullet.

The *oesophagus*, a muscular tube lined with mucous membrane, stretches from the lower limit of the pharynx, at the level of the cricoid cartilage, to the cardiac orifice of the stomach. It is about roin. long (25 cm.) and $\frac{1}{2}$ in. to 1 in. in diameter. At first it lies in the lower part of the neck, then in the thorax, and lastly, for about an inch, in the abdomen. As far as the level of the fourth or fifth thoracic vertebra it lies behind the trachea, but when that tube ends, it is in close contact with the pericardium, and, at the level of the tenth thoracic vertebra, passes through the oesophageal opening of the diaphragm (*q.v.*), accompanied by the two vagi nerves, the left being in front of it and the right behind. In the abdomen it lies just behind the left lobe of the liver. Both in the upper and lower parts of its course it lies a little to the left of the mid line. Its mucous membrane is thrown into a number of longitudinal pleats to allow stretching.

The *stomach* is an irregularly pear-shaped bag, situated in the upper and left part of the abdomen. When moderately distended the thick end of the pear or *fundus* bulges upward and to the left, while the narrow end is constricted to form the *pylorus*, by means

of which the stomach communicates with the small intestine. The *cardiac orifice*, where the oesophagus enters, is placed about a third of the way along the upper border from the left end of the fundus, and, between it and the pylorus; the upper border is concave and is known as the *lesser curvature*. From the cardiac to the pyloric orifice, round the lower border, is the *greater curvature*. The stomach has in front of it the liver (see fig. 1), the



ILLUSTRATIONS FROM CUNNINGHAM, "TEXTBOOK OF ANATOMY," BY PERMISSION OF OXFORD MEDICAL PUBLICATIONS.
FIG. 1.—DIAGRAM OF THE ARRANGEMENT OF THE INTERNAL ORGANS AS SEEN ON REMOVAL OF FRONT ABDOMINAL WALL.

diaphragm and the anterior abdominal wall, while behind it are the pancreas, left kidney, left adrenal, spleen, colon and mesocolon. When the stomach is empty it contracts into a tubular organ, and the transverse colon ascends to occupy the vacant space.

The *pylorus* is an oval opening, averaging $\frac{1}{2}$ in. in its long axis but capable of considerable distension; it is formed by a special development of the circular muscle layer of the stomach, and during life is tightly closed, except during the periodic escape of gastric contents into the duodenum. The mucous membrane of the stomach is thrown into pleats or rugae when the organ is not fully distended, while between these it has a mammillated appearance.

Superficial to the mucous coat is a submucous, consisting of loose connective tissue, while superficial to this are three coats of unstriated muscle, the inner oblique, the middle circular and the outer longitudinal. The peritoneal coat is described in the article on the coelom and serous membranes.

The *small intestine* is a tube, from 22 to 25 ft. long, beginning at the pylorus and ending at the *ileo-caecal valve*; it is divided into duodenum, jejunum and ileum.

The *duodenum* is from 9 to 11 in. long and forms a horseshoe or C-shaped curve, encircling the head of the pancreas. It differs from the rest of the gut in being retroperitoneal. Its first part is horizontal and lies behind the fundus of the gall-bladder, passing backward and to the right from the pylorus. The second part runs vertically downward in front of the hilum of the right kidney, and into this part the pancreatic and bile ducts open. The third part runs horizontally to the left in front of the aorta and vena cava, while the fourth part ascends to the left side of the second lumbar vertebra, after which it bends sharply downward and forward to form the duodeno-jejunal flexure.

The *jejunum* forms the upper two-fifths of the rest of the small intestine; it, like the ileum, is thrown into numerous convolutions and is attached by the mesentery to the posterior abdominal wall. (See COELOM and SEROUS MEMBRANES.)

The *ileum* is the remaining three-fifths of the small intestine,

though there is no absolute point at which the one ends and the other begins. Speaking broadly, the jejunum occupies the upper and left part of the abdomen below the subcostal plane (see ANATOMY: *Superficial and Artistic*), the ileum the lower and right part. At its termination the ileum opens into the large intestine at the ileo-caecal valve.

The *caecum* is a blind sac occupying the right iliac fossa and extending down some 2 or 3 in. below the ileo-caecal junction. From its posterior and left surface the *vermiform appendix* protrudes, and usually is directed upward and to the left. This worm-like tube is blind at its end and is usually 3 or 4 in. long. Its internal opening into the caecum is about 1 in. below that of the ileum. On transverse section it is seen to be composed of (1) an external muscular coat, (2) a submucous coat, (3) a mass of lymphoid tissue, which appears after birth, and (4) mucous membrane. In many cases its lumen is wholly or partly obliterated, though this is probably due to disease. Guarding the opening of the ileum into the caecum is the *ileo-caecal valve*, which consists of two cusps projecting into the caecum; of these the upper forms a horizontal shelf, while the lower slopes up to it obliquely. At birth the caecum is a cone, the apex of which is the appendix; it is bent upon itself to form a U, and sometimes this arrangement persists throughout life.

The *ascending colon* runs up from the caecum at the level of the ileo-caecal valve to the hepatic flexure beneath and behind the right lobe of the liver; it is about 8 in. long and posteriorly is in contact with the abdominal wall and right kidney. It is covered by peritoneum except on its posterior surface (see fig. 1).

The *transverse colon* is variable in position, depending largely on the distension of the stomach, but usually corresponding to the subcostal plane (see ANATOMY: *Superficial and Artistic*). On the left side of the abdomen it ascends to the splenic flexure, which may make an impression on the spleen (see DUCTLESS GLANDS), and is bound to the diaphragm opposite the 11th rib by a fold of peritoneum. The peritoneal relations of this part are discussed in the article on the coelom and serous membranes.

The *descending colon* passes down in front of the left kidney and left side of the posterior abdominal wall to the crest of the ilium; it is about 6 in. long and is usually empty and contracted while the rest of the colon is distended with gas; its peritoneal relations are the same as those of the ascending colon, but it is more likely to be completely surrounded.

The *iliac colon* stretches from the crest of the ilium to the inner border of the psoas muscle, lying in the left iliac fossa, just above and parallel to Poupart's ligament. Like the descending, it is usually uncovered by peritoneum on its posterior surface. It is about 6 in. in length.

The *pelvic colon* lies in the true pelvis and forms a loop, the two limbs of which are superior and inferior while the convexity reaches across to the right side of the pelvis. In the foetus this loop occupies the right iliac fossa, but, as the caecum descends and enlarges and the pelvis widens, it is usually driven out of this region. The distal end of the loop turns sharply downward to reach the third piece of the sacrum, where it becomes the rectum. Formerly the iliac and pelvic colons were spoken of as the *sigmoid flexure*.

The *rectum*, according to modern ideas, begins in front of the third piece of the sacrum. It ends in a dilatation or *rectal ampulla*, which is in contact with the back of the prostate in the male and of the vagina in the female and is in front of the tip of the coccyx. The rectum is not straight, as its name would imply, but has a concavity forward corresponding to that of the sacrum and coccyx.

At the end of the pelvic colon the mesocolon ceases, and the rectum is then only covered by peritoneum at its sides and in front; lower down the lateral covering is gradually reflected off and then only the front is covered. About the junction of the middle and lower thirds of the tube the anterior peritoneal covering is also reflected off on to the bladder or vagina, forming the *rectovesical pouch* in the male and the *pouch of Douglas* in the female. This reflexion is usually about 3 in. above the anal aperture.

The *anal canal* is the termination of the alimentary tract, and runs downward and backward from the lower surface of the rectal ampulla between the levatores ani muscles. It is about an inch long and its lateral walls are in contact.

Structure of the Intestine.—The intestine has four coats: serous, muscular, submucous and mucous. The serous or peritoneal coat has already been described wherever it is present. The muscular coat consists of unstriated fibres arranged in two layers, the outer longitudinal and the inner circular (see fig. 2). In the large intestine the longitudinal fibres, instead of being arranged evenly round the tube as they are in the small, are gathered into

agminated glands or *Peyer's patches*, the long axes of which, from $\frac{1}{2}$ in. to $\frac{1}{4}$ in. long, lie in the long axis of the bowel. They are always found in that part of the intestine which is farthest from the mesenteric attachment. In the interior of the rectum three shelf-like folds, one above the other, project into the cavity and correspond to the lateral concavities or kinks of the tube. They are not in the same line and the largest is usually on the



CUNNINGHAM, "TEXT-BOOK OF ANATOMY," COURTESY OF OXFORD MEDICAL PUBLICATIONS
FIG. 3.—CIRCULAR FOLDS IN THE MUCOUS MEMBRANE OF THE SMALL INTESTINE THAT INCREASE THE SECRETORY AND ABSORBENT SURFACE

right side. They are known as the *pliae recti* or *valves of Houston*. In the anal canal are four or five longitudinal folds called the *columns of Morgagni*. (For further details, see Quain's *Anatomy*, 1896; Gray's *Anatomy*, 1926; Cunningham's *Anatomy*, Edinburgh 1922).

Embryology.—The greater part of the alimentary canal is formed by the closing-in of the entoderm to make a longitudinal tube, ventral and parallel to the notochord. This tube is blind in front and behind (cephalad and caudad), but the middle part of its ventral wall is for some distance continuous with the wall of the yolk-sac, and this part of the canal, which at first opens into the yolk-sac by a very wide aperture, is called the *mid gut*. The part in front of it, which lies dorsal to the heart, is the *fore gut*, while the part behind the aperture of the yolk-sac is the *hind gut*.

The pharynx, oesophagus, stomach and part of the duodenum are developed from the fore gut, a good deal of the colon and the rectum from the hind gut, while the mid gut is responsible for the rest. The cephalic part of the fore gut forms the pharynx (*q.v.*), and about the fourth week the stomach appears as a fusiform dilatation in the straight tube. Between the two the oesophagus gradually forms as the embryo elongates. The opening into the yolk-sac, which at first is very wide, gradually narrows, as the ventral abdominal walls close in, until in the adult the only

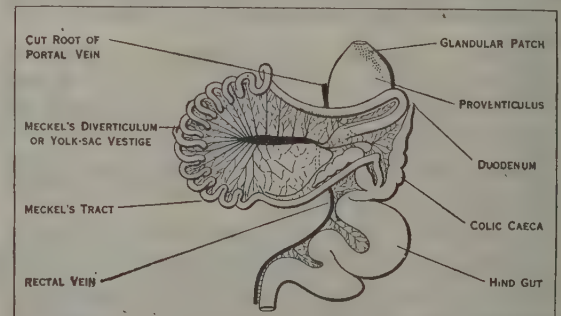


FIG. 4.—THE INTESTINAL TRACT OF A BIRD

indication of the connection between the gut and the yolk-sac is the very rare presence (about 2%) of Meckel's diverticulum. The stomach soon shows signs of the greater and lesser curvatures, the latter being ventral, but maintains its straight position. About the sixth week the caecum appears as a lateral diverticulum, and until the third month, is of uniform calibre; after this period the terminal part ceases to grow at the same rate as the proximal, and so the vermiform appendix is formed. The mid gut forms a loop with its convexity toward the diminishing *vitelline duct*, or remains of the yolk-sac, and until the third month it protrudes

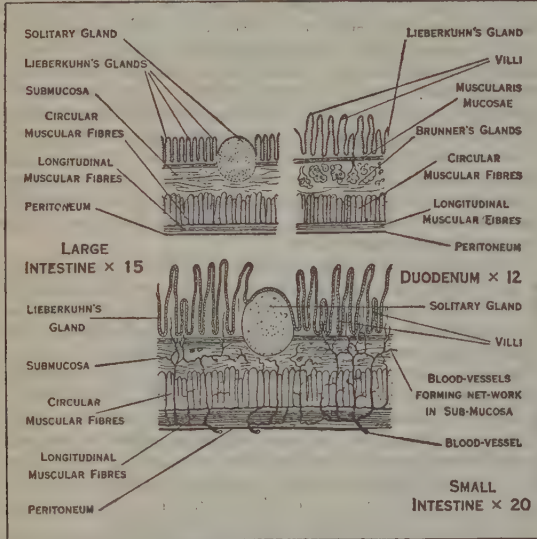


FIG. 2.—DIAGRAM SHOWING STRUCTURE OF THE INTESTINAL WALL. Upper left is the large intestine; upper right is the duodenum, or first portion of the small intestine; below is the small intestine

three longitudinal bands called *taeniae* (see fig. 1); by the contraction of these the large intestine is thrown into a series of *sacculi* or slight pouches. The *taeniae* in the caecum all lead to the vermiform appendix, and form a useful guide to this structure. In the rectum the three *taeniae* once more become evenly arranged over the whole surface of the bowel, but more thickly on the anterior and posterior parts. The circular layer is always thicker than the longitudinal; in the small intestine it decreases in thickness from the duodenum to the ileum, but in the large it gradually increases again, so that it is thickest in the duodenum and rectum.

The submucous coat is very strong and consists of loose areolar tissue in which the vessels break up.

The mucous coat is thick and vascular (see fig. 2); it consists of an epithelial layer nearest the lumen which forms the intestinal glands (see also the articles *EPITHELIUM* and *ENDOTHELIUM*). External to this is the *basement membrane*, outside which is a layer of retiform tissue, and this is separated from the submucous coat by a very thin layer of unstriated muscle called the *muscularis mucosae*. In the duodenum and jejunum the mucous membrane is thrown into a series of transverse pleats called *valvulae conniventes* (see fig. 3); these begin about an inch from the pylorus and gradually fade away as the ileum is reached. About $\frac{1}{4}$ in. from the pylorus the common bile and pancreatic ducts form a papilla, above which one of the *valvulae conniventes* makes a hood and below which a vertical fold, the *frenulum*, runs downward. The surface of the mucous membrane of the whole of the small intestine has a velvety appearance, due to the presence of closely-set, minute, thread-like elevations called *villi* (see fig. 2). Throughout the whole length of the intestinal tract are minute masses of lymphoid tissue called *solitary glands* (see fig. 2); these are especially numerous in the caecum and appendix, while in the ileum they are collected into large oval patches, known as

into the umbilical cord. The greater curvature of the stomach grows more rapidly than the lesser, and the whole stomach turns over and becomes bent at right angles, so that what was its left surface becomes ventral. This turning over of the stomach throws the succeeding part of the intestine into a *duodenal loop*, which at first has a dorsal and ventral mesentery (see COELOM and SEROUS MEMBRANES). The intestine now grows very rapidly and is thrown into a series of coils; the caecum ascends and passes to the right ventral to the duodenum, and presses it against the dorsal wall of the abdomen; then it descends toward its permanent position in the right iliac fossa.

From the ventral surface on the hinder (caudal) closed end of the intestinal tube the *allantois* grows to form the placenta and bladder (see URINARY SYSTEM; REPRODUCTIVE SYSTEM; ANATOMY OF, and PLACENTA), and this region is the *cloaca* into which the alimentary, urinary and generative canals or ducts all open, but later two lateral folds appear which, by their union, divide the cloaca into a ventral and a dorsal part, the former being genito-urinary and the latter alimentary or intestinal. In this way the rectum or dorsal compartment is shut off from the genito-urinary. Later an ectodermal invagination at the hind end of the embryo develops and forms the anal canal; this is the *proctodaeum*, and for some time it is separated from the hind (caudal) end of the rectal part of the *mesodaeum* (or part of the intestinal canal formed from the mesoderm) by a membrane called the *anal membrane*. This is eventually absorbed and the digestive tract now communicates with the surface by the anus.

Comparative Anatomy.—The primitive condition of the vertebrate alimentary canal may be described as a straight, simple tube, consisting of an anterior portion, formed by an ectodermal invagination, a long median portion lined by endoderm, and a short posterior portion formed by ectodermal invagination. In the lower vertebrates the primitive tube subserved also the purpose of respiration, and traces of the double function remain in the adult structure of all vertebrates (see MOUTH AND SALIVARY GLANDS; PHARYNX). In fish, the pharynx, or branchial region, suddenly becomes narrower, posterior to the gill-slits, to form the oesophagus; in higher animals the oesophagus, in the adult, is separated from the primitive pharyngeal region and lies dorsal to it. Probably, in the primitive vertebrata, the entire alimentary canal was lined with ciliated cells. Traces of this ciliation persist in many living forms.

The *oesophagus* is essentially merely a passage, as straight as may be, from the pharynx to the stomach, varying in length with the length of the neck and thoracic regions in different animals, and in calibre with the nature of the food. It is almost invariably lined with a many-layered epithelium, forming a tough coating, readily repaired and not easily damaged by hard food masses. There are only a few exceptions to this structural and functional simplicity. In fishes (see FISHES: *Anatomy*) the swim-bladder is developed as a dorsal outgrowth of the oesophagus and may remain in open connection with it. In many birds part of the oesophagus may be temporarily dilated, forming a "crop," as for instance in birds of prey and humming birds. In the flamingo, many ducks, storks and the cormorant the crop is a permanent although not a highly specialized enlargement. Finally, in the vast majority of seed-eating birds, in gallinaceous birds, pigeons, grouse, parrots and many *Passeres*, particularly the finches, the crop is a permanent globular dilatation, in which the food is retained for a considerable time, mixed with a slight mucous secretion, and softened and partly macerated by the heat of the body. Many birds feed their young from the soft contents of

the crop, and in pigeons, at the breeding season, the cells lining the crop proliferate rapidly and are discharged as a soft cheesy mass into the cavity, forming the substance known as pigeon's milk.

Stomach.—Where the oesophagus passes into the stomach, the lining wall of the alimentary tract changes to a mucous epithelium, consisting of a single layer of endodermal cells, frequently thrown into pits or projecting as processes; from being chiefly protective, it has become secretory and absorbing, and maintains this character nearly to the anus. The fundamental form of the stomach is a sac-like enlargement of the canal, the whole forming an enlarged bent tube. At the distal end of the tube the intestinal tract proper begins, and the two regions are separated by a muscular constriction. In fishes the stomach may be a simple bent tube, or an expanded, globular or elongated sac. In *Batrachia* and *Reptilia* it is in most cases a simple sac, marked off from the oesophagus only by increased calibre. In the *Crocodylia*, however, the anterior portion of the stomach is much enlarged and very highly muscular, the muscles radiating from a central tendinous area on each of the flattened sides. The cavity is lined by a hardened secretion and contains pebbles and gravel for mechanical trituration of the food, so that the resemblance to the gizzard of birds is well marked. This muscular chamber leads by a small aperture into a distal, smaller and more glandular chamber. In birds the stomach exhibits two regions, an anterior glandular region, the proventriculus, the walls of which are relatively soft and contain enlarged digestive glands. The distal region (gizzard) is larger and is lined in most cases by a more or less permanent membrane which is thick and tough in birds with a muscular gizzard, very slight in the others.

In mammals, the primitive form of the stomach consists of a more or less globular or elongated expansion of the oesophageal region, forming the cardiac portion, and a forwardly curved, narrower pyloric portion, from which the duodenum arises. The whole wall is muscular, and the lining membrane is richly glandular. In many mammals one, two or three protrusions of the cardiac region occur, whilst in the manatee and in some rodents the cardiac region is constricted off from the pyloric portion. In the *Artiodactyla* the stomach is always complex, the complexity reaching a maximum in ruminating forms. In the chevrotains, which in many other respects show conditions intermediate between non-ruminant artiodactyles and true ruminants, the oesophagus opens into a wide cardiac portion, incompletely di-

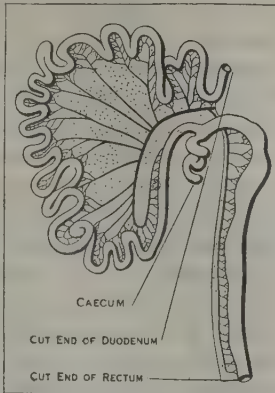


FIG. 5.—THE INTESTINAL TRACT OF THE FOX

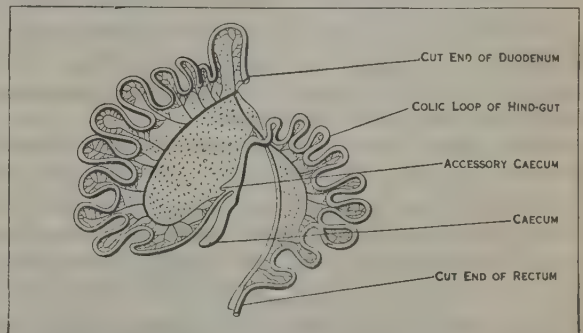


FIG. 6.—THE INTESTINAL TRACT OF THE WALLABY

vided into four chambers. Three of these, towards the cardiac extremity, are lined with villi and correspond to the *rumen* or paunch; the fourth, which lies between the opening of the oesophagus and the pyloric portion of the stomach, is the ruminant *reticulum* and its wall is lined with very shallow "cells." The fourth or true pyloric chamber is an elongated sac with smooth glandular walls and is the *abomasum*, or rennet sac. In the camel the rumen forms an enormous globular paunch with villous walls and internally showing a trace of division into two regions. It is well marked off from the reticulum, the "cells" of which are extremely deep, forming the well-known water-chambers. In the true ruminants, the rumen forms a capacious, villous reservoir, nearly always partly sacculated, into which the food is

passed rapidly as the animal grazes. The food is subjected to a rotary movement in the paunch, and is thus repeatedly subjected to moistening with the fluids secreted by the reticulum, as it is passed over the aperture of that cavity, and is formed into a rounded bolus. The food bolus, when the animal is lying down after grazing, is passed into the oesophagus and reaches the mouth by antiperistaltic contractions of the oesophagus. After prolonged mastication and mixing with saliva, it is again swallowed,

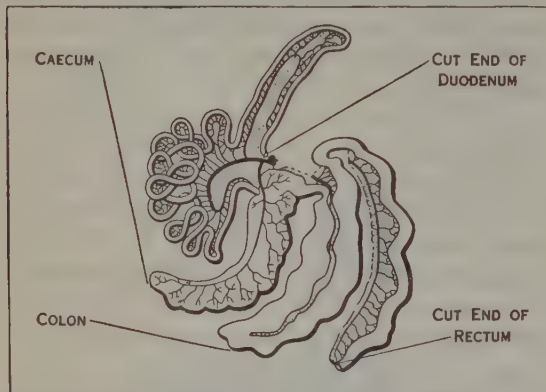


FIG. 7.—THE INTESTINAL TRACT OF THE TAPIR

but is now passed into the psalterium, which, in true ruminants, is a small chamber with conspicuous longitudinal folds. Finally it reaches the large abomasum, where the last stages of gastric digestion occur.

In the *Cetacea* the stomach is different from that found in any other group of mammals. The oesophagus opens directly into a very large cardiac sac the distal extremity of which forms a long caecal pouch. At nearly the first third of its length this communicates by a narrow aperture with the elongated, relatively narrow pyloric portion. The latter is convoluted and constricted into a series of chambers that differ in different groups of *Cetacea*. In most of the *Marsupialia* the stomach is relatively simple; in the kangaroos, on the other hand, the stomach is divided into a relatively small, caecal cardiac portion and an enormously long sacculated and convoluted pyloric region, the general arrangement of which closely recalls the large caecum of many mammals.

Intestinal Tract.—It is not yet possible to discuss the general morphology of this region in vertebrates as a group, as, whilst the modifications displayed in birds and mammals have been compared and studied in detail, those in the lower groups have not yet been systematically co-ordinated.

Fishes.—In the *Cyclostomata*, *Holocephali* and a few *Teleostei* the course of the gut is practically straight from the pyloric end of the stomach to the exterior, and there is no marked differentiation into regions. In the Dipnoi, a contracted sigmoid curve between the stomach and the dilated intestine is a simple beginning of the complexity found in other groups. In very many of the more specialized teleosteans the gut is much convoluted, exhibiting a series of watchspring-like coils. In a number of different groups, increased surface for absorption is given, not by increase in length of the whole gut, but by the development of an internal fold known as the spiral valve. A set of organs peculiar to fish, known as the *pyloric caeca*, is present in numbers ranging from one to nearly 200 in the vast majority of fish. These are outgrowths of the intestinal tract near the pyloric extremity of the stomach, and their function is partly glandular, partly absorbing.

In the *Batrachia* the course of the intestinal tract is nearly straight from the pyloric end of the stomach to the cloaca, in the case of the perennibranchiates there being no more than a few simple loops between the expanded "rectum" and the straight portion that leaves the stomach.

In fishes, batrachians and reptiles the intestinal tract is swung from the dorsal wall of the abdominal cavity by a mesentery

which is incomplete on account of secondary absorption in places. There are also traces, more abundant in the lower forms, of the still more primitive ventral mesentery.

Intestinal Tract in Birds and Mammals.—The primitive gut must be supposed to have run backwards from the stomach to the cloaca suspended from the dorsal wall of the body-cavity by a dorsal mesentery. This tract, in the course of phylogeny of the common ancestors of birds and mammals, became longer than the straight length between its extreme points and, consequently, was thrown into a series of folds. The mesentery grew out with these folds, but the presence of adjacent organs, the disturbance due to the outgrowth of the liver, and the secondary relations brought about between different portions of the gut, as the out-growing loops invaded each other's localities, disturbed the primitive simplicity. Three definite regions of outgrowth, however, are to be recognized in the actual disposition of the gut in existing birds and mammals. The first of these is the *duodenum*. The second portion is *Meckel's tract*. It consists of the part generally known as the small intestines, the *jejunum* and *ileum* of human anatomy, and stretches from the distal end of the duodenum to the caecum or caeca. It is the chief absorbing portion of the gut, and in nearly all birds and mammals is the longest portion. It represents, however, only a very small part of the primitive straight gut, corresponding to not more than two or three somites of the embryo. The third portion of the gut should be termed the *hind-gut*, and lies between the caecum or caeca and the anus, corresponding to the large intestines, colon and rectum of human anatomy. It is formed from a much larger portion of the primitive straight gut than the duodenum and Meckel's tract together, and its proximal portion, in consequence, lies very close to the origin of the duodenum.

Adaptations of the Intestinal Tract to Function.—The chief business of the gut is to provide a vascular surface to which the prepared food is applied so that the nutritive material may be absorbed into the system. Overlying and sometimes obscuring

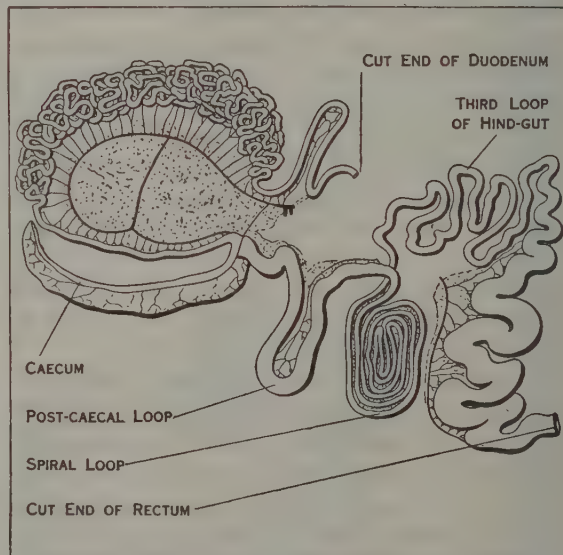


FIG. 8.—THE INTESTINAL TRACT OF THE GIRAFFE

the morphological patterns of the gut, are many modifications correlated with the nature of the food. Thus in birds and mammals alike there is a direct association of herbivorous habit with great relative length of gut. In fish-eating birds and mammals, the gut is very long, with a thick wall and a relatively small calibre, whilst there is a general tendency for the regions of the gut to be slightly or not at all defined. In fruit-eating birds the gut is strikingly short, wide and simple, whilst a similar change has not taken place in frugivorous mammals. Carnivorous birds and mammals have a relatively short gut.

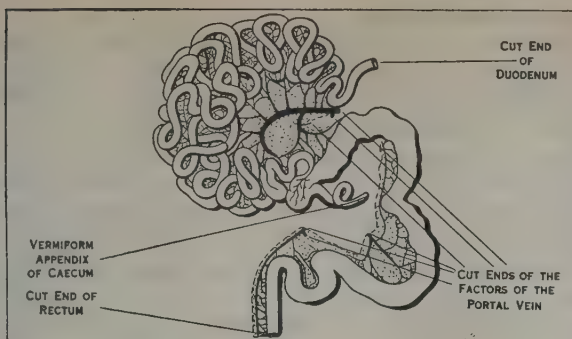


FIG. 9.—THE INTESTINAL TRACT OF THE GORILLA

The Colic Caeca.—These paired or single organs lie at the junction of the hind-gut with Meckel's tract and are homologous in birds and mammals although their apparent position differs in the majority of cases in the two groups. The caeca are hollow out-growths of the wall of the gut, the blind ends being directed forwards. They vary in size within very wide limits and there is no invariable connection between the nature of the food and the degree of their development. The caecal wall is in most cases highly glandular and contains masses of lymphoid tissue. In birds and in mammals this tissue may be so greatly increased as to transform the caecum into a solid or nearly solid sac.

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(P. C. M.; X.)

ALIMENTARY SYSTEM, DISEASES OF THE.

Despite deterrent factors inseparable from World Wars I and II, great progress had been made by mid-20th century in knowledge of diseases of the alimentary system, not only from the standpoint of diagnosis but from that of treatment.

The Oesophagus.—Difficulty in swallowing (dysphagia) is the commonest symptom of disease or disorder of this organ as the result of obstruction. Such complication is due, in order of frequency, to cancer, inflammation (oesophagitis), or its sequel, benign stricture, and functional disorders such as cardiospasm. The location, extent and probable nature of these abnormalities are chiefly determined by means of X-rays, oesophagoscopy and fluoroscopy. The importance of the last-mentioned method cannot be overestimated, for diaphragmatic (hiatus) hernia and shortened oesophagus are frequent causes of spasm, obstruction and ulceration of the terminal portion of the gullet, especially in middle-aged, overweight persons. Improved gastroscopes which added to the comfort and safety of examination, in obtaining biopsy specimens, and examination of exfoliated epithelium for cancer cells (cytology) increased diagnostic efficiency.

The satisfactory treatment of bleeding, distended, engorged veins (varices) continued to pose a serious problem at mid-century. About 25% of patients with chronic diffuse inflammation of the liver (cirrhosis), as well as of the liver and spleen (Banti's disease), eventually die of haemorrhage from oesophageal varices. Injection of sclerosing substances into the veins, or even removal of the spleen, had not been too effective. This resulted in the advocacy of more formidable as well as hazardous surgical procedures, known as shunt operations, or even the more direct method of D. B. Pheister and E. M. Humphreys whereby a trans-thoracic resection of the lower oesophagus and removal of the stomach is done. But published reports of the end results had

not been too reassuring.

The importance of psychosomatic (emotional) factors in the genesis of visceral disorders was exemplified in the results of the experimental observations of Stewart Wolf, T. P. Almy and Catherine R. Lee on 14 human subjects with cardiospasm. The personality disorders of such patients were described. In all patients in the series it was possible to correlate episodes of symptomatic exacerbation and remission with variations in life situation, feeling state, and attitude.

The Stomach.—The factor or factors giving rise to the formation of the chronic lesion in man were still elusive at mid-20th century. Emphasis was being placed on the psychosomatic factor and on the corrosive or digestive action of the acid gastric juice. The latter concept, largely formulated and promulgated by B. W. Sippy and his protégés, found a later champion in G. W. Pickering and his associates, G. L. W. Bonney and A. H. James. Many experimental and clinical observations pointed to the dominant role that acid-pepsin plays in ulcer genesis, especially in the increasingly prevalent duodenal ulcer. Of great interest was the revelation by A. C. Ivy, M. I. Grossman and W. H. Bachrach of the multiplicity and interdependence of factors in the production of experimental ulcer in the rabbit and dog, and the superimposition of one factor on another. While proof of psychogenesis remained extremely difficult, the psychosomatic factor as causative of the disease in whole or large part had been quite convincing. Thus peptic ulcer, like cardiospasm, pylorospasm, anorexia nervosa, spastic or "irritable" colon and chronic ulcerative colitis, had been placed in the category of psychosomatic disease by many authorities.

Investigations directed to the gastric secretory status of patients with gastric and duodenal ulcer and cancer of the stomach were fruitful. Those by E. Levin, J. B. Kirsner, W. L. Palmer and C. Butler (1948) confirmed the conclusions of Lester Dragstedt (1944) and earlier workers that the volume of gastric secretion at night was usually highest in patients with duodenal ulcer. In patients with gastric ulcer the average nocturnal volume of gastric juice was about the same as for normal subjects but the average content of hydrochloric acid was lower. Such observations have direct bearing on treatment, and probably on aetiology. The investigations of Richard Doll, F. A. Jones and N. F. MacLagan in London probably supplied the answer to the question frequently raised: Does hypersecretion of gastric juice exist prior to the development of ulcer, duodenal ulcer in particular, or is it a result of ulcer? In a follow-up study of 100 normal medical students who had undergone histamine tests 15 years previously, the results indicated that hypersecretion is a cause rather than an effect of ulcer. M. W. Comfort, M. P. Kelsey and J. Berkson (1948) demonstrated the subnormal state of gastric secretory functions before the onset of cancer in a study of 277 cases. The evidence which they presented lent support to the hypothesis that atrophy of the lining membrane of the stomach (mucosa) plays an important role in the depression of secretory activity prior to the development of the disease.

Diagnosis of peptic ulcer at mid-century was still dependent on time-honoured methods, including X-rays. Improvement in radiologic technique had made possible more frequent depiction of the niche, i.e., the ulcer crater, as well as shallow ulcerating lesions or abnormalities of the gastric mucosa through study of the mucosal pattern. Increasing recourse to the gastroscope had also made possible more frequent identification of ulcerative and inflammatory changes in the stomach which may have escaped detection by X-rays.

Among later developments in treatment of ulcer are safe neutralizing agents like aluminum hydroxide, protein hydrolysates, continuous intragastric drip, drugs with atropine effect, the psychosomatic approach and vagotomy. As the sustained neutralization of the acid already secreted is very difficult, attempts were made to depress or prevent acid secretion by use of hormones such as enterogastone and by drugs with atropine effect, like bethanechol. The ultimate results of medical treatment as reported by various medical authorities both in Europe and in America were not encouraging at mid-century. For example, L. Martin and N. Lewis (Cambridge) in a study based on ten years' observation concluded

that medical treatment did not influence the natural course of the disease and urged surgical removal of a major portion of the stomach (partial or subtotal gastrectomy) of all patients with peptic ulcer of 10 or more years' duration, preferably before the age of 50. The prevention of recurrence of peptic ulcer following medical treatment had been the subject of numerous articles. One authority (T. L. Althausen, 1949) was convinced that the problem of peptic ulcer could be greatly lessened thereby. In his opinion the most important known causes are physical and mental fatigue, emotional disturbances, dietary indiscretions and infections.

Thanks to the great progress made in the preoperative preparation of the patient so that all physiological requirements are met, in surgical technique and anaesthesia, and in drugs and antibiotics of great bactericidal potency, extensive surgical operations had become possible with remarkably low mortality and morbidity. Hence the increasing vogue of gastrectomy instead of the more conservative and less successful gastro-enterostomy for ulcer. It had become evident that the end results of the much-publicized operation of vagotomy were not superior to those after gastro-enterostomy; in fact they were remarkably identical. Vagotomy may have its greatest usefulness in the treatment of secondary ulcer at the anastomosis following partial or subtotal gastrectomy.

There were many contradictory opinions at mid-century regarding the degree to which gastritis may produce symptoms and its relation to other diseases, specifically ulcer and cancer. In the opinion of many physicians, hypertrophic erosive or ulcerative gastritis is one of the most important types because of its simulation of peptic ulcer with respect to pain or haemorrhage, or both. Whatever the individual conviction with respect to gastritis, it is wise to carry out a gastroscopic examination of every patient with chronic, recurring, otherwise unexplainable dyspepsia.

Cancer of the stomach persisted as one of the most pressing and difficult problems confronting the medical profession at mid-century. Attempts at earlier detection of this disease had been characterized by two innovations: routine X-ray examination of the stomachs of apparently normal persons, and cytologic study of the gastric secretions. It was doubtful whether mass screening tests would prove practicable owing to the paucity of findings. However, repeated examination was indicated for patients with ulcer, polyp of the stomach and pernicious anaemia. Despite some inherent difficulties it appeared that cytologic examinations might prove to be of real value in the early diagnosis of cancer.

Liver, Gall-Bladder, and Bile Ducts.—Knowledge of the diagnosis and treatment of diseases of the liver and its appendages increased in unprecedented fashion in the first half of the 20th century. Among the impelling factors to account for this were the incidence of acute inflammation of the liver (acute infectious hepatitis), world-wide in extent, homologous serum hepatitis and inoculation hepatitis, all three forms eventually proved to be due to infection by a virus; the development, refinement and broadened application of biochemical tests of function of the liver; removal of bits of hepatic tissue by trocar for microscopic diagnosis; and improvement of the method of treatment for cirrhosis. The exposure of countless numbers of military personnel to diseases prevalent in the tropics during both World Wars I and II necessitated increasing familiarity with disorders of the liver that were the result of amoebiasis, bacillary dysentery, malaria, schistosomiasis and leishmaniasis. To what extent the countless victims of acute viral hepatitis would lapse into the chronic form (cirrhosis) was the subject of much investigation. Careful follow-up studies were made by the National Research Council and other authorities.

Adequate nutrition and prolonged rest in bed are the most effective form of treatment of acute viral hepatitis. A diet high in carbohydrates and protein, and medium to low in fat, is the conventional one. Treatment of the chronic form is along similar dietetic lines. Brewers' yeast, other vitamins, especially B₁, liver extract, parentally administered, and general symptomatic and sustaining measures also are essential. In addition choline, plus cystine or methionine, is favoured by many. While cirrhosis remained a serious disease at mid-century, methods of treatment had made for more favourable prognosis and more frequent arrest of the disease. Chloroquine had been found effective in the treat-

ment of amoebic hepatitis.

Classification of jaundice into three types, intrahepatic or parenchymatous, obstructive and haemolytic, is satisfactory. From a practical standpoint, however, there are only two types—surgical and nonsurgical; that is, the primary responsibility in management of the jaundiced patient is the decision whether or not to operate. Experienced clinicians maintain that correct diagnosis can be made in about 90% of patients through evaluation of the clinical picture. Tests which may aid in differentiating intrahepatic (nonsurgical) and obstructive (surgical as a rule) jaundice are the bilirubin, alkaline phosphatase, urobilinogen, Quick prothrombin time and thymol turbidity tests. These tests, supplemented by single or repeated duodenal drainage, and if necessary, by needle biopsy of the liver, should furnish adequate information as a rule.

While great progress had been made in the diagnosis of disease and disorders of the gall-bladder and larger (extrahepatic) bile ducts, some problems persisted at mid-20th century. Cholecystography had proved to be invaluable and indispensable in the detection or exclusion of disease or dysfunction of the gall-bladder. Functional disorders of the gall-bladder, bile ducts or sphincter of Oddi, giving rise to pain or digestive disturbances or both, usually come under the classification of dyskinesia. Such disturbances are attributed to a hypertonic or atonic state provoking spasm or atony of these structures in whole or part. The routine exploration of the bile ducts for stones after removal of the diseased gall-bladder is expedient. Visualization of the ducts after injection of contrast media (cholangiography) after operation for removal of ductal stones is a good precautionary measure. The various conditions giving rise to a persistence or recurrence of the painful manifestations after removal of a diseased gall-bladder (postcholecystectomy syndrome) were better understood. Injuries to the ducts at operation were still too frequent, with the resulting stricture too frequently ending up in death. By and large, cancer of the gall-bladder, papilla of Vater and bile ducts are difficult of timely diagnosis. Cancer cells had been found in the duodenal contents of patients with cancer of these organs as well as of the pancreas. But the outlook was still unfavourable.

The Pancreas.—The comparatively simple and reliable tests for certain ferments in the blood (amylase and lipase) are essential to the early diagnosis of acute pancreatitis. It is apparently well established that the acute form consists of two types: the more frequent, less severe, acute interstitial pancreatitis (acute pancreatic oedema), which is amenable to medical treatment; and acute pancreatic necrosis. This fact, coupled with the knowledge that surgical intervention had always been attended by a high mortality, reversed the former radical trend in treatment.

Pancreatitis in its elusive chronic form was being recognized with increasing frequency at mid-century. This had been made possible by the direct examination of the duodenal secretions for certain elements obtained through the medium of secretin as a stimulus and the Agren-Lagerlöf double-lumen tube, supplemented by all the time-honoured diagnostic procedures including X-rays for pancreatic stones. Significant too had been an increased familiarity with the symptoms, signs and complications of the disease. The investigations of M. W. Comfort, E. E. Gambill and A. H. Baggenstoss on chronic relapsing pancreatitis without associated disease of the biliary or upper part of the digestive tract were especially illuminating in this respect.

Intestines.—Intubation of the small intestine with the Miller-Abbott tube or one of its modifications greatly enhanced knowledge of the normal and morbid physiology of the organ, as well as the diagnosis and treatment of obstruction, inflammatory processes and new growths. Radiology also contributed greatly. Segmental inflammation of the small bowel (regional enteritis) became an important entity.

Air contrast films proved helpful in the recognition of small growths in the colon. Colitis in its acute and chronic nonspecific ulcerative forms is quite prevalent and effective treatment is difficult. Sulfonamides and antibiotics have been freely resorted to in diverse acute and chronic infections and inflammatory processes in small bowel and colon. Streptomycin was found to be uniformly effective in relieving

the symptoms of tuberculous enteritis. It was claimed that the the arsenites are superior to all other arsenical preparations in the treatment of amebiasis; good results were also obtained in refractory cases with aureomycin. Atabrine is strikingly effective in the treatment of giardiasis.

Small out-pouchings of the wall of the large intestine are called diverticulae. When they become infected and inflamed, the condition is known as diverticulitis.

Cancer occurs only rarely in the small intestine but is fairly common in the colon.

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ALIMONY, in law the allowance for maintenance to which a wife is entitled out of her husband's estate for her support in or consequent upon a matrimonial cause. Though, as a rule, payable to a wife, it may, if the circumstances of the case warrant it, be payable by the wife to the husband. Alimony is of two kinds, (a) temporary (*pendente lite*), and (b) permanent. Temporary alimony, or alimony pending suit, is the provision made by the husband for the wife in causes between them to support her during the progress of the suit, and is allowed whether the suit is by or against the husband and whatever the nature of the suit may be. The usual English practice is to allot as temporary alimony about one-fifth of the husband's net income; where it appears that the husband has no means or is in insolvent circumstances, the court will refuse to allot temporary alimony. So where the wife is supporting herself by her own earnings, this fact will be taken into consideration. And where the wife and husband have lived apart for many years before the institution of the suit, and she has supported herself during the separation, no alimony will be allotted. Nor will the wife be entitled to alimony where she has sufficient means of support independent of her husband. *Permanent* alimony is that which is allotted to the wife after final decree. By the Matrimonial Causes Act, 1907, the court may, if it think fit, on any decree for dissolution or nullity of marriage, order that the husband shall, to the satisfaction of the court, secure to the wife such a gross sum of money or such annual sum of money for any term not exceeding her life, as having regard to her fortune (if any), to the ability of her husband, and to the conduct of the parties, it may deem reasonable. The court may suspend the pronouncing of its decree until a proper deed or instrument has been executed by all necessary parties. The court may also make an order on the husband for payment to the wife during their joint lives of a reasonable monthly or weekly sum for her maintenance; the court may also at any time discharge, modify, suspend or increase the order according to the altered means of the husband; the court has also power to make provision for children. Alimony is paid direct to the wife or to a trustee or trustees on her behalf, but the court may impose any restrictions which seem expedient. We may also describe as a kind of alimony the allowance of a reasonable weekly sum not exceeding £2 which in England, under the Summary Jurisdiction (Married Women) Act, 1895, may be given to a married woman on applying to a court of summary jurisdiction if she has been forced by cruelty to leave her husband or has been deserted by him.

United States.—Alimony is granted on much the same principle as in England, though in many states the courts of equity as such may grant alimony without divorce or separation proceedings independently of any statute, on the ground that the husband ought to support his wife when she lives apart from him for his fault, and since the courts of common law provide no remedy the courts of equity will. This is so in Alabama, Kentucky, North Carolina, Iowa, California, Ohio, Virginia, South Dakota and the

District of Columbia. In other states alimony without such proceedings is allowed by statute, and such alimony is now very general throughout the United States. The usual grounds for the allowance of it are desertion and such conduct as would amount to legal cruelty. After divorce *a vinculo*, alimony or separate maintenance is sometimes granted on good reason. In several states alimony or maintenance is by statute allowed to the husband in certain cases out of the wife's property. This is so in Massachusetts, Virginia, Rhode Island and Iowa. In Oregon he is entitled to one-third of his wife's real estate in addition to maintenance on divorce for her fault. Judgment for alimony is considered a judgment *in personam* and not *in rem*, and can only be enforced outside the state where rendered in case the husband has been personally served with process within that state.

ALIN, OSCAR JOSEF (1846-1900), Swedish historian and politician, was born at Falun Dec. 22, 1846, and became rector of Uppsala university.

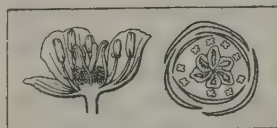
Among his numerous works the following are specially worthy of note: *Bidrag till svenska rådets historia under medel tiden* (1872); *Sveriges Historia, 1511-1611* (1878); *Bidrag till svenska statsrättens historia* (1884-87); *Den svensk-norsk Unionen* (1889-91), the best book on the Norweco-Swedish union question from the Swedish point of view; *Fjerde Artikklen af Fredstraktaten i Kiel* (1899); *Carl Johan och Sveriges yttre politik, 1810-1815* (1899); *Carl XIV. och Rikets Ständer, 1840-1841* (1893). He also edited *Svenska Riksdagsakter, 1521-1554* (1887), in conjunction with E. Hildebrand, and *Sveriges Grundlagar* (1892).

ALINGTON, CYRIL ARGENTINE (1872-), British educationist and writer, was born in Ipswich, Oct. 22 1872, and educated at Marlborough College and Trinity College, Oxford. In 1908 he was appointed headmaster of Shrewsbury School and in 1916 succeeded his brother-in-law, Edward Lyttelton, as headmaster of Eton. Dr. Alington commanded the respect and affection of his pupils and while not hostile to new ideas sought to maintain rather than modify the public school tradition. In 1933 he left Eton, to become Dean of Durham. His published works include *A Schoolmaster's Apology* (1914); *Doubts and Difficulties* (1929); *The Life Everlasting* (1947); novels, sermons, addresses and light verse.

ALIQOT PART, an exact divisor of a number or quantity (that is, a divisor giving an integral quotient). For example, 2 is an aliquot part of 10, $3\frac{1}{3}$ is an aliquot part of 100, a line $2\frac{1}{2}$ in. long is an aliquot part of one that is $7\frac{1}{2}$ in. long, and $\frac{1}{2}$ is an aliquot part of 1; but $\frac{2}{3}$ is not an aliquot part of 1, the quotient of 1 divided by $\frac{2}{3}$ not being an integer.

ALIRAJPUR, a state in the Malwa agency in Central India agency. It lies near the frontier of Bombay. It has an area of 849 sq.mi.; and a pop. (1941) of 112,754. The country is hilly, and many of the inhabitants are aboriginal Bhils.

ALISMATACEAE, in botany, a family of monocotyledons belonging to the series Helobiaeae, and represented in Britain by the water plantain, *Alisma plantago*, the arrow-head, *Sagittaria*



A VERTICAL SECTION THROUGH THE FLOWERING RUSH AND ITS FLORAL DIAGRAM

and the starfruit, *Damasonium*. They are marsh or water plants with generally a stout stem (*rhizome*) creeping in the mud, radical leaves and a large, much branched inflorescence. The submerged leaves are long and grass-like, the floating leaves oblong or rounded, while the aerial leaves are borne on long, thin stalks above the water, and are often arrow-shaped at the base. The flower-bearing stem is tall; the flowers are borne in whorls on the axis as in arrow-head, on whorled branchlets as in water plantain or in an umbel as in *Butomus* (see fig.). They are regular and rather showy, generally with three greenish sepals, followed in regular succession by three white or purplish petals, six to indefinite stamens and six to indefinite free carpels. The fruit is a head of achenes or follicles. The flowers contain honey, and attract flies or other small insects by which pollination is effected. There are about 75 species in 12

genera, widely distributed in temperate and warm zones. *Alisma plantago* (see fig.), a common plant in Britain (except in the north) in ditches and edges of streams, is widely distributed in the north temperate zone and on mountains. In the United States and Canada the family is represented by about 40 native species, some three-fourths of which are arrow-heads. Among the other representatives are the cosmopolitan water plantain, two species of burhead (*Echinodorus*), the dwarf burhead (*Helianthium parvulum*) and the fringed water plantain or starfruit (*Damasonium californicum*) of California. See F. Buchenau, *Alismataceae*. *Pflanzenreich* 14 (IV, 15): 1-66, figs. 1-19 (1903). (See ARROW-HEAD.)

ALISON, SIR ARCHIBALD, BART. (1792-1867), Scottish historian, was born at Kenley, Shropshire, England. His father, ARCHIBALD ALISON (1757-1839), was the author of a well-known book of *Essays on the Nature and Principles of Taste* (1790). The son was educated at Edinburgh university and held various high legal positions in Scotland. He spent fifteen years in collecting the materials for his *History of Europe*.

The history of the period from the beginning of the French Revolution till the restoration of the Bourbons in 1815 was completed in ten volumes in 1842. Within a few years it ran through ten editions, and was translated into many of the languages of Europe, as well as into Arabic and Hindustani. It brought together, though not always in a well-arranged form, an immense amount of information that had before been practically inaccessible to the general public. A continuation of the *History*, embracing the period from 1815 to 1852, which was completed in four volumes in 1856, did not meet with the same success as the earlier work. His literary activity continued till within a short time of his death, the chief works he published in addition to his *History* being the *Principles of Population* (1840), in answer to Malthus; a *Life of Marlborough* (1847, 2nd edition, greatly enlarged, 1852); and the *Lives of Lord Castlereagh and Sir C. Stewart* (1861). Three volumes of Alison's political, historical and miscellaneous essays were reprinted in 1850. His autobiography, *Some Account of My Life and Writings*, edited by his daughter-in-law, Lady Alison, was published in 1883 at Edinburgh. His elder son, SIR ARCHIBALD ALISON (1826-1907), was a distinguished soldier who served in the Crimea and the Indian Mutiny, was second in command of the Ashanti expedition (1873-74), and led the Highland Brigade at Tel-el-Kebir. He was made full general in 1887, and became military member of the Council of India in 1889.

ALIWAL, a village in British India, Ludhiana district, Punjab, on the left bank of the Sutlej, famous as the scene of a great battle of the first Sikh War (*q.v.*).

In Jan. 1846 Aliwal was held by a Sikh army, which had crossed the river and threatened Ludhiana. On the 28th Sir Harry Smith attacked, and after a desperate struggle pushed the enemy into the river, where large numbers perished, leaving 67 guns to the victors.

ALIWAL NORTH, a town of Cape Province, South Africa, on the left bank of the Orange river, 30° 31' S., 26° 53' E. Population (1936): Europeans 2,566; natives 3,948; coloured 1,112; Asiatics 21. Altitude 4,350 ft.; distance by rail from East London, 280 miles. Aliwal North is a trading centre for the surrounding country and for southwest Basutoland. It is also the administrative centre for the magisterial district of the same name. The

town was founded in 1849 and is laid out on the usual South African rectangular plan. The streets are bordered by open water-furrows, and lined with trees. A dam, built across the Orange river, has made available for boating a six-mile stretch of water, which provides the town with electric light.

Aliwal North is becoming recognized as one of the chief inland health resorts of South Africa. The climate is recommended for sufferers from lung troubles. The average relative humidity for the year is 61.5 and the average cloudiness 3.3. The temperature may rise to over 90° in summer, but the nights are cool, and in winter sharp frosts occur.

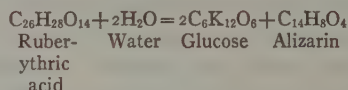
A little over a mile from the town are high-temperature mineral springs yielding more than 1,000,000 gal. a day. The water is beneficial for rheumatism and skin diseases. A gallon contains 0.85 grains of lithium carbonate, 7.41 carbonate of lime, 1.95 sulphate of magnesium, 3.24 ammonia, 0.95 potash, 8.10 calcium chloride, 61.35 sodium chloride, 1.04 silica, 0.12 sodium bromide, 5.22 carbonic acid gas. At the springs, baths have been built, and 14 ac. of pleasure grounds have been laid out.

The town was named in honour of Sir Harry Smith, governor of Cape Colony (1847-52), to commemorate the victory of Aliwal.

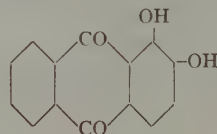
ALIZARIN, a vegetable dyestuff prepared from the root of the madder (*Rubia tinctorum*), was known to the ancients, and was prepared entirely from this source until 1868. The pure substance crystallizes in red prisms melting at 290° C. It is insoluble in water, and not very soluble in alcohol. It dissolves readily in caustic alkalis on account of its phenolic character, and it forms a yellow-coloured di-acetate.

Its value as a dyestuff depends on its power of forming insoluble compounds (lakes) with metallic oxides. It is in the form of these lakes that it produces coloured effects on textile fibres. Alizarin red on wool is a complex lake of alizarin with the oxides of calcium and aluminium (see DYEING).

Madder contains a glycoside, ruberythric acid, which is readily broken up (hydrolysed) by acids or ferments into alizarin and glucose:



Alizarin has the chemical constitution 1,2 Dihydroxyanthraquinone and the structural formula



It owes its phenolic properties to the two —OH (hydroxy) groups attached to a benzene nucleus.

The first step in the synthetical production of alizarin was the discovery in 1868 of C. Graebe and C. Liebermann that on heating with zinc dust, alizarin was converted into anthracene, an aromatic hydrocarbon obtained from coal tar. They then oxidized anthracene to anthraquinone and brominated the quinone. The dibrominated product so obtained was fused with potassium hydroxide, the melt dissolved in water, and on the addition of hydrochloric acid to the solution, alizarin was precipitated. This process, owing to its expensive nature, was soon superseded by another, discovered simultaneously by the above-named chemists and by Sir W. H. Perkin, the method being to sulphonate anthraquinone, and then to convert the sulphonic acid into its sodium salt and fuse this with sodium hydroxide.

ALKAHEST (a pseudo-Arabic word believed to have been invented by Paracelsus), a liquid having the power of dissolving gold and every other substance, much sought after by the alchemists, who supposed it would possess invaluable medicinal qualities.

ALKALI, an Arabic term, was originally applied to the ashes of plants from which the carbonates of sodium and potassium were lixiviated or leached. The conversion of these "mild" alkalis



THE WATER PLANTAIN, THE COMMON REPRESENTATIVE OF THE ALISMATACEAE FAMILY IN GREAT BRITAIN. Upper left, the flower enlarged. Upper right, its floral diagram. Lower left, vertical section through flower. Lower right, the fruit

into "caustic" alkalis by treatment with lime was practiced in Pliny's time and was utilized in the manufacture of soap, the ashes of sea plants yielding a hard soap and those of land plants a soft one. The distinction between the two components of this fixed alkali was made by the French chemist, Duhamel du Monceau, who in 1736 established that the ashes of sea plants contain the same base as is found in natural deposits of sodium salts or mineral alkali, and that this substance was different from the vegetable alkali obtained from the ashes of land plants (potashes). Later, Martin Heinrich Klaproth who found the vegetable alkali in certain minerals, proposed the name potash. The symbol for potassium, K (*kalium*), was taken from the word alkali.

In modern chemistry the term alkali is specifically applied to the very soluble hydroxides of lithium, sodium, potassium, rubidium and caesium which are known as the alkali metals. An alkali is distinguished from an acid or a neutral substance by its characteristic action on litmus, phenolphthalein and other indicators. The term is shared by the less soluble hydroxides of the alkaline earth metals, calcium, strontium and barium, also by ammonium hydroxide and thallous hydroxide. Industrially the term is extended to include other compounds which are soluble and which behave actively as bases (*q.v.*). (See ALKALI MANUFACTURE.) (J. B. Ps.)

ALKALI AND SALINE SOILS. The term alkali has been rather loosely applied to all soils containing sufficient amounts of soluble salts to cause injury to plant life. When correctly used, the term alkali soils refers only to those soils that have a high pH value (high alkalinity) caused by sodium ions absorbed by the clay particles, and to those that sometimes have considerable amounts of the alkaline salt, sodium carbonate. Reaction between water and the sodium-saturated clay liberates sodium and hydroxyl ions into the solution, making it alkaline. These soils were formerly called black alkali in the U.S.

Saline soils are those that contain less absorbed or exchangeable sodium and that are high in nonalkaline salts such as sodium chloride and sodium sulphate, or those that contain enough salts such as sodium chloride to maintain flocculation and repress hydrolysis of the clay portion of the soil which is itself the insoluble salt of a strong base and a weak acid. The term white alkali frequently has been used for these soils. Alkali and saline soils are widely distributed in the drier portions of the world. On soils where salts may be a problem a great deal of foodstuff is produced. In regions of low rainfall, salts accumulate where drainage is poor, their origin being caused by insufficiency of percolating moisture to wash out and carry away in the drainage the soluble salts present in the parent soil material or those that are formed by its weathering. They are frequently formed in localized areas by seepage water from higher elevations. Soil-forming materials reclaimed from the sea, as on the coast of the Netherlands, are also saline. The salts that most frequently predominate are the carbonates, chlorides and sulphates of sodium, magnesium and calcium, or mixtures of two or more of these salts.

The tolerance of the various species and varieties of plants to soluble salts in soils is very different. Among the more tolerant agricultural plants are sugar beets, garden beets, milo, Bermuda grass, Rhodes grass, alfalfa, cotton, tomatoes and barley. The less tolerant ones include beans, field peas, red clover, vetch, oats and peaches. It has been found that the presence of high concentrations of salts in the soil solution (the liquid portion of the soil in which the plant roots obtain nutrients) limits the intake of water by plant roots. Yields are reduced approximately in proportion to the osmotic pressure of the nutrient solution. Although definite limits cannot be set for the amount of soluble salts required to reduce the yield of plants, less than 0.2% of salts in a soil is usually not harmful to salt-tolerant crops; in an alkali soil, lower percentages are harmful because of more toxic effects of the ions present. Relatively large amounts of salts may be added to the soil in irrigation water. In order to maintain the "salt balance" as much salt must be removed in drainage water from the soil as is introduced in the irrigation water. Many irrigation projects have failed because of salinization caused by lack of proper drainage facilities or failure to use enough water to move excess salts

down and out of the soil profile. Others have failed because of the high percentage of sodium in the irrigation water.

The chemical reactions by which a normal soil, the exchange complex of which (essentially the fine or clay fraction) is saturated with calcium and magnesium ions, is converted to an alkaline soil are as follows: $\text{Ca-sat. soil} + 2\text{NaCl} \rightarrow \text{Na-sat. soil} + \text{CaCl}_2$. When the sodium-saturated soil is leached by water, little happens to it until the excess of soluble salts is removed. Further leaching brings about the reaction that is involved in the formation of the alkali soils of columnar structure called Solonetz. This reaction is $\text{Na-sat. soil} + \text{H}_2\text{O} - \text{H soil} + \text{NaOH}$. Then, in the presence of carbon dioxide of the soil air, the salt sodium carbonate is formed— $2\text{NaOH} + \text{CO}_2 + \text{H}_2\text{O} = \text{Na}_2\text{CO}_3 + 2\text{H}_2\text{O}$. Alkali soils are sticky, impervious to water and unfavourable for agriculture. At the high pH values of alkali soils, dissolved organic matter coats the soil grains and gives a black colour. The reclamation of alkali soils is the reverse of the above processes. A soluble calcium salt such as gypsum is applied to the soil— $2 \text{Na-sat. soil} + \text{CaSO}_4 = \text{Ca-sat. soil} + \text{Na}_2\text{SO}_4$. The sodium salt is then removed in the drainage water. Sulphur may be used in place of gypsum if the soil contains calcium carbonate. By biological action sulphur is converted to sulphuric acid, which reacts with the calcium carbonate to give gypsum. Good drainage is necessary to remove end products so that the reactions can proceed. Sodium-saturated colloids, in the absence of flocculating salts, "run together" or "freeze up." Sodium-saturated colloids in the presence of excess sodium salts may not be high in pH and are flocculated.

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ALKALI MANUFACTURE. The group of materials includes sodium carbonate (soda ash), caustic soda, bicarbonate of soda, soda crystals (washing soda), sodium silicate (water glass), sulphate of soda (salt cake) and sodium sulphide. Certain other substances are linked with these in manufacture, such as chlorine, which is produced simultaneously with caustic soda by certain processes, and which in turn gives rise to bleaching powder, hydrochloric acid and so forth. Alkali and chlorine are, under modern practice, inseparable, and form one comprehensive and intimately connected group of manufactures (the heavy-chemical trade). The principal products (soda ash, caustic soda and chlorine) form raw materials for other industries.

The chief centres of alkali production are England, Belgium, France, Germany and the United States.

MANUFACTURE OF SODIUM CARBONATE

The manufacture of alkali and chlorine by modern methods requires a complicated plant; but the relatively few plants in operation

are highly efficient and, economically placed as regards carriage of raw materials and shipping of products, and work on a very large scale. It is to be emphasized that the industry has been very considerably standardized in recent years; the old Le Blanc black-ash process has been replaced by the Solvay ammonia-soda process, the basis of which is the mutual decomposition, in water, of ammonium bicarbonate and sodium chloride

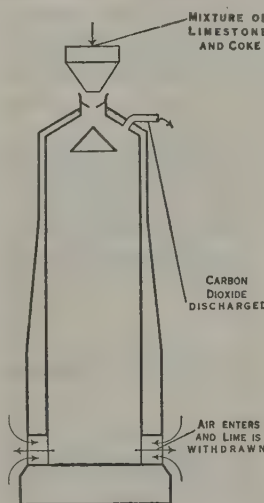
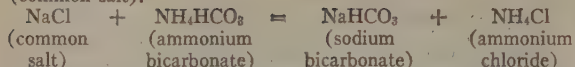


FIG. 1.—DIAGRAM OF A LIME KILN The mixture is discharged from the hopper at the top at intervals. The one immediately below spreads the charge evenly. The carbon dioxide is drawn off through the vent shown, and the lime is withdrawn at the bottom. Kilns vary in size, some being 70 ft. high with an internal diameter of 14 ft.

(common salt).



Raw Materials.—The raw materials required are coal (to supply power and heat), salt and limestone of good quality. Salt is the source of the sodium in the finished products. It occurs as a mineral, widely distributed over the globe, in subterranean beds of great thickness. For the purpose of alkali manufacture it is not mined, but extracted in the form of brine by pumping. This brine occurs naturally in many places and has been formed by the percolation of underground springs through the salt beds; when of a sufficient degree of saturation it is used direct. In other cases water has to be admitted artificially to the salt deposits and then, after saturation, pumped again as brine.

The limestone serves a double purpose; it is the source of the carbon dioxide gas which when combined with the sodium of the salt produces sodium bicarbonate; and it is also the source of the lime with which, as we shall see presently, the ammonia (from which the process takes its name) is recovered and returned to the cycle of operations. Only the better class of limestone is used for alkali. The stone is quarried and crushed; it is then burned, intimately mixed with coke, in tall kilns to which a regulated quantity of air is admitted (see fig. 1). These kilns are periodically charged at the top; and as the charge travels downward the lime is extracted at the bottom and the kiln gases containing the carbon dioxide are drawn off at the top. Ammonia, which forms

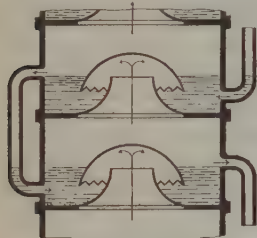


FIG. 2.—SECTION OF PART OF AN AMMONIA ABSORPTION TOWER

The gas enters each compartment through funnel-shaped holes which are surmounted by domes to distribute the gas evenly into the liquor. The liquor descends through the pipes, comes in contact with the gas, absorbs part of it and leaves the compartment

the key to the whole operation and is obtained principally from gas-works liquor (a residue from the distillation of coal), cannot properly be regarded as a raw material.

The Process.—The production of crude sodium bicarbonate is the central operation. The brine, usually after purification to remove undesirable magnesium and calcium compounds, is pumped into the top of tall vertical iron absorption towers. Simultaneously ammonia gas and some carbon dioxide are pumped in at the bottom. The thorough contact of the falling brine and the rising gases is ensured by the internal partitioning of the vessel in such a way that the whole of the ammonia is absorbed (see fig. 2). This absorption gives rise to a considerable evolution of heat, so the ammoniated brine is passed through a series of coolers to reduce its temperature.

From the coolers the liquor is pumped to the top of a system of iron towers, subdivided internally, at the bottom of which carbon dioxide gas enters; this carbon dioxide is obtained partly from the limekilns as already described and partly from a later stage of the process in which sodium bicarbonate is heated to form the carbonate. The interaction of this carbon dioxide with the ammoniated brine produces a precipitate of sodium bicarbonate and at the same time disengages a considerable quantity of heat which has to be counteracted by a system of coolers in the lower part of the towers; the reaction is reversible, and is greatly influenced by the temperature, so that the

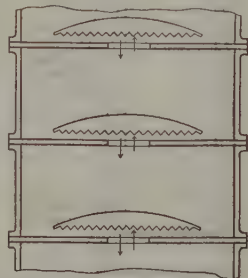


FIG. 3.—PART OF AN AMMONIA-SODA PRECIPITATING TOWER

The gas rises from the bottom through holes in the partitioning plates. Each hole is surmounted by a flat dome. The liquor descends and the contact with the gas produces sufficient agitation to enable the bicarbonate so formed to be carried to the bottom with the liquor

maintenance of the liquor at the correct temperature is of the first importance (see fig. 3).

The magma of bicarbonate and mother liquor is taken continuously from the towers and fed on to rotary vacuum filters (see fig. 4). Here the mother liquor is removed and the bicarbonate washed with a little water. The crude bicarbonate is then conveyed automatically to the so-called finishing machines for conversion to carbonate. These machines consist of hemicylindrical iron vessels, with mechanical agitators, and are heated from below either with producer gas or by direct coal-firing. The crude bicarbonate is fed in at one end, and in its passage along the length of the machine loses carbon dioxide, water and any ammonia

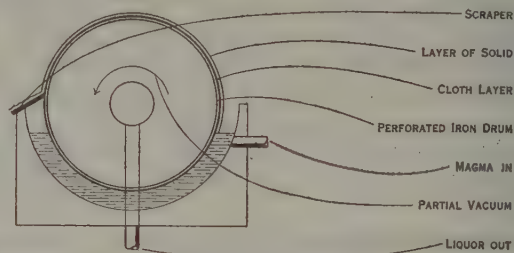


FIG. 4.—ILLUSTRATING THE PRINCIPLE OF THE ROTARY FILTER

The perforated iron drum revolves continuously and is so arranged that a partial vacuum exists within it. As the drum turns, the vacuum sucks in the liquor through the cloth layer and leaves a layer of solids upon it. The scraper removes this layer from the drum, leaving the cloth clean for the next revolution

that it may contain. These gases are then returned to the towers. The product issuing from the finishing machines is sodium carbonate, and is usually referred to as soda ash. The purity is very high, averaging 98% sodium carbonate, the remainder being mostly salt.

Uses of Soda Ash.—Almost every manufactured commodity has at some stage of its production made use of soda ash or its derivatives, the yearly world production of which has reached about 3,500,000 tons. For example, glass of all kinds contains from 10% to 20% by weight of soda and accounts for roughly one-quarter of the total consumption. There are indeed certain qualities of glass which do not use soda ash, but these are for special use and do not affect the general statement. All hard soap has been made primarily from animal or vegetable fats and caustic soda, the latter being derived directly from soda ash; this accounts for another quarter of the consumption. The textile industry accounts for one-sixth, employed in wool-scouring, cotton-scouring, calico printing, flax boiling and so on. The general chemical industry takes about one-tenth, and paper one-twentieth. The remainder is consumed in comparatively small quantities by a number of industries, a full list of which is astonishing in its length and variety. Fig. 5 gives this distribution, which is of course only approximate, in a graphic form.

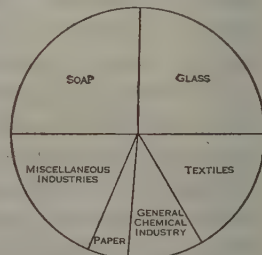


FIG. 5.—APPROXIMATE DISTRIBUTION OF SODA ASH

Almost every manufactured commodity needs soda ash or its derivatives in its production. The annual world requirements reach 3,500,000 tons

Recovery of Ammonia.—Apart from the small amount carried forward with the crude bicarbonate, which is recovered separately, the bulk of the ammonia is contained in the mother liquor separated at the filters and is in the form of ammonium chloride. This liquor is therefore distilled with lime. As, however, the liquor still contains some ammonia in combination with residual carbon dioxide it is first of all subjected to treatment with steam to eliminate these compounds.

The liquor is then fed, together with milk of lime produced by

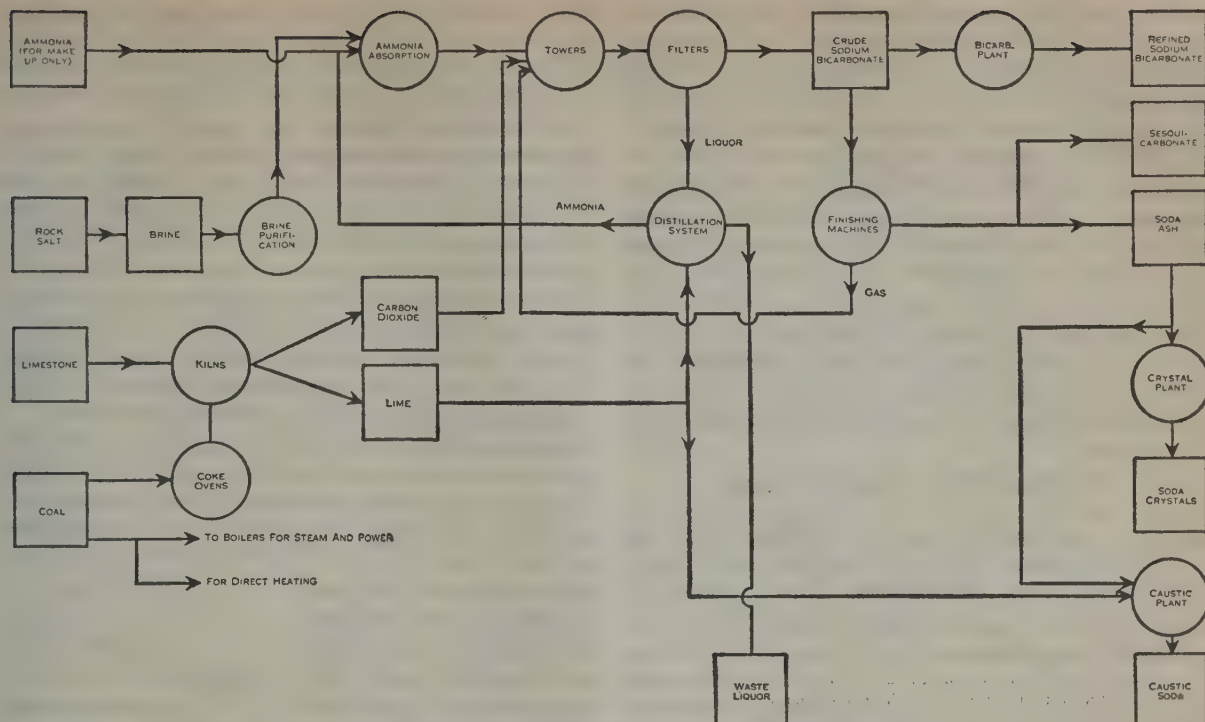


FIG. 6.—THE AMMONIA-SODA PROCESS AND PRINCIPAL PRODUCTS

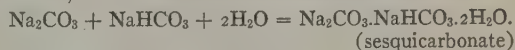
The raw materials used are shown to the left. The plant and the processes are shown in continuous progression across the diagram. The resulting products are to be seen on the right

mixing lime from the kilns with water, into the top of the distiller, a tall iron tower with internal divisions: exhaust steam is admitted to the bottom, the temperature of the liquor is raised, and the ammonia distils off accompanied by some carbon dioxide. These gases, together with those given off in the preliminary steam treatment, are cooled and then pass to the absorption system to undergo a further round of the process. Under modern methods the loss of ammonia is extremely small. The liquor leaving the bottom of the distiller contains calcium chloride and about one-third of the salt that originally entered the process; some calcium chloride is occasionally extracted and sold, but in general it is a waste product. It also contains excess lime, grit and pebbles, the economical disposal of which is a problem still to be solved. Fig. 6 is a diagram that will serve to connect the foregoing operations with some of those about to be described.

Sodium Bicarbonate.—Part of the crude bicarbonate obtained by the ammonia soda process is converted into refined bicarbonate of soda which is largely used in the preparation of food and drugs. The trade in it is very steady, and does not vary appreciably from year to year. It is principally used as a source of carbon dioxide gas for the manufacture of artificial mineral waters. Another source of consumption is the baking industry: baking powders contain sodium bicarbonate and a weak vegetable acid (citric, tartaric, etc.) which are prevented from reacting on one another when dry by a film or glaze of starch around the individual grains: on moistening in the process of doughmaking, these compounds react, carbon dioxide is evolved, and the dough rises. The action of yeast is similar in that carbon dioxide is produced but dissimilar in that the production of the gas is due to organic fermentation. Bicarbonate of soda is also used largely in medicine and in proprietary compounds for daily use. It is one of the principal ingredients of blue for laundry purposes, and a large amount is consumed in the manufacture of dry soap.

Sodium Sesquicarbonate.—This is the form in which soda occurs in nature, mixed of course with more or less impurity. In composition it is intermediate between sodium carbonate and

bicarbonate, and it contains some combined water:



It is manufactured directly from crude bicarbonate, the process of heating to drive off carbon dioxide not being carried as far as for the manufacture of soda ash. It has the advantage of being a mild alkali well suited for laundry detergent purposes and is sometimes known as concentrated soda crystals.

Soda Crystals (Washing Soda).—If soda ash be dissolved in water and the solution allowed to crystallize slowly, large transparent crystals are produced of the composition $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$. In this form the product is familiar to everyone as washing soda. In practice the manufacture is not quite so simple. Soda ash is first dissolved in hot water. This solution frequently contains small amounts of iron and organic matter which are removed and the liquor is rendered colourless by the addition of small quantities of bleaching powder. The clear settled liquor is then transferred to large steel crystallizing pans where it gradually cools and deposits the crystals. After a few days these are fished out, dried, graded for size and packed. Their principal use is in domestic and laundry work, in the manufacture of dyestuffs, varnishes and photographic materials, and in tanning.

Sodium Silicate (Water Glass).—This familiar product is manufactured by fusing together soda ash and clean pure sand in a furnace. The latter is built of fireclay blocks with an arched roof of silica, and is heated internally by a direct flame produced by the combustion of producer gas or oil. The mixed charge of ash and sand is fed in at one end of the furnace and the molten glass is drawn off at intervals at the other. The glass may either be broken up by jets of water as it runs in a molten stream from the furnace, or it may be allowed to cool and be subsequently broken up by hand. It is then fed into a dissolver which may be either of a horizontal and rotary type, or stationary and vertical. In either case the glass is treated with a mixture of water and steam and goes into solution. The latter is then bleached, if necessary, and clarified; and is then concentrated in evaporators of

modern type. The resultant viscous fluid is the water glass of commerce. A familiar but minor use is that of preserving eggs; the effect is produced by the closing of the pores of the egg shell by the silicate, which results in the exclusion of air and the prevention of putrefaction. It is an excellent adhesive for all purposes and particularly for machine work in boxmaking. In the United States particularly this application has become very widespread. It is used with remarkable effect to harden and consolidate the surface of concrete: the effect is produced by the interaction of the silicate with the lime of the concrete whereby hard calcium silicate is formed. The silicate may be applied either during the process of concrete making or to the finished concrete surface. It often forms an ingredient of soap of inferior quality. Other applications include the lining of casks, ceramics, fireproofing of wood, preservation of wood against the attacks of insects, ink making, flotation of ores, paints, silk weighting, and so on. For all these various uses there is usually available a particular grade of silicate, dependent upon the ratio of silica to soda best suited to the purpose, the degree of viscosity required and the rate of drying.

MANUFACTURE OF CAUSTIC SODA

Caustic soda can be produced in two separate ways by the conversion of soda ash direct, or by subjecting brine to the action of the electric current (electrolysis) whereby caustic soda is produced simultaneously with chlorine. Two methods may be used for the direct conversion of soda ash, that of Löwig, a now obsolete process, and the lime-caustic process.

The Lime-Caustic Process.—In this process a solution of soda ash is treated with lime, either in the form of milk of lime or by direct introduction of quicklime. The ensuing reaction causes a double decomposition to take place, which produces a solution of caustic soda and a precipitate of calcium carbonate.

$$\text{Na}_2\text{CO}_3 + \text{Ca}(\text{OH})_2 = 2\text{NaOH} + \text{CaCO}_3$$

(soda ash) (slaked lime) (caustic soda) (calcium carbonate)

This reaction does not proceed to completion at once nor does the precipitate settle readily; so that a large part of the plant, after the reaction vessel, consists of time vessels and settling vats. After the liquor has passed through these, and the residual calcium carbonate has been filtered out, it passes to a series of vacuum evaporators, working usually in two or three stages, where it is concentrated by steam heat to a degree that is limited by the economics of the method. The final stage of the concentration, which results in the complete elimination of all water, is accomplished in large hemispherical iron pots heated underneath by direct firing by coal or producer gas. The final product is molten caustic soda which is run or ladled off into thin iron drums where it solidifies (see fig. 7).

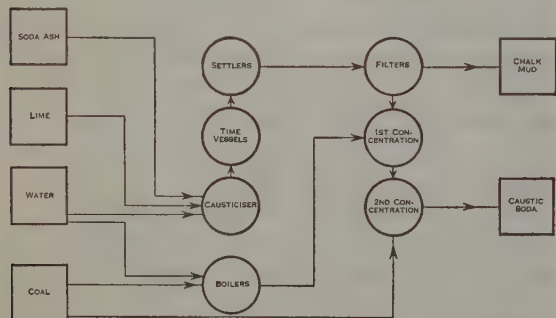


FIG. 7.—THE MANUFACTURE OF CAUSTIC SODA FROM SODA ASH

The raw materials are shown on the left. The lines show the flow of materials through the various processes, with the finished products on the right

As the conversion of soda ash can never be taken to absolute completion whatever method be employed (the reaction being a balanced or reversible one), means must be found for the re-

moval of unchanged ash and impurities. These salts separate out in the earlier stages of the concentration of the liquor. The precipitated calcium carbonate (chalk) may either be sold, after drying, for agricultural use or may be calcined and returned to the first stage of the process.

The Electrolytic Process.—This method is entirely different and depends upon the effect produced when a current of electricity is passed through brine. This is more particularly described under the heading *CHLORINE: In Industry*. The effect, in short, is to produce simultaneously a solution of caustic soda, chlorine gas and hydrogen gas. The caustic solution is treated as already described; the chlorine is piped off to subsidiary plants; the hydrogen may either be allowed to escape into the air or may be converted to ammonia or hydrochloric acid. This method is finding increased application and the caustic soda made by it forms an appreciable proportion of the total; at the same time it is evident that the output is limited by the extent to which it may be found possible to dispose of the concomitant chlorine.

Uses of Caustic Soda.—An important consumer of caustic soda is the artificial silk trade which uses it for digesting and purifying the cellulose which forms the basis of the industry. One-third or more of the total output of caustic soda is used for this purpose, no account being taken of the caustic soda made by soapmakers themselves. The largest consumer of caustic soda is the soap

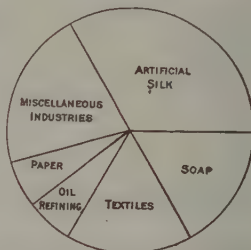


FIG. 8.—APPROXIMATE DISTRIBUTION OF CAUSTIC SODA

Caustic soda is the second most important product in the alkali industry. The two largest consumers are the soap and artificial silk industries

Caustic soda is the second most important product in the alkali industry. The two largest consumers are the soap and artificial silk industries

MANUFACTURE OF SALT CAKE

By this name is known the residue resulting from the treatment of salt with strong sulphuric acid in the manufacture of hydrochloric acid (*q.v.*). It consists of sodium sulphate with a small proportion of free sulphuric acid. Apart from the strictly utilitarian view, this product has an interest inasmuch as its manufacture, together with that of sodium sulphide, is the only surviving part of the celebrated Le Blanc soda process.

In brief, the process consists of two parts, the salt-cake process and the black-ash process. The salt-cake process is described elsewhere (see *HYDROCHLORIC ACID*); the reaction of sulphuric acid with common salt produces hydrochloric acid and sodium sulphate (salt cake).

$$\text{H}_2\text{SO}_4 + 2\text{NaCl} = \text{Na}_2\text{SO}_4 + 2\text{HCl}$$

(sulphuric acid) (salt) (sodium sulphate) (hydrochloric acid)

The second stage involves the conversion of the salt cake to carbonate by heating with limestone and coal; the former to provide the required carbonic acid and the latter to reduce the salt cake to a form in which it will react with the limestone. Thus:

$$1. \text{Na}_2\text{SO}_4 + 2\text{C} = \text{Na}_2\text{S} + 2\text{CO}_2$$

(carbon or coal) (sodium sulphide) (carbonic acid)

$$2. \text{Na}_2\text{S} + \text{CaCO}_3 = \text{CaS} + \text{Na}_2\text{CO}_3$$

(limestone) (calcium sulphide) (sodium carbonate)

The mass (black ash) resulting from this furnace operation was

then, after standing for a day or two, extracted with water and the liquor evaporated for the recovery of sodium carbonate. The insoluble part of the black ash formed unsightly heaps of alkali waste upon which much research had to be conducted before a satisfactory method of utilizing their valuable sulphur contents was discovered.

Salt cake itself is a white powder and usually contains a small proportion, about 1%, of free sulphuric acid, with a smaller amount of undecomposed salt.

When the Le Blanc process was the principal source of alkali, salt cake was required in such quantity that the hydrochloric acid produced with it was more than could be absorbed in industry, so that processes were devised by Weldon and Deacon for converting a large proportion to chlorine for subsequent use in the manufacture of bleaching powder. The introduction of the ammonia-soda process has completely reversed that state of affairs. Although a certain quantity of salt cake is still required, for purposes specified below, the hydrochloric acid thereby produced does not suffice for modern requirements; the quantity is therefore supplemented by direct synthesis of acid from hydrogen and chlorine, or by manufacturing a further supply of salt cake. As for chlorine, so far from it being deliberately manufactured as an outlet for surplus hydrochloric acid, it is a matter of some difficulty to dispose of the quantity produced in the electrolytic process for making caustic soda.

Salt cake is used to a certain extent in the glass industry where it serves as a source of sodium; for the manufacture of sodium sulphide and Glauber's salts (*q.v.*); and, in far larger quantities, as a raw material for the sulphite process of wood pulp and paper manufacture. It is a matter of some difficulty to dispose of all the salt cake now produced; more especially as it is also obtained as a by-product of the potash industry in Germany, and further occurs naturally in Canada. (A. E. H.)

AMERICAN PRACTICE

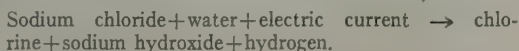
The ammonia-soda process, established about 1870, superseded the Le Blanc process which has never been used in the U.S. The first U.S. plant for the synthesis of soda ash by the ammonia-soda process was built in New York state during 1882.

In the ammonia-soda process, salt, ammonia and carbon dioxide are interrelated under controlled conditions of temperature and pressure.

The slightly soluble sodium bicarbonate is precipitated, collected on a filter, washed, and calcined to soda ash. The filtrate, consisting largely of ammonium chloride in solution, is treated with lime to recover the ammonia which is recirculated to fresh brine (sodium chloride solution), so that the process may be repeated. The carbon dioxide evolved in calcining the sodium bicarbonate to soda ash is also recirculated to saturate the fresh brine. Calcium chloride is a by-product of the process. The steps in this process may be represented as follows:

1. Salt + ammonia + carbon dioxide + water $\rightarrow$ sodium bicarbonate + ammonium chloride
2. Sodium bicarbonate + heat $\rightarrow$ soda ash + carbon dioxide
3. Ammonium chloride + lime $\rightarrow$ ammonia + calcium chloride.

Caustic soda (NaOH) is produced by reacting soda ash with lime. More recently, the large demand for chlorine has led to the establishment of a large number of electrolytic plants in which salt is electrolyzed and chlorine and caustic are produced. The reactions in the electrolytic process may be indicated in a general way as follows:



In 1938 approximately 50% of the total caustic production was prepared by the electrolytic process. As a general rule, the ammonia-soda plants have been built in the vicinity of salt and limestone deposits, such as those in Michigan, Ohio, New York, Virginia, Louisiana and Texas. The first electrolytic plants were built near cheap sources of power and salt. Later a number of users of chlorine and caustic soda built small plants at the point of use

of these products. Soda ash, sodium bicarbonate and trona are also produced from the natural alkaline lake brines of California and Washington, but the production is relatively unimportant and is mainly for local consumption. It has been estimated that approximately 100,000 tons of natural soda were produced in 1938. Sodium sulphate is also produced from natural reservoirs in California, Texas, Nevada and Wyoming. Sodium sulphate is the only alkali imported in significant quantities, all the others being exported.

According to the U.S. Census of Manufactures, 32 establishments, employing an average of 19,853 persons, were producing alkalies and chlorine in 1947; value added by manufacture was \$113,868,000.

BIBLIOGRAPHY.—The literature on the alkali industry may be found in the regular technical periodicals such as the *J. Am. Chem. Soc.*; *J. Phys. Chem.*; *Ind. Eng. Chem.*; *J. Soc. Chem. Ind.*; *Trans. Electrochem. Soc.*; *Z. Elektrochem.*; *Z. physik. Chem.*; *Z. angew. Chem.*; etc. The following works may also be consulted: G. Lunge, *The Manufacture of Sulphuric Acid and Alkali*, vol. 2 and 3 (1909–11); *Thorpe's Dictionary of Applied Chemistry*, revised ed. (1927); H. Schreib, *Die Fabrikation der Soda nach dem Ammoniakverfahren* (1905); H. Tedesco, *Studien über den Ammoniaksoxa Prozess* (1910); H. Molitor, *Die Fabrikation der Soda* (1925); J. R. Partington, *The Alkali Industry* (1925); Tè-Pang Hou, "Manufacture of Soda," A.C.S. Monograph Series No. 65 (1933); J. E. Teeple, "Industrial Development of Searles Lake Brines," A.C.S. Monograph Series No. 49 (1929); A. J. Allmand and H. J. T. Ellingham, *The Principles of Applied Electrochemistry*, 2nd ed. (1924); C. L. Mantell, "Industrial Electrochemistry," Chemical Engineering series (1931). Consult also the *Annual Reports on Alkali*. (I. E. M.)

ALKALIMETRY, the determination of the quantity of available base in a sample of material. (See **CHEMISTRY: Analytical Chemistry**.)

ALKALINE EARTHS. By the early chemists, the term *earth* was used to denote those nonmetallic substances which were insoluble in water and were unaffected by strong heating; and since some of these substances (*e.g.*, lime) were found to be very similar in properties to those of the alkalis, they were called alkaline earths. The alkaline earths, lime, strontia and baryta, were assumed to be elements until 1807, when Sir Humphry Davy showed that they were oxides, respectively, of the metals calcium, strontium and barium. The metals are never found in the uncombined condition, but occur most often in the form of carbonates and sulphates; they form oxides of the type RO, and peroxides of the type RO₂. The oxides of type RO are soluble in water, with generation of heat (*e.g.*, the slaking of lime); the resulting solution possesses a strongly alkaline reaction because of the presence of the hydroxide R(OH)₂, which rapidly absorbs carbon dioxide on exposure. These oxides and hydroxides are basic in character and dissolve readily in acids with the formation of the corresponding salts. As the atomic weight of the elements increases, it is found that the solubility of the hydroxides in water increases although that of the sulphates decreases.

The metals calcium, strontium and barium oxidize rapidly on exposure. Their salts usually crystallize well, the chlorides and nitrates dissolve readily in water, while the carbonates, phosphates and sulphates are either sparingly soluble or insoluble in water.

ALKALOIDS. Man has from very early times made use of natural drugs, but his knowledge of the alkaloids, glycosides and other components to which natural drugs owe their potency is of comparatively late date and in the case of the alkaloids began in 1803, when Charles Derosne observed that a syrupy extract of opium (*q.v.*), when diluted with water, deposited crystalline matter, which he separated and purified and so prepared the first alkaloid, probably impure narcotine (*q.v.*). He attempted to improve the yield by adding alkali to the diluted opium syrup and obtained a different substance, which undoubtedly contained the alkaloid morphine (*q.v.*). About the same time A. Séguin made similar observations and also had obtained morphine. But the credit of first isolating a typical alkaloid in a pure state and describing its properties in unmistakable terms was reserved for F. W. A. Sertürner, who in 1816 was able to announce that he had found morphine, a new organic, alkaline, salt-forming base, apparently related to ammonia, of which he had prepared a number

of salts and whose physiological action he had been able to demonstrate. Meanwhile, in 1810, B. A. Gomes, by treating an alcoholic extract of cinchona bark with alkali, obtained a precipitate, which he purified by crystallization from alcohol and called cinchonino. J. J. Houtou-Labillardière observed its basic properties and brought it to the notice of his friends Pierre Pelletier and J. B. Caventou, who, guided by Sertürner's description of morphine as an "organic alkali," were able to show in 1820 that cinchonino was a mixture of two substances, which they named quinine and cinchonine. Between 1817 and 1840 there were isolated, practically all the more important alkaloids, including veratrine, strychnine, piperine, caffeine, quinine, berberine, conine, atropine, codeine, thebaine, (*q.v.*), cinchonine (*see CINCHONA BARK, ALKALOIDS OF*), hyoscyamine (*q.v.*), curarine, emetine, quinidine, aconitine and colchicine.

Definition.—The two points Sertürner stressed in his description of morphine—its basic, salt-forming, ammonialike character and its physiological action—would be enough upon which to frame a definition of the term alkaloid were it not for the fact that since then substances such as methylamine and amino-acids, such as asparagine and betaine, have been found in plants.

A growing knowledge of the intimate structure of some typical alkaloids led at one time to a proposed restriction of the term to naturally occurring derivatives of pyridine (*q.v.*), which is a structural feature of many alkaloids; further knowledge made it clear that pyridine formed no part of the structure of some alkaloids and this narrow definition had to be abandoned. With our present knowledge, alkaloids may be defined as relatively complex, basic substances, occurring naturally and exhibiting physiological action. The simple substances already referred to, such as methylamine, asparagine and betaine, together with those formerly known as animal alkaloids, have been grouped together by G. Barger as "simple natural bases," though it is difficult to draw the dividing line.

General and Special Interest of Alkaloids.—Everyone is familiar with the physiological action of alkaloids; *e.g.*, quinine is naturally associated with the treatment of malaria; morphine (*q.v.*), with the relief of pain; cocaine (*q.v.*), with minor surgical operations; and atropine (*q.v.*), with the skilled work of the oculist. The chemist on the other hand looks upon alkaloids as providing fascinating problems for the exercise of his technique and imagination. He has devoted much attention to devising methods for their detection, isolation and purification, and has displayed great ingenuity in splitting them into recognizable fragments, so acquiring such a knowledge of their intimate structure as may provide a basis for their eventual synthesis in the laboratory. He is interested also in the reason for the occurrence of these things in plants and the methods by which they are produced in nature; and one of his aims is to place the pharmacology (*q.v.*) of alkaloids on a sound chemical basis so that we may know, for example, the precise nature of the chemical action which takes place when a neutral salt of cocaine is applied to a nerve ending and local anaesthesia ensues, and be able to explain the remarkable specific toxicity of quinine and emetine to the protozoa which cause malaria and amoebic dysentery, respectively, in man.

More than 800 alkaloids are known, but of these only about 24 are in common use, chiefly in medicine, though some of them find other outlets; *e.g.*, strychnine as a vermin killer and nicotine as an insecticide. They are comparatively restricted in their distribution among plants, occurring chiefly in the Rubiaceae, Papaveraceae, Fumariaceae, Solanaceae, Leguminosae and Apocynaceae, and to a lesser extent in the Rosaceae, Gramineae, Labiatae and Compositae. To a limited degree it is correct to say that the same genus, and in some cases related genera, yield the same, or at least the same type of, alkaloid; *e.g.*, seven distinct genera of the Solanaceae yield the alkaloid hyoscyamine, the form in which atropine occurs in nature, and interesting investigations on this natural phytochemical distribution of alkaloids have been made. This subject is not without practical interest; *e.g.*, a widespread and variously named cattle disease due to liver necrosis is known to be caused by a particular type of alkaloid occurring in *Senecio* species, of which the noxious weeds groundsel and ragwort are common examples. The *Senecios* are apt to infest cattle pasture lands, and so clear-cut is this connection of liver disease with this type of alkaloid that an outbreak generally leads to an investigation of the local *Senecios*. Much valuable work of this kind has been done in the Union of South Africa.

Detection and Preparation of Alkaloids.—The processes by which alkaloids are obtained from plants depend upon the complete extraction of the dry ground material (bark, roots, leaves or seeds) with a suitable solvent, usually alcohol or slightly acidified water. The solvent is then distilled off *in vacuo* and the resulting extract diluted with water, made distinctly acid, if necessary, and left to stand to deposit impurities. It is next made alkaline, preferably with sodium carbonate or ammonia, when the bulk of the alkaloid is usually precipitated and can be filtered off. If the alkaloid is soluble in water, other devices involving the use of immiscible solvents (*i.e.*, liquids which, when shaken with watery fluids, will remove soluble substances

therefrom and then form a separate layer) and sometimes special precipitants or absorbents have to be adopted. These processes almost invariably yield a mixture of alkaloids, since the latter rarely occur singly in plants. The separation of these mixtures into their components can generally be achieved by (1) treating the mixture of bases with various solvents in turn, or (2) converting the partially separated components into salts by exact neutralization with acids and fractional crystallization of the salts. These processes have to be repeated until there are no longer changes in the physical and chemical properties of the fractions. Each kind of alkaloidal plant requires different treatment and long experience has enabled the processes to be greatly simplified for most of the alkaloids which are produced on a large scale for use in medicine, though on the other hand the standard of purity required in these is constantly rising. The balance between quality and cost of production is settled periodically by the standards set up for medicinal alkaloids and their salts in the various national pharmacopoeias (*q.v.*). The criteria of purity for alkaloids are the same as those for any other organic chemical; *viz.*, determination of physical constants such as melting point, boiling point, optical rotation and the chemical composition as determined by ultimate analysis (*see CHEMISTRY: Analytical*). These, the methods of the research laboratory, are those which the works chemist and the analyst must always have in mind as the ultimate court of appeal, in evolving their short routes to control of quality in alkaloids.

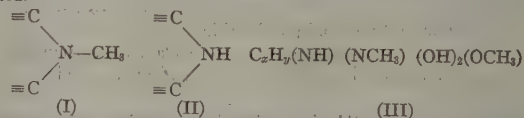
The analytical work of the toxicologist in connection with alkaloids is important. The methods by which poisonous alkaloids are extracted from viscera and stomach contents do not differ in principle from those for the extraction of alkaloids from plant material, but in these cases the problem is greatly complicated by the risks of loss by decomposition of the small quantities of alkaloid to be recovered. The usual methods of purification and conversion into identifiable derivatives cannot always be applied to these minute quantities; so use has to be made of crystalline form, colour tests which most of the alkaloids give with certain reagents, or in a few cases special pharmacological tests, methods which are perfectly satisfactory in the hands of experts.

Determination of the Intimate Structure of Alkaloids.

A few of the alkaloids are liquid and volatile and contain only three elements—carbon, hydrogen and nitrogen; but most of them contain oxygen in addition, and are colourless, crystalline solids. Most alkaloids are optically active (*see STEREOCHEMISTRY*) and in a few cases the salts show an optical activity opposite in kind to that of the base. Regarding the alkaloids as extensively substituted ammonias, those containing two atoms of nitrogen should be capable of forming salts containing two molecules of monobasic acids; and this is so with some alkaloids such as quinine, $C_{20}H_{21}O_4N_3$, but quite frequently, as in the case of strychnine (*q.v.*), also containing two atoms of nitrogen, the alkaloid combines with only one molecule of a monobasic acid, so that its hydrochloride is represented by the formula $C_{22}H_{22}O_2N_3$, HCl, and this difference in the basicity of the two nitrogen atoms must be taken into account in assigning constitutional formulas to such alkaloids.

In most cases the nitrogen atoms are tertiary; that is, each is united to three different carbon atoms, one of which in such cases is generally in a methyl group, so that the state of such nitrogen atoms can be graphically represented by (I).

Such a group is called a methylimino group, and a method of estimating these in alkaloids has been devised. Sometimes a secondary nitrogen group is present (*e.g.*, ammonia, NH_3), in which only two of the hydrogen atoms have been replaced by carbon linkages (II). The hydrogen of a secondary nitrogen group can in most cases be replaced in an alkaloid by a methyl group, and the secondary nitrogen (II) is thereby converted into a methylimino group (I) which can be estimated.



By similar means it is possible to discover how the oxygen atoms in an alkaloid are built into the molecule. Most frequently they are present as hydroxyl (OH) groups or derivatives of such groups, such as methoxy (OCH_3), acetoxy (O.COCH_3) or benzoxy ($\text{O.CO.C}_6\text{H}_5$). Occasionally a carboxyl group (COOH) is present, either as such or linked up with the nitrogen to form a betaine (*q.v.*) or with its hydrogen atom replaced by methyl forming a methyl ester. There are now well-established methods of ascertaining the presence or absence of these types of groups, and after a preliminary investigation of a new alkaloid in this fashion the chemist arrives at a point at which he can write the empirical formula of the alkaloid in some such extended form as (III); that is, he has still to ascertain how the alkaloidal nucleus, consisting of x carbon atoms and y hydrogen atoms is built up, and how the groups shown in brackets are built into it. This further information is generally obtained by breaking up the alkaloid chemically into small fragments, examining each of the pieces in the same way as the parent alkaloid was examined, and going on with this process until a recognizable fragment, which may be any one of the thousands of known organic compounds, is found. With that first clue to guide him, and

within the limits rigidly prescribed by all he knows as to the composition and reactions of the alkaloid, the chemist can then proceed to visualize a constitutional formula. This breaking-down process is generally accomplished by carefully regulated oxidation of the alkaloid, with such agents as potassium permanganate, chromic acid or nitric acid, substances which burn off a few carbon atoms at a time leaving products which generally become simpler in character; or there may be used a more complicated process called exhaustive methylation, in which the nitrogen atom of a carbon-nitrogen ring is loaded with substituents until it breaks from its cyclic carbon attachments leaving fragments either recognizable or convertible into recognizable substances.

The Opium Alkaloids.—Opium (*q.v.*) contains at least 25 alkaloids, of which morphine (*q.v.*) is by far the most important, followed by codeine (morphine methyl ether), narcotine, papaverine (*q.v.*), thebaine and protopine. Much progress has been made in the determination of the intimate structure of the alkaloids of opium and they can all be regarded in a broad sense as derivatives of isoquinoline. Thus, the five minor alkaloids, papaverine, laudanose, codamine, laudanine and laudanidine, form a group of substituted *l*-benzylisoquinolines; narcotine and narceine (*q.v.*) are *l*-meconylisoquinolines; and as the meconyl residue $\text{CH}_2\text{C}_6\text{H}_2(\text{OMe})_2\text{COO}$ itself can be regarded as derived from benzyl, $\text{C}_6\text{H}_5\text{CH}_2$; all seven alkaloids are derivatives of *l*-benzylisoquinoline.

The next group of opium alkaloids, morphine, codeine and thebaine, are more condensed and more complex in structure. The simplest member of the group to which they belong is glaucine, found in the yellow-horned poppy, *Glaucium luteum*, but not in the opium poppy. Glaucine has been synthesized from laudanose by a simple reaction, which gives rise to a phenanthrene (*q.v.*) complex by internal condensation within the benzylisoquinoline structure and so this group of alkaloids is conveniently spoken of as the phenanthrene group. Synthesis of the simpler members of this group is in progress, but their representatives in opium, the three alkaloids just mentioned, constitute an interesting variation on the typical structure of the phenanthrene group and for them the formulas first proposed by J. M. Gulland and Sir Robert Robinson (1924–25) became generally accepted. Morphine and codeine are still indispensable in medicine and morphine is a drug of addiction. On these grounds it is desirable that a drug as effective as morphine, but without its disadvantages, should be made available. Much chemical and pharmacological work has been devoted to this subject and a number of useful synthetic analgesics have been discovered, though the ideal morphine substitute has still to be found.

A third group is represented in opium by two members, protopine and cryptopine. The former is almost the typical alkaloid of the poppy order (Papaveraceae) since it has been found in most species of this order, the alkaloids of which have been systematically examined. This group can be regarded as developed from berberine (*q.v.*), though curiously enough no alkaloids of the berberine type have been found in any member of the poppy order. Their intimate structure has been determined by W. H. Perkin, in whose laboratory both protopine and cryptopine have been synthesized (1926).

(See also CHEMISTRY: *Organic*; EPHEDRINE; HYDRASTINE; NICOTINE; PILOCARPINE; PURINES.)

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ALKANET, a plant, *Kanana* or *Anchusa tinctoria*, of the family Boraginaceae, also known as orchanet, dyer's bugloss, Spanish bugloss or bugloss of Languedoc, which is grown in the south of France and on the shores of the Levant. Its root yields a fine red colouring matter which has been used to tint tinctures, oils, wines, varnishes, etc.

AL-KASR AL KEBIR: see KASR AL KEBIR.

ALKMAAR, town in the province of North Holland, Netherlands, 24½ mi. by rail north-north-west of Amsterdam, communicating with Haarlem and Amsterdam, and on the North Holland canal. Pop. (1940) 31,774. The name Alkmaar ("all sea") first occurs in the 10th century and recalls the original situation of a fishing village in the midst of marshes and lakes. The first charter was dated 1254; charters (1436 and 1437) of Philip the Good of Burgundy established an oligarchy on grounds of previous mismanagement; much damage was done in wars between Hollanders and Frisians, and the Gelderlandes and Frisians captured the town in 1517. In 1573 it successfully sustained a siege by the Spaniards. It acquired an important trade after reclamation of the surrounding swamps from 1685 onward. In 1799 it gave its name to a convention by which the Russo-British

army evacuated Holland. It is a typical North Holland town, with tree-lined canals and brightly coloured 17th-century houses. The city walls have been replaced by boulevards and there is a park with a monument commemorating the siege by the Spaniards in 1573.

The Groote Kerk (1470–98) has the tomb of Floris V, count of Holland (d. 1296). In the town hall (1507) are the library and a small museum with two pictures by Caesar van Everdingen, who, with his brother Allart van Everdingen (*q.v.*), was a native of the town. The weighhouse (1582) has a quaint gable and tower.

Alkmaar has a flourishing butter and cheese trade and is a centre of cheese export. It is also a considerable market town. Tramways connect Alkmaar with Egmond and the summer resort of Bergen, sheltered by woods and dunes.

ALLACCI, LEONE (LEO ALLATIUS) (1586–1669), Greek scholar and theologian, and a voluminous writer, was born in the island of Chios. His early years were passed in Calabria and at Rome, where he finally settled as a teacher of Greek at the Greek college, at the same time devoting himself to the study of classics and theology. Allacci was sent to superintend the removal to Rome of the 196 cases of mss. from Heidelberg presented by the elector Maximilian of Bavaria to Pope Gregory XV. This collection (*bibliotheca Palatina*) was incorporated with the Vatican library. On the death of Gregory, Allacci became librarian to Cardinal Berberini, and subsequently (1661) librarian of the Vatican, which post he held till his death.

BIBLIOGRAPHY.—Stephanus Gradi, *Leonis Allatii vita* (published in the *Nova Bibliotheca Patrum*); Curzio Mazzi, *Leone Allacci e la Palatina di Heidelberg* (Bologna, 1893); E. Legrand, *Bibliographie hellénique du XVII^{ème} siècle*, iii, 435–471 (1895); L. Petit's article in A. Vacant's *Dictionnaire de théologie*, cols. 830–833 (1900).

ALLĀH, the Arabic name used by Moslems of all nationalities for the one true God, compounded of *al*, the definite article, and *ilāh*, "god." The same word is found in Syriac as well as in Arabic inscriptions prior to the rise of Islam.

See A. Jeffery, *Foreign Vocabulary of the Qur'ān*, p. 66 (Baroda, 1938); J. Wellingshausen, *Reste arabischen Heidentums*, p. 217 ff., 2nd ed. (Berlin, 1897).

ALLAHABAD, a city of India, the capital of the United Provinces of Agra and Oudh, giving its name to a district and a division. The city (pop. 260,630 in 1941) is situated at the confluence of the Ganges and the Jumna rivers, 564 mi. from Calcutta by rail.

Its most conspicuous feature is the fort, at the junction of the rivers. It contains one of Asoka's pillars; the remains of a splendid palace erected by the emperor Akbar and once a favourite residence of his; and an important arsenal. Outside the fort the places of most historic interest are the tomb and gardens of Khasru, the son of the emperor Jehangir, and the Jama Masjid or Great Mosque. Allahabad (Ilahabad) was the name given to the city when Akbar built the fort. To the Hindus it is still known by its ancient name of Prag or Prayag ("place of sacrifice"), and is a noted resort of Hindu pilgrimage. A bathing festival, known as the Magh-mela, is held at the confluence of the rivers during the Hindu month of Magh. It is attended by as many as 250,000 persons in ordinary years and every 12th year it becomes the Kumbh-Mela, when as many as 1,000,000 devotees crowd to it from all parts of India. Allahabad was taken by the British in 1765 from the wazir of Oudh, restored to him in 1771, and by him finally ceded together with the district to the British in 1801, in commutation of the subsidy which the wazir had agreed to pay for British protection. During the Mutiny of 1857 (see INDIAN MUTINY) Allahabad became the scene of one of the most serious outbreaks and massacres which occurred in the northwestern provinces. The fort was held by a little garrison of Europeans and loyal Sikhs until it was relieved by Gen. James Neill on June 11 of that year.

The modern buildings of Allahabad include Government House, the High Court, the university, the Mayo memorial and town hall, the Muir central college, the Thornhill and Mayne memorial library and museum, the Naini central jail and the Anglican and Roman Catholic cathedrals. Both rivers are crossed by fine rail-

way bridges; and the place is an important railway centre. The military cantonments contain accommodation for all three arms and are the headquarters of a brigade. At Allahabad was published, until it was removed to Lucknow in 1935, the *Pioneer*, perhaps the best known paper in India. It is the home of the parent university of the provinces, from which most of the others have branched off; and it is a centre of numerous educational and missionary institutions.

The district of Allahabad has an area of 2,798 sq.mi. In shape it is an irregular oblong, and it is very difficult to define its boundaries, as at one extremity it wanders into Oudh, while on the south the villages of the state of Rewa and those of this district are intermingled. The Jumna and the Ganges enclose within their angle a fertile tract well irrigated with tanks and wells. The East Indian railway and the Grand Trunk road afford the principal means of land communication. Pop. (1941) 1,812,981.

The present division of Allahabad has an area of 10,102 sq.mi. Population in 1941 was 6,014,813. It comprises the five districts of Farrukhabad, Etawah, Cawnpore, Fatehpur and Allahabad.

ALLAMANDA, named after J. N. S. Allamand (1713-87), of Leyden, a genus of shrubby, evergreen climbers, many with showy flowers, belonging to the family Apocynaceae, and a native of tropical America.

ALLAN, DAVID (1744-1796), Scottish historical painter, was born at Alloa. On leaving Foulis's academy of painting at Glasgow (1762) Lord Cathcart and Erskine of Mar furnished him with the means of proceeding to Rome (1764), where he remained for a number of years. Returning from Rome in 1777, he lived for a time in London. In 1780 he removed to Edinburgh, where he was appointed director and master of the Academy of Arts. There he painted and etched in aquatint a variety of works, those by which he is best known—as the "Scotch Wedding," the "Highland Dance," the "Repentance Stool," and his "Illustrations of the Gentle Shepherd"—all being remarkable for their comic humour. Allan died at Edinburgh on Aug. 6, 1796.

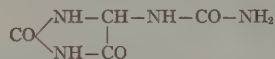
ALLAN, SIR HUGH (1810-1882), Canadian financier, was born on Sept. 29, 1810, at Saltcoats, Ayrshire, Scotland. He emigrated to Canada in 1826, and in 1831 entered the employ of the chief shipbuilding and grain-shipping firm of Montreal, of which he became a junior partner in 1835. In 1853 he organized the Allan line of steamships, plying between Montreal, Liverpool and Glasgow; till his death he was closely associated with the commercial growth and prosperity of Canada, and in 1871 was knighted in recognition of his services. In 1872-73 he obtained from the Canadian Government a charter for building the Canadian Pacific railway, but the disclosures made with reference to his contributions to the funds of the Conservative Party led to the Pacific scandal (see CANADA: History), and that company was soon afterwards dissolved. He died in Edinburgh on Dec. 9, 1882.

See J. C. Dent, *Canadian Portrait Gallery* (1881).

ALLAN, SIR WILLIAM (1782-1850), Scottish historical painter, was born in Edinburgh, and studied at the school of design in his native city. Allan spent some years in Russia between 1805 and 1814 and travelled extensively in Southern Russia, bringing back a portfolio of vivid sketches which provided material for much of his later work. In 1814 he returned to Edinburgh and in the two following years exhibited at the Royal Academy "The Circassian Captives" and "Bashkirs conducting Convicts to Siberia." In the next 20 years he established his fame by the illustration of Scottish history in a series of works which included "Archbishop Sharpe on Magus Moor"; "John Knox admonishing Mary Queen of Scots" (1823), engraved by Burnet; "Mary Queen of Scots signing her Abdication" (1824); and "Regent Murray shot by Hamilton of Bothwellhaugh." The last subject procured his election as A.R.A. (1825). In 1834 he visited Spain and Morocco, and in 1841 went again to St. Petersburg, when he undertook, at the request of the tsar, his "Peter the Great teaching his Subjects the Art of Shipbuilding", exhibited in London in 1845, and bought for the Winter Palace of St. Petersburg. Allan received many honours, including that of knighthood in 1842. He died on Feb. 22, 1850.

ALLAN-DESPRÉAUX, LOUISE ROSALIE (1810-1856), French actress, was "discovered" by Talma in Brussels as a child, when she played Joas. She played children's and then *ingénue* parts at the Théâtre Français, and in 1831 began to play at the Gymnase. During her six years at the Gymnase she made a great name. Madame Allan (she married an actor in the Gymnase company) then went to St. Petersburg, and there discovered *Un Caprice* by Alfred de Musset, made a success of it, and on her return to Paris chose it for her reappearance at the Théâtre Français. This was the beginning of Alfred de Musset's success as a dramatist. Madame Allan held her own as an actress even when she appeared by the side of Rachel. She died at the height of her success in 1856.

ALLANTOIN is found in the allantoin liquid of the cow, and in the urine of sucking calves. It forms glancing prisms of neutral reaction slightly soluble in water. It can be obtained by the oxidation of uric acid by means of lead dioxide, manganese dioxide, ozone or potassium permanganate, and has been synthesized by E. Grimaux by heating one part of glyoxylic acid with two parts of urea (*q.v.*) for ten hours at 100° C. It is the diuride of glyoxylic acid, with the formula



ALLARGANDO (Ital.), a musical term indicating a slackening of the speed and a general increase of weight and breadth in the style of performance.

ALLBUTT, SIR THOMAS CLIFFORD (1836-1925), British physician, was born at Dewsbury, Yorkshire, July 20, 1836. Educated at St. Peter's school, York, and Caius college, Cambridge, he studied medicine at St. George's hospital, London, and afterwards in Paris, subsequently practising in London and Leeds. He carried out much valuable work on the pathology of the nervous system, and made important investigations of tetanus and hydrophobia, devoting, in addition, considerable time to ophthalmoscopy and inventing the short clinical thermometer.

He was consulting physician to many institutions and from 1889 to 1892 was a commissioner in lunacy. In 1892 he became regius professor of physic at Cambridge, in 1907 was created K.C.B. and in 1920 a privy councillor. He died at Cambridge, Feb. 22, 1925.

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ALLEGHENY MOUNTAINS or THE ALLEGHENIES, a name formerly applied to all the Appalachian mountains (*q.v.*), and now, sometimes, to all that system lying west and south of the Hudson river, being steep and narrow-crested in Pennsylvania (1,500-1,800ft.), in Maryland, Virginia and West Virginia rising to above 4,000ft. and with broader crests. It is also used to include the ridges (the Allegheny ridges) parallel to the Blue ridge; the north-western part of this region is called the Allegheny Front, and is characterized by a bold south-eastward facing escarpment and a gentle north-westward slope. The Allegheny plateau is the north-westernmost division of the Appalachian system; it is an eroded mass of sedimentary rock sloping north-westward to the Lake plains in the region of the Great Lakes and reaching south-west from the Catskill (see CATSKILL MOUNTAINS) region of New York state to the Cumberland plateau region in Tennessee. The Alleghenies, which once formed a barrier to western communication, have long since been crossed by numerous railways and highways which follow the lower elevations or the "water gaps" of the eastward-flowing streams.

ALLEGHENY RIVER, a river of Pennsylvania and New York and the principal tributary of the Ohio river, whose source is the confluence of the Allegheny and the Monongahela at Pittsburgh. The Allegheny rises in the high, hilly plateau region of

Potter County, Pa., at an elevation of about 2,250ft. above sea-level. From its source it flows in a general north-westerly direction about 80m., crossing into New York, to a point 11m. N. of the State line. Here it turns abruptly south-west and continues in this direction for 120m. to the central part of Venango county, Pennsylvania. It then turns to the south-east and again south-west to its confluence with the Monongahela at Pittsburgh. Its total length is about 310m. and its drainage basin 11,400 sq. miles. The topographical character of its drainage basin ranges



PART OF A TOW ON THE ALLEGHENY RIVER OF 9 BARGES OF STEEL PRODUCTS FROM PITTSBURGH AND 2 BARGES OF COAL FOR THE FUEL OF THE STERN-WHEEL STEAMER DURING THE TRIP

from the steep hills and broken country of the eastern slope to the comparatively level marshy western slope. The chief tributaries of the Allegheny are Conewango creek (which flows from the lake region of Chautauqua county, N.Y.), French creek, and Clarion and Kiskiminetas rivers. The Allegheny once served as an important highway for keel-boat navigation and later for transporting the petroleum and coal produced along its banks, but this was only before the beginning of railway competition. The canalized portion of the river, extending from Pittsburgh to Natrona (24m.) and seven feet in depth, has an annual traffic valued at about \$12,000,000.

ALLEGIANCE, the duty which a subject or citizen owes to the State or to the sovereign of the State to which he belongs. It is often used by English legal commentators in a larger sense, divided by them into natural and local, the latter applying to the deference which even a foreigner must pay to the institutions of the country in which he happens to live; but it is in its proper sense, in which it indicates national character and the subjection due to that character, that the word is important. In that sense it represents the feudal *liege homage*, which could be due only to one lord, while simple homage might be due to every lord under whom the subject held land. The English doctrine asserted that allegiance was indelible: *Nemo potest exuere patriam*.

It was said to be a debt and duty to the sovereign co-extensive with the life of the subject. As Blackstone wrote: "It is a principle of universal law that the natural-born subject of one Power cannot by any act of his own (no, not by swearing allegiance to another) put off or discharge his natural allegiance to the former; for this natural allegiance was intrinsic . . . and cannot be diverted without the concurrent act of that Prince to whom it was first due." This doctrine was one of the causes of the war of 1812 with the United States, which had already rejected it. Eventually, after much controversy with Great Britain, Congress in 1868 ordained that "The right of expatriation is a natural and inherent right of all people, indispensable to the enjoyment of the rights of life, liberty and the pursuit of happiness," and one of the "fundamental principles of the Government." In the same year a Royal Commission was set up by the British cabinet to enquire into the subject, resulting in the Naturalization Act 1870, whereby for the first time British subjects, whether natural-born or naturalized, were enabled, apart from an Act of Parliament

or cession of British territory, to renounce their nationality and allegiance. This right of expatriation was substantially re-enacted by the British Nationality and Status of Aliens act 1914-22. By this act also a natural-born British subject who has become a subject of a foreign state may, if of full age and not under disability, make a declaration of alienage. But it was held in *Lynch's Case* (1903), 1 K.B. 444, that a British subject could not become naturalized in an enemy's country during time of war. Taking an oath of allegiance to the enemy state was an act of treason. It would appear, however, from the decision in *Pedlar v. Johnson* (1920), 2 I.R. 450, that a British subject may become naturalized in a neutral state and engage in acts of hostility against his state of origin without sacrificing his rights as a friendly alien. (See OATH; NATIONALITY AND NATURALIZATION.)

See Salmond, "Citizenship and Allegiance" in the *Law Quart. Rev.*, vols. 17 and 18; and J. A. Foote, *Private Inter. Law*, 5th ed. (1925). (J. W.; H. H. L. B.; X.)

ALLEGIANCE PLEDGE TO U.S. FLAG. The pledge to the U.S. flag was first published in the *Youth's Companion* of Sept. 8, 1892. Conflicting claims have arisen about its authorship, but a committee of historians appointed by the United States Flag association decided in 1939 that the author was Francis Bellamy of Rome, New York. Bellamy was chairman of the National Columbian Public School celebration, for which the pledge was originally written. The text of the pledge, as modified by the national flag conferences, is as follows:

"I pledge allegiance to the Flag of the United States of America and to the Republic for which it stands; one nation indivisible, with liberty and justice for all."

ALLEGORY, a figurative representation conveying a meaning other than and in addition to the literal. It is generally treated as a figure of rhetoric, but the medium of representation is not necessarily language. An allegory may be addressed to the eye, and is often embodied in painting, sculpture or some form of mimetic art. The etymological meaning of the word is wider than that which it bears in actual use. An allegory is distinguished from a *metaphor* by being longer sustained and more fully carried out in its details, and from an *analogy* by the fact that the one appeals to the imagination and the other to the reason. The fable or parable is a short allegory with one definite moral. The allegory has been a favourite form in the literature of nearly every nation. The Hebrew scriptures present frequent instances of it, one of the most beautiful being the comparison of the history of Israel to the growth of a vine in the 80th psalm. In classical literature one of the best-known allegories is the story of the belly and the members in the speech of Menenius Agrippa (Livy ii. 32, Plutarch's *Life of Coriolanus*, and Shakespeare's play derived therefrom); and several occur in Ovid's *Metamorphoses*. Perhaps the most elaborate and the most successful specimens of allegory are to be found in the works of English authors. Spenser's *Faerie Queene*, Swift's *Tale of a Tub*, Addison's *Vision of Mirza*, and, above all, Bunyan's *Pilgrim's Progress*, are examples which it would be difficult to match in elaboration, beauty and fitness, from the literature of any other nation.

ALLEGRI, GREGORIO (1582-1652), Italian priest and composer, was born at Rome and studied music under G. Maria Nanini, the friend of Palestrina. He was a member of the Sistine chapel choir from 1629 until his death on Feb. 18, 1652. His most famous composition is the *Miserere*, performed once a year in Holy Week at the Sistine chapel, the score of which was jealously guarded for a century. But in 1769 Mozart, then a boy of 13, heard it and wrote it down from memory—a wonderful feat—and Dr. Burney afterwards (1771) obtained a copy and published it. Two volumes of concertos (published 1618-19), and two volumes of motets (published 1620-21) are available, but much of his work remains in manuscript.

ALLEGRO, an Italian word meaning literally "cheerful," which, however, as used in music has come by a natural process to mean a quick or lively rate of speed, coming between *andante* and *presto*. It is also used of a separate piece of music, or of a movement in a sonata, symphony, etc. The diminutive form *allegretto* signifies a speed somewhat less fast.

ALLEINE, JOSEPH (1634–1668), English Nonconformist divine, was born at Devizes, Wiltshire, and educated at Oxford, where he became a fellow and tutor of Corpus Christi. He was curate to George Newton, vicar of St. Mary Magdalene, Taunton, from 1655 to 1662, when both he and his vicar were ejected for nonconformity. He was several times imprisoned for preaching during the remaining six years of his life, which were spent in wandering from one place of temporary safety to another. He died on Nov. 17, 1668. Alleine was one of the best loved of the Puritan preachers, and a considerable scholar. His *Alarm to the Unconverted* (1672) had an enormous circulation.

See *Life*, edited by Baxter; *Joseph Alleine: his Companions and Times*, by Charles Stanford (1861); Wood's *Athenae*, iii, 819.

ALLELOMORPH, the name applied to each of a pair of characters in Mendelian inheritance. (See **HEREDITY**; **MENDELISM**.)

ALLEMANDE, a name for two kinds of dance, one a German national dance, in 2-4 time, the other somewhat resembling a waltz (from Fr. for German). In music, it signifies a certain kind of movement in a suite, usually following the prelude and preceding the courante (*q.v.*), with which it is contrasted in rhythm; but this has no connection with the dance. The name, however, is also applied to pieces of music based on the dance movement, examples of which are found in Beethoven's German dances for the orchestra. (See **DANCE**.)

ALLEN, ETHAN (1739–1789), U.S. soldier, was born at Litchfield, Conn., on Jan. 10, 1739. He removed, probably in 1769, to the "New Hampshire grants," where he took up lands, and eventually became a leader of those who refused to recognize the jurisdiction of New York, and contended for the organization of the "grants" into a separate province. About 1771 he was placed at the head of the "Green Mountain boys," an irregular force organized for resistance to the "Yorkers." On May 10, 1775, soon after the outbreak of the Revolutionary War, in command of a force, which he had assisted some members of the Connecticut assembly to raise for the purpose, he captured Ticonderoga from its British garrison, calling upon its commanding officer—according to the unverified account of Allen himself—to surrender "in the name of the great Jehovah and the Continental Congress." Seth Warner being elected colonel of the "Green Mountain boys" in July 1775, Allen, piqued, joined General Philip Schuyler, and later with a small command, but without rank, accompanied General Richard Montgomery's expedition against Canada. On Sept. 25, 1775, near Montreal he was captured by the British, and remained a prisoner until exchanged on May 6, 1778. Upon his release he was brevetted colonel by the continental congress. He then, as brigadier general of the militia of Vermont, resumed his opposition to New York, and from 1779 to 1783, acting with his brother, Ira Allen, and several others, carried on negotiations, indirectly, with Governor Frederick Haldimand of Canada, who hoped to win the Vermonters over to the British cause. He seems to have assured Haldimand's agent that "I shall do everything in my power to make this state a British province." In March 1781, he wrote to congress, with characteristic bluster, "I am as resolutely determined to defend the independence of Vermont as Congress that of the United States; and rather than fail will retire with the hardy Green Mountain boys into the desolate caverns of the mountains and wage war with human nature at large." He removed to Burlington, Vt., in 1787, and died there Feb. 11, 1789. He was, says Tyler, "a blustering frontier hero—an able-minded ignoramus of rough and ready humour, of boundless self-confidence, and of a shrewdness in thought and action, equal to almost any emergency." Allen wrote a *Narrative of Colonel Ethan Allen's Captivity* (1779), the most celebrated book in the "prison literature" of the American revolution; *A Vindication of the Inhabitants of Vermont to the Government of New York and their Right to form an Independent State* (1779); and *Reason, the Only Oracle of Man* (1784).

Ethan's youngest brother, **IRA ALLEN** (1751–1814), born on April 21, 1751, at Cornwall, Conn., also removed to the New Hampshire grants, where he became one of the most influential

political leaders. In 1775 he took part in the capture of Ticonderoga and the invasion of Canada. He was a member of the convention which met at Winchester, Vt., and in Jan. 1777 declared the independence of the New Hampshire grants; served (1776–1786) as a member of the Vermont council of safety; conducted negotiations, on behalf of Vermont, for a truce with the British and for an exchange of prisoners, in 1781; served for eight terms in the general assembly, and was state treasurer from 1778 to 1786 and surveyor general from 1778 to 1787. In 1789, by a gift of £4,000, he made possible the establishment of the University of Vermont, of which institution, chartered in 1791 and built at Burlington in deference to his wishes, he was thus virtually the founder. In 1795, on behalf of the state, he purchased from the French government arms for the Vermont militia, of which he was then the ranking major general, but he was captured by a British cruiser west of Ireland on his return journey, was charged with attempting to furnish insurrectionary Irish with arms, and after prolonged litigation in the British courts, the case not being finally decided until 1804, returned to Vermont in 1801. During his absence he had been dispossessed of his large holdings of land through the operation of tax laws, and to escape imprisonment for debt, he removed to Philadelphia, where on Jan. 4, 1814, he died. He published a dull and biased, but useful *Natural and Political History of Vermont* (1798), reissued (1870) in vol. i of the *Collections of the Vermont Historical society*.

J. B. Wilbur, *Ira Allen, Founder of Vermont* (2 vol., 1928); Henry Hall's *Ethan Allen* (New York, 1892) may be consulted. The best literary estimate may be found in M. C. Tyler's *Literary History of the American Revolution* (1897). See also John Spargo, *Ethan Allen at Ticonderoga* (1926); John Pell, *Ethan Allen* (1929).

ALLEN, FREDERICK MADISON (1879–), U.S. physician, was born in Des Moines, Ia., on March 16, 1879. He graduated at the University of California in 1902, studied medicine for one year in the University of Chicago, and in 1907 graduated in medicine at the University of California. He made researches on diabetes at the Harvard medical school in 1909–12 and at the Rockefeller institute for medical research in 1913–18. He was director (1920–33) of the Psychiatric institute, Morristown, N.J., where he continued investigation and treatment of diabetes and related disorders. In 1922 he became the editor of the *Journal of Metabolic Research*.

His published writings include *Studies Concerning Glycosuria and Diabetes* (1913), *Total Dietary Restriction in the Treatment of Diabetes*, with E. Stillman and R. Fitz (1919), and *Treatment of Kidney Diseases and High Blood Pressure* (1925).

ALLEN, GEORGE (1832–1907), English engraver and publisher, was born at Newark-on-Trent on March 26, 1832, and died at Orpington, Kent, on Sept. 5, 1907. He was apprenticed to a Clerkenwell builder, and became a skilled joiner. He came into contact with Ruskin at Ruskin's drawing class at the Working Men's college, and was closely associated with him as general assistant engraver and publisher for 50 years. He studied mezzotint under Lupton, under J. H. Le Keux, and produced the plates for Ruskin's later books. In 1862 Allen went to Mornex, Savoy, where Ruskin then thought of settling, and there he made a considerable collection of minerals. He began his publishing business in 1871, in his cottage at Keston, and afterward in the garden of his house at Orpington, as the publisher of Ruskin's works. Twenty years later he removed to London, and began business as general publisher. He was engaged on the library edition of Ruskin's works (1903–11) at the time of his death.

ALLEN, GLOVER MORRILL (1879–1942), U.S. naturalist, born at Walpole, N.H., Feb. 8, 1879, was educated at Harvard university (A.B., 1901, A.M., 1903, Ph.D., 1904). Before graduation from college he completed, with R. H. Howe, Jr., *The Birds of Massachusetts* (1901). He served as secretary and editor (1901–24) and librarian (1901–27) of the Boston Society of Natural History, and completed the *Birds of New England* (1909) and his widely used manual on *Birds and Their Attributes* (1925). He began his systematic study of mammals during a post-doctoral year at Harvard (1906–07). From 1924 until his death on Feb. 14, 1942, he was curator of mammals at the Museum of

Comparative Zoology, Harvard, and professor of zoology. His many expeditions took him to the Bahamas (1904), Labrador (1906), British East Africa (1909), island of Granada, British West Indies (1910), Sudan (1912), Liberia and Belgian Congo (1926), Brazil (1929) and Australia (1931). He published many reports on birds and mammals, notably *Bats* (1939), *Checklist of African Mammals* (1939) and *Mammals of China and Mongolia* (1939). He was editor of *The American Naturalist* (1906-07) and *The Auk* (1937-42), and president of the Nuttall Ornithological club (1919-42) and the American Society of Mammalogists (1927-28). (G. F. Ss.)

ALLEN, GRANT (CHARLES GRANT BLAIRINDIE) (1848-1899), English author, son of a clergyman of Irish descent, was born at Kingston, Ont., Canada, on Feb. 24, 1848. He was educated partly in America and France, and in England at King Edward's school, Birmingham, and afterward at Merton college, Oxford. He was for a few years a schoolmaster in Jamaica, but then made his home in England. He died in his house at Hindhead, Surrey, on Oct. 24, 1899. Grant Allen was a voluminous author. His scientific books (such as *Physiological Aesthetics*, 1877; *The Evolutionist at Large*, 1881; *The Evolution of the Idea of God*, 1897) contain much original matter, popularly expressed. He first attracted attention as a novelist with a sensational story, *The Devil's Die* (1888), though this was by no means his first attempt at fiction; and *The Woman who Did* (1895), which had a temporary *succès de scandale* because of its treatment of the sex problem, inspired many imitations.

See E. Clodd, *Grant Allen: A Memoir* (London, 1900).

ALLEN, SIR HUGH PERCY (1869-1946), director of the Royal College of Music and professor of music at Oxford university, was born at Reading, Dec. 23, 1869, and received his first appointment as organist of St. Saviour's, Reading, at the age of 11. After holding many similar appointments he became closely associated with the music of both Cambridge and Oxford, in the one case as organ scholar of Christ's college and in the other as organist of New college. In the latter capacity he displayed characteristic energy and enthusiasm in developing the musical life of the university. Concurrently he became known to the London musical public as conductor of the Bach choir, and on the death of Sir Hubert Parry (*q.v.*) in 1918 he was chosen to succeed him at the Royal College of Music. He succeeded Sir Walter Parratt as professor of music at Oxford in the same year. He was knighted in 1920, and received the K.C.V.O. in 1928 and the G.C.V.O. in 1935. He died on Feb. 20, 1946, at Oxford.

ALLEN, SIR JAMES (1855-1942), New Zealand statesman, was born in South Australia on Feb. 10, 1855, his parents settling in New Zealand a year later. He was educated in England at Clifton and St. John's college, Cambridge, and afterward studied at the Royal School of Mines, in London. Returning to New Zealand, he was, in 1887, elected a member of the house of representatives. He was minister of finance, defense and education from 1912-15, and, in 1915, when a separate ministry of defense was formed, he took charge of it, retaining the post until 1920. It was largely due to his efforts that, in 1914, the New Zealand force was one of the most effective of the British dominion armies. In the absence of Mr. Massey in England during and after World War I, he acted as prime minister for two years. He was made a K.C.B. in 1917 and was high commissioner for New Zealand in London from 1920 to 1926. His long, practical experience as a dominion administrator and his sympathetic understanding of the needs of the empire rendered his presence in London especially valuable both to the dominion and the empire. He was the author of *New Zealand and Federation: The Financial Aspect* (1899), a pamphlet issued by *The Press*, Christchurch; *New Zealand's Possessions in the South Seas* (1903); and *New Zealand and Naval Defence* (1930). He died July 28, 1942.

ALLEN, JAMES LANE (1849-1925), U.S. author, was born Dec. 21, 1849, on a small plantation near Lexington, Ky., where he passed most of his early life. He acquired a scholarly background for his creative work through his study at Transylvania university (then called Kentucky university), his professorship of Latin and English at Bethany college, West Virginia, his

teaching of languages in preparatory schools and his own wide reading and early essays in criticism. The landscape and gentle breeding of Kentucky inspired his first ripe and polished series of tales, *Flute and Violin* (1891). These are the dominant notes also in his sketches, *The Blue-Grass Region of Kentucky* (1892), and his early novels, *A Kentucky Cardinal* (1894) and its sequel, *Aftermath* (1895), and *The Choir Invisible* (1897). *A Summer in Arcady* (1896) marks a transition to a second phase in which he is preoccupied with problems, largely of sex, as in *The Mettle of the Pasture* (1903), *The Bride of the Mistletoe* (1909) and *The Doctor's Christmas Eve* (1910), although *The Reign of Law* (1900) concerned itself with a youth whose old-fashioned faith was shattered by his new-found science.

His last novels were more varied. His early poems were beautiful and serious. He died in New York, Feb. 18, 1925.

See G. C. Knight, *James Lane Allen and the Genteel Tradition* (1935).

ALLEN, JOEL ASAPH (1838-1921), U.S. zoologist, was born in Springfield, Mass., on July 10, 1838. He attended Wilbraham academy and then studied zoology under Louis Agassiz in the Lawrence scientific school, Harvard university. From 1865 to 1869 and again in 1873 he was a member of scientific expeditions to Florida, the Rocky mountains and Brazil. In connection with these expeditions he collected much zoological material on which he made extensive investigations, the results of which were published chiefly in the *Proceedings of the Boston Society of Natural History*. His *Mammals and Winter Birds of Eastern Florida* (1871) won for him the Humboldt scholarship of the Lawrence scientific school, and placed him in the front rank of American naturalists. In 1871-73 he was lecturer and in 1873-85 assistant in ornithology in the Museum of Comparative Zoology, Harvard. From 1885 until his death he was curator of mammalogy and ornithology in the American Museum of Natural History, New York city. During this period he published a large number of papers on birds and mammals and for more than 30 years gave editorial supervision to all the zoological publications of the museum, about 60 volumes. He took a leading part in organizing the American Ornithologists' Union, edited three issues of its *Check List of North American Birds*, and from 1884 to 1912 edited its official journal *The Auk*, to which he contributed more than 600 papers. His *Autobiographical Notes* (1916) contains a bibliography of his scientific writings, including some 1,400 titles. He died at Cornwall-on-Hudson, Aug. 29, 1921.

Among his more important works, other than those before mentioned, are *The American Bisons Living and Extinct* (1876); with Elliott Coues, *Monographs on North American Rodentia* (1877); *History of North American Pinnipeds* (1880); *Mammals of Patagonia* (1905); *The Influence of Physical Conditions on the Genesis of Species* (1905); and *Ontogenic and Other Variations in Musk-Oxen* (1913).

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ALLEN, JOHN (1476-1534), English divine, after studying at both Oxford and Cambridge, was sent by Archbishop Warham on an ecclesiastical mission to Rome. He was one of Wolsey's agents in the suppression of the minor monasteries in 1524-25, and in 1528 became archbishop of Dublin. For four years he was chancellor of Ireland. In 1531 he was fined under the statutes of provisors and praemunire, and in 1534 was murdered by Lord Thomas Fitzgerald's followers.

ALLEN, RICHARD (1760-1831), U.S. Negro clergyman, was born of slave parents in Philadelphia, Pa., in 1760. Soon after his birth his parents were sold into slavery in Delaware. At 17 years of age he joined the Methodist Episcopal Church and when 22 years old was licensed to preach. Four years later (1786) he purchased his freedom for \$2,000, Continental money, and returned to Philadelphia. Here he joined St. George's M.E.

Church in which he was permitted to preach to Negroes at 5 o'clock meetings. Dissatisfied with the restrictions placed upon those who attended these meetings, he decided to withdraw. He personally purchased a lot at the corner of 6th and Lombard streets, and moved upon it an old blacksmith shop which he refurbished as a house of worship. Here he organized in 1787 the first church for Negroes in the United States. His followers who congregated here were called Allenites. Despite opposition and a series of obstructive lawsuits, a charter was secured from the general assembly of Pennsylvania. A new church building was erected and opened in 1794. It was dedicated by Bishop Francis Asbury (*q.v.*) and called Bethel. In 1799 Allen was regularly ordained in the ministry of the Methodist Episcopal Church, the first Negro minister so ordained. In 1816, upon the organization of the African Methodist Episcopal Church, Allen was elected bishop. He died in Philadelphia on March 26, 1831.

See *Centennial Encyclopedia of the African Methodist Church* (Philadelphia, 1916).

ALLEN, VIOLA (1869–1948), U.S. actress, was born in Huntsville, Ala., on Oct. 27, 1869. She was a daughter of C. Leslie Allen, an actor of ability, and was educated in Boston, Toronto and New York city. At the age of 13 she made her debut in the title role of *Esmeralda* at Madison Square theatre, New York. Later she appeared in leading classical, Shakespearian and comedy roles with Lawrence Barrett, Tommaso Salvini, Joseph Jefferson and other noted actors. She created and played leading parts in *Sowing the Wind*, *The Masqueraders* and *Under the Red Robe*. In 1898 she appeared with marked success as Gloria Quayle in *The Christian* by Hall Caine, and in 1902 as Roma in Hall Caine's *The Eternal City*. Beginning in 1903 in a series of Shakespearian productions, she played Viola in *Twelfth Night*, in 1904–05 she appeared as Hermione and Perdita in *A Winter's Tale* and in 1906–07 she played in a repertoire which included, besides the foregoing, *Cymbeline* and *As You Like It*. After an interval in modern comedy parts, she returned in 1915 to Shakespearian drama, playing Lady Macbeth in company with J. K. Hackett, and in 1916 she appeared as Mistress Ford in *The Merry Wives of Windsor*. In 1906 she was married to Peter Duryea. She died on May 10, 1948, in New York city.

ALLEN, WILLIAM (1803–1879), American lawyer and politician, was born in Edenton, N.C., in 1803. When 16 years old he moved to Chillicothe, O., attended the Chillicothe academy, studied law, and at the age of 21 was admitted to the bar. He rapidly attained prominence as a lawyer and in 1833 was elected to congress as a Democrat, the youngest member, when seated, of the national house. In 1836, following his energetic support of Van Buren's presidential campaign, he was elected to the U.S. senate, in which he served two terms, 1837–49. In the senate, in which he was a forceful figure, he received the nicknames "Earthquake Allen," "Petticoat Allen" and the "Ohio Gong," and is said to have originated the famous slogan used so effectively in the presidential campaign of 1844, "Fifty-four forty, or fight!" Following the defeat in 1848 of Lewis Cass, the Democratic candidate for president, whom he most ardently supported, and the expiration soon after of his own term in the senate, Allen withdrew from active participation in politics until 1873, when he was elected governor of Ohio. While governor, he became a prominent advocate of an irredeemable currency, and in 1875, on the Greenback issue, he was defeated for re-election by Rutherford B. Hayes (*q.v.*). Allen died in Chillicothe, O., on June 11, 1879.

See Reginald Charles McGrane, *William Allen* (Columbus, O., 1925).

ALLEN, ZACHARIAH (1795–1882), American scientist, inventor and manufacturer, was born in Providence, R.I., on Sept. 15, 1795, the son of a wealthy merchant. He graduated at Brown university in 1813, was admitted to the bar in 1815, and in 1822 became engaged in manufacturing enterprises. By the use of his wealth and through his inventions he substantially aided the development of various industries in Rhode Island. In 1821 he constructed the first hot-air furnace for the heating of dwelling houses. For the purpose of studying advanced mechanical methods he visited in 1825 England, France and the Netherlands. In 1833 he secured the patent for the automatic cutoff valve for

steam-engines, his most widely known invention. He made an improved fire engine, devised a storage reservoir for water-power and was the first to make a calculation of the motive power of Niagara Falls, which he published in *Silliman's Journal* in 1844. Among his published writings are: *The Science of Mechanics* (1829); *Philosophy of the Mechanics of Nature* (1852); *The Rhode Island System of Treatment of the Indians*, and of *Establishing Civil and Religious Liberty* (1876); and *Solar Light and Heat, the Source and Supply* (1879). He died in his native city on March 17, 1882.

See Amos Perry, *Memorial of Zachariah Allen, 1795–1882* (Cambridge, Mass., 1883).

ALLEN, BOG OF, a group of morasses in Kildare, King's county, Queen's county, and Westmeath, Ireland. Clane bog, the eastern extremity, is within 17 mi. of Dublin, and the morasses extend westward almost to the Shannon. Their total area is about 238,500 ac. The tract of country to which the name is given is intersected by strips of dry cultivated land. The rivers Brosna, Barrow, and Boyne rise in the morasses, and the Grand and Royal canals cross them. The bog has a general elevation of 250 ft. above sea level, and the average thickness of the peat beds is 25 ft. It rests on clay and marl.

ALLENBY, EDMUND HENRY HYNMAN, 1ST VISCOUNT (1861–1936), British field marshal, was born April 23, 1861, and joined the Inniskilling dragoons in 1882. He saw active service early in the Bechuanaland expedition of 1884–85 and in Zululand 1888, and later passed through the Staff college. During the South African war (1899–1902) he took part in the cavalry operations leading to the relief of Kimberley, in the battle of Paardeberg, and in the advance to Pretoria. His command of the 5th lancers from 1902–05 spread his reputation throughout the army. After commanding a cavalry brigade, he became inspector of cavalry in 1910 and in 1914 went out to France in command of the cavalry division.

The work of his troops, mounted, during the retreat from Mons and advance to the Aisne, and, dismounted, in holding the line south of Ypres during the critical weeks of October, won high praise in Sir John French's despatches. When a second cavalry division arrived, Allenby was given command of the cavalry corps then formed, and in Oct. 1915 he succeeded Sir Charles Monro as commander of the 3rd army. Throughout 1916 his army front was relatively quiet, but in the spring of 1917 it played a foremost role in the battle of Arras.

In June Allenby left France to succeed Sir Archibald Murray in charge of the forces in Egypt and Palestine. His first three months on the borders of Palestine, the season being still unsuitable for operations, were devoted to intensive preparations for an autumn offensive, reorganizing the command, greatly developing the communications, and moving his own general headquarters from Cairo to the front at Rafa. Complete secrecy and many ruses misled the Turks as to the main point of attack. The strong defences of Gaza were bombarded from Oct. 26 onward, and serious attacks followed on Nov. 1 to fix the enemy's attention and compel him to draw in his reserves.

Meanwhile, as a necessary preliminary to the real blow, the outlying bastion of Beersheba, 35 mi. E. of Gaza, was gained by a convergent manoeuvre on Oct. 31, a prelude to the decisive attack on Nov. 6 which broke through the enemy's weakened centre and into the plain of Philistia. This compelled a general retreat of the Turks, and the pursuit was pressed so relentlessly that by Nov. 14 the port of Jaffa had been seized, the Turkish armies driven apart in two divergent masses, and Allenby was able to wheel his forces to the right for an advance inland on Jerusalem. The British troops kept too closely on the heels of the Turks for the latter to block the narrow mountain passes, and, despite a stout Turkish resistance almost at the gates of Jerusalem the objective was gained with the surrender of the city on Dec. 9. By the time the winter rains set in the position of the British had been improved and their hold on Jaffa and Jerusalem had been made thoroughly secure.

The further advance initiated in the spring was interrupted by the crisis on the western front, which forced the dispatch to

France of most of Allenby's British troops. The depletion was made up by reinforcements from India and Mesopotamia, and the summer of 1918 was devoted to reorganization and the training of these new units. Finally, in mid-September, the carefully planned and prepared offensive was launched. Feinting toward the east bank of the Jordan, to distract the enemy's attention, Allenby secretly concentrated, on the Mediterranean flank, the mass of the infantry and behind them the cavalry. In this way he changed a two-to-one superiority on the general front into a four-to-one superiority at the decisive point of attack. On the night Sept. 18-19 the forces in the hilly centre had attacked to fix the enemy's attention, and at dawn on the 19th the western mass struck; the result was to roll the Turks back northeast, like a door on its hinges.

Through the open doorway the cavalry passed, riding straight up the coastal corridor for 30 mi. before swinging east to cut the Turkish communications and close all exits of retreat. Completely trapped, the main Turkish armies were rounded up, while the British cavalry exploited the victory of Megiddo by a swift and sustained pursuit which gained first Damascus and finally Aleppo. The capitulation of Turkey rang down the curtain on this brief and dazzling campaign. Making all allowances for the British superiority in strength, it must rank as one of the masterpieces of military history, as perfect in execution as in design. For his services the victor was promoted field marshal and raised to the peerage as Viscount Allenby of Megiddo and Felixstowe, receiving also a grant of £50,000.

Though his campaign had been waged beyond the borders of Egypt, Allenby had been throughout responsible for the protection and internal order of the Nile delta, where the military situation and the changed status of Egypt had led to considerable unrest. In 1919 he was appointed British high commissioner in Egypt, and held the post until 1925, through the long sequence of political trouble and disturbances arising out of the agitation for independence. In such conditions criticism of the administration was inevitable, but it is a testimony to Allenby's impartiality and sympathy that it was rather of the velvet glove than of the iron hand. If the ultimate verdict rests with history, it can at least be recognized now that the prestige of his name was a unique asset, and indeed made him the only possible choice for the post at such a critical period. He died in London, May 14, 1936. See PALESTINE, OPERATIONS IN. (B. H. L. H.)

ALLENSTEIN, a town in East Prussia, Germany, on the river Alle, 100 mi. N.E. of Thorn by rail. Pop. (1939) 50,474. The town possesses a mediaeval castle, and has courts, with superior courts at Königsberg. The town makes machines, cement, furniture, gloves and umbrellas. It trades in grain, leather and cattle.

ALLENSTEIN-MARIENWERDER, a region composed of districts of the former Prussian provinces of East and West Prussia.

Articles 94-98 of the Treaty of Versailles (*q.v.*) provided that the East Prussian circles (Kreise) of Allenstein, Ortelburg, Ostérode, Sensburg, Johannsburg, Lotzen, Lyck and Neidenburg, in so far as they had not already been ceded to Poland, and further the West Prussian circles of Marienwerder (east of the Vistula), Stuhm, Rosenberg and the section of the circle Marienburg situated east of the Nogat, should declare by a plebiscite whether they desired to belong to Germany or Poland. Until the plebiscite should take place the administration of these circles was taken over by inter-Allied commissions for East and West Prussia respectively, supported by Allied garrisons.

The plebiscite held on July 11, 1920, was preceded by much agitation and band warfare. In the East Prussian region 98% of the population voted for Germany, in the West Prussian 92%. Both districts were assigned to Germany on the basis of the vote; but, in accordance with the terms of the Treaty of Versailles, a zone 50 mi. broad and some 30 mi. long on the east bank of the Vistula near Marienwerder and four villages with the harbour of Kurzebrack on the same river were assigned to Poland in order to secure for the Polish state, at this point, the sovereignty over the course of the Vistula accorded to it by the treaty. The inhabitants of the adjacent East Prussian territory are at all times

to have access for themselves and their boats to the Vistula. Three frontier communes in the southwest of East Prussia were also assigned to Poland. On Aug. 16 both the inter-Allied commissions left the plebiscitary areas.

ALLENTOWN, a city of Pennsylvania, U.S., on the Lehigh river, 56 mi. N.N.W. of Philadelphia; county seat of Lehigh county. It is on federal highways 22, 222 and 309 and is served by the Reading system, the Central Railroad of New Jersey and the Lehigh Valley railroad and the Lehigh and New England (for freight only); also by Trans World and United air lines. Pop. (1950) 106,233; (1940) 90,904 by federal census.

Deposits of iron ore, slate and cement rock in the hills surrounding the city, and development of a cement manufacturing process by David O. Saylor, a native, led to the city's development as one of the state's leading industrial communities. There were approximately 285 manufacturing plants in the city at mid-20th century, with products valued at \$235,000,000. The city is the centre of the nation's largest cement producing district and is also noted for the manufacture of motor trucks, motor buses, machinery and tools, textiles, clothing and cigars. It is also a distribution centre; one-fifth of the nation's people live within a radius of 200 mi. A modern airport and daily transcontinental air service aided the city's commercial growth. The annual retail volume is about \$140,000,000.

Allentown is the seat of Muhlenberg college for men and Cedar Crest college for women.

The city was founded in 1762 by Chief Justice William Allen of the Pennsylvania supreme court. It was incorporated as the borough of Northampton in 1811; in 1812 it was made the county seat; in 1838 the original name was resumed; in 1867 it was incorporated as a city. Trout hall, built by Judge Allen, is now occupied by the Lehigh County Historical society. During the Revolutionary War the Liberty Bell was taken to Allentown from Philadelphia and hidden in the basement of Zion Reformed church for safekeeping.

The city is known for its flower-trimmed light standards and its extensive park system. Trexler-Lehigh county game preserve, north of the city, contains the largest herd of buffalo in eastern United States and also large herds of elk and deer. The buffalo were originally native to the territory but were driven west by the early settlers. When the game preserve was created the animals were brought back to their original habitat.

ALLEPPEY, a seaport of south India, in the state of Travancore, 33 mi. south of Cochin, on a strip of coast between the sea and one of those backwaters that here form the chief means of inland communication. Pop. (1941) 56,300. There is a lighthouse 85 ft. high. Though the third town in the state in point of population, Alleppey is the first in commercial and industrial importance. It commands a fine harbour, affording safe anchorage for the greater part of the year. It was opened to foreign trade toward the latter end of the 18th century. The exports include pepper, cardamoms, copra, coir, ginger and coconuts. There are several oil mills.

ALLERGY, from the Greek *ἀλλή ἐργεια*, means literally an altered reaction. The word is used to designate a group of diseases, or sometimes a field of study, but more properly it describes the reaction on which these diseases depend. Allergy may be defined as the reaction exhibited by certain persons when they are exposed to certain substances which are harmless to normal people.

The reaction is characteristic: it depends upon a dilatation of local blood vessels (redness), a leakage of fluid from the blood capillaries (swelling or oedema) and sometimes upon a spasm of the smooth muscles in bronchi or in blood vessels (wheeze or asthma). The capacity to develop sensitiveness and to react defines the "allergic individual." The capacity is often inherited, whereas the specific allergy is not inherited. The father or mother may have hay fever, while the child may have eczema. Only those who have the capacity develop the typical symptoms.

Exposure to certain substances causes allergy. The reaction is specific: the patient will react only when he is sensitized to the particular substance. Thus, the patient with cat asthma will react in his skin, his eye, or his nose, to the local application of an ex-

tract of cat hair and dander; he will not react to ragweed, as does another patient with August and September hay fever, or to egg white as may a child with eczema. The reaction depends on antibodies, which in allergy are fixed to the tissues and which are specific for the particular sensitizing substance. It is the union between allergen and antibody which causes the release of histamine, which, in turn, produces the symptoms.

The list of substances which can act as allergens is long. Pollens, animal danders, moulds, domestic dusts that arise from kapok or feather upholstery, are all of great practical importance. Food substances are less important. Drug allergy is increasing as research in chemistry yields new and more complex medicines.

The symptoms of allergy depend on the mode of contact, as well as on the varying susceptibility of different tissues. When the symptoms are in the nose and the patient sneezes, he is said to have hay fever; when in the chest and he wheezes, he is said to have asthma; or when the skin erupts and itches, he is said to have eczema.

History.—The term "allergy" was proposed by Clement Von Pirquet in 1906. He noted that individuals who recovered from infections reacted to the causative organism, or its products, in an abnormal fashion: the tuberculous patient showed a positive tuberculin reaction. The patient treated with immunizing serum from an animal often developed a "serum disease" which began about ten days later. After that, a skin test with the same serum resulted in an immediate local reaction quite different from the negative test before treatment. In each case the normal reaction was altered, and Von Pirquet called it *allergie*.

In the meantime, anaphylaxis had been recognized first by Charles Richet and Paul Portier in 1902. When foreign protein, like horse serum or egg white, is injected into a normal guinea pig, nothing happens, but the animal becomes sensitized after an incubation period. If at that time a second dose of the same material is injected, shock occurs immediately.

In 1910, S. J. Meltzer recognized that the lungs of patients dead of asthma looked much the same as the lungs of guinea pigs dead of anaphylactic shock. The phenomena of natural sensitiveness in man came to be correlated with the phenomena of experimental anaphylaxis in animals. In 1912, O. M. Schloss published his classical description of the child sensitive to eggs, almonds and oatmeal, and described the results of skin tests with extracts of the offending substances. After 1914, J. L. Goodale, R. A. Cooke, I. C. Walker and others advanced the study of allergy rapidly.

Diagnosis is facilitated by the skin test. In 1893 Charles H. Blackley, who himself had hay fever, applied grass pollen to a scratch on his forearm, producing a swelling, redness and itching which developed in a few minutes. Nearly 20 years passed before real attention was paid to this observation. After 1916, skin tests were applied with great enthusiasm and were made with an ever-increasing number of allergens, derived both from foods and dust. Slowly, it was appreciated that many positive tests had no symptoms to go with them, and that many patients were clinically sensitive, even though the skin tests remained negative. Skin tests are tests of the skin only and may or may not reflect the sensitiveness of the nose or of the bronchial tubes. Positive skin tests, which may remain for some time after clinical sensitiveness has cleared, reflect the past history rather than the present illness. It is the clinical history which offers the best method of diagnosis. Thus, when the patient loses all his symptoms within two days after admission to the hospital, or when he clears on a trip away from home, he probably has escaped from a dust which was causing trouble at home. The doctor must be also a detective.

Incidence of Allergy.—This is estimated at from 2% to 5% of the general population. It is a disease of youth, and the age of onset is usually before 30. There are a few cases, however, in which hay fever, for example, does not begin until after the age of 40. Meantime, the saying: "All is not allergy that wheezes"—or sneezes or itches—often applies to the older age group.

Manifestations.—Hay fever, asthma and eczema are typical. In a few cases, urticaria (hives) or migraine headaches, or colitis, can be shown to depend on allergic reactions to foods, or perhaps to drugs. Toxic and allergic reactions must be distinguished. In the former, the drug is poisonous for every patient. In the latter, it affects only those few who have become sensitive to it, usually as a result of previous treatment with it. The adjective allergic indicates that the tissues of the patient play an active part in producing the reaction. The increasing incidence of drug allergy makes it important to be cautious about using such drugs as the sulfonamides or penicillin in cases where

they are not really necessary. Even small doses may give rise to a hypersensitiveness which will cause trouble when the drugs are used another time.

Treatment.—Whenever the specific factor can be identified, the patient should avoid it. To remove the cat or dog; to change the kapok ("silk floss") pillow; to clean house and remove the dusty rug or the old stuffed sofa may be all that is necessary, and the clue is in the clinical history. When elimination is not possible, then desensitization, by a series of injections of small doses of the specific allergen, can be attempted, but the technique is difficult. In hay fever, particularly, where a large number of patients makes it easy to compare one with another, the results are good. Moreover, the study of the same patient in successive years has made it possible to reduce greatly the number of doses and sometimes to omit them entirely.

Beginning about 1945, a series of useful antihistaminic drugs was discovered and developed. In May, 1949, Philip S. Hench, Edward C. Kendall and their associates at the Mayo clinic announced the discovery of cortisone and ACTH—hormonelike substances derived from the adrenal cortex and the pituitary gland respectively. These extraordinarily active substances are concerned with the defense of the body against the damages of stress and strain. They can relieve the symptoms of many diseases, including the so-called allergic diseases, for so long a time as they are administered in adequate doses. The allergic reaction is not inhibited, but the effects of it are modified in some way. When continued for too long a time, these new drugs may lead to complications which are serious. They do not represent the final answer. (See also ANAPHYLAXIS; ASTHMA; ECZEMA; HAY FEVER.)

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ALLERTON, ISAAC (1583?-1659), one of the American Pilgrims, was born probably in England about 1583. The first record concerning him is as a merchant in Leyden, Holland. He was a member of the English Separatist Church there and was made a freeman of the city in 1614. On the first voyage of the "Mayflower" in 1620 he came to Plymouth, Mass., and was the fifth to sign the historic "Mayflower Compact" (see MAYFLOWER). One of the most enterprising members of the colony, he took a prominent part in the conduct of its early affairs. As the colony's first assistant or agent he made several voyages to England and also carried on negotiations with the Indian chief Massasoit. A disagreement in 1631 led to his separation from the colony. He went first to Marblehead, Mass., and later, about 1635, to New Amsterdam, now New York, where in 1643 he was made a member of the council. His latter years were spent at New Haven, Conn., where he died in 1659. His daughter Mary, whose death occurred in 1699, was the last survivor of the original "Mayflower" company.

See William Bradford, *History of the Plymouth Plantation* (Boston, 1856, 1898); Annie A. Haxton, *Signers of the "Mayflower Compact"* (1896-99); Edward Beaman Patten, *Isaac Allerton, First Assistant of Plymouth Colony* (1908); and George E. Bowman, *The "Mayflower Compact" and Its Signers* (Boston, 1920).

ALLESTREE or ALLESTRY, RICHARD (1619-1681), royalist divine and provost of Eton college, son of Robert Allestree, and a descendant of an ancient Derbyshire family, was born at Uppington in Shropshire. He took an active part in the Civil War, and during the Commonwealth frequently carried despatches between Prince Charles and the English royalists. He was imprisoned for a brief period after one of these missions. At the Restoration he became canon of Christ Church, D.D. and city lecturer at Oxford, in 1663 chaplain to the king and regius professor of divinity, and in 1665 provost of Eton college. He introduced order into the disorganized finances of the college and procured the confirmation of Laud's decree, which reserved five of the Eton fellowships for members of King's college. His additions to the college buildings were less successful; for the "Upper School," constructed by him at his own expense, was falling into ruin almost in his lifetime, and was replaced by the present structure in 1689. Allestree died Jan. 28, 1681, and was buried in the chapel at Eton college, where there is a Latin inscription to his memory.

His writings include many controversial tracts. A share in the composition, if not the sole authorship, of the books published under the name of the author of the *Whole Duty of Man*, has been attributed to Allestree (Nichols' *Anecdotes*, ii, 603), and the tendency of modern criticism is to regard him as the author. His lectures, with which he was dissatisfied, were not published. Alles-

tree was a man of extensive learning, of moderate views and a fine preacher. He was generous and charitable, of "a solid and masculine kindness," and of a temper hot, but completely under control.

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ALLEYN, EDWARD (1566–1626), English actor and founder of Dulwich college, was born in London Sept. 1, 1566, the son of an innkeeper. In 1586 his name was on the list of the earl of Worcester's players, and he was eventually rated by common consent as the foremost actor of his time. Ben Jonson bestowed unstinted praise on Alleyn's acting (*Epigrams*, No. 89). Nash expresses in prose, in *Pierce Penniless*, his admiration of him, while Heywood calls him "inimitable," "the best of actors," "Proteus for shapes and Roscius for a tongue." Alleyn inherited house property in Bishopsgate from his father. His marriage, on Oct. 22, 1592, with Joan Woodward, stepdaughter of Philip Henslowe, brought him eventually more wealth. He became part owner in Henslowe's ventures and, in the end, sole proprietor of several play-houses and other profitable pleasure resorts. Among these were the Rose theatre at Bankside, the Paris garden and the Fortune theatre in St. Luke's—the latter occupied by the earl of Nottingham's company, of which Alleyn was the head. He filled, too, in conjunction with Henslowe, the post of "master of the king's games of bears, bulls, and dogs." On some occasions he directed the sport in person, and Stow, in his *Chronicles*, gives an account of how Alleyn baited a lion before James I. at the Tower.

Alleyn's connection with Dulwich began in 1605, when he bought the manor of Dulwich from Sir Francis Calton. The landed property, of which the entire estate had not passed into Alleyn's hands earlier than 1614, stretched from the crest of that range of Surrey hills on whose summit the Crystal Palace stood, to the crest of the parallel ridge, three miles nearer London, known in its several portions as Herne hill, Denmark hill and Champion hill. He began the task of building and endowing in his own lifetime the College of God's Gift at Dulwich. All was completed in 1617 except the charter or deed of incorporation for setting his lands in mortmain. Tedious delays occurred in the Star Chamber, but the College of God's Gift at Dulwich was founded and endowed under letters patent of James I. dated June 21, 1619. Alleyn died in Nov. 1626, and was buried in the chapel of the college which he had founded.

ALL FOOLS' DAY: see APRIL-FOOLS' DAY.

ALL FOURS, name of a family of card games known in England in the 17th century or before, and the national game of U.S. card players, especially in the west, until poker replaced it. Auction pitch was the only variant that remained popular far into the 20th century.

The parent game of all fours (or seven-up, old sledge, high-low-jack-and-the-game) is played by two, three or four. Four may play, each for himself or in partnerships. The 52-card pack is used and 6 cards are dealt to each player, 3 at a time. The next card is turned as the trump card. Eldest hand may say, "I stand," accepting the turned-up card as trump, or "I beg." In the latter case dealer may say "Take it," and the turned-up card establishes the trump, whereupon eldest hand scores one for "gift"; or dealer may score one for "refusal of gift" and "run the cards," dealing three more cards to each player and turning a new trump card. If the new trump card is of the same suit as the first, the cards are run again and a new trump card turned. When the new trump card is of a different suit from the first, it establishes the trump suit.

Once the trump suit is established, each player discards as many cards as are necessary to bring his hand down to six cards, and play commences. Eldest hand leads. Each player in rotation (which is clockwise), if able to follow suit, must either follow suit or trump. The cards rank: ace high, king, queen, knave, ten, down to two. The highest card of the suit led, or

the highest trump if the trick contains one, wins the trick. The winner of each trick leads to the next.

One point each is scored for holding the highest and lowest trumps in play; one point is scored for winning the jack (knave) of trumps in a trick; one point is scored for game—winning the most scoring cards, counting ace 4, king 3, queen 2, knave 1, ten 10. If dealer and another player tie for game, dealer loses it. The winner is the first player or side reaching seven (seven-up), or ten, if that is preferred. When two players or sides could win on the same deal, the points are counted in order high, low, jack, game. The right to deal passes in rotation.

Auction Pitch (or setback or pitch) may be played by four to seven players but is best for four, each playing for himself. No trump card is turned. Each player in turn, beginning with eldest hand, has one chance to bid, the highest bid being four. The high bidder "pitches" (leads) first, and the suit of the card he pitches is trump. If the pitcher at least fulfils his contract, he scores as many points as he has made; if he falls short of his contract, he is "set back" the amount of his bid (has those points deducted from his score). Each other player scores what he makes. The object is to be first to reach seven points; if two or more players could reach seven on the same deal, the pitcher's points are counted first; among other players the points are counted in order: high, low, jack, game.

Smudge is often played as a part of auction pitch. It means that a player bidding and making four wins the game in the one hand, unless he was "in the hole" (had a minus score) at the time.

Some play that the dealer can assume the contract at the highest preceding bid, without "bidding over." Others give the dealer this privilege except when another player has bid four.

Sell-out or commercial pitch is an earlier form of auction pitch, superseded by the game described above. Cinch, at one time the most popular club game of the all fours family, passed from favour when auction bridge was introduced. California Jack, a two-handed game of the all-fours family, is still played.

See Albert H. Morehead, *The Modern Hoyle* (1944).

ALLGEMEINE-ELEKTRIZITÄTS-GESELLSCHAFT, commonly known as the A.E.G. Prior to 1923, this was the largest electrical manufacturing concern in Germany and one of the most important industrial undertakings in the world. After that year, however, the rapid expansion of the Siemens-Schuckert, Siemens-und-Halske group served to relegate it to second place. In 1933 the capital invested in the company was 185,000,000 marks and the total balance sheet 216,133,000 marks. The total number of employees engaged directly by the firm at the start of World War II was probably 50,000. Including subsidiaries it employed more than 100,000 workers. As a result of administrative and financial changes caused by the nazi regime, reconstruction was forced on the company whereby its capital was reduced and increased again to 160,000,000 marks, 40,000,000 marks being provided by the power finance group, the Gesellschaft für Elektrische Unternehmen. The General Electric company of the U.S. owned 25% of the capital. In Feb. 1942 the A.E.G. and the Gesellschaft für Elektrische Unternehmen amalgamated, the former increasing its capital to 260,000,000 marks, exchanging 100,000,000 marks for the 80,000,000 marks capital held by the latter. Control over the A.E.G. was divided as a consequence between the financial consortium and the U.S. G.E.C. whose holding was now equivalent to 18%. Prior to World War II the A.E.G. increased its interest in radio, largely through purchase of control over the Telefunken company, in cables, porcelain and insulating material generally, and communications. It played an important part in nazi railway electrification schemes and entered into aeroplane manufacture on a large scale; it supplied complete range of equipment for the secret munition works built by the German government after 1936. (H. Q.; X.)

ALLIA (mod. Fosso Bettina), a small tributary of the Tiber on the left (east) bank, about 11 mi. N. of Rome. It gave its name to the terrible defeat of the Romans by the Gauls on July 18, 390 B.C. Despite objections, Livy's account, placing the battle on the left bank of the Tiber, must probably be accepted.

ALLIANCE, a city of northwest Nebraska, U.S., county seat of Box Butte county, served by the Burlington railroad and by Western air lines. The population was 7,852 in 1950 and 6,253 in 1940 by federal census.

Alliance is the centre of an extensive cattle-raising area and has large railroad shops.

ALLIANCE, a city of Stark county, O., U.S., on the Mahoning river, 55 mi. S.E. of Cleveland, about 1,080 ft. above sea level. It is served by the Pennsylvania and the New York Central railway systems. The population was 26,112 in 1950, 22,405 in 1940 and 23,047 in 1930 by the federal census. The city has important manufactures, including railroad equipment, heavy industrial machinery, steel forgings, metal stampings, steel castings, welded tubes, household appliances, paint, electric motors, ladies apparel, rubber products, porcelain products, brick and pottery.

Mount Union college, a co-educational school of the Methodist church, is located in the southwest part of the city. It began as a select school of six pupils in 1846 and in 1858 was chartered as a college. In 1911 Scio college (1857) was merged with it. Alliance was settled and laid out in 1838, incorporated as a village in 1854 and as a city in 1888.

The name "Alliance" was derived from the junction or crossing of the two railroads.

ALLIANCE, in international law, a league between independent States, defined by treaty, for the purpose of combined action, defensive or offensive, or both. Alliances have usually been directed to specific objects carefully defined in the treaties. Thus the Triple Alliance of 1688 between Great Britain, Sweden, and the Netherlands, and the Grand Alliance of 1689 between the emperor, Holland, England, Spain and Saxony, were both directed against the power of Louis XIV. The Quadruple or Grand Alliance of 1814, defined in the treaty of Chaumont, between Great Britain, Austria, Russia and Prussia, had for its object the overthrow of Napoleon and his dynasty, and the confining of France within her traditional boundaries. The Triple Alliance of 1882 between Germany, Austria and Italy was ostensibly directed to the preservation of European peace against any possible aggressive action of France or Russia; and this led, some 10 years later, to the Dual Alliance between Russia and France, for mutual support in case of any hostile action of the other powers. Occasionally, however, attempts have been made to give alliances a more general character. Thus the "Holy Alliance" (*q.v.*) of Sept. 26, 1815, was an attempt, inspired by the religious idealism of the emperor Alexander I. of Russia, to find in the "sacred precepts of the Gospel" a common basis for a general league of the European governments, its object being, primarily, the preservation of peace. So, too, by Article VI. of the Quadruple Treaty signed at Paris on Nov. 20, 1815 (which renewed that of Chaumont and was again renewed, in 1818, at Aix-la-Chapelle) the scope of the Grand Alliance was extended to objects of common interest not specifically defined in the treaties.

It was this article of the treaty of Nov. 20, 1815, rather than the "Holy Alliance," that formed the basis of the serious effort made by the great powers, between 1815 and 1822, to govern Europe in concert, which will be found outlined in the article on the history of Europe. In general it proved that an alliance, to be effective, must be clearly defined as to its objects, and that in the long run the treaty in which these objects are defined must—(to quote Bismarck's somewhat cynical dictum)—"be reinforced by the interests" of the parties concerned. Yet the "moral alliance" of Europe, as Count Nesselrode called it, though it failed to secure the permanent harmony of the powers, was an effective instrument for peace during the years immediately following the downfall of Napoleon; and it set the precedent for those periodical meetings of the representatives of the powers, for the discussion and settlement of questions of international importance, which have contributed much to the preservation of the general peace. (*See EUROPE: History.*)

In the war of 1914-18 the United States were "Associates," not "Allies," signifying the want of a common agreement on the objects to be attained by the war.

(W. A. P.)

ALLIARIA OFFICINALIS: *see* GARLIC-MUSTARD.

ALLIBONE, SAMUEL AUSTIN (1816-1889), American author and bibliographer, was born in Philadelphia (Pa.), April 17, 1816, of French Huguenot and Quaker ancestry. He was privately educated and for many years was engaged in mercantile business in his native city. He, however, acquired a very unusual knowledge of English and American literature, and is remembered as the compiler of the well-known *Critical Dictionary of English Literature and British and American Authors* (1854-71), and of various anthologies and indexes. From 1867 to 1873, and again in 1877-79, Allibone was book editor and corresponding secretary of the American Sunday School Union; and from 1879 to 1888 he was librarian of the Lenox library, New York city. He died at Lucerne, Switzerland, Sept. 2, 1889.

See the "Memoir" by S. D. McConnell, an address delivered before the Historical Society of Philadelphia (1890).

ALLIED MARITIME TRANSPORT COUNCIL. This Council (which will be referred to below as the A.M.T.C.) was the organ through which, in the latter months of World War I, the Allied Powers decided how the merchant shipping at their disposal should be allotted among their different supply services. Throughout 1918 shipping was, in each of the Allied countries, the limiting factor in the whole of the civilian effort by which the military struggle was supported and conditioned. The authorities responsible for securing the food of their respective populations and for meeting the needs of the armies in munitions and other supplies found at this period that the primary factor in all their calculations was the amount of shipping space which they could obtain for their imported supplies or raw materials. Thus in 1918 the policy governing, in main principle, the allocation of merchant shipping determined in a very large measure the character and direction of the whole effort of the several Allied countries. It involved decisions of such intricate, far-reaching and decisive consequence that they could not be properly taken by a pure shipping authority nor indeed by any body of ministers except with the aid of a system which could give them at once access to the advice of the many authorities concerned and the means to judge between their competing claims.

We thus find that the A.M.T.C., the body of Allied ministers by whom the ultimate decisions were to be taken, was a part only, but the pivotal part, of a vast system partly national and partly international, through which the competing demands were sifted and adjusted and reduced to questions of principle, few in number but far-reaching in effect, for decision by the Council itself. This system was the counterpart in the civilian sphere of the unity of military command which was achieved at about the same time, and it was among the decisive factors in the issue of the struggle. It was different, not only in its enormous range, but in the principles of its organization; from anything previously known in administration; and it has had a profound effect on the methods and machinery by which world problems have been handled since the war. For all these reasons it deserves more attention than it has yet received both from the historian and the student of political and economic science.

The different parts of the system which were linked together by the A.M.T.C. had a separate existence, fulfilling in most cases some functions unconnected with shipping; and they are described in various other articles (*see* list at end of article). But as the A.M.T.C. was the pivotal part, it is here that we may conveniently give a brief sketch of the whole structure. Without such a general view no account of the A.M.T.C. would be intelligible, for it was essentially an instrument for linking together, for a special purpose, other authorities whose range of action extended beyond its own sphere, and except with them and through them it had no separate existence or means of action. The A.M.T.C. linked together a number of international (Allied) authorities dealing with the control of different commodities; and each of these was formed by linking together the national authorities dealing with the same commodities in the different Allied countries. The whole system was built up on the basis of national departmental control and administration, which it united and in no way replaced. We must therefore sketch, in the briefest practicable outline, the way in which the State control system grew up,

first nationally and then internationally; and for this purpose we can properly write mainly from the point of view of Great Britain, which was the principal centre of the whole Allied supply organization.

The British System of State Control.—Under the economic system in operation before the war, as now in most countries, supply is adjusted to demand by a method which is not only elastic and responsive but also automatic. Increased demand for an article pushes the price up; increased prices make it pay to produce more; they also pare off from the demand the poorer or less eager consumer. The essential characteristic of this system is that, over the whole range of human activity, needs and the means to satisfy them are adjusted without any human brain requiring to survey the system as a whole; without any attempt being made to measure competing demands in terms of either human need or public interest except so far as they are reflected in economic demand.

But for the conditions of war needs and shortage this system, independent of deliberate direction and control, proved blind and wasteful. It produced too little, it produced the wrong things, and it distributed them to the wrong people.

The State in war can order in large quantities; it can therefore dispense with many middlemen. And in war the necessities of all must have priority over the luxuries of a few. Under conditions of national shortage the criterion of effective economic demand does not secure this; with only bread enough to go round it will cause alternate surfeit and starvation. For these reasons, from the early days of the war, we find State control extending over spheres previously occupied by unfettered private enterprise. The new system was not introduced full-fledged on any general principles. On the contrary it was applied piecemeal, and often with obvious reluctance, under the compelling force of a breakdown or obvious defect of the peace system. Usually the earliest motive was to save the Treasury the expense of inflated competitive prices for war materials; then came the desire to mitigate the public indignation at similar prices for their own purchases; and lastly there was the necessity of distributing equitably what had become a bare sufficiency of the necessities of life.

90% of British Imports Under Control.—First sugar, then some two years later wheat and flour, were bought by the State. In time all the prime articles of food, both fresh and frozen meat, all cereals, oils and fats and subsidiary foodstuffs, were brought within the extending sphere of State control. And the control developed in intensity as well as range, passing from purchase to distribution, and in some cases to a detailed rationing of the individual consumer. Ultimately these activities were grouped under a central Ministry of Food. Meantime a similar process was developing in an equally wide sphere. First the manufacture of munitions and then not only all the raw materials needed for munitions, the metals and the chemicals required for explosives (coin ores, copper, zinc and spelter, lead, tin, aluminium, oils, nitrates, coal tar, etc.), but also, by a necessary consequence, all the manufactures of the country which were dependent on them, were brought within the single authority of the Ministry of Munitions. By the end of 1917 the national system of control was practically complete for both metals and food, and the two great ministries ultimately brought under their direct authority 70% of the national imports. Many of the remaining raw materials (wool, flax, jutes, hides and leather, and the connected industries) were being dealt with simultaneously, on similar principles, by the War Office. Finally, the Board of Trade, more slowly, less completely, and by more commercial methods, exercised its authority over the remaining imports (timber, cotton, paper and pulp, etc.). Ultimately 90% of the imports of Great Britain and something like that proportion of the principal productive activities of the country, were directed by the Government in the public interest. One by one the necessities of life, and of war, were brought under control, their purchase centralized, their transport allotted, their prices fixed, their consumption rationed.

It was the necessity of organizing a priority between different

services and requirements needing the same raw materials of which the full supplies available were insufficient that, to a large extent, compelled the grouping within a few great ministries which has just been described. The same necessity was constantly improving the mechanism of consultation and authority within each of these great departments which determined the proportions of the available resources to be allotted to different services and different industries. This was sufficient until a serious shortage began to be felt in the three great requirements common to them all—men, finance for the purchase of foreign supplies, and shipping to import them. This needed new machinery to decide not only within each of the ministries but between them. The system devised to allot men and to ration finance need not be described here. The central requirement, which at the most difficult period was the most serious of all, was shipping; it was upon this need that the international system under the A.M.T.C. was ultimately based.

Before describing this international development it is therefore necessary to add a note on the British control of shipping; for it was this control which the submarine made the centre of the whole system. So long as the shipping authorities were able to do their proper and normal work, that of providing the tonnage the supply services wanted, they were the servants of the supply departments. Just in proportion as submarine losses and increased requirements made it impossible for the shipping authorities to supply all the ships they were asked for, they necessarily tended to become the masters. For the allotment of the ships rested with them and that allotment set the limit to the programme of the supply department. This position only developed gradually. The British shipping department at first requisitioned only the ships needed for army and navy supplies and transport, leaving the rest for free or only partially controlled chartering. But the area extended as the stringency increased, and as a natural counterpart to the increasing control of supplies and materials by the other departments. With this extension the responsibility attaching to the allocation made by the shipping department constantly increased, till it became obviously too great to be exercised except in effective collaboration with the supply departments concerned. The successive methods by which this collaboration was attempted are described in another article (**WAR CONTROL OF SHIPPING**). Only the later developments can be noted here.

Tonnage Priority Committee.—The process by which the control of commodities was both extending and becoming grouped in a few great departments has already been described. In all these supply departments, specialized experts from the business world were incorporated in the official machine. Day by day they were testing the requirements of each industry by the criterion, not of changing market prices (which were ended by control) but of intrinsic importance in the general scheme of national policy. The Ministry of Shipping therefore, in allocating its ships, no longer had to deal with innumerable demands from hundreds of private industries, nor even directly with a score of government controls, but only with a few great ministries. In the penultimate state of this process, from Feb. 1917 till towards the end of that year, the task of balancing competing demands for shipping was facilitated by a new committee (viz., the Tonnage Priority Committee) presided over by Sir Leo Chiozza Money, the under-secretary in the Ministry of Shipping) consisting of executive officials from each of the main supply departments. Finally, in the last year of the war, after the intensive submarine campaign had made the allocation of tonnage the crucial factor in all supply arrangements, the decisions involved exceeded the authority of the officials who composed the greater part of that committee, and it was succeeded by a standing committee of cabinet ministers, presided over by Lord Milner, in which both the great supply departments and the Ministry of Shipping were represented. Here at last was a mechanism—a central committee of supreme authority, having behind it centralized and co-ordinated commodity controls—by which the nation's requirements as a whole could be surveyed, adjusted and directed. The problem of national organization was solved; and with it was secured the foundation of the wider international organization which was to follow.

The International System.—For the real problem was international as well as national, and the need for common action increased with the stress. France and Italy were buying supplies in the same neutral markets and they needed transport from the same interchangeable pool of tonnage under British and Allied control.

To understand the significance of the system which gradually grew up to meet this need it is necessary to recall the normal method by which arrangements were made between countries before the war broke out. If the French Ministry of Commerce needed to arrange something with the British Board of Trade, e.g., about shipping, it transmitted its request through the British embassy in Paris, or the French embassy in London, to the British Foreign Office, who in turn sent it on to the Board of Trade. The reply would come by the same channel, so that the communication between two specialized departments would have passed four times through the hands and pens of non-specialists—or, to be exact, of those who were specialized not in shipping but in the foreign relations of the two countries. This system was based on the principle that in such discussions the primary fact was not that shipping was the subject, but that two countries were negotiating. A shipping concession on the one hand might be set off against a concession of quite another kind, perhaps political. This could only be done by those dealing with the general foreign policy of their countries.

This procedure was obviously unsuitable in war. The intricacy of the arrangements necessitated direct contact between specialized ministers and officials; the common interests of the Allies outweighed their divergencies. Gradually a system was developed of which it was the fundamental principle that a French official wanting British ships was primarily a person wanting ships from someone who could supply them and not primarily a Frenchman negotiating with an Englishman.

Commission Internationale de Ravitaillement.—This result, which will be described later, was reached through many intermediate stages. The first modest beginning was in the establishment in 1914 of a body known as the *Commission Internationale de Ravitaillement*, whose principal object was to prevent the confusion and waste caused by hundreds of Allied agents in England placing orders with private manufacturers in competition both with each other and the British War Office. This body included representatives of the Allied purchasing departments and served a useful purpose in restraining prices, distributing orders with some regard to urgency, and to some extent in pooling knowledge and experience. Essentially, however, it was not an Allied organization but a British organization to help Allied purchases. At the same time it marked a progress towards the final development. At first the British representative in the C.I.R. would collect Allied demands and then himself deal with the officials of the British departments concerned. Then he would bring the Allied supply specialist with him. Then he ceased to come himself. "Direct contact" between specialists was established in individual cases; but it still needed to be developed and organized into a system.

Shipping assistance from Great Britain to the Allies was in the first years rather improvised than organized. Appeals for help were dealt with as far as possible on their merits by the British shipping authority, a method not unjustified at first when shipping was among the least of the Allied problems. But it was obviously inadequate when the shipping situation became so serious that the allocation of tonnage was of the most vital importance to the whole of the supply arrangements. A British authority was ill-equipped to measure British against French or Italian needs.

Wheat Executive.—A further development which began, on the supply side, with the establishment in 1916 of an effective Allied committee, the "Wheat Executive," led the way to the final solution. The British Royal Commission on Wheat Supplies had found itself faced with the evils of competitive purchase in the same markets by France and Italy; and the Wheat Executive, consisting of the cereal specialists of the three countries, was formed primarily to arrange combined purchase. In this it was very successful, but it soon had other advantages. The cereal

specialists in this committee settled among themselves the proportion of the total supplies each country should have. Henceforth the Ministry of Shipping could deal with cereal demands in the mass. It no longer had to weigh France's claim for wheat tonnage against Italy's, but only the competing claim of cereals as a whole against other commodities. A little later similar committees of specialists from the Allied countries were formed for some of the "munitions" commodities; and these were gradually increased and finally grouped under an Allied munitions council of ministers.

A new impulse to developing organization on an Allied basis was given when the United States entered the war in 1917 by the formation of a council to advise as to the allocation of American Credits (see INTER-ALLY COUNCIL OF WAR PURCHASES). Had finance been more limited than ships the council might have proved the centre of the whole system; but as transport could be found only for the most vital supplies, and it was certain that for these finance would be forthcoming, the real struggle was to squeeze supply demands within the limits of the available shipping, not within those of the available finance. This meant that the shipping organization was the centre of the system; and that it was under the pressure of shipping shortage that the highly developed national and the more partially developed Allied organs were linked into one comprehensive international system. The final impetus to this development was given by the transport crisis of 1917.

Transport Crisis of 1917.—By the autumn of 1917 the pressure on shipping was greater than it had ever been; 17,000,000 tons dead-weight of the world's shipping had been lost, and less than half had been replaced. More shipping had been lost in the first ten months of this year than in the previous 30 months of the war. American building had not yet seriously begun. The prospect of her vital contribution to the armed forces meant further demands on transport. And, apart from this, the demands were constantly increasing. All the distant expeditions, except to the Dardanelles, were fully maintained, and both troops and supplies were being sent to Salonica, Mesopotamia, Palestine and East Africa. Drafts were still required from Canada, South Africa, Australia and New Zealand. The scale of the war in France grew constantly, and the development in the character of warfare involved a larger expenditure of munitions. The navies were at their maximum strength. And serious food troubles throughout the winter and spring were anticipated in Great Britain, France and Italy alike.

The strain on the shipping authorities, while there was still no comprehensive inter-Allied organization fitted to determine priority between the different supplies, was in these conditions an intolerable one. At any moment the allocation of a batch of ships to food might mean a shortage of vital munitions, an allocation to munitions might entail starvation.

But by this time the national organization in the several countries, which was the indispensable condition of the inter-Allied system, was at its full development, and in wheat and munitions partial international arrangements were already working. In Great Britain the Ministry of Shipping had full and effective control over every voyage and every cargo, and the whole system of supply was centralized under the Milner Committee. A standing committee under M. Clémentel, Minister of Commerce, played a similar rôle in France. Italy's problem resolved itself practically into coal and cereals, and she had both of these as well as her shipping under complete control. Except, however, for consultation between munitions experts and the more fully developed Allied action of the Wheat Executive, these national supply systems were working with little knowledge of each other's needs. As regards most commodities there was still no means of judging fairly whether the standards of sacrifice and restriction were approximately equal or not.

The Allied Maritime Transport Council Established.—Those who realized the desperate position of shipping were convinced that it was now essential to develop and complete the system by extending Allied committees like the Wheat Executive over the whole range of supplies, and linking them up by depend-

ence for their transport upon a supreme Allied Shipping Council. On their proposal the necessary decisions were taken at the important Allied Conference which met in Paris in Nov. and Dec. 1917; and the A.M.T.C., consisting of two ministers of the three principal European Allies and two delegates from the United States of America was constituted and furnished with an executive organization.

What was the nature of this new council and of the Allied supply organization which now developed rapidly round it? It was not a supreme authority acting with a delegated power enabling it to override the governments which created it. No body of men could have been entrusted with such power, and those who at this time proposed either the appointment of a council with supreme executive power or a single economic dictator, were misled by the military analogy or ignorant of the realities of the supply situation. A single decision of such an authority, a reduction in sugar or in wheat imports for example, would affect every civilian household in the countries concerned. No cabinet could divest itself of responsibility for such decisions. The Paris Conference rightly, therefore, at the end of 1917, rejected the proposal of an "International Board with complete executive power over a common pool of tonnage."

Its Constitution.—On the other hand, if the A.M.T.C. was not in principle executive, it was in practice much more than advisory. If the first was impracticable, the second would have been useless. How could the need for urgent and desperate decisions be met by a body which, when it had itself decided, could only make recommendations to four governments and wait for their assent?

The solution of this particular dilemma was found in appointing as members of the council the ministers who in their own countries had the right to decide, and in forming the executive organization of the officials who in their own countries actually directed, or could effectively influence, the execution. This principle practically destroyed distinction between the executive and the advisory. In principle the council was advisory. But, if the British Shipping Controller agreed as a member of it to a decision involving orders to British shipping, he gave effect to it as a minister in his own department; and the same thing followed if the French Minister of Commerce agreed as a member to a decision involving a change in French supplies.

Had this principle been confined to the ministerial councils it would have represented some advance, but a quite insufficient one. Departmental conferences of ministers had often taken place before. To develop these into councils with a regular constitution and periodical meetings would have been useful, but not decisive. Ministers meet for a day or two and return. On matters of such intricate and detailed daily administration as are involved by arranging supplies in war, no such occasional meetings can resolve the difficulties of diverging national interest. The novelty of the new system consisted in the extension of this new principle, so far as was materially possible, to a series of committees of officials covering the whole range of shipping and supplies and responsible to the A.M.T.C. and two similarly formed Munitions and Food Councils.

Immediately under the A.M.T.C. was the first of these bodies, the Allied Maritime Transport Executive, of which, on the principle described above, the British member, who was the chairman, was the Director of Ship Requisitioning in the Ministry of Shipping, the French member, the influential *chef du cabinet* of the French Minister of Commerce, the Italian, an official of great influence in the Italian supply departments, while the American was one of the American members of the council. The headquarters were in London, and the staff was grouped in four national divisions under the direction respectively of the four members of the executive. The Council of ministers itself met only three times before the end of the war. But the Executive of officials met frequently, and in the long intervals between the council meetings was the instrument through which Allied co-ordination in the direction of shipping was secured.

Ultimately the whole range of imported commodities was covered by the following committees:—

Under the (Allied) Food Council:

1. Cereals (the wheat executive).
2. Oils and Seeds.
3. Sugar.
4. Meats and fats.

Under the (Allied) Munitions Council:

5. Nitrates.
6. Aircraft.
7. Chemicals.
8. Explosives.
9. Non-Ferrous Metals.
10. Mechanical Transport.
11. Steel.

And (without being grouped under a similar ministerial council):

12. Wool.
13. Cotton.
14. Flax, Hemp and Jute.
15. Hides and Leather.
16. Tobacco.
17. Paper and Pulp.
18. Timber.
19. Petroleum.
20. Coal and Coke.

It had been intended to group these last nine committees under a Raw Materials Council, but this council had not been formed when the Armistice made further organization of this kind unnecessary.

These committees secured combined Allied plans on all questions within their respective spheres on which combined action was necessary. It was only so far as their programmes needed shipping that they needed the approval of the A.M.T.C. But as the allocation of shipping was the crucial factor in all the main supply arrangements, the A.M.T.C. and its executive acquired the dominant position.

Working of the Machine.—As an example of the working of this system let us look at the duties of the most important of the Allied supply committees, the Wheat Executive, say in the spring of 1918. The committee is working, within a general programme agreed for the cereal year 1917-18. It has arranged through common agents for the provision of supplies in the United States, Canada, the Argentine and elsewhere. In contact with the shipping authorities, shipping has been sent to the loading ports. The ships are provisionally allotted for discharge in Great Britain, France and Italy; but the stocks, port facilities, etc., in each of these countries are watched daily, and the ships directed where desirable by orders sent to the ports of loading or even on arrival on the eastern side of the Atlantic.

Meantime, the Wheat Executive is negotiating with the Transport Executive as to the new programme for 1917-18. The latter, conscious of the competing claims for munitions, etc. is urging reduction. The Wheat Executive makes efforts at reduction and tries to distribute this reduction among the three countries. The margin of difference between the two executives is diminished, but not removed. An attempt is made by negotiations with the other food committees, and under the general authority of the Food Council, to balance the respective claims of cereals and other foodstuffs. The final food programme put forward by the Food Council is still in excess of what is likely to be obtained, but the difference is reduced to manageable dimensions. And the final issue is presented to the A.M.T.C., when it is practically simplified, to a decision between the competing claims of Allied food as a whole and Allied munitions.

The concluding stages of this process are best illustrated by the decisions taken at the A.M.T.C. meeting in Sept. 1918. The council, at that meeting, reviewed the whole of the prospective shipping position for 1918-19. They had before them estimates carrying the authority of the shipping experts of all the countries concerned to the effect that, after allowing for ships allotted to military expeditions and the fleets, the total imports could not exceed:

72,500,000 tons	{	for coal raw materials food munitions	}	for Great Britain France Italy

They decided, on the advice of the Transport Executive, that 25,200,000 tons must be allowed for coal, and 7,500,000 tons for raw materials, leaving 39,800,000 tons for food and munitions;

TABLE SHOWING THE ORGANIZATION OF INTER-ALLIED CONTROLS

1 Commodity.	2 Inter-Allied Body.	3 Method of Purchase.	4 Purchasing Body or Bodies.	5 Represented in United States by	6 Represented in certain other countries as follows:
1. Wheat.	Wheat Executive.	Single buyer.	Royal Commission on Wheat Supplies (British).	Wheat Export Company of America.	Canada: Wheat exporters. India: Controlled firms. Argentina: Controlled firms. Brazil: Controlled firms. Russia: French Commission.
2. Sugar.	Inter-Allied Sugar Programme Committee.	Single buyer in London and from International Sugar Committee in U.S.A.	Royal Commission on Sugar Supplies (British).	Representatives of Royal Commission on the International Sugar Committee.	In addition to purchases made as in column 3, the produce of some small British colonies was secured through the British Colonial Office.
3. Meats, fats, and other foodstuffs.	Inter-Allied Meats and Fats Executive.	Purchasing Organization in each procuring country aimed at.	Various.	Allied Provisions Export Committee.	British Colonies and also Argentina by the British Government.
4. Oil and oil-seeds.	Oil and Oil-seeds Executive.	Purchasing through A.P.E.C. or the govts. concerned (see cols. 4, 6).	The Executive.	A.P.E.C.	British and French Colonies by the respective governments. Brazil by agents of Wheat Commission.
5. Copper.	Copper Sub-committee, allocating powers only.	By the governments requiring supplies.	See column 3.	Purchase in U.S.A. by govts. from producers at controlled price, in account with allocation by Copper Committee.	Purchases in Spain by British Government.
6. Tin.	Tin Executive.	Supplies for France and Italy through British Ministry of Munitions.	Tin Executive.	..	The Executive generally represented in the producing countries by controlled firms.
7. Nitrate of Soda.	Nitrates Executives.	Agents on Commission.	Director of Purchases under the Executive.	..	Special agreement with the Government of Chile.
8. Rubber.	Allied Rubber Committee.	Generally by governments concerned.	Bulk of trade in hands of City merchants.	..	..
9. Wool, hair and products of wool and hair.	Wool Programme Committee (Advisory).	Australian and N.Z. clip bought by British Government, otherwise trade channels.	..	..	France partially controlled prices and quantities through Inter-departmental Wool Committee.
10. Cotton.	Cotton Programme Committee.	Usual trade channels except for Egyptian crop.	..	..	Egyptian crop bought by British and Egyptian Governments.
11. Jute, hemp and flax:- (a) Jute. (b) Hemp.	Jute, Hemp and Flax Programme Committee. Jute, Hemp and Flax Programme Committee.	Purchase by British Government from leading jute firms. British Government purchase for European Allies.			.. Controlled firms in Manila.
(c) Flax.	Jute, Hemp and Flax Programme Committee.	Local Allied representatives at Archangel.	..	..	Informal Inter-Allied buying arrangements at Archangel.
12. Hides and leather.	Hides and Leather Programme Committee (an Executive under consideration).	British Government purchase in India through Buying Committee of British firms in Calcutta.	Great Britain and United States control the market (chiefly India and Argentina).	..	..
13. Timber.	Timber Programme Committee and Commission Internationale d'Achats de Bois.	Purchase centralized in Italy, France, Gt. Britain, C.I.A.B. control purchasing policy.	C.I.A.B.	Purchase in United States through War Missions.	..
14. Coal.	Coal Programme Committee.	British Government controls the mines and works them through existing channels on basis of profits over period of pre-war years.	..	..	France.—Office National des Charbons, buying in United Kingdom through existing channels on a fixed basis. Italy.—All purchases made on Italian Government account.
15. Paper.	Paper and Paper-making Materials Programme Committee.	Central purchase of woodpulp in each country.	Centralized purchase through British Controller for European Allies suggested.	..	Italy.—Italian Paper Commission. France.—Office National de la Presse.
16. Petroleum.	Inter-Allied Petroleum Conference (Advisory).	By central purchase in United States of America at fixed price. Usual trade channels in other countries, subject to allocation by Conference.	..	United States Fuel Administration.	..
17. Tobacco.	Tobacco and Matches Programme Committee.	No purchasing arrangements between the Allies, price control being purely national through medium of the state monopolies in France and Italy, and the Tobacco and Matches Control Board in Great Britain.	..	..	..

against demands of 49,000,000 (27,000,000 for food and 22,000,000 for munitions). Finally, after difficult negotiations, they allowed 22,000,000 for food and 17,800,000 for munitions. The conclusion of the Armistice a few weeks later robbed these decisions of the practical importance they would otherwise have possessed. But they illustrate the way in which the whole Allied system was by the end of the war linked together and dominated by the supreme shipping authority.

The system was, however, not fully and equally working when brought to an end by the Armistice. It was tested and working fully for food and beginning to work for munitions; but was still in its preparatory stages for miscellaneous raw materials for civilian use.

Summary of Achievements.—Imperfect as it was, however, and having to build up its elaborate organization and carry on its work simultaneously, its achievements were very striking. Though the shipping available for European supplies was some 2,000,000 tons less, the import services of France and Italy were, in 1918, for the first time put on a substantially satisfactory and substantially equal basis. Food stocks were raised to a much safer level. The Belgian relief requirements, previously in a desperate condition, were adequately met and the American troping needs substantially assisted. These results were obtained partly through shipping economies effected by the pooling of tonnage and partly by supply economies effected by the common examination of needs and resources by the programme committees.

The fundamental principle is the *direct* contact of specialized ministers and officials of different countries effected through a regular organization whose members are grouped according to special experience and authority, not according to nationality. The national administrations now touched each other, not at one point (the Foreign Offices), but at scores (the officials engaged in the different controls) and the contact was no longer occasional but continuous. Any divergence of national interest was settled within its own sphere, and independently of differences elsewhere. Agreement once reached within each specialist committee, the further issue was not between nation and nation but between supply and supply. The Allied munitions demands were pressed as a whole with the support of the representatives of all countries against the claims of Allied food demands supported by all theirs. Thus was co-operation between the Allies at last shifted from a diplomatic to an administrative basis.

Influence of War System on Later International Organization.—The machinery so erected, and the principles of administration so developed, have left a deep impress upon subsequent organization. In the Armistice period, after some delay due to the desire of the American Government to terminate all war organizations at once, a Supreme Economic Council based on the principles described above and with a personnel very largely the same carried on the Armistice tasks of removing the blockade, bringing the German ships into use, re-allotting ships for the repatriation of troops and prisoners, for the import of raw materials required for reconstructions, arranging relief for the starving countries of Europe, and re-establishing railway transport and communications.

More important and more permanent is the influence of the same experience upon the administrative organization of the League of Nations. In spite of the obvious differences of the tasks, the student of political science will find many resemblances to the A.M.T. organization in the composition and method of working of the technical committees for finance, economics, transit, mandates, etc.—by which the Assembly and Council of the League are advised. The members of such committees regard themselves primarily as specialists in their particular subject-matter. At the same time, as they are in fact of differing nationality and know the tendencies of opinion and interest in their different countries, they afford just the kind of bridge between national opposing views which was provided by the programme committees. It was perhaps useful that all three of the European members of the A.M.T. executive joined the secretariat of the League and had a part in building up the new machinery. But essentially that machinery was constructed as it was because it is

among the fundamental principles of the League itself, first that the common interests of nations are no less important than their differences, and secondly that these common differences must be resolved by agreement and not by the overriding decision of a superior authority.

With some difference of emphasis, these were the principles which determined the Allied system; with some difference of application, the international system follows the same principles. With this system the real instrument of the League's action is not merely its permanent staff but the national organizations, public and private, which are linked together through its specialist committees and commissions. Its real executive is located not in one city but in sections, in all the main capitals of the world. Its central staff is the "coupling" which unites this intricate mechanism and enables it to achieve an international task. Geneva is not a centre of controlling power but an instrument to co-ordinate activity which is world-wide in its influence and means of action. It is an instrument, not for governing the world, but for assisting the world to govern itself in agreement and in co-operation. It permeates and transforms the policy of the world as the Allied organization permeated and transformed, without an overriding authority, the policy of the Allies. (See also SHIPPING, MINISTRY OF; WAR CONTROL OF FOOD; MUNITIONS, MINISTRY OF; WAR CONTROL OF SHIPPING; COMMISSION INTERNATIONALE DE RAVITAILLEMENT; ETC.)

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ALLIER, a department of France on the northern border of the *Massif Central*, formed in 1790 from the old province of Bourbonnais. Area 2,850 sq.m. Pop. (1936) 368,778, a considerable decrease since 1906. It is bounded on the north by Nièvre, east by Saône-et-Loire, south-east by Loire, south by Puy-de-Dôme, south-west by Creuse, and north-west by Cher. The department is a well watered plateau, mostly 600–1,500ft. above sea-level, with heights reaching 4,239ft. in the south, in the Bois-Noirs, and forests in the northern zone. The Allier crosses the centre from south to north, the Loire forms most of the eastern boundary, and the Cher runs parallel to the Allier across the west. The heights of the Forez in the south-east and beyond get one metre of rain or more per annum and the mean winter temperature (reduced to sea level) is 39°, implying severe conditions on the heights. In the lower lands the rainfall is 600–800mm. per annum. The basin of the Allier east of its tributary the Sioule, within the department, is largely a northward continuation of the fertile Limagne of the Allier valley in Puy-de-Dôme, and is called the Limagne Bourbonnaise. It grows cereals, potatoes, and fruits, including some vines. Sheep and cattle rearing are active in the department and goats and pigs are numerous, while there are also several forests.

Carboniferous rocks outcrop along north-east to south-west lines west of the Allier, with coal seams worked for the iron and other industries at Montluçon, Commentry, Murat, etc. There are also lime and building stone quarries, so that the mineral wealth is considerable. The mineral waters of the region are widely famed, Vichy, in the arrondissement de la Palisse, being the best known spa in France.

Allier is served chiefly by the Orléans and P.L.M. railways and the lateral Loire canal; the Berry canal and the canal from Roanne to Digoin touch the department. Moulins (the capital), Montluçon and Lapalisse are towns which give their names to

the usual three *arrondissements* of the modern system. There are 29 cantons and 321 communes. The department is also the diocese of Moulins under the Archbishop of Bourges. It is in the region of the XIII army corps and in the *académie* or educational promise of Clermont Ferrand. Its court of appeal is at Riom.

Apart from Moulins (*q.v.*), it may be mentioned that the department has interesting mediaeval buildings at Souvigny (Cluniac priory 11th–15th century), St. Menoux, Ebreuil, Gannat, Veauce and Ygrande (Romanesque churches), Huriel (fine 11th century church, also castle), St. Pourçain sur Sioule (11th–18th century church). The castle at Bourbon l'Archambault (13th–15th century) was the house of the Bourbon dukes.

ALLIER (anc. *Elaver*), river of central France flowing into the Loire. Rising in the department of Lozère, its upper course is mostly through deep gorges following structural lines of weakness between the mountains of the Margeride and those of the Velay. It then traverses the basins of Langeac and Brioude, receives torrents from the mountains of Dore and Dôme, and flows through a wide but shallow channel in the fertile wheat-growing plains north of Clermont Ferrand, being joined by the Sioule above Moulins, the chief town on its banks. It reaches the Loire, 4 mi. W. of Nevers, after a course of 269 mi. (154 navigable). Its basin has an area of 6,755 square miles.

ALLIFAE (mod. *Alife*), a town of the Samnites, 15 mi. N.W. of Telesia, and 17 mi. E.N.E. of Teanum. The site of the Samnite city, which in the 4th century B.C. had a coinage of its own, is not known; the Roman town lay in the valley of the Vulturmus, and its walls (4th century A.D.) enclose a circuit of 1½ mi.; they have four gates at the ends of the *cardo* and *decumanus* (the main streets) by which it is still divided. Outside are preserved remains of large baths (*Thermae Herculis*) and a theatre.

ALLIGATOR, a crocodilian closely allied to the true crocodiles. In popular speech alligator and crocodile are often confused. The American alligator differs from the true crocodiles principally in having the head broader and shorter and the snout more obtuse; in having the fourth, enlarged tooth of the under jaw received, not into a notch at the side of the jaw, but into a pit formed for it within the upper one; in wanting a jagged fringe that appears on the hind legs and feet of the crocodile; and in having the toes of the hind feet webbed not more than half way to the tips. Two species, *Alligator mississippiensis* in the southern states of North America up to 12 ft. in length, and the small *A. sinensis* in the Yangtze Kiang region of China, are still living. In Central and South America alligators are represented by the various caymans, which differ from *Alligator* by the absence of a bony septum between the nostrils, differences in the bony scales of the ventral armour, and in various other respects. (See *CROCODILIAN*). Several extinct species of the genus *Alligator* are known from the American Tertiary.

ALLIGATOR PEAR: see *AVOCADO*.

ALLINGHAM, WILLIAM (1824–1889), Irish poet and man of letters, was born at Ballyshannon, Donegal, Mar. 19, 1824, and died at Hampstead, London, Nov. 18, 1889. He held various posts in the customs until 1870, when he became sub-editor of *Fraser's Magazine*, where he succeeded Froude as editor in 1874. He was a friend of D. G. Rossetti, and the 2nd edition of *Day and Night Songs* (1855) had two illustrations by Rossetti and Millais. Allingham is best remembered for many charming lyrics, some of which, like "Up the airy mountain," still find a place in anthologies.

His chief works are *Poems* (1850); *Laurence Bloomfield in Ireland* (1864); *Irish Songs and Poems* (1887); *Flower Pieces and other Poems* (1888), with two designs by D. G. Rossetti. *William Allingham: a Diary* (1907), ed. Mrs. Allingham (Helen Paterson, b. 1848) and D. Radford, contains many interesting reminiscences of Tennyson; Carlyle and other famous contemporaries. Mrs. Allingham also published a volume of letters addressed to her husband. She died in 1926 and was herself an artist of some distinction.

ALLISON, WILLIAM BOYD (1829–1908), American legislator, was born at Perry, O., on March 2, 1829. Educated at Allegheny and Western Reserve colleges, he studied law, and prac-

tised in Ohio until 1857. In that year he settled in Dubuque, Ia., where he took a prominent part in Republican politics; and in 1860 he was a delegate to the national convention at Chicago which nominated Abraham Lincoln for the presidency. In 1861 he was appointed a member of the staff of Governor Samuel J. Kirkwood (1813–1894), and was of great service in the work of equipping and organizing the Iowa volunteers. From 1863 until 1871 he served with distinction in the House of Representatives; in 1873 he was elected to the United States Senate, and was re-elected for five consecutive terms. He became one of the highest authorities on questions connected with finance, and from 1877 he was a member of the Senate committee on finance. In 1881–93, and again from 1895, he was chairman of the committee on appropriations, in which position he had great influence. He declined offers of the secretaryship of the treasury made to him by Presidents Garfield and Harrison. He was a prominent candidate for the presidential nomination in the Republican national conventions of 1888 and 1896. In 1892 he was chairman of the American delegation to the International Monetary Conference at Brussels. He died at Dubuque, on Aug. 4, 1908.

ALLITERATION, the commencing of two or more words, in close juxtaposition, with the same sound. As Milton defined rhyme to be "the jingling sound of like endings," so alliteration is the jingle of like beginnings. All language has a tendency to jingle in both ways, even in prose. Thus in prose we speak of "near and dear," "high and dry," "health and wealth." But the initial form of jingle is much more common—"safe and sound," "thick and thin," "weal or woe," "fair or foul," "spick and span," "fish, flesh or fowl," "kith and kin." The poets of nearly all times and tongues have not been slow to seize upon the emphasis which could thus be produced.

Although mainly Germanic in its character, alliteration was known to the Latins, especially in early times, and Cicero blames Ennius for writing: "O Tite tute, Tati, tibi tanta, tyranne, tulisti." We read in Chaucer:—

But of the fyr and flaumbe funeral
In which my body breannen shal to glede.

In Shakespeare:—

Full fathom five thy father lies.

In Coleridge:—

The fair breeze blew, the white foam flew,
The furrow followed free;
We were the first that ever burst
Into that silent sea.

As thus far considered, alliteration is a device wholly dependent on the poet's fancy. He may use it or not, or use it much or little, at his pleasure. But there is an extensive range of Teutonic poetry whose metrical laws are entirely based on alliteration. This, for example, is the principle on which Icelandic verse is founded; and we have a yet nearer interest in it, because it furnishes the key to Anglo-Saxon and a large portion of early English verse. Here is a passage from the famous epic *Beowulf*, alliteratively rendered by Mr. C. K. Scott-Moncrieff:—

Off Shield of the Sheaf from scathing hordes
From many meines their mead-stoves tore;
Afrighted them the Earl since erst he was
Found unwealthy; then friendship he awaited,
Waned under the welkin, in worship throve,
Until each one of those outdwellling
Over the whale-road, must hearken to him,
Gold must give him; that was a good king.

The rhymeless lines divide into halves, and each half has normally two strong accents, irrespective of the number of syllables, all, or some; of the accented syllables being alliterated—three in each line being the usual number. Double alliteration is occasionally found. The influence of French poetry, with its definite syllabic system, worked against the continuance of this ancient recitative, and the alliterative line gradually ceased to be the vehicle of serious verse in England. But there were two great revivals, one in the 14th century, when such poems as *Pearl* (*q.v.*),

Syr Gawayne and the Grene Knight, and the *Morte Arthure* were written; the other, also in the 14th century, but quite independent, when the great poem known as *Piers Plowman* was written.

Piers Plowman, consciously archaic, suggests the Anglo-Saxon manner:—

Then gan I to meten a mervelouse swevene,
That I was in a wilderness, wist I never where;
As I behelde into the east, an heigh to the sonne,
I seigh a tour on a toft, trielich ymakid;
A depe dale benethe, a dongeon there-inne,
With depe dyches and derke and dredful of sight.

But though alliteration lingered on as a form of emphasis in popular songs, it ceased to be a regular way of English verse. Chaucer makes his Parson refer contemptuously to alliteration; but as he sneers at rhyme as well, perhaps we should not take him too seriously:—

But, trusteth wel, I am a southern man,
I can not geste "rum, ram, ruf" by lettre,
Ney, God woot, rym holde I but litel bettre.

For a study of alliterative verse see J. Schipper, *History of English Versification* (1910).

ALLIUM (Lat. for "garlic"), a genus of plants, of the family Liliaceae, with about 325 species (eight of which occur in Britain), found in central and south Europe, north Africa, the dry country of west and central Asia, and North and Central America. The plants are bulbous herbs, with flat or rounded radical leaves and a central naked or leafy stem, bearing a head or umbel of small flowers, with a spreading or bell-shaped white, pink, red, yellow or blue perianth. Several species afford useful foods such as onion (*Allium Cepa*), leek (*A. Porrum*), shallot or eschallot (*A. ascalonicum*), garlic (*A. ursinum*) and chives (*A. Schoenoprasum*). See CHIVES; GARLIC; LEEK; ONION; SHALLOT.

In North America there are about 70 native species, most numerous in the Rocky Mountain region and in California where the majority are found. Among some 10 species occurring in the Eastern United States and Canada are the meadow garlic (*A. canadensis*), formerly used for food by the Indians; the wild leek (*A. tricoccum*), found in rich woods; the wild chives or rush-garlic (*A. sibiricum*), found from Maine to Alaska; the nodding wild onion (*A. cernuum*), with inverted clusters of handsome flowers; and the prairie wild onion (*A. stellatum*), of rocky banks in the interior. The field garlic (*A. vineale*) of Europe, widely naturalized in meadows and pastures, is a troublesome weed tainting the flavour of butter.

ALLMAN, GEORGE JAMES (1812-1898), British biologist, was born in Cork, Ireland, and died at Parkstone, Dorset, Nov. 24, 1898. His most important work was upon the gymno-blastic hydrosoma, on which he published in 1871-72, through the Ray Society, an exhaustive monograph, based largely on his own researches and illustrated with drawings of remarkable excellence from his own hand.

ALLMERS, HERMANN (1821-1902), German writer, was born on Feb. 11, 1821, at Rechtenfleth, near Bremen. In 1858 he wrote *Marschenbuch*, in which northern lands and peoples are described. In 1860 appeared his *Dichtungen*, and nine years later his *Römische Schlendertage*, both manifesting his love of landscape imagery. The drama, *Elektra* (1872), and his somewhat stiff lyric and ballad poetry are among other writings in his *Sämtliche Werke*, 6 vols. (1891).

ALLOA, small burgh and seaport, Clackmannanshire, Scotland. It is on the north bank of the Forth, 32 mi. from Edinburgh by the L.N.E.R. via the Forth Bridge, and 28 mi. from Leith by steamer. Pop. (est. 1938) 13,436. The L.M.S.R. enters the town from the southwest by a steel bridge across the river, and also owns a ferry to South Alloa, on the opposite shore, in Stirling-shire. Between Alloa and Stirling the stream forms the famous sinuous "links," giving a 12-mile river-course as against 6½ mi. by road. Alloa makes yarn, the famous Alloa ale, spirits and yeast (Carsebridge), glass, pottery, electrical appliances, brass, iron and bricks. Coal is exported and oil imported. The docks are accessible only at high water. Among the principal buildings are the fine Gothic parish church, the town hall, including the free public

library, and the museum of the Natural Science and Archaeological society. Alloa park, the seat of the earl of Mar and Kellie, is in the immediate vicinity, and in its grounds stand the ruins of Alloa tower (1315), once the residence of the powerful family of Erskine, descendants of the earl of Mar. There Mary and James VI spent part of their youth.

ALLOBROGES (äl-löb'rö-gäs), a Celtic tribe in the north of Gallia Narbonensis, inhabiting the low ground called the "island" between the Rhodanus, the Isara, and the Graian Alps, corresponding to the modern Dauphiné and Savoy. If the name is rightly interpreted as meaning "aliens," they would seem to have driven out the original inhabitants. Their chief towns were Vienna (Vienne), Genava (Geneva) and Cularo (later Gratianopolis, whence Grenoble). The Allobroges first occur in history as taking part with Hannibal in the invasion of Italy. After the subjugation of the Salluvii (Salvies) by the Romans in 123 B.C., the Allobroges were attacked and finally defeated (121 B.C.) at the junction of the Rhodanus and Isara by Q. Fabius Maximus (afterwards Allobrogicus). But they still remained hostile to Rome, as is shown by the conduct of their ambassadors in the Catilinarian conspiracy (63 B.C.; see CATILINE).

BIBLIOGRAPHY.—See A. Desjardins, *Géographie historique de la Gaule romaine* ii. (1876-1893); Mommsen, *Hist. of Rome* (Eng. trans.) bk. iii. ch. 4, iv. ch. 5; T. R. Holmes, *Caesar's Conquest of Gaul* (1899); G. Long in Smith's *Dict. of Greek and Roman Geography*; M. Ihm in Pauly-Wissowa's *Realencyklopädie*, i. 2 (1894).

ALLOCATUR, a law term, meaning a certificate given by a taxing master, at the termination of an action, for the allowance of costs.

ALLOCUTION, a name given to the formal addresses made by the pope to the College of Cardinals and through them to the church (Lat. *allocutio*, an address). Allocutions are usually called forth by ecclesiastical or political circumstances, and aim at safeguarding papal principles and claims. They are published by being affixed to the door of St. Peter's church.

ALLODIUM, that portion of land allotted to an individual by the chief, as representing the community, in the early Anglo-Saxon settlement of Britain. It usually consisted of the homestead, and was regarded as the property of the family. It was free from rent and services. Later, *allodium* is the regular Latin translation of bocland (*q.v.*).

ALLOMERISM, a similarity in crystalline form exhibited by substances of different composition.

ALLON, HENRY (1818-1892), English Congregational minister, was born on Oct. 13, 1818, at Welton, Yorkshire. In 1844 he became co-pastor with Thomas Lewis of Union chapel, Islington. In 1852, on the death of Lewis, Allon became sole pastor, and this position he held with increasing influence till his death in 1892.

Under his ministry the social aspects of church life were developed, and Union chapel became the first of what have since come to be known as institutional churches. Allon published in 1858 the original edition of his well-known *Congregational Psalmist*. For many years his collection of hymns, chants and anthems was used in hundreds of churches throughout England. Allon edited the *British Quarterly Review* from 1874 onwards, and was twice chairman of the Congregational Union.

ALLONGE, a slip of paper affixed to a negotiable instrument, as a bill of exchange, for the purpose of receiving additional endorsements for which there may not be sufficient space on the bill itself. An endorsement written on the allonge is deemed to be written on the bill itself.

ALLOPHANE, a hydrous aluminium silicate, said to be $Al_2SiO_5 \cdot 5H_2O$: it only occurs as an amorphous incrustation in thin layers on the walls of fissures and cavities in rocks, and is sometimes stained blue by copper, though usually white, yellow, or brownish.

The hardness is 3 and the density 1.9.

ALLORI, CRISTOFANO (1577-1621), Italian portrait painter of the Florentine school, was the son of ALESSANDRO ALLORI (1535-1607). Cristofano, who was born at Florence, received his first lessons in painting from his father, but becoming dissatisfied with the hard anatomical drawing and

cold colouring of the latter he entered the studio of Gregorio Paganì (1558-1605), who was one of the leaders of that later Florentine school which endeavoured to unite the rich colouring of the Venetians with the correct drawing of Michelangelo's disciples. Allori became one of the foremost of that school. His technical skill is proved by the fact that several copies he made after Correggio have been taken to be duplicates by Correggio himself. The finest of all his works is his "Judith and Holofernes," in the Pitti Palace. The model for the Judith was his mistress, the beautiful Mazzafirra, who is also represented in his Magdalene; and the head of Holofernes is generally supposed to represent his own.

ALL OR NONE, a condition set by a bidder for an issue of securities meaning that at the price he offers he wants the entire issue and cannot be held to his offer unless the issue in its entirety is awarded to him. Sellers of securities use the same term to indicate that prospective buyers must bid for, and stand ready to take, the entire issue and cannot demand a portion of it at the price offered.

ALL-OR-NONE LAW in physiology relates response to stimulus in excitable tissues. It was first established for the contraction of heart muscle by H. P. Bowditch in 1871. Describing the relation of response to stimulus, he stated, "An induction shock produces a contraction or fails to do so according to its strength; if it does so at all, it produces the greatest contraction that can be produced by any strength of stimulus in the condition of the muscle at the time." It was believed that this law was peculiar to the heart and that the other highly specialized and rapidly responding tissues—skeletal muscle and nerve—responded in a different way, the intensity of response being graded according to the intensity of the stimulus. This impression arose because nerves and muscles are composed of hundreds or thousands of individual fibres, and since some of these do not respond to a weak stimulus the total response of the organ is apparently subject to such gradation. It has been established that the individual fibres of both skeletal muscle and nerve respond to stimulation according to the all-or-none principle. This does not mean that the size of response is immutable. Functional capacity varies with the condition of the tissue. The response to a stimulus applied during recovery from a previous response is subnormal. But the size of response is independent of the strength of stimulus, provided this be adequate. These facts show that the functional response is essentially alike in these specialized tissues—heart, skeletal muscle and nerve; its precise nature is not known, but it resembles an explosive reaction in that it depletes for a time the available store of energy on which it depends.

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ALLOSAURUS, a large carnivorous dinosaur from the Morrison formation (Jurassic), North America; bipedal in locomotion, with very small front feet. (See DINOSAURIA; REPTILES.)

ALLOTMENT. In England, the term denotes a portion of land assigned on partition or under an inclosure award (see COMMONS); also a division of land into small portions for cultivation by a labourer or artisan at a small rent (see ALLOTMENTS and SMALL HOLDINGS). In company law, "allotment" is the appropriation to an applicant by a resolution of the directors of a certain number of shares in response to an application. The document sent to such an applicant, which announces the number of shares assigned and concludes the contract, is called a *letter of allotment* or *allotment certificate*.

Allotment note is a writing by a seaman authorizing his employers to make an allotment of part of his wages, while he is on a voyage, in favour either of a "near" relative or of a savings bank.

In the U.S., the term allotment was used during World War I to denote that portion of the pay of a member of the army, navy or marine corps which was sent by direction of such person in the service to dependant relatives. In those cases, the government paid an additional sum to such dependants as were nominated.

ALLOTMENTS. An allotment, in England and Wales, as defined by the Allotments Act, 1922, is any parcel of land, whether attached to a cottage or not, of not more than two acres in extent held by a tenant under a landlord and cultivated as a farm or a garden, or partly as a garden and partly as a farm.

Borough, urban and parish councils may, however, provide allotments up to five acres each if they so desire, but as county councils provide small holdings exceeding one acre it is customary to leave the provision of these larger plots to them. This type of allotment is not numerous and is found in counties which are mainly agricultural. Councils providing them are not compelled to do so, Section 23 (4) of the 1908 Act limiting this obligation to the provision of one acre only for each applicant. The term "allotment" in common use invariably refers to an "allotment garden," and as the laws which govern them often differ it is necessary to distinguish between them.

Allotment Gardens.—An allotment garden is defined by the Allotments Act, 1922, as . . . "an allotment not exceeding 40 poles (½ acre) in extent which is wholly or mainly cultivated by the occupier for the production of vegetable or fruit crops for consumption by himself or his family. . . ." It will be observed, therefore, that while the produce of an allotment may be marketed, that of an allotment garden should be used in the home of the cultivator. Councils with a population of 10,000 or upwards are under a statutory obligation only to provide allotment gardens up to 20 poles in extent. They have to provide allotments and allotment gardens on the application of six registered parliamentary electors or ratepayers residing in their districts, and they may either let or sell land to allotment associations.

Allotments in Peace and War Periods.—The passing of the Small Holdings and Allotments Act, 1908, gave the first real impetus to allotment cultivation. It was followed by a great increase in the number of allotments. On Dec. 31, 1909, there were 58,648 allotments in England and Wales covering 17,529 ac., and in five years these figures were increased to 130,526 allotments covering 33,523 ac. In Scotland and Ireland the number was relatively small. World War I changed the aspect of allotment cultivation. Emergency legislation was passed giving local authorities power to confiscate land for allotment purposes. The number of allotments soon passed the million mark, the peak year being reached in 1920 when the official figures recorded were 1,330,000 covering 185,000 ac.

As normal conditions were restored, possession was taken of many allotments for other purposes and a rapid decline followed. An attempt was made to arrest it by the passing of the Allotments Act, 1922, but although it improved tenure and other conditions the great problem of insecurity remained practically untouched. Then followed the Allotments Act, 1925, giving local authorities power to town-plan allotments and also to incur a loss in providing them not exceeding 1d in the £ on their rates, increased by one-third of a penny under the Local Government Act, 1929. These powers were, as a rule, neither fully nor properly used, and consequently allotments continued to decline year by year.

To enable the local authorities to use land for allotments during World War II which they acquired for other purposes, a grant of £2 (\$8) an acre was made. Councils of boroughs and urban districts with a population of 10,000 and upwards, or which provided 400 allotments, were under statutory obligation to appoint allotments committees (with allotments representatives) to ensure provision and administration of allotments. In other cases non-statutory bodies—allotments managers or parish committees—without power of acquisition were appointed. County horticultural instructors, appointed by the county education authorities provided horticultural instruction. County garden produce committees, with voluntary panels of lecturers and advisers, also engaged in this work.

The ministry instituted a 'Dig for Victory' campaign on a national basis for the encouragement and instruction of allotment cultivators. The ministry's Allotments and Gardens council has been responsible for the conduct of this campaign. A large number of voluntary and co-operative bodies—such as the National Allotments society, affiliating nearly 4,000 local allotment asso-

cations—gave assistance, including special facilities for the supply of fertilizers, insurance of huts against fire and the marketing of surplus produce.

The Number of Allotments.—There were 608,286 allotments in urban areas at the end of 1931 and 589,015 in 1937. These figures take no account of railway allotments which are found in both urban and rural districts in England and Wales and number about 80,000.

The increase up to the end of 1934 was mainly due to the provision of allotments for unemployed men; the decrease afterward to allotments being required for building purposes. In 1944 there were about 1,750,000 allotments, nearly double the number at the outbreak of World War II. About 5,000,000 private gardeners also contributed to the war effort. A plot of 300 sq.yd. should supply a family of three all the year round.

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(G. W. G.; C. L. St.)

ALLOTMENTS ORGANIZATION. In England and Wales the National Allotments society, Ltd. (an amalgamation of the former Allotments Organization Society and Smallholders, Ltd., and the National Union of Allotment Holders, Ltd.), continued the co-operative organization of small cultivators, a task first undertaken by the Agricultural Organization society, many years before. Its principal functions were the registration of allotment and small holding associations under the Industrial and Provident Societies acts and the giving of expert advice on the leasing and purchase of land and co-operative trading. Prospective associations were supplied with model rules and when these were used the chief registrar of friendly societies reduced his fee from £10 to £3. The society acted as a central bureau of information and supplied facts and figures on the various phases of the movement of which it was the mouthpiece. It was recognized by the ministry of agriculture, and six of its members each had a seat on the ministry of agriculture's Allotments Advisory committee. The amalgamation under the title Allotments organization took place in 1930.

The society's work, so far as the smallholder was concerned, consisted principally of advice in the co-operative purchase and distribution of agricultural requirements, the co-operative marketing of produce and the joint ownership of implements.

ALLOTROPY: see POLYMORPHISM.

ALLOTT or ALLOT, ROBERT (fl. 1600) was probably the editor of a book of "elegant extracts" of Elizabethan poetry entitled *England's Parnassus*. The full title of the book is *England's Parnassus; or the choycest Flowers of our Modern Poets, with their Poeticall comparisons, Descriptions of Bewties, Personages, Castles, Pallaces, Mountaines, Groves, Seas, Springs, Rivers, &c. Whereunto are annexed other various discourses, both pleasant and profitable. Imprinted in London for N.L., C.B., and T.H., 1600.*

The compiler of this volume is not identified on the title page; but the initials "R.A.," which follow two preliminary sonnets, probably belonged to Robert Allott. William Oldys, the English scholar, wrote in the preface to Hayward's *British Muse* (1738) that he had seen a copy signed in full "Robert Allott." The suggestion of J. P. Collier that Robert Armin, author of *Nest of Ninnies*, may have been the "R.A." in question was not generally accepted.

England's Parnassus is an interesting curiosity of literature. A thick work of approximately 500 pages, it is a collection of quotations, which are arranged alphabetically under various subject headings, from the works of contemporary poets. The name of the author follows each excerpt. Although it has been criticized as badly edited and inaccurate, its contribution to literature consisted not only in preserving some poetry of merit but also in

identifying the authors of a number of books. It was reprinted in Park's *Heliconia* (1815) and was also reprinted for private circulation by Collier in 1867.

Allott's other work was *Wits Theatre of the Little World*, a prose "collection of the flowers of antiquities and histories." A collection of classical sayings, anecdotes, etc., this anthology, which was published in 1599, also carried no name on the title page. Many bibliographers ascribed the volume to John Bodenham, but a copy which is signed "Robert Allott" and is dedicated to "John Bodenham" was preserved in the British museum. Other evidence supports the conclusion that Bodenham was the patron rather than the compiler of early 17th-century prose and verse anthologies such as *Wits Theatre*.

It was suggested that Allott might have been the Robert Allott who in 1599 was a fellow at St. John's college, Cambridge, or an early 17th-century publisher of the same name. Since there are no biographical facts available about the editor of *England's Parnassus* and *Wits Theatre*, it is not possible to identify him with either of these "Robert Allotts."

See J. P. Collier, *Seven English Poetical Miscellanies* (1867); appendix to Algernon C. Swinburne's *Essay on the Poetical and Dramatic Works of George Chapman* (1875).

ALLOTT or ALLOT, WILLIAM (d. 1590?), English theologian, was a native of Lincolnshire and attended Cambridge university. On the accession of Queen Elizabeth in 1558, Allott went to Louvain, where he studied theology and was ordained a priest. He later lived in Cologne and in 1579 returned to England.

Allott was in the favour of Mary Queen of Scots, and he visited her frequently during her imprisonment. He was later imprisoned and banished. In return for his services, Mary recommended him to her friends in France, and he was appointed canon of St. Quentin in Picardy.

Lord Morley and his brother Charles Parker, bishop elect at the time of Queen Mary's death, had also retired from England for religious reasons. They aided Allott and many other students in their studies.

Allott died at Spa about 1590.

Allott wrote *Thesaurus Bibliorum, omnem utriusque vitae antidotum secundum utriusque instrumenti veritatem et historiam succincte complectens*, with which was printed an *Index rerum memorabilium in epistolis et evangelis per anni circulum* (Antwerp, 1577).

ALLOU, GILLES (1670-1751), French portrait painter, was born in Paris in 1670. Allou's portraits were often favourably compared with the works of his contemporaries Hyacinthe Rigaud (1659-1743) and Nicolas de Largillière (1656-1746). In 1711 he became a member of the French academy.

He was employed at Beauvais in the royal carpet factory. Allou died on Feb. 2, 1751, in Paris.

He painted portraits of leading persons of the day, including Antoine Coysevox (1640-1720), French sculptor.

ALLOUEZ, CLAUDE JEAN (1622-1689), French Jesuit missionary to the Indians of North America, was born in St. Didier, Fr., on June 6, 1622. At the age of 17 he graduated from the college at Le Puy, where one of his teachers was the missionary François Regis. He then entered the Jesuit novitiate at Toulouse, and, upon completion of student life at Rodez in 1655, was ordained a priest.

Accompanied by Pierre d'Argenson, the newly appointed governor of New France, Allouez went to Canada in 1658. He devoted the remainder of his life to work among the Indians.

At first he served at settlements on the St. Lawrence river and then became superior at Three Rivers. On July 21, 1663, Allouez, who was then at Three Rivers, was appointed by the bishop of Quebec vicar-general for all the natives and traders of the north-west. His duties as vicar-general included procuring missionaries, establishing new missions and supervising relations between the traders and Indians.

In 1664 Allouez set out for Lake Superior, but he missed the canoe flotilla for the year and had to wait until 1665 to begin his work among the Ottawas of Lake Superior, which he later named Lac de Tracy. He arrived at Chequamegon (Ashland) bay on Oct. 1, 1665, and found at La Pointe on Madeline Island a large

settlement of 800 warriors from several tribes.

He left the village on May 6, 1667, and went about 1,500 mi. to Lake Nipigon, where he found the Nipissiriniens, a tribe of Christian Indians who had retired there to escape from the Iroquois in the Ontario country. After a stay of two weeks, he returned to La Pointe settlement.

He later returned to Quebec; for his superiors had not heard from him for two years and had believed him dead. But he remained there only two days and then went back to his missions in the west. He was in Quebec again for a short time in 1669 before undertaking a journey to the Potawatomi near the Baie des Puants (Green bay). After spending a winter with them, he left on April 16, 1670, to visit the Outagamies.

Allouez kept interesting records of his experiences and observations, and many of his accounts were printed in *The Jesuit Relations*. During the journey to Lake Winnebago, which he called St. Francis Xavier, he wrote an account of an eclipse of the sun which occurred on April 19, 1670. The following day he was at the present city of Oshkosh, and on April 25 he founded St. Mark's mission; the location of this mission, where he remained only two days, is uncertain. On April 29 he founded the mission of St. James among the Miamis and the Mascoutens.

He later went to Sault Ste. Marie, and in 1671 he returned to Green bay to establish on the Fox river the mission of Rapides des Pères (De Pere, Wis.). It was reported that more than 2,000 Indians who had become Christians were at this mission in 1674.

About 1675 Allouez settled in the Indian village of Kaskaskia and developed the mission started there by Jacques Marquette (*q.v.*). In 1679, on the approach of René Robert Cavelier, sieur de la Salle (*q.v.*), who was unfriendly to the Jesuits, Allouez withdrew from Kaskaskia. Thereafter he laboured chiefly among the Miamis of the St. Joseph river in southeastern Michigan.

He died in one of the Ottawa missions near the site of the present town of Niles, Mich., on Aug. 27, 1689.

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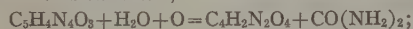
ALLOWAY, hamlet and ecclesiastical parish (pop. 997), in Ayrshire, 2½ mi. S. of Ayr (*q.v.*), Scot. It is famed as the birthplace of Robert Burns and the scene of his "Tam o' Shanter."

In 1820 a Grecian round temple with nine fluted Corinthian columns was built as a monument to Burns. The Bibles exchanged by Burns and "Highland Mary" and other mementos were preserved within the monument.

James Thom, a sculptor of local repute (d. 1850), made figures of "Tam o' Shanter" and "Souter Johnnie" which were placed in the garden of the monument.

ALLOXAN or MESOXALYL UREA crystallizes from water in colourless rhombic prisms containing four molecules of water of crystallization. It possesses an acid reaction; it colours the skin purple-red, and with ferrous sulphate it develops an indigo-blue coloration.

It is an oxidation product of uric acid, being obtained from it by the action of cold nitric acid,



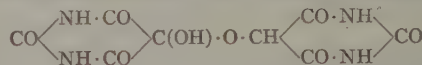
it has the structural formula $\text{CO} \begin{array}{c} \text{NH}-\text{CO} \\ \text{NH}-\text{CO} \end{array} \text{CO}$. Zinc and hy-

drochloric acid in the cold convert it into alloxantin, hydroxylamine to isonitrosobarbituric acid (violic acid), $\text{C}_4\text{H}_2\text{N}_4\text{O}_3$; NOH , baryta water to alloxanic acid, $\text{C}_4\text{H}_4\text{N}_4\text{O}_5$; hot dilute nitric acid oxidizes it to parabanic acid, hot potassium hydroxide solution hydrolyzes it to urea and mesoxalic acid, and zinc and hot hydrochloric acid convert it into dialuric acid, $\text{C}_4\text{H}_4\text{N}_4\text{O}_4$.

Alloxan combines with thiourea in alcoholic solution in the presence of sulphur dioxide to form pseudothiouric acid; and it is one of the substances employed in the synthesis of riboflavin

or vitamin B_2 (Karrer, 1936). Methyl and dimethylalloxans are also known, the former being obtained on oxidation of methyl uric acid and the latter on oxidation of caffeine. (See PURINES.)

ALLOXANTIN, a product obtained by the combination of alloxan and dialuric acid. It forms small hard prisms which become red on exposure to air containing ammonia, owing to the formation of murexide (ammonium purpurate), $\text{C}_8\text{H}_4(\text{NH}_4)_2\text{N}_6\text{O}_8$. The formation of murexide is used as a test for the presence of uric acid, which on evaporation with dilute nitric acid gives alloxantin; by the addition of ammonia to the residue the purple-red colour of murexide becomes apparent. Alloxantin, $\text{C}_8\text{H}_4\text{N}_4\text{O}_7 \cdot 3\text{H}_2\text{O}$, may also be obtained by the action of hydrogen sulphide on alloxan, and it probably possesses the constitution



one of the three molecules of water being possibly constitutional.

The tetramethyl derivative, amalic acid, $\text{C}_8(\text{CH}_3)_4\text{N}_4\text{O}_7$, has been prepared by oxidizing caffeine (see PURINES) with chlorine water, and forms colourless crystals which are only slightly soluble in hot water.

ALLOYS, a term applied in its broadest sense to any metallic substance which is not a chemical element. If this definition is taken literally all of the metals of commerce could be regarded as alloys, since even the purest ones contain some foreign substance. It is the practice, however, to classify the metallic materials of commerce into two main groups—pure or commercially pure metals and alloys. The commercial metals are often graded with respect to the nature and amount of "impurity" present, thus giving some justification for differentiating between a "commercially pure" metal and an alloy. It is interesting to note a use of the term alloy applying to "impurities" in connection with gold. For several thousand years gold was the most valuable metal known and any other metal mixed with it decreased the value for a given weight. The art of alloying cheaper metals with gold was practised so fraudulently that "alloy" became associated with "impurity" or an addition which detracted from the value. This usage is standard in general English literature. It is not intended to convey the idea that the art of alloying was used formerly only to degrade or debase, but such practices became common knowledge, whereas the constructive practices did not. The great efforts in the 19th century toward modifying the properties of one metal by the addition of others served not only to popularize the benefits of alloying, but also contributed generously to the great industrial advances of the last few generations.

A definition of alloy is given by the American Society for Testing Materials, 1939, as follows: "A substance having metallic properties, consisting of two or more metallic elements or of metallic and non-metallic elements, which are miscible with each other when molten, and have not separated into distinct layers when solid." Although this definition suggests what should obtain in the molten condition—and most alloys are prepared by melting—they may be made in other ways. One of the oldest alloys is steel, composed essentially of iron and carbon. The old method of adding carbon was by heating solid iron in charcoal or in the reducing portions of wood fires, similar in principle to the present methods of adding carbon to solid iron or steel by carburization. Also alloys may be formed by mixing metal powders and heating to a temperature below the melting point, and they may be formed directly by electrodeposition. The art of preparing alloys is very old. In ancient times a number of alloys were produced by direct and simultaneous reduction of two or more metals from the ores. All the material in a metallic substance need not be part of the alloy. For example, puddled iron or wrought iron contains some nonmetallic material called slag. Wrought iron is not regarded as an alloy of iron and slag but as a relatively pure iron because the metallic constituent is relatively pure. The slag is regarded as an "inclusion." On the other hand,

non-metallic particles of cuprous oxide in copper may technically be regarded as part of the alloy because molten copper dissolves several per cent of this oxide.

Gradually the metallurgical art has advanced until nearly all of the metallic elements can be produced in a more or less pure state. Tens of thousands of combinations of 50 or more of the metallic elements with one another and with non-metallic elements have been prepared in recent times in the search for useful mixtures. It is estimated that more than 5,000 alloy compositions are in current use. This number does not include small variations such as may be expected in attempts to produce the same composition. In some respects the most common of the alloys are those used in coinage and jewellery. The so-called copper coins are really "bronze" alloys containing usually 95% copper, 4% tin and 1% zinc. Silver coins in Great Britain until 1920 were made of "sterling" silver containing 92.5% silver and 7.5% copper. All U.S. silver coins contain 90% silver and 10% copper; the five-cent piece contains 75% copper and 25% nickel. British gold coins contain 91.67% gold and 8.33% copper, whereas U.S. gold coins contain 90% gold and 10% other metals, mostly copper. Platinum, gold and silver used in the manufacture of jewellery are nearly always alloyed with other metals to modify colour, improve strength, hardness and wearing qualities or to effect economy. The purity of gold jewellery is indicated by the "karat," 24-karat being pure gold. Eighteen-karat gold containing 75% gold and 25% silver is green, 75% gold, 12.5% silver and 12.5% copper is yellow, and 75% gold and 25% copper is red. White gold can be made by the addition of nickel. These precious metal alloys comprising many specific compositions also have other important uses. For example, platinum alloys are used in thermo-couples and electric contacts of magnetos, gold alloys in dentistry and silver alloys for table ware.

Ferrous Alloys.—Alloys are classified industrially into the two main divisions, ferrous (iron base alloys) and non-ferrous. Many ferrous alloys are termed steel. (See IRON AND STEEL; STEELS, ALLOY; TOOL STEEL; STAINLESS STEELS.) Steels are by far the most important industrial alloys. They not only differ markedly in composition, but also the properties of many steels can be profoundly changed by heat treatment or mechanical working. A piece of carbon steel containing 1% carbon quenched in water from 775° C is hard and may be used for a cutting tool. It will readily machine a piece of the same steel which has been "annealed" by holding at 700° C followed by slow cooling. One steel may be magnetized by an electric circuit and become a permanent magnet. Another (iron-silicon alloy) is used in transformers partly because of its high magnetic permeability and its low magnetic hysteresis. An iron alloy containing 13% manganese and 1% carbon (Hadfield's manganese steel) is soft and non-magnetic after quenching from a high temperature, and relatively hard and magnetic when slowly cooled. Invar is an alloy containing about 64% iron and 36% nickel which does not expand when heated 200° C above room temperature. Rustless, heat-resisting and stainless qualities are imparted to iron by adding chromium, with or without nickel, silicon or aluminium, and varying the carbon content and heat treatment. Iron alloys may be made to retain high hardness at a dull red heat by suitable additions of tungsten, or molybdenum, with or without carbon, chromium or vanadium, each composition requiring a special heat treatment to develop "red" hardness. Certain of these alloys are termed "high speed" steels.

Steels are made in the form of castings, and all kinds of wrought shapes such as forgings, bars, rods, plates, sheets, structural shapes, tubing and wire. Cast irons not used in the wrought form are also included in the ferrous alloys. These are classified in three main groups: grey, white and malleable cast iron. Grey iron is essentially an iron alloy containing 2 to 4.5% carbon and sufficient silicon to cause the major part of the carbon to separate as graphite on solidification and cooling. White iron contains so little silicon or is solidified and cooled so rapidly that the carbon does not separate as graphite. It is hard and has a white fracture, whereas grey iron is relatively soft and machinable and has a grey fracture. Malleable iron is obtained by annealing white iron

in such a manner as to eliminate the carbon or more commonly to cause its separation into small and more or less spherical particles of graphite resulting in relative softness and absence of brittleness.

Non-ferrous Alloys.—Non-ferrous alloys are further classified industrially in terms of the most important metal present. Brass, for example, is termed a copper base alloy because copper is present in greater proportion than zinc. Other industrial copper base alloys are tin-bronze, silicon-bronze, aluminium-bronze, nickel-silver, copper-nickel-silicon, phosphor-bronze and cupro-nickel. (See COPPER: *Alloys of Copper*.) Zinc base alloys are used extensively in pressure die castings. A popular alloy contains about 92 to 93% zinc, 4.5% aluminium and 3% copper, with or without a little magnesium. (See ZINC.) Lead base alloys are also used extensively in pressure die castings for bearings, acid-resisting parts, storage battery grids, etc. Plumbers' solder (*q.v.*) is an alloy containing about 67% lead and 33% tin. Type metal (*q.v.*) is also a lead base alloy containing up to 20% antimony, with or without other elements. (See LEAD: *Metal Products and Alloys*.) Aluminium and magnesium base alloys are known as the "light alloys" because of their low specific gravity. (See ALUMINUM: *Alloys of Aluminum*.) A number of nickel base alloys have found important industrial applications. (See MONEL METAL.) Among other important nickel alloys are those used as high temperature heating units in electric furnaces, thermo-couples, etc., known as nichrome, chromel, alumel, etc. These alloys all contain from 60% to 94% nickel, the other alloying elements being chromium, iron or manganese. Of particular industrial as well as scientific interest is an alloy containing 79% nickel and 21% iron, known as permalloy. This alloy when properly prepared has a low magnetic hysteresis and a very high magnetic permeability in weak fields. Its properties have made possible great advances in transoceanic communication by wire. (See MAGNETISM: *Iron-nickel Alloys [Permalloys]*.) Tin base alloys are used for many purposes, but the principal use is in bearings. Britannia metals and babbitts are tin alloys containing antimony and copper with or without zinc, lead or bismuth. (See Plate II, fig. 7.) Ordinary pewter is a tin base alloy containing 8% to 15% lead. Stellite, a cobalt-chromium-tungsten alloy containing a small amount of carbon, is so hard that it is used as a cutting tool. It is not only hard at ordinary temperatures but possesses useful "red" hardness. (See Plate II, fig. 8.)

CONSTITUENTS OF ALLOYS

With so many alloys, each having its special properties and internal structure, and with countless possible combinations, the need for scientific as well as industrial classification is apparent. The study of the constitution and crystalline structure of alloys by means of the microscope (*q.v.*), X-ray spectrometer, thermal analysis, chemical analysis and various physical tests, has resulted in a classification of the constituents with reference to the manner of aggregation of the atoms. Three types of constituent are found: (1) Pure or substantially pure metals; (2) solid solutions; (3) chemical compounds.

Nature of Pure Metals.—A pure metal constituent is composed substantially of one kind of atom. The atoms of different metallic elements vary somewhat in effective size but they are on the order of a hundred-millionth of an inch in diameter. X-ray wave lengths are the same order of magnitude as the diameter of an atom and hence the arrangement of atoms in a crystal can be determined by diffraction of X-rays of known wave length. Although solid metals are opaque they are crystalline. The crystalline structure is described by the type and dimensions of a space lattice. A space lattice consists of a series of points in space such that every point is situated similarly to every other point. Space may be imagined as divided into cells by three sets of parallel planes, the intersections of these planes constituting the points of the space lattice. The angles which these planes make with one another and the distances apart determine the type and constants of the crystal. Most pure metals crystallize in the cubic and hexagonal systems. (See CRYSTALLOGRAPHY.) The microscope is a coarser grained tool than the X-ray spectrometer

and can only resolve particles comprising about 1,000,000,000 atoms and more. It reveals the presence of grains and grain boundaries in metals as shown in a number of the accompanying micrographs shown in Plates I. and II. Each grain in a pure metal is the same kind of a crystal but differs in orientation of the crystal axes from its neighbours. Grains may also differ markedly in size and shape.

Before making micrographs of a sample of alloy, a surface is highly polished and usually "etched" by slight chemical attack. In Plate I., figs. 1 and 10, and in Plate II., figs. 5 and 8 the different colours represent different constituents. In Plate I., figs. 9 and 12 and in Plate II., fig. 10, only one constituent is present, the different colours being due to different orientation of the grains.

Nature of Solid Solutions.—Metallic solid solutions are also crystalline. Adopting the terminology of aqueous solutions, metallic solid solutions consist of "solvent" and "solute." If, for example, a small amount of copper is alloyed with nickel, the crystalline identity of copper is lost and the nature of the nickel is changed. Copper atoms are supposed to substitute for some of the nickel atoms in the space lattice. Nickel is the solvent and copper is the solute. It so happens that nickel and copper crystallize with the same type of space lattice, and that each is soluble in the other in the solid state to an unlimited extent. Therefore in the alloy containing 50 atomic per cent of each metal no attempt is made to differentiate between solvent and solute. In other alloys of these metals the element present in the higher atomic per cent is the solvent. Although these metals crystallize with the same type of space lattice, a side of the unit cube in copper is $3.60 \text{ by } 10^{-8}$ and in nickel $3.54 \text{ by } 10^{-8}$ centimetres. The dimensions of the unit cube of the solid solution bear an approximately linear relationship to the atomic concentration, that is, the unit cube of an alloy containing 50 atomic per cent each of copper and nickel is about $3.57 \text{ by } 10^{-8}$ centimetres.

Nickel and chromium form a complete series of solid solutions but the pure metals crystallize with different types of space lattice. The solvent metal in any such solid solution alloy is the one whose type of space lattice persists. Within a certain range of composition it appears that either type of space lattice may be stable at ordinary temperatures. Nickel is the only solvent up to about 65% chromium, whereas chromium persists as the sole solvent up to only about 5% nickel. Many pairs of metals do not form solid solutions throughout the whole composition range. In the aluminium-magnesium alloys, for example, even the systems of crystallization are different, the former being cubic and the latter hexagonal. Solid aluminium dissolves only a limited amount of magnesium and vice versa. The aluminium-rich solid solutions have the same type of space lattice as aluminium, and the magnesium-rich solutions the same as magnesium. These are referred to as cases of "limited solid solubility." Not only is the solid solubility limited but the limit changes with change in temperature, usually increasing with increase in temperature, but sometimes the reverse. If a solute is present in an amount less than the solubility limit, the solution is "under-saturated," and if equal to the solubility limit it is "saturated." A solid solution saturated or nearly so at a relatively high temperature may be cooled so quickly that a "super-saturated" solid solution obtains either temporarily or more or less permanently at some lower temperatures.

An alloy composed of two elements is termed binary, one of three elements ternary, and one of four elements quaternary. Solid solution alloys may be binary or they may contain a large number of elements. Although atom substitution seems to be the rule in solid solutions, it appears that carbon atoms dissolved in solid iron occupy spaces between iron atoms.

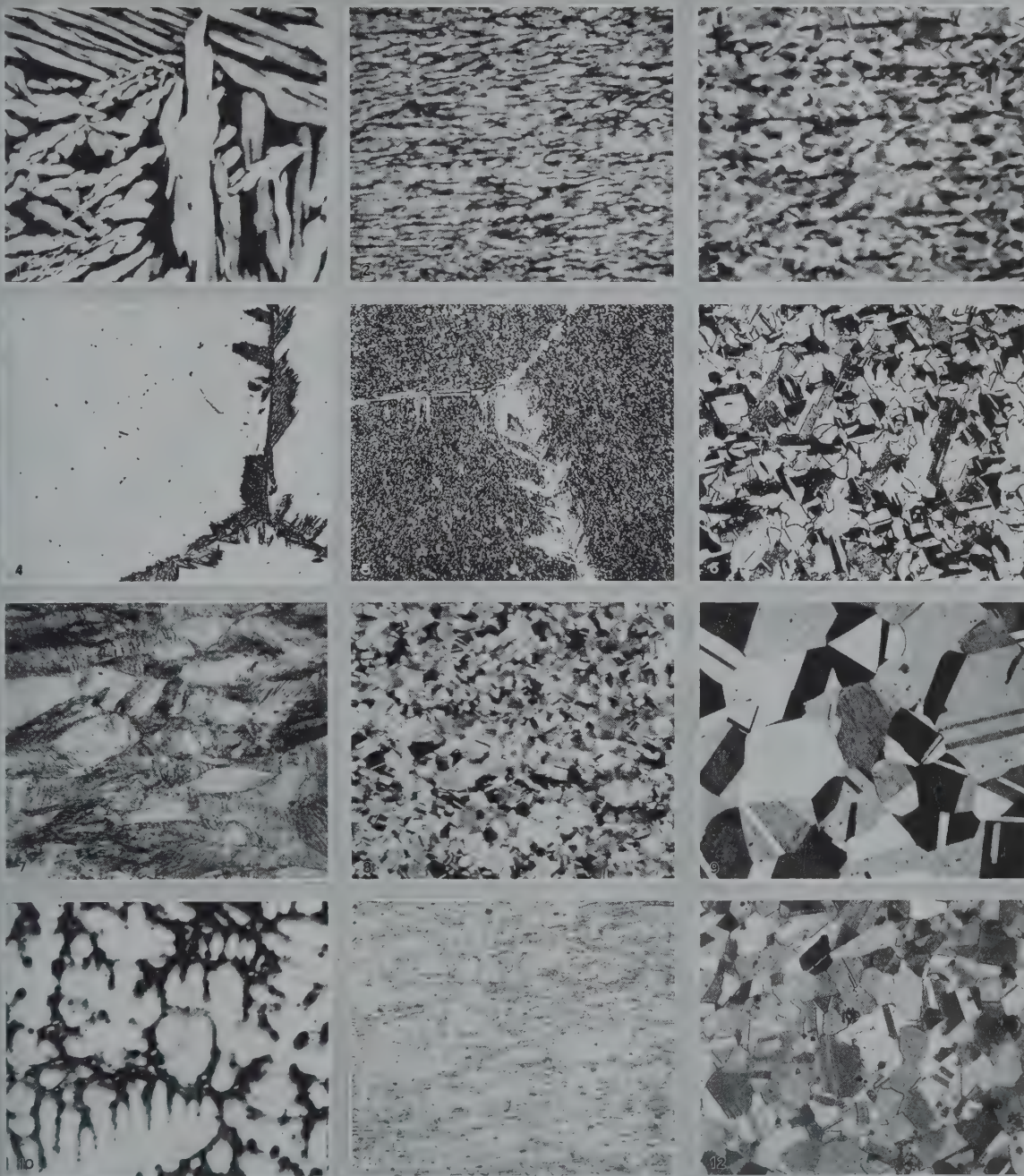
Nature of Compounds.—Certain combinations of metals produce materials with space lattices different from that of either of the constituent elements. These materials are called, in general, compounds. Compounds have definite proportions of the elements, such as FeAl_3 , Fe_3C , CuAl_2 , Mg_2Si , etc. Usually inter-metallic compounds possess lower crystalline symmetry than the elements

from which they are formed. The constituent atoms of a compound crystal are supposed to be so fixed in their positions that different kinds of atoms are not readily interchangeable in position. It is not supposed that an oxygen atom, for example, in Cu_2O would be interchangeable with a copper atom in the Cu_2O space lattice. On the other hand, a metallic compound may be the solvent of a solid solution. Mn_3C seems to be soluble in solid Fe_3C . If so, the material would be a solid solution of manganese carbide in iron carbide. Even in this case, it is suggested that the manganese substitutes only for the iron in the space lattice, the carbon atoms being interchangeable only with one another.

PROPERTIES OF ALLOYS

Properties of Pure Metals.—The properties of an alloy depend on the properties, the proportions and arrangement of the constituents. Pure metals differ greatly in specific properties, such as hardness, melting point, electrical conductivity, ductility, density, etc. Many of these properties are transmitted to alloys of which a pure metal is one constituent, and the effect can be approximately calculated by applying the rule of mixtures. One of the outstanding characteristics of metals is their ability to be plastically deformed without rupture. This plastic deformation is possible because a portion of a crystal of a metal will slip on one or more of the crystallographic planes without rupture. In general, slip takes place the more easily the purer the given metal, and the larger the grains. Slip takes place at a much lower unit load than that which would be required to separate one plane of atoms from the other simultaneously. The total attractive forces on one of these planes would be the sum of the attractive forces of all of the atoms participating, a value termed "absolute cohesion," which is large as compared with the force required to produce slip. An automobile, weighing two tons, standing on a smooth but level pavement exerts a pressure on the pavement equal to its weight. A force of 150 lb. applied horizontally, however, may start the car in motion. This latter force would be comparable to that required to produce slippage in a metal crystal, whereas the weight of the automobile would be compared with the absolute cohesion. That the absolute cohesion is markedly greater than the unit force required to produce slip in a plastic metal crystal is clearly demonstrated by the fact that the same atoms can be differently arranged, as by reduction in grain size or by cold working, so as to greatly increase not only the force required to produce slip but also that required to produce rupture. A single crystal of iron, for example, may have a tensile strength of only 11 tons per square inch. Iron of the same purity composed of small grains may have a tensile strength of 20 tons per square inch. Another piece of iron of the same purity drawn cold through a number of dies may have a tensile strength of 40 tons per square inch. In general, the strength and hardness of a given pure metal increase with decrease in grain size, with decrease in temperature, and with increase in degree of cold work. There are some exceptions to the rule in connection with temperature change, notably in iron which undergoes an allotropic transformation at about 900°C and has a higher tensile strength in the gamma condition slightly above 900°C than in the alpha condition slightly below this temperature. Also, commercial iron and most of the ordinary steels have higher tensile strength at about 200°C than at room temperature. Because the softness of a metal is dependent on ease of slip on the crystallographic planes, any condition which interferes with the ease or freedom of this slip movement is a hardening factor. The factors favouring high plasticity are generally those which favour softness, namely large grain size, freedom from cold work and high temperature.

Properties of Solid Solutions.—The properties of very dilute solid solutions are usually quite similar to the properties of the commercially pure solvent metals themselves. The departure from similarity takes place gradually as the amount of solute increases, and obtains to a different degree for equal amounts of different solutes. Pure metals freeze or melt at a constant temperature, whereas most solid solution alloys freeze or melt throughout a range of temperature. Solid solution alloys are harder and



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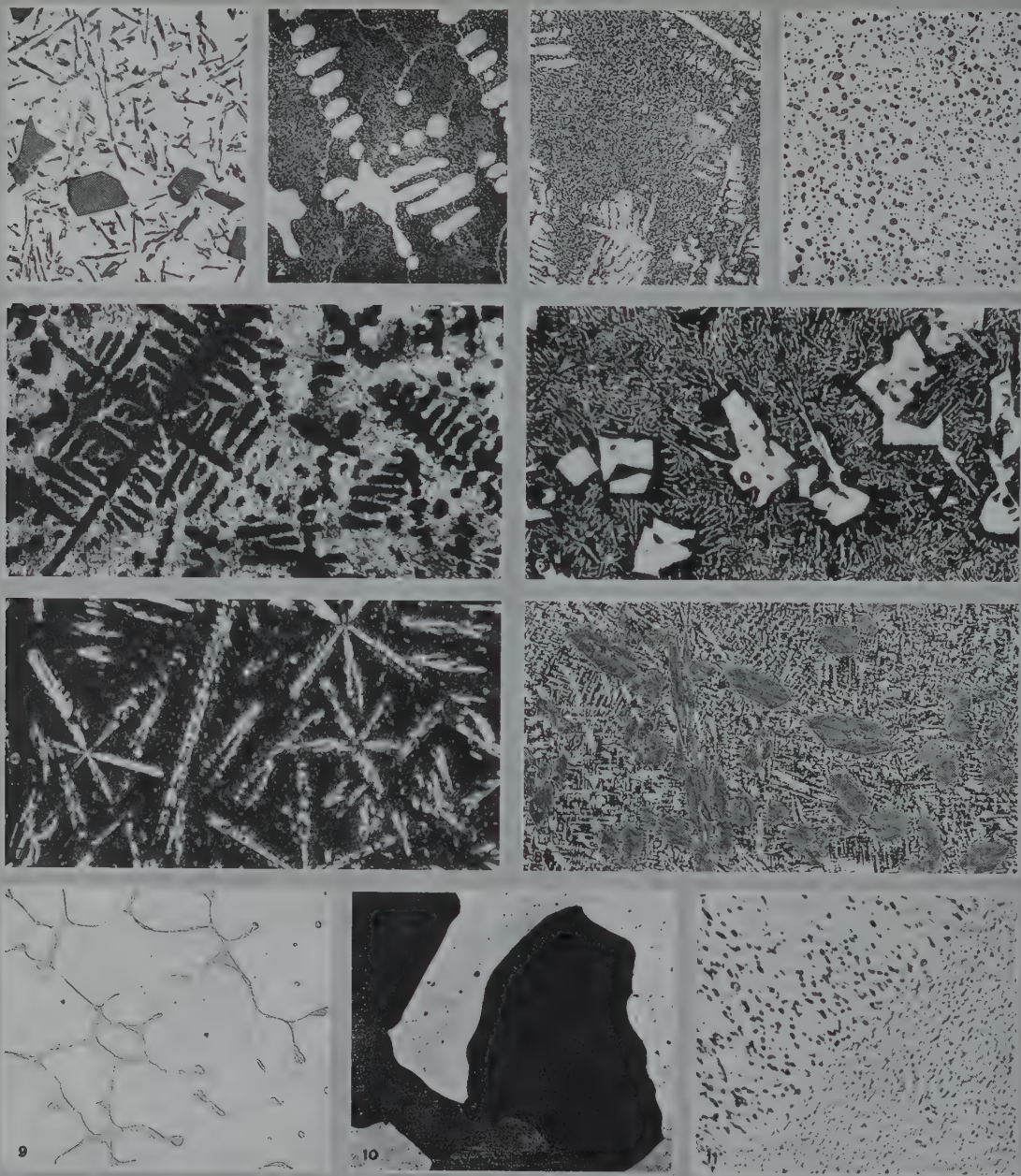
PHOTOMICROGRAPHS OF ALLOYS AND METALS

Figs. 1, 2, 3.—Brass, Muntz metal (60% copper, 40% zinc). 1, as cast, Brinell hardness number B.H.N. 68; 2, hot rolled, B.H.N. 77; 3, cold drawn, B.H.N. 107, magnified 75x

Figs. 4, 5, 6.—Rolled Muntz metal quenched from 825° C. and reheated. 4, reheated 2 hrs. at 150° C., B.H.N. 100; 5, reheated 2 hrs at 300° C., B.H.N. 143; 6, reheated 2 hrs at 470° C., B.H.N. 59; 100x

Figs. 7, 8, 9.—Brass, 70% copper, 30% zinc. 7, cold rolled, B.H.N. 150; 8, cold rolled and annealed at 425° C., B.H.N. 70; 9, cold rolled and annealed at 700° C., B.H.N. 49; 75x

Figs. 10, 11, 12.—Monel metal (67% nickel, 28% copper, 5% other elements), 10, as cast, B.H.N. 105; 11, cold rolled, B.H.N. 200; 12, hot rolled, B.H.N. 144; 100x



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PHOTOMICROGRAPHS OF ALLOYS AND METALS

Figs. 1, 2, 3, 4.—Aluminum alloy containing 13% silicon. 1, sand cast, tensile strength (T.S.) 19,000 lb. per sq. in. (psi), elongation (El.) 1%. 2, "modified" with 0.05% sodium before sand casting, T.S. 27,000 psi, El. 12%. 3, Chill cast, T.S. 34,000 psi, 5.8% El. 4, chill cast and heated 40 hrs. at 565° C and quenched, T.S. 28,000 psi; El. 16%; 100x

Figs. 5, 6, 7.—Lead alloy containing 10% antimony; lead-rich solid solution dendrites in eutectic; 90x. 6, lead alloy containing 18%

antimony; antimony crystals in eutectic; 90x. 7, Babbitt, tin 91%, copper 4.5%, antimony 4.5%; 50x

Figs. 8, 9, 10.—Stellite cutting tool, 45% cobalt, 30% chromium, 15% tungsten, balance carbon, manganese, silicon and iron; 100x. 9 and 10, aluminum alloy containing 5.5% copper. 9, as sand cast, T.S. 20,500 psi. 10, same after prolonged heating at 544° C, followed by quenching, T.S. 37,000 psi; 100x

Fig. 11.—Aluminum alloy containing 4.05% copper, quenched from 540° C and heated two weeks at 200° C; 1,500x

in general less plastic than the solvent metal. The electrical conductivity is less than that of the solvent metal. In fact, this property changes to a much greater extent than would be indicated by the law of mixtures. The hardness also disobeys the law of mixtures. For example, tin is much softer than copper, but a solid solution of tin in copper is considerably harder than the copper itself. The temperature coefficient of electrical resistivity of solid solution alloys is usually lower and sometimes markedly lower than in the pure metals. Certain solid solution alloys possess a zero or even slightly negative temperature coefficient. Also, the thermo-electric force of a solid solution is often markedly different from that of the solvent metal.

Properties of Compounds.—Compounds, and particularly inter-metallic compounds, are characterized by relatively high hardness and low plasticity. Metallic compounds are very important constituents in alloys from the standpoint of increasing hardness, decreasing grain growth and particularly for the purpose of maintaining strength of alloys at high temperatures. Each compound has its specific properties, some having high melting point, some low, some with high hardness, some with low hardness, a few with considerable plasticity, but many with practically no useful plasticity.

Proportions and Arrangements of Constituents.—Certain properties of alloys, such as density and resistance to penetration by X-rays, may be determined by the proportions and specific properties of the various constituents. Many of the properties, however, depend to a greater or less extent on the *arrangement* as well as the proportions. In an alloy containing more than one type of constituent, the most important thing to be considered is which constituent possesses continuity. This is particularly important if the different constituents vary considerably in hardness and plasticity.

The importance of the degree of refinement of the separate constituents has been demonstrated forcibly in recent years. In many alloys the proportions of the constituents may be changed by heat treatment, and at the same time the manner of aggregation may be changed. Using the copper- Ni_2Si system as an example, the alloy containing 6% Ni_2Si will consist largely of solid solution of nickel and silicon in copper after quenching from 900°C . The Brinell hardness is about 70. By heating to 525°C a short time a considerable portion of the nickel and silicon precipitate in submicroscopic particles of Ni_2Si , increasing the hardness to above 200. During this heating period the hardness rises for a certain length of time, reaches a maximum and eventually may decrease somewhat to approximately a constant value. These changes in hardness are associated with change in amount and size of the hard particles of Ni_2Si . There appears to be an average size of precipitated particle which produces maximum hardening effect for a given quantity of the constituent. In this condition, referred to as "critical dispersion" for maximum hardness, the particles are too small to be resolved with a microscope.

The above is an example of what has become a common practice in commercial selection and heat treatment of a number of alloy types. The high temperature step in the heat treatment is referred to as the *solution treatment*, and the low temperature step as *precipitation treatment*. Many alloys have been found to exhibit changes in properties and structure when subjected to this type of heat treatment. The alloy compositions must be carefully selected with reference to solubility limits of solid solutions, change of solubility with change in temperature, and the temperature and time of the heat treatment must be varied to suit the particular alloy. Some alloys, for example, duralumin and lead-antimony alloys, need not be given an "artificial" precipitation heat treatment because the precipitation takes place spontaneously at room temperature. Other alloys must be heated above room temperature in order to cause precipitation. These changes in particle size and in the amount of solute in a solid solution are possible in alloys only because of diffusion in the solid state. Diffusion is supposed to occur by migration of solute atoms in the grain boundaries and in the space lattice of the solvent. Rapid diffusion is favoured by high temperature and at certain

relatively low temperatures, different for different alloys, diffusion may, for practical purposes, be considered not to take place. Also diffusion is more rapid along grain boundaries than through the crystalline grains themselves.

CONSTITUTION DIAGRAMS

The number, composition and proportions of the constituents in equilibrium at any given temperature, and changes due to change in temperature may be represented graphically in a constitution diagram. Such diagrams present only equilibrium conditions and are not concerned with the arrangement of the constituents. A binary alloy diagram may be represented on a two dimensional chart, as in fig. 1, but ternary alloy systems require three dimensions for suitable graphic representation. Complete graphic representation of the constitution becomes difficult if not hopeless in alloys containing four or more components. Plane charts, however, within restricted composition limits, particularly

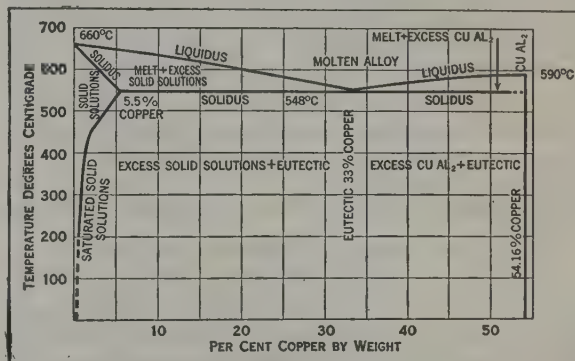


FIG. 1.—CONSTITUTION DIAGRAM SHOWING NUMBER, COMPOSITION AND PROPORTION OF THE CONSTITUENTS IN EQUILIBRIUM AT ANY GIVEN TEMPERATURE, AND CHANGES DUE TO CHANGES IN TEMPERATURE

when only two of the components are allowed to vary at one time, are exceedingly useful even with complex alloys. In alloy systems each physically distinct and homogeneous part is called a "phase," and the chemical elements or compounds which participate in the equilibria are called "components."

In fig. 1, the liquid alloy is one phase, the solid aluminium or aluminium-rich solid solution another, and the solid compound CuAl_2 another. Aluminium and CuAl_2 are the components. In the whole system other compounds are formed and the elements, aluminium and copper, may be regarded as the components. The *liquidus* is the line or curve representing the beginning of solidification, and the *solidus* represents the end of solidification on cooling. In some alloy systems the liquidus passes through a minimum temperature, coinciding with the solidus at a certain composition. If the solidified alloy having such a minimum freezing point shows the presence of at least two phases under the microscope it is called a *eutectic* alloy. Eutectics may be binary, ternary, etc., in accordance with the number of phases present. Eutectic alloys freeze and melt at a constant temperature rather than through a temperature range, and the eutectic composition does not, except by coincidence, represent simple whole number proportions of the elements.

The properties and structures of alloys may be profoundly changed by mechanical working and by heat treatment. Certain of these changes in structures are indicated in the accompanying micrographs and the corresponding changes in properties are indicated in the titles.

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and Metallurgical Engineers, American Society for Testing Materials, and American Society for Metals. Periodicals: *The Metallurgist*; *Supplement to the Engineer* (London); *Zeitschrift für Metallkunde*; *Revue de Métallurgie*; *Métals and Alloys*. (Z. J.)

ALLOY STEELS: see STEELS, ALLOY.

ALLPORT, SIR JAMES JOSEPH (1811–1892), English railway manager, was, for 20 years onwards from 1853, the general manager of the Midland railway. He is remembered as the pioneer of cheap and comfortable railway travelling. He was the first to appreciate the importance of the third-class passenger as a source of revenue, and in 1872 he inaugurated the policy, subsequently followed by all the important railways of Great Britain, of carrying passengers in well-fitted third-class carriages at the rate of a penny a mile. He was also the first to introduce the Pullman car on British railways. Allport was knighted in 1884. He died in London on April 25, 1892.

ALLPORT, SAMUEL (1816–97), English petrologist, was born in Birmingham Jan. 23, 1816, and died at Cheltenham July 7, 1897. He was a pioneer in microscopic petrology. The basalts of south Staffordshire, the diorites of Warwickshire, the phonolite of the Wolf Rock (to which he first directed attention), the pitchstones of Arran and the altered igneous rocks near the Land's End were investigated and described by him during the years 1869–79 in the *Quarterly Journal of the Geological Society* and in the *Geological Magazine*.

ALL RISKS INSURANCE: see INSURANCE: MISCELLANEOUS.

ALL SAINTS, FESTIVAL OF (ALL HALLOWS, HALLOWMASS), a feast of the church celebrated on Nov. 1 in honour of all saints, known or unknown, as a festival of the first rank, with vigil and octave. The first trace of a general commemoration of martyrs is in Antioch on the Sunday after Pentecost; Chrysostom (d. 407) also refers to the custom. At Rome the feast of St. Mary ad Martyres was instituted on May 13, 609 or 610, when Boniface IV dedicated the Pantheon to the Blessed Virgin and all martyrs. Gregory III (731–741) dedicated an oratory in St. Peter's to all saints, and fixed the anniversary for Nov. 1. This observance was extended by Gregory IV (827–844) to the whole church; the octave was added by Sixtus IV (1471–84). At the Reformation the festival was retained in the calendars of the Church of England and many of the Lutheran Churches; in the latter, however, it has fallen into complete disuse.

ALL SAINTS BAY or **BAIA DE TODOS OS SANTOS**, a land-locked bay and natural harbour on the eastern coast of Brazil about 738 mi. (1,187 km.) northeast of Rio de Janeiro. The bay is about 20 mi. wide and 23 mi. long with an entrance from the Atlantic about 2 mi. broad. The channel leading through this entrance is rather circuitous and varies with the seasons of the year. Detached breakwaters, one 1,300 yd. long and another about 1,000 yd. long, cause the water of the bay to be less disturbed by the winds. The controlling depth of the channel varies from 26 ft. to 33 ft. On entering All Saints bay from the Atlantic, one is impressed with the beauty of the bay and the hills rising from the water's edge. On the western side of the peninsula, separating the bay from the Atlantic, in 13° S. and 38° 30' W., is Salvador or Baía (population [1940] 293,278), an important seaport and capital of the state of Baía.

ALL SOULS' DAY, the day (Nov. 2 or, if that be a Sunday or festival of the first class, Nov. 3) set apart in the Roman Catholic Church for commemoration of the faithful departed; a custom based on the doctrine that souls which at death are not yet sufficiently purified to be fit for the Beatific Vision may be helped by the prayers of the faithful here on earth. The practice of devoting certain days to intercession for particular groups of the dead is of great antiquity; but the institution of this feast of general intercession is due to Odilo, abbot of Cluny (d. 1048), who ordered its observance in the Cluniac monasteries. It spread thence among other congregations, and became practically universal before the end of the 13th century. It was abolished in the Church of England at the Reformation, but has been revived in "Anglo-Catholic" churches. Among continental

Protestants its tradition has been more tenaciously maintained, especially in Saxony, where, though its ecclesiastical sanction has long since lapsed, its memory survives strongly in popular custom. As in France people of all ranks and creeds decorate the graves of their dead on the *jour des morts*, so in Germany the people stream to the graveyards once a year with offerings of flowers.

Certain popular beliefs connected with All Souls' Day are of pagan origin and immemorial antiquity. In many Catholic countries the dead are believed by the peasantry to revisit their homes on All Souls' night and partake of the food of the living. In Tirol cakes are left for them on the table. In Brittany the people flock into the cemeteries at nightfall to kneel bare-headed at the graves of their loved ones, and to pour libations of milk or holy water on the tombstones, and at bedtime supper is left on the table for the dead.

ALLSPICE, the dried unripe berry of the pimento or allspice tree (*Eugenia pimenta* or *Pimenta officinalis*) of the myrtle family. The tree, which attains a height of 40 ft., is native to Central America and to the West Indies where it is also cultivated. This highly aromatic spice, widely used in cookery and in medicine, is supposed to combine the flavour of cinnamon, nutmeg and cloves, whence its name. The name is applied also to other aromatic shrubs, especially to the Carolina allspice (*Calycanthus floridus*), a handsome flowering shrub, native to the south-eastern United States and often cultivated in England; to the Japanese allspice (*Chimonanthus fragrans* or *Meratia praecox*), native to Eastern Asia and planted for ornament in England and the United States; and to the wild allspice or spicebush (*Benzoin aestivale*), a lauraceous shrub of eastern North America, with aromatic berries, reputed to have been used as a substitute for spice.

ALLSTON, ROBERT FRANCIS WITHERS (1801–1864), the fifth child of Benjamin Allston and Charlotte Anne Allston his second cousin, was born at Brookgreen plantation in All Saints' parish, South Carolina, April 21, 1801. He descended from the Alstons of Hammersmith, England. The first American member of the family, John Alston, in 1682 was apprenticed to a merchant of Charleston, South Carolina. The young immigrant preferred agriculture, acquired extensive lands, and became the founder of one of the most famous of the old coast country rice planting families. The narrow peninsula between the Waccamaw river and the sea ("Waccamaw Neck") came to consist largely of Alston plantations. The name acquired the spelling Allston; but about the time of the Revolution the father of the later Governor Joseph Alston reverted to the original spelling. We have thenceforth the "one l Alstons" and the "two l Allstons." R. F. W. Allston graduated at West Point in 1821 and was appointed lieutenant of artillery and was assigned to the Coast Survey. He aided in the survey of Plymouth and Provincetown harbours, Mass., and the entrance of Mobile bay. In 1822 he resigned his commission in order to manage the plantation of his widowed mother. He was elected surveyor general of South Carolina in 1823 and served two terms. In 1828 and 1830 he was elected to the lower house of the legislature, and in 1832 to the State Senate, where he served for the next 24 years. From 1847 to 1856 he served as president of the Senate, the lieutenant governor before 1865 not having that or any other duty. Allston co-operated with the Nullificationists, and in 1832 was defeated for the House by a Unionist, though immediately afterwards elected to the Senate. He was at this crisis commissioned a colonel in the State militia and was later deputy adjutant general. He married in 1832 James L. Petigru's sister Adele. As the secession movement of 1847 to 1852 in South Carolina took form, Allston favoured the "co-operationists" as against those who urged the immediate secession of South Carolina irrespective of action by any other State. He was a delegate to the Nashville Convention of 1850, called in the hope of a general Southern secession. He was elected governor by the legislature for the term 1856–58. He encouraged railroads, which were being rapidly built in the '50s, partly with State aid, and was active both as legislator and governor in seeking to improve the unsatisfactory "free school" system for the poor. He published in 1843 *A Memoir on the Intro-*

duction and Planting of Rice in South Carolina, which is still the standard work on the subject, and in 1854 *An Essay on Sea Coast Crops*. He died April 7, 1864.

Allston's daughter, Mrs. Elizabeth W. A. Pringle, gives a picture of him in her *Chronicles of Chicora Wood* (1922). Prof. J. H. Easterby cites in *Dictionary of American Biography* Mss. in the possession of Allston's daughter, Mrs. C. A. Hill, a sketch in *DeBow's Review*, XII, 574-5, and obituaries in *Charleston Courier*, April 12, 1864, and *Charleston Mercury*, April 23, 1864.

ALLSTON, WASHINGTON (1779-1843), American historical painter and poet, was born Nov. 5, 1779, at Waccamaw (S. C.), where his father was a planter. He graduated at Harvard in 1800, and for a short time pursued his artistic studies at Charleston with Edward Greene Malbone (1777-1807), the miniature painter, and Charles Fraser (1782-1860). With the former, in 1801, he went to London, and entered the Royal academy as a student of Benjamin West, with whom he formed a lifelong friendship. In 1804 he went to Paris, and, after a few months' residence there, to Rome, where he spent the greater part of the next four years. During this period he became intimate with Coleridge and Thorwaldsen. From 1809 to 1811 he resided in his native country, and from 1811 to 1817 he painted in England. After visiting Paris a second time, he returned to the United States and practised his profession at Boston (1818-30) and afterwards at Cambridge (Mass.), where he died July 9, 1843. He was elected an associate of the Royal academy in 1819. In colour and the management of light and shade Allston closely imitated the Venetian school, and he has hence been styled the "American Titian." Many of his pictures have biblical subjects, and Allston himself had a profoundly religious nature. His first considerable painting, "The Dead Man Revived," executed shortly after his second visit to England, and now at the Pennsylvania Academy of Fine Arts in Philadelphia, gained a prize of 200 guineas. In England he also painted his "St. Peter Liberated by the Angel," the remarkable canvas, "Uriel in the Sun," "Jacob's Dream" (at Petworth) and "Elijah in the Wilderness." To the period of his residence in America belong "The Prophet Jeremiah" (at Yale), "Saul and the Witch of Endor," "Miriam," "Beatrice," "Rosalie," "Spalatro's Vision of the Bloody Hand" and the vast but unfinished "Belshazzar's Feast" (in the Boston Athenaeum), at which he was working at the time of his death. As a writer, Allston shows great facility of expression and imaginative power. Coleridge (a portrait of whom by Allston is in the National Portrait gallery) said of him that he was surpassed by no man of his age in artistic and poetic genius. His literary works are—*The Sylphs of the Seasons and other Poems* (1813), where he displays true sympathy with nature and deep knowledge of the human heart; *Monaldi* (1841), a tragical romance, the scene of which is laid in Italy; and *Lectures on Art*, edited by his brother-in-law, R. H. Dana, the novelist (1850).

See J. B. Flagg's *Life and Letters of Washington Allston* (1892).

"ALL THE TALENTS," MINISTRY OF, the name given to the coalition government which came into office after the death of Pitt (Jan. 23, 1806). Lord Grenville was at the head of the ministry, which included Fox and Lord Sidmouth. Fox died on Sept. 13; and after a disastrous year in which Napoleon reached the summit of his power, Grenville resigned (March 18, 1807) rather than agree to George III's unconstitutional demand that the ministers should undertake never again to approach him on the subject of concessions to Roman Catholics. It was due to the Ministry of All the Talents that the bill for the abolition of the slave trade was passed on March 25, 1807.

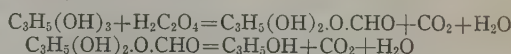
ALLUVION, a word taken from Roman law, in which it was one of the examples of *accessio*, that is, acquisition of property without any act being done by the acquirer. It signifies the gradual accretion (*q.v.*) of land or formation of an island by imperceptible degrees. If the accretion or formation be by a torrent or flood, the property in the severed portion or new island continues with the original owner until the trees, if any, swept away with the island take root in the ground. Alluvion never attached at all in the case of *agri limitati*; *i.e.*, lands belonging to the state and leased or sold in plots. Dig. xli, 1, 7, is the main authority. English law is in general agreement (except as to *agri limitati*) with Roman, as appears from the judgment in *Foster v. Wright*, 1878, 4 C.P.D. 438. The Scottish law, as laid down by the house of lords in *Earl of Zetland v. Glover Incorporation*, 1872, L.R. 2 H.L., Sc., 70, is in accordance with the English. (See **WATER RIGHTS**.)

ALLUVIUM, the material deposited by rivers (see the general article **GEOLOGY**). It is usually most extensively developed in the lower part of the course of a river, forming flood-plains and

deltas, but may be deposited at any point where the velocity of a river is checked; for example, where it runs into a lake. Alluvium in the true sense consists mostly of silt, sand, and gravel, without much true clay; it often contains a good deal of organic matter and therefore yields very fertile soils. Some of the great alluvial deposits of the world are: the flood-plain of the Mississippi, the deltas of the Nile, of the Ganges and Brahmaputra, and of the Hwang Ho in China. Owing to elevation of the land and consequent deepening of the river channel, patches of alluvium are often left forming terraces on the sides of valleys. On such terraces much of London is built. In some regions alluvial deposits contain gold, platinum or gem-stones, and the greater part of the world's supply of tin ore comes from similar sources.

(R. H. RA.)

ALLYL ALCOHOL, a colourless mobile liquid of pungent smell, boiling at 97°C. Its chemical formula is C_3H_5OH or $CH_2:CH.CH_2OH$. It is an unsaturated primary alcohol occurring in very small quantities in impure methyl alcohol obtained from the distillation of wood. It may be prepared by heating glycerin with oxalic acid and a little ammonium chloride to 260°C. In this reaction glycerol monoformin is produced as an intermediate product, but is decomposed as the temperature rises:—



Allyl alcohol is now made also by the hydrolysis of allyl chloride, which is obtained by the chlorination of propylene at 400°C:



Being unsaturated, allyl alcohol combines readily with the halogens. Oxidation by strong oxidizing agents converts it successively into its aldehyde, acrolein, and into acrylic acid. By gentle oxidation with potassium permanganate, it may be converted into glycerin. A more practical synthesis of glycerin from allyl alcohol involves the addition of hypochlorous acid and the subsequent hydrolysis of the resulting chlorohydrin:



ALMA, a city of Gratiot county, Mich., U.S., on the Pine river, 37 mi. W. of Saginaw, in the centre of the lower peninsula. It is served by the Ann Arbor and the Pere Marquette railways. The population increased between 1910 and 1950 from 2,757 to 8,327. Its factories make bicycle rims, house trailers, beet sugar, cement blocks, seed cleaning machinery, bean elevator equipment and automobile parts. It has the world's largest duck and turkey farm. It is the shipping point for a farming district. It is the home of Alma college and the State Masonic home. Two of the state's largest oil refineries are in the city. The city was incorporated in 1905 and adopted a commission form of government in 1919.

ALMA, a river of Russia, in the southwest of the Crimea, entering the Black sea 17 mi. N. of Sevastopol. It gives its name to a famous victory gained over the Russians, on Sept. 20, 1854, by the allied armies in the Crimean War (*q.v.*). The south bank of the river is bordered by a long ridge, which becomes steeper as it approaches the sea, and upon this the Russians, under Prince Menshikov, were drawn up, to bar the Sevastopol road to the allies, who under General Lord Raglan and Marshal St. Arnaud approached from the north over an open plain. The Russian commander massed his troops in heavy columns after the fashion of 1813 and drew in his left wing so that it should as far as possible be out of range of the allied men-of-war, which were sailing down the coast in line with their land forces. The allied generals decided that the French (right wing) and the Turks should attack Menshikov's left, while the British, farther inland, were to assault the front of the Russian position. The forces engaged are stated by Hamley (*War in the Crimea*) as, French and Turks, 35,000 infantry, with 68 guns; British, 23,000 infantry, 1,000 cavalry and 60 guns; Russians 33,000 infantry, 3,800 cavalry and 120 guns; by the Austrian writer Berndt (*Zahl im Kriege*) the allied forces are reckoned at 57,000 men with 108 guns, and the

Russians at 33,600 men with 96 guns. The French advance met at first with little opposition, and several divisions scaled the cliffs of the lower Alma without difficulty. Menshikov relied apparently on being able to detach his reserves to cope with them, but the assailants moved with a rapidity which he had not counted upon, and the Russians only came into action piecemeal in this quarter. Opposite the British, who as usual deployed at a distance and then advanced in long continuous lines, the Russians were posted on the crest of a long glacis-like slope, which offered but little dead ground to an assailant. The village of Burliuk, and the vineyards, which bordered the river, were quickly cleared by the British skirmishers, and the line of battle behind them crossed though with some difficulty. On emerging from the cover afforded by the river-bed the British divisions, now crowded together, but still preserving their general line, came under a terrible fire from heavy guns and musketry. The enemy's artillery was three hundred yards away, yet the British pressed on in spite of their losses, and as some of the Light Division troops reached the "Great Battery" the Russians hurried their guns away to safety. In the meantime, on both sides of this battery, the assailants had come to close quarters with the Russian columns, which were aided by their field guns. A brave counter-attack was made by the Russian Vladimir regiment, 3,000 strong, against the troops which had stormed the great battery, and for want of support the British were driven out again. But they soon rallied, and now the second line had crossed and formed for attack. The Guards brigade attacked the Vladimir regiment, and on the left the Highland brigade and the cavalry moved forward also. Some of the field artillery, which had now crossed the Alma, fired steadily into the closed masses of the Russian reserve, and the Vladimir regiment lost half of its numbers under the volleys of the Guards. The French were now severely pressing the Russian left, and one-third of Menshikov's forces was drawn into the fight in that quarter. The success of the frontal assault had dispirited the remainder of the defenders, and Menshikov drew off his forces southwards. He had lost 5,700 men (Berndt and Hamley). The British had about 2,000 killed and wounded; the French stated their losses at 1,340 men.

ALMA-ATA (formerly Verni). (1) An administrative centre of the Kazakh Soviet Socialist Republic. Pop. (1939) 230,528. It was founded as a fortified settlement by the Russians in 1855, but is now important commercially and is becoming more so since the links with the Trans-Siberian and Chkalov-Tashkent railways have built.

(2) A district round the town, area 27,812 sq.mi. Population 370,806, on the northern slopes of the beautiful Khungai Ala Tau mountains, watered by streams which run through the fertile loess area below to Lake Balkash. The climate and soil are favourable to vine and fruit cultivation.

ALMACANTAR (also written **ALMUCANTAR**), an astronomical term for a small circle of the sphere parallel to the horizon; when two stars are in the same almacantar they have the same altitude. The term is also given (1880) to instruments of a pattern invented by S. C. Chandler to determine the latitude or the time by observing the times of transit of stars across a fixed almacantar.

ALMACK'S, formerly the name of a famous London club and assembly rooms. The founder is usually said to have been one Macall, or McCaul, of which name Almack is an anagram. In 1764 he founded a gentlemen's club in Pall Mall, where the present Marlborough Club stands. It was famous for its high play. In 1778 it was taken over by one Brooks, and established as Brooks's Club in St. James's Street, where it still exists. In 1765 Almack built a suite of assembly rooms in King Street, St. James's. At his death in 1781 they were left to his niece Mrs. Willis, and as "Willis's Rooms" lasted till 1890, when they became a restaurant; but as "Almack's" they ceased in 1863. A 20th century club has since adopted the old name.

ALMADÉN or **ALMADÉN DEL AZOGUE**, a town in Spain, province of Ciudad Real. Pop. (1940) 12,468. Almadén (Ar. almadén, the mine) has been for centuries the principal centre for the famous ores of mercury, impregnating the quartzite of certain

ridges between the Sierras of Chillón (N.) and Cordoneros (Alcudia) (S.). The *Sisapo* of the Romans lay in the same neighbourhood. Almadén and Adria (Southern Austria) were the chief sources of mercury till New Almadén (California) was opened up (1853-57). The city was of strategic importance during the civil war of 1936-39 and remained in government hands until the end of the conflict.

See *Minas de Almadén* (Madrid, 1926), guide-book, XIVth. Int. Congr. of Geol., with diagram showing entire production of the mines since the 15th century.

ALMAGEST, the famous treatise on astronomy by Ptolemy in the 2nd century A.D. Besides the exposition of the Ptolemaic theory of the heavens, it contains an important catalogue of the places of 1,080 stars. (See **PTOLEMY**.)

ALMAGRO, DIEGO DE (c. 1470-1538), Spanish *conquistador*; a founding, born in Spain about 1470. In 1526, he contracted with Francisco Pizarro (*q.v.*) an equal partnership in the conquest of Peru. Pizarro immediately assumed the precedence; Almagro was delegated to provide reinforcements and supplies. He arrived in Peru in 1532, was present at the death of Atahualpa (*q.v.*), assisted in the capture of Cuzco (Nov., 1533) and in 1534 was sent to stop Pedro de Alvarado's march upon Quito, from the coast. Receiving, in 1535, a royal grant of 200 leagues, south of Cuzco, he undertook the terrible march into Chile, but finding no gold, returned and seized Cuzco. In the battle of Abancay (1537), he destroyed Pizarro's army, but allowing himself to be drawn into a truce, was completely routed by Hernando Pizarro at Las Salinas (April 1538) and captured. Convicted by his captor of treason against the crown, in July, 1538, he was garrotted in his prison, and beheaded in the public square of Cuzco.

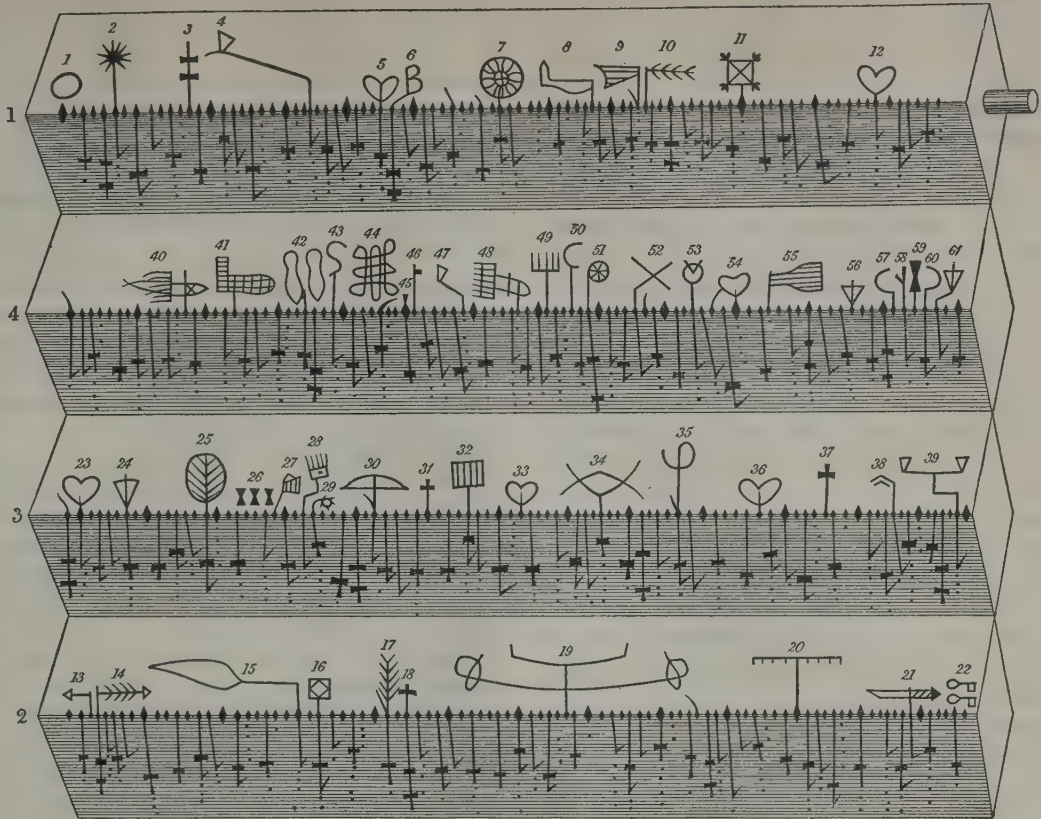
ALMA MATER, a name, signifying "bounteous mother," given by the Romans to certain goddesses, especially to Ceres and Cybele, and now applied to universities and schools regarded as the "foster mothers" of those who have attended them.

ALMANAC, a book or table containing a calendar of the days, weeks, and months of the year, a register of ecclesiastical festivals and saints' days, and a record of various astronomical phenomena, etc.

The attention given to astronomy by Eastern nations probably led to the early construction of such tables as are comprised in our almanacs; of these we know little or nothing. The *fasti* (*q.v.*) of the Romans are far better known and were similar to modern almanacs. Almanacs of a rude kind, known as *clogg almanacs*, consisting of square blocks of hard wood, about 8 in. in length, with notches along the four angles corresponding to the days of the year, were in use in some parts of England as late as the end of the 17th century.

Early almanacs had commonly the name of "prognostications" in addition, and what they professed to show may be gathered from titles like the following, which is quoted by J. O. Halliwell: "Pronostycacyon of Mayster John Thybault, medycyner and astronomer of the Emperyall Majestie, of the year of our Lorde God MCCCCXXXIJ., comprehending the iiij. partes of this yere, and of the influence of the mone, of peas and warre, and of the sykenesses of this yere, with the constellacions of them that be under the vij. planettes, and the revolutions of kynges and princes, and of the eclipses and comets." Most English almanacs were published by the Stationers' Company, the most famous of them being the *Vox Stellarum* of Francis Moore (1657-1715?), the first number of which was completed in July 1700, and contained predictions for 1701. Its publication has been continued under the title of *Old Moore's Almanac*.

The exclusive right to sell "almanacs and prognostications" in England, enjoyed in the time of Elizabeth by two members of the Company of Stationers, was extended by James I. to the two universities and the Stationers' Company jointly; but the universities commuted their privilege for an annuity from the company. This monopoly was challenged by Thomas Carnan, a bookseller, who published an almanac for three successive years, after having been thrice imprisoned on that account by the company. The case came, in 1775, before the court of common pleas,



1 Jan 1 ○ New years day. a Ring, in fese volvitur Annus.

2 6 ✨ Epiphany. a Star.

3 13 ✨ St Hilary. a Bishop's Croz.

4 25 ✨ an Axe or Hatchet. St Paul was beheaded.

5 Feb 2 ♥ An Heart. All y^e 6 Feasts of y^e B Virgin have this Symbol or Hieroglyphick the Purification is Feb. 2.

6 3 B St Blase. B. y^e initial. Letter of his name.

7 14 ☯ A True Love Knot. St Valentine.

8 24 ☯ A Leg. St Matthias.

9 March 1 ☯ A Leek. St David.

10 2 ☯ A Branch. St Chad.

11 12 ☯ St Gregory.

12 25 ♥ An Heart. y^e Annunciation.

13 April 3 ☯ St Richard B^p & Confessor.

14 4 ☯ St Ambrose.

15 23 ☯ St George. a Spear.

16 25 ☯ St Mark.

17 May 1 ☯ A Green Branch for May Day.

18 3 ✨ Inventio Sanctae Crucis.

19 19 ☯ St Dunstan. A pair of Tongs.

20 June 1 ☯ St Barnabas. A Rake. Hay time comes in.

21 24 ☯ A Sword. St John. who was beheaded in prison.

22 29 ☯ St Peter. with his 2 keys.

23 July 2 ♥ Visitation Mariam.

24 7 ☯ St Thomas Becket. a Torz. his Translation.

25 16 ☯ St Swythia. A flower of rain. Suppose.

26 20 ☯ St Margaret.

27 22 ☯ St Mary Magdalen.

28 25 ☯ St James.

29 26 ☯ St Anne.

30 Aug 1 ☯ Lammes.

31 6 ☯ Transfiguration.

32 10 ☯ St Lawrence. a Gridiron.

33 15 ☯ Assumptio Virginis.

34 24 ☯ St Bartholomew.

35 Sept 1 ☯ St Giles.

36 8 ♥ Nativitas Virginis.

37 14 ✨ Exaltatio Crucis.

38 27 ☯ St Matthew.

39 29 ☯ St Michael. A pair of Scales.

40 Oct 13 ☯ Translatio Edwardi Confessoris.

41 18 ☯ St Luke.

42 25 ☯ St Crispin. A pair of Shoes.

43 30 ☯ St Simon and St Jude.

44 Nov 1 ☯ All Saints.

45 2 ☯ All Souls.

46 6 ☯ St Leonard.

47 11 ☯ St Martin.

48 16 ☯ St Edmund.

49 20 ☯ St Edmund y^e King.

50 23 ☯ St Clement.

51 25 ☯ St Katherine. A Wheel.

52 30 ☯ St Andrew.

53 Dec 6 ☯ St Nicholas.

54 8 ♥ Conceptio Virginis.

55 13 ☯ St Lucy.

56 21 ☯ St Thomas. A Spear.

57 25 ☯ Christmas day.

58 26 ☯ St Stephen.

In the old Calendars we have mention of quinke dies Nativitatis; and they are C Christmas & St Stephen.

St John. Childermas. St Thomas of Canterbury. Dec 26

The notches on the other side opposite to y^e days & holy days are y^e Golden N^o which is full 19 and yet varies & thus.

J^o 5. J^o 6. J^o 7. J^o 8. J^o 9. J^o 10. J^o 11. J^o 12. J^o 13. J^o 14. J^o 15. being J & 4 added.

FROM "CAMDEN'S BRITANNIA" (GOUGH'S EDITION, 1806)

A CLOGG ALMANAC OF WOOD, THE ORIGINAL CALENDAR OF THE NORWEGIANS AND DANES

Each of the four edges contained the calendar for three months. The number of days in them were expressed by notches, and every seventh day by a large sized notch. Over against many of the notches were placed on the left hand, marks or symbols denoting the golden number of cycle of the moon. The festivals are marked with symbols of the several saints

and was decided in Carnan's favour. The company, however, virtually retained its monopoly for many years, but this power has altogether ceased, although a considerable proportion of the almanacs published in England still issue from the hall of the Stationers' Company.

On Jan. 1, 1828, the Society for the Diffusion of Useful Knowledge issued the *British Almanac* for that year. Its success, with its valuable supplement, the *Companion to the Almanac*, led to a great improvement in this class of publications. The Stationers' Company issued the *Englishman's Almanac*, a work of a similar kind. Since 1870, the *British Almanac* and *Companion* have been the principal almanacs published by the Stationers' Company. *Whitaker's Almanac*, commenced in 1868 by Joseph Whitaker (1820-1895), is perhaps the best known of modern almanacs.

In Scotland, almanacs containing much astrological matter appeared to have been published at about the beginning of the 16th century; and about a century later those published at Aberdeen enjoyed considerable reputation. In 1683, *Edinburgh's True Almanack*, or a *New Prognostication*, appeared, a publication which improved with years and was issued after 1837 as *Oliver and Boyd's New Edinburgh Almanac*, a standard book of reference for Scottish affairs. *Thom's Irish Almanac* (since 1843) deals mainly with Ireland.

The earliest almanac published in the United States is probably to be ascribed to Bradford's press in Philadelphia for the year 1687. *Poor Richard's Almanack*, commenced in 1732 by Benjamin Franklin under the pseudonym of "Richard Saunders," and continued by him for 25 years, gained a high reputation for its wise and witty sayings. *The American Almanac and Repository of Useful Knowledge* was published at Boston from 1828 to 1861. *The Old Farmer's Almanac* enjoys considerable popularity and has been published for many years.

In France prophetic almanacs circulated very freely among the poorer and rural classes, although an *Ordonnance* of Charles IX. required the seal of a diocesan bishop on all almanacs. In 1579 Henry III. prohibited the publication of predictions relating to political events, a prohibition renewed by Louis XIII. Of such almanacs, the most famous was the *Almanach Liégeois*, first published in 1625 at Liège by Matthieu Laensbergh. The most important French almanac is the *Almanach Royal*, afterwards *Impérial*, and now *National*, first published in 1679.

A number of publications, issued in Germany, from the middle of the 18th to the middle of the 19th century, under such titles as *Musenalmanach*, modelled on the *Almanach des Muses*, a contemporary almanac published at Paris, contain some of the best works of some of the most celebrated German poets. The *Almanach de Gotha*, which has existed since 1763, published since 1871 both in French and German, gives a particular account of all the royal and princely families of Europe, and ample details concerning the administration and the statistics of the different states of the world.

For the *Nautical Almanac* and similar publications see EPEMERIS.

ALMANSA, a town in Spain, in the province of Albacete, at the foot of a castle-topped crag, above a fertile plain, which is the principal "gate" to the interior of Spain on the Mediterranean side. Pop. (1940) 14,358 (mun., 16,025). Almansa is, in consequence, an important railway junction, and was the scene of a decisive defeat of the British and their peninsular allies by the French under the Duke of Berwick (1707). (See SPANISH SUCCESSION, WAR OF THE.)

AL-MANŞŪR (Arab. "victorious"), a surname (laqab) assumed by a large number of Mohammedan princes. The best known are: (1) ABŪ JA'FAR IBN MOHAMMED, second caliph of the Abbasid house born A.D. 712, who reigned A.D. 754-775 and founded the city of Baghdad in 764 (see CALIPHATE); (2) ABŪ TĀHIR ISMA'IL IBN AL-QĀ'M, the third Fatimite caliph of Africa (946-953) (see FATIMITES); (3) ABŪ YŪSUF YA 'QUB IBN YUSUF, often described as Jacob Almanzor, of the Moorish dynasty of the Almohades, conqueror of Alfonso VIII. in the battle of Alarcos (1195); (4) IBN ABĪ 'ĀMIR MOHAMMED, commonly called Almanzor by European writers, of an ancient but not illustrious Arab family, which had its seat at Torrox near Algeiras. The last-

named was born A.D. 939, and began life as a lawyer at Cordova. In 967 he obtained a place at the court of Hakam II., the Andalusian caliph, and rapidly rose to distinction, enjoying the powerful support of Subh, the favourite of the caliph, and mother of his heir Hishām. In 978, two years after the death of Hakam he became chief minister, but at first Manşūr had to share the power with his father-in-law Ghālib, the best general of Andalusia, and with Subh. At last a rupture took place between the two ministers. Ghālib professed himself the champion of the caliph and called in the aid of the Christians of Leon, but Manşūr, anticipating the struggle, had long before remodelled the army and secured its support. Ghālib fell in battle (981); a victorious campaign chastised the Leonese, and on his return to Cordova the victor became practically sovereign of Andalusia. The caliph was a mere prisoner of state, and Manşūr ultimately assumed the title of king (996). He reconquered territory from Christians, and restored the Muslim power in Spain. In Africa his armies were for a time hard pressed by the revolt of Ziri, viceroy of Mauretania, but before his death this enemy had also fallen. Manşūr died at Medinaceli on Aug. 10, 1002, and was succeeded by his son Mozaffar.

ALMANZOR: see AL-MANŞŪR.

ALMA-TADEMA, SIR LAURENCE, or LAURENS (1836-1912), British artist, was born Jan. 8 1836, at Dronrijp, a Frisian village near Leeuwarden, the son of Pieter Tadema, a notary, who died when the boy was four years old. In 1852 he entered the Antwerp academy under Gustav Wappers, and subsequently that of Henri (afterwards Baron) Leys, whom he assisted in 1859 in painting the frescoes in the hall of the Hôtel de Ville at Antwerp.

In the exhibition of Alma-Tadema's collected works at the Grosvenor Gallery in London in the winter of 1882-83 were two pictures which may be said to mark the beginning and end of his first period. These were a portrait of himself, dated 1852, and "A Bargain," painted in 1860. His first great success was a picture of "The Education of the Children of Clovis" (1861), which was exhibited at Antwerp. In the following year he received his first gold medal at Amsterdam.

In the '60s and '70s he produced two series of pictures, the subjects of which are drawn from Merovingian and Egyptian history. These had a considerable popular vogue because each of them told a "story." But Alma-Tadema's most characteristic work was done in his scenes from Greek and Roman life. Among the best known of his earlier pictures of scenes from classical times are "Tarquinius Superbus" (1867), "Phidias and the Elgin Marbles" (1868), and "The Pyrrhic Dance" and "The Wine Shop" (1869). "The Pyrrhic Dance," though one of the simplest of his compositions, is one of the best. "The Wine Shop" is one of his many pictures of historical *genre*, but marked with a humour more robust than usual.

In 1863 Alma-Tadema married a French lady, and lived at Brussels till 1869, when she died, leaving him two daughters, Laurence and Anna, both of whom afterwards made reputations—Laurence in literature, Anna in art. In 1869 he sent from Brussels to the Royal Academy two pictures, "Un Amateur romain" and "Une Danse pyrrhique," which were followed by three pictures, including "Un Jongleur," in 1870, when he came to London. In 1871 he married Miss Laura Epps, who also won a high reputation as an artist.

After his return to England he continued to exhibit important pictures each year, generally on subjects drawn from the classics. Apart from these large canvases he painted some small pictures of exquisite finish, like the "Gold-fish" of 1900. These, as well as all his works, are remarkable for the way in which flowers, textures and hard reflecting substances, like metals, pottery, and especially marble, are painted. His work shows much of the fine execution and brilliant colour of the old Dutch masters.

Alma-Tadema became a naturalized British subject in 1873, and was knighted on the occasion of Queen Victoria's 80th birthday, 1899. He was made an associate of the Royal Academy in 1876 and a Royal Academician in 1879. In addition he received honours in many of the capitals of Europe. He died on June 25 1912; a posthumous exhibition of his work was held in London in 1913.

See Georg Ebers, "Lorenz Alma-Tadema," *Westermann's Monatshefte*, Nov. and Dec. 1885, since republished in volume form; Helen Zimmer, "L. Alma-Tadema, his Life and Work," *Art Annual*, 1886; C. Monkhouse, *British Contemporary Artists* (London, 1899).

ALME or **ALMAI** (from *ālim*, "wise," "learned"), the name of a class of singing girls in Egypt who are present at festivals and entertainments and act as hired mourners at funerals. They are to be distinguished from the *ghawazee*, or dancing girls, who perform in the public streets, and are of a lower order.

ALMEIDA, DOM FRANCISCO DE (c. 1450-1510), the first viceroy of Portuguese India, was born in Lisbon about the middle of the 15th century. In March 1505, having received from Emmanuel I. the appointment of viceroy of the newly conquered territory in India, he set sail from Lisbon in command of a large and powerful fleet, and arrived in July at Quiloa (Kilwa), which yielded to him almost without a struggle. Mombasa was taken and destroyed, and its large treasures went to strengthen the resources of Almeida. At the island of Angediva, near Goa, and Cannanore, he built forts, and adopted measures to secure the Portuguese supremacy. Upon his arrival in India, he took up his residence in Cochin, where a Portuguese fort had been built by Alphonso d'Albuquerque in 1503.

The most important events of Almeida's brief but vigorous administration were the conclusion of a commercial treaty with Malacca, and the discoveries made by his son Lorenzo, who acted as his lieutenant. Lorenzo was probably the first Portuguese who visited Ceylon, where he established a settlement, and Fernando Soarez, a captain commanding a squadron of his fleet, appears to have been the first European to sight Madagascar. In 1508 he was killed at Dabul in a naval engagement with the Egyptians, who at this time endeavoured to dispute Portuguese supremacy in the Indian Ocean. His father was preparing to avenge his death when Alphonso d'Albuquerque (*q.v.*) arrived in Cochin, and presented a commission empowering him to supersede Almeida in the government. He refused to recognize Albuquerque's commission, and cast him into prison.

The punishment he inflicted on the Arabs and their Egyptian allies was speedy and terrible. Sailing along the coast, he pillaged and burned various ports, including Goa and Dabul, and finally, encountering the enemy's combined fleet off Diu in Feb. 1509, he completely destroyed it. Returning immediately to Cochin, he held out for a few months against the claims of Albuquerque, but in Nov. 1509 he was compelled to yield.

On Dec. 1 he set sail for Europe with an escort of three vessels. On the voyage the fleet called at Table bay, then known as Saldanha bay, to procure water, and here Almeida was killed (March 1, 1510) in an attack upon the Hottentot natives, during which he showed great personal courage. In this fight, which took place on the site of Cape Town, 65 Portuguese perished, including 12 captains. Almeida's body was recovered on the following day and buried on the spot where he fell.

See Franz Hümmerich, *Die erste deutsche Handelsfahrt nach Indien, 1505-06*, Historische Bibliothek, Bd. 49 (1922).

ALMEIDA, a town of north-eastern Portugal, in the district of Guarda; situated in hilly country near the River Côa, a tributary of the Douro, and long an important frontier fortress. Pop. (1940) 1,691. During the Peninsular War (*q.v.*) much fighting occurred between the Côa and the Spanish fortress of Ciudad Rodrigo, 25m E.S.E. Almeida was taken by the French in 1810, and its recapture, by allied British and Portuguese forces, was only effected after a relieving force under Marshal Masséna had been defeated at Fuentes de Oñoro, 13m. S.S.E., on May 5, 1811.

ALMELO, town in the province of Overysel, Holland, 12m. by rail N.W. of Hengelo, at the junction of the Overysel and Almelo canals. Pop. (1939) 35,621. The lordship of Almelo belonged to the lords of Heeckeren, who acquired the barony of Rechteren by marriage in 1350, and the countship of Limpourg in 1711. A branch of the family still holds the seat. The town has shared in the extraordinary development of the Twente district and possesses many cotton and other textile factories. Almelo is at the railway crossroads to Zwolle, Deventer, Hengelo and Coevorden. There is a court.

ALMENDRALEJO, town in Spain, Badajoz province, 27 mi. E.S.E. of Badajoz. Pop. (1940) 21,071 (mun., 21,276). It has an annual sheep fair, handles farm produce and makes brandy. Local Roman antiquities are preserved in the palace of the Marqués de Monsalad. The development of the Merida-Seville railway (1875-1905) increased the trade in grain, fruit and wine of the Guadiana valley and the Tierra de Barros highland.

ALMERÍA, maritime province in southern Spain, formed in 1833, from the parts of the ancient kingdom of Granada. Pop. (1940) 359,730; area, 3,388 sq.mi. This most easterly part of Upper Andalusia (see *ANDALUSIA*) is crossed by sierras in which terminate successive zones of the Andalusian, or Baetic, Cordillera. The Sierra de Gádos and Sierra Alhamilla form part of, or continue, the Alpujarra system (see *ALPUJARRAS, THE*); the Sierra de los Filabres continues the Nevada core of the Cordillera, while the enveloping crystalline of the Málaga zone is represented in the Sierra de las Estancias. The intervening valleys of the rivers Adra, Andaraz-Almería, and Almanzora provide the only fertile land. The annual rainfall is below 200 mm. in the east of the province, and the supply of water for irrigation is most irregular. For these reasons Almería has always been notable for the number of absentees, who may be described as temporary drought-refugees. Despite the high birth rate, the population (106.2 per sq.mi.) actually fell after 1900. Minerals and grapes, with oranges and esparto to a lesser extent, are the only significant exports. Only 40% of the area is cultivated; there are no large systems of irrigation; but some fruit-growing districts produce well, especially white Almería grapes of which 2,000,000 barrels are ordinarily exported annually. The demand for packing material has a considerable effect on the cork trade of Andalusia, Estremadura and Catalonia. The livestock of the province was tragically diminished by a series of dry years before 1920, but later recovered, with sheep taking the lead. Almería is rich in minerals, especially iron and lead; gold, silver, salt, barium sulphate, white lead, sulphur and zinc are also obtained. Fine marble is quarried in the Sierra Nevada. Roads are poor, but railways serve the mining areas. The principal seaports are Almería, the capital, pop. (1940) 69,824, Adra (6,907), Berja (7,291), Cuevas de Vera (2,920), Huércal Overa (4,180) and Níjar (1,925) (described in separate articles) and Garrucha (2,771). Education is backward, the majority of the population being illiterate, and the standard of living low. In the districts of Cuevas de Vera, Sorbas and Berja there are numerous groups of caves used as habitations. The province was controlled by the Loyalists during the civil war of 1936-39.

ALMERÍA, capital of the province of that name, was the ancient Urci (or Portus Magnus), one of the chief harbours of Spain under the Romans after 19 B.C. Under the Moslems it was a great arsenal (al meriya—the watch-tower and harbour). After the fall of the Umayyads it became the head of a small independent state and then (1288-1489) a petty kingdom dependent on Granada. The dismantled Castillo de San Cristóbal with four Moorish towers overlooks the city which stands at the mouth of a rich alluvial valley enclosed by hills. It is an episcopal see with a Gothic cathedral (1524), and the terminus of a railway from Madrid. Pop. (1940) 69,824 (mun., 79,539). The harbour, sheltered and adapted for vessels of large draught, is equipped with oil-fuel depôts and all modern facilities. Ships ordinarily bring fuel and timber and take away iron, lead, esparto and fruit, especially white grapes. Government forces held Almería until the close of the civil war of 1936-39.

See D. F. Margall, *Almería* (Barcelona, 1886).

ALMERY: see *AMERY*.

ALMODÓVAR DEL CAMPO or **ALMODÓVAR**, a town of Spain, province of Ciudad Real, north of the Sierra de Alcudia. Pop. (1940) 8,488 (mun., 14,633). Almodóvar was a Moslem fortress in the middle ages (*Ar. al-mudawwar*, round). It owes its modern prosperity to the valuable Puertollano coal-field, 3 mi. to the south by a branch of the Madrid-Badajoz-Lisbon railway. At Horcajo (1½ mi.) and elsewhere in the vicinity are mines of argentiferous lead. South of the Sierra lies the Alcudia valley, crown-wooded pasture for immense sheep flocks.

ALMOGÁVARES (from Arabic *al-Mughāwir*, "raider"), the name of a class of Spanish soldiers who came originally from the Pyrenees and were in later times recruited mainly in Navarre, Aragon and Catalonia. They were frontiersmen and professional foot soldiers who wore no armour, dressed in skins, were shod with brogues (*abarcas*) and carried the same arms as the Roman legionaries—two heavy javelins (Spanish *azagaya*, the Roman *pilum*), a short stabbing sword and a shield. When Peter III of Aragon made war on Charles of Anjou after the Sicilian Vespers—March 30, 1282—for the possession of Naples and Sicily, the Almogávares formed the most effective element of his army. When the peace of Caltabellotta in 1302 ended the war in southern Italy, the Almogávares followed Roger di Flor (Roger Ruman), the unfrocked Templar who entered the service of the east Roman emperor Andronicus, as *condottieri* to fight against the Turks. When Roger di Flor was assassinated by his Greek employer in 1305, they turned on the emperor, held Gallipoli and ravaged the neighbourhood of Constantinople. In 1310 they marched against the duke of Athens, of the French house of Brienne. Walter of Brienne was defeated and slain by them with all his knights at the battle of Cephissus, or Orchomenus, in Boeotia in March 1311. The foundation of the Aragonese duchy of Athens was the culmination of the achievements of the Almogávares. In the 16th century the name died out. It was, however, revived for a short time as a party nickname in the civil wars of the reign of Ferdinand VII.

See Ramon de Muntaner's *Chronicle*, Eng. tran. by Lady Goodenough (London, 1920); G. Schlumberger, *Expédition des "Almogávares" ou routiers catalans en orient, de l'an 1302 à l'an 1311* (Paris, 1902).

ALMOHADES, properly *AL-MUWAHHIDŪN*, i.e., "Unitarians", a Mohammedan religious confederation which, in the 12th century, founded the most powerful of Berber dynasties and conquered all northwest Africa together with Moslem Spain. Its founder was Mohammed ibn Tūmart, a Berber of the Masmūda tribe in the Atlas mountains.

Of weak physique and devoted to asceticism from his youth, Ibn Tūmart journeyed to the east to study in its famous schools and returned to northwest Africa in 1118 to preach a thoroughgoing reform of Moslem practice, law and theology. Driven from city to city for his exhibitions of reforming zeal, which culminated in an assault on the sister of the Almoravide amir Ali in the streets of Marrakesh because she was going about unveiled after the manner of Berber women, he took refuge among his own people, the Masmūda. After years of religious and political propaganda among the tribes of the Atlas, he built up an elaborate organization in opposition to the Almoravide power from his headquarters at Tinnel. On his death in 1130 he nominated as his successor 'Abd al-Mu'min al-Kūmi, a Berber from Algeria, who was undoubtedly a soldier and statesman of a high order.

Having routed out the Almoravides (1147), al-Kūmi extended his power over all northern Africa as far as Tripoli, assumed the caliphal title *amir al-mu'minin* and received the homage of the Moslem princes of Spain. His successors, mainly engaged in warring against the Christians in Spain, founded in Seville the great mosque (now superseded by the cathedral), the tower of which (la Giralda) was erected in 1184 to mark the accession of Ya'kub. His title al-Mansūr ("the victorious") was earned by the defeat he inflicted on Alphonso VIII of Castile at Alarcos in 1195. But in 1212 al-Mansūr's successor, Mohammed al-Nāsir, was utterly defeated by the five allied Christian princes of Spain, Navarre and Portugal at Las Navas de Tolosa in the Sierra Morena, and the Almohade empire in Spain rapidly disintegrated.

In Africa also the organization of the Almohades was undermined by internal rivalries and challenged by the growing strength of the Arab and Zenata Berber nomads under the leadership of the Marinid house, who seized Fez in 1250. In 1228 the governor of Tunisia broke with the caliphs of Morocco and founded an independent Almohade dynasty at Tunis (the Hafsids). With the capture of Marrakesh in 1269 by the Marinids, the rule of the Almohades was brought to an end in Morocco also.

The caliphs of the dynasty were as follows: 'Abd al-Mu'min (1145); Abu Ya'kub Yūsuf (1163); Abu Yūsuf Ya'kub I al-

Mansūr (1184); Mohammed ibn Ya'kub al-Nāsir (1199); Abu Ya'kub Yūsuf II al-Mustansir (1213); 'Abdulwāhid I ibn Yūsuf al-Makhlu' (1224); Abu 'Abdullah Mohammed ibn Ya'kub al-Adil (1224); Yahya ibn Mohammed al-Mo'tasim (1226); Idris ibn Ya'kub al-Ma'mūn (1227); 'Abdulwāhid II ibn Idris I al-Rashid (1232); Abu'l-Hasan Ali ibn Idris al-Sa'id (1242); Omar ibn Ishāk ibn Yūsuf al-Murtadā (1248); Idris II al-Wāthik, called Abu Dab-būs (1266-69).

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ALMON, JOHN (1737-1805), English political pamphleteer and publisher, was born at Liverpool on Dec. 17, 1737, and died on Dec. 12, 1805. He came to London in 1758 at a time when the Whig opposition, hampered and harassed by the Government to an extent that threatened the total suppression of independent opinion, needed a channel of publicity, which they found in Almon. He was already known by *The Conduct of a late Noble Commander* (Lord George Sackville); *Examined* (1759); *A Review of his late Majesty's Reign* (1760); *A Review of Mr. Pitt's Administration* (1761); and a number of letters on political subjects. The review of Pitt's administration secured for Almon the friendship of Earl Temple, to whom it was dedicated. In 1763 he opened a bookseller's shop in Piccadilly, chiefly for the publication and sale of political pamphlets. In 1765 the attorney-general moved to have him tried for the publication of the pamphlet entitled *Juries and Libels*, but the prosecution failed; and in 1770, for merely selling a copy of the *London Museum* containing Junius's celebrated "Letter to the King," he was sentenced by Lord Mansfield to pay a fine of ten marks and give security for his good behaviour. It was this trial that called forth the letter to Lord Mansfield, one of the bitterest of the Junius series. In 1774 Almon commenced the publication of his *Parliamentary Register*, a monthly report of the debates in Parliament, and he also issued an abstract of the debates from 1742, when Richard Chandler's *Reports* ceased, to 1774. He became proprietor in 1784 of the *General Advertiser*, in the management of which he lost his fortune and was declared insolvent. To these calamities was added an imprisonment for libel. Almon had to leave the country, but after some years in France he returned and resumed business, publishing among other works an edition of Junius. His last publication was an edition of Wilkes's correspondence, with a memoir (1805).

ALMOND, the tree, nut or seed of *Prunus amygdalus*, an important food-producing species appearing to be native to western Asia, Barbary, and Morocco. The nuts are of two distinct types, sweet and bitter. The former are the well-known edible almonds of the world's market. The kernels of the bitter almonds are as inedible as peach kernels. They contain about 50% of a fixed oil which occurs also in the sweet almond, together with a ferment emulsin, which in the presence of water acts on the glucoside, amygdalin, yielding glucose, prussic (hydrocyanic) acid, and the essential oil of bitter almond—benzaldehyde. When freed from prussic acid, the oil of bitter almonds is used in the manufacture of flavouring extracts. The sweet almond is extensively cultivated in certain favoured regions between latitudes 28° and 48° N. and between 20° and 40° S. Sweet almonds are eaten as nuts, or are used in confectionery, or as a source of almond oil or almond meal. Production during the 5-year period ending June 30, 1940, in the five leading countries was estimated as follows: Italy, 97,334 tons; Spain, 79,334 tons; France, including French Morocco, 30,334 tons; United States, 14,080 tons (22,000 tons in 1942); and Portugal, 10,000 tons (for the 5-year period ending in 1939). In 1940, Australia reported 425,545 orchard trees, of which 289,828 were of bearing age.

The almond tree greatly resembles the peach, to which it is closely related and is nearly as hardy, but the extreme earliness of its flowering habit, which north of the equator is from late January to early April, causes crops of nuts to be uncertain

wherever frosts are likely to occur at that time. While almonds occasionally mature in southern England and in Pennsylvania, the flowers are too often killed in those regions for local culture to be profitable.

The almond tree grows somewhat larger than the peach and lives longer. It is so strikingly beautiful when in flower that local festivals are often held at that time. The growing fruit resembles the peach until it approaches maturity; then, instead of the cheeks turning red, the entire surface remains dull gray. In ripening, the outer covering, called the hull, which is thin and leathery rather than fleshy, splits open, curls outward, and discharges the nut.

The old world almond industry is characterized by small plantings; trees interplanted with other crops; great variability in age, condition and bearing capacity of individual trees; and by hand labour, often with crude implements. To a great extent production is primarily for food to be used by the family. Exports largely represent small surpluses from many small plantings. Little attention is paid to improvement of varieties. Sales are by type rather than by variety in a true horticultural sense. Two of the best-known "variety" names are Jordan and Valencia from Spain. However, neither is a true variety as each includes many clones producing nuts similar in appearance and general character. The kernels of each are excellent for certain purposes, particularly in making glacé almonds. However, in each case, the shells are hard and the trees light bearers and neither has been found profitable to grow elsewhere.

Almond growing in the United States is almost wholly confined to interior valleys and hillsides of California which are protected from cold Pacific breezes by mountain ranges near the coast. Production is mainly from orchards having from a few trees to several hundred acres. The land is usually devoted solely to the almond, with the trees being of much the same age throughout and of carefully selected varieties of California origin. A few special pollinizing varieties are systematically placed in all plantings. As an important aid in pollination, colonies of bees are placed in strategic positions while the trees are in flower. The leading varieties are Drake, Harpareil, I. X. L., Jordanola, Ne Plus Ultra, Nonpareil, Peerless, and Texas. Of these Harpareil and Jordanola are the result of controlled breeding and were introduced to the trade in 1939.

In frosty localities, most orchards are equipped with firepots ready for prompt lighting when sub-freezing temperatures appear imminent during still nights while the trees are in flower. Unless the wind blows or temperatures drop to entirely too low levels, it is often possible by artificial heating or other protective measures to save the major portion of a crop which otherwise would be lost. Flooding with irrigation water and forcing air currents from powerful electric fans through the trees are both successful methods of practice. The fans drive cold air from the low levels and allow it to be replaced with warmer air from higher levels. The same principle is employed to help in controlling certain fungus diseases by replacing damp, foggy air in low pockets with dryer air from slightly higher altitudes. A dominant factor in selling the nuts is the California Almond Growers exchange, which maintains rigid standards of size, appearance, and general quality.

(C. A. Rd.)

ALMOND OIL, the fixed oil termed in the *British Pharmacopoeia* as *Oleum amygdalae*, is obtained from the ground blanched kernels of the fruit of the almond, either by expression or by extraction with a volatile solvent; the latter process is used in the case of damaged seeds where the residual meal is valueless. The commercial oil is prepared from the kernels of the bitter almond (*Prunus amygdalus*, var. *amarus*), or from a mixture of these and the seeds of the sweet variety. Yield from sweet almonds ranges from 44%–55%; the bitter variety averages 35%–45% of oil.

The expressed oil is pale yellow in colour and possesses a bland, nutty flavour; the extracted oil is darker and has a harsh taste. Almond oil is used in pharmacy as a vehicle for drugs, and is employed in the preparation of cosmetics. Its scarcity leads to extensive sophistication, the usual adulterants being apricot, plum and peach kernel oils, which closely resemble almond oil.

Oleum amygdalae amarum (*essentiale*), "ethereal bitter almond oil," is produced by trituration of the oil-free meal of bitter almonds with water. The natural ferment *emulsin* acting on the glucoside *amygdalin* also present in the seed produces a mixture of glucose, benzaldehyde and prussic acid. The distilled product contains up to 5% prussic acid, which is removed by treatment with lime and iron sulphate when the essence is required for flavouring purposes.

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(P. R. E. L.; G. H. W.)

ALMONER, an officer charged with the distribution of alms, primarily for a religious house or bishop (from Lat. *elemosynarius*, through M. Lat. *almonarius* and Fr. *almosnier*). Almoners attached to the French court appear early, but the title of grand almoner of France first appears in 1486. The office, which acquired great importance through its control of preferments, was revived by Napoleon I and again by Napoleon III, but was abolished in 1870. In England the offices of hereditary grand almoner (a sinecure held by the marquess of Exeter) and lord high almoner still exist. The latter, usually a bishop or other prelate, distributes the royal alms of silver pennies on Maundy Thursday (*q.v.*).

ALMONRY, the name for the place where alms were distributed to the poor in churches or other ecclesiastical buildings. At Bishopstone church (Wilts.), it is a sort of covered porch attached to the south transept, but not communicating with the interior of the church.

At Worcester cathedral the alms are said to have been distributed on stone tables, on each side, within the great porch. In large monastic establishments, as at Westminster, it seems to have been a separate building of some importance, either joining the gatehouse or near it.

ALMORA, a town and district of British India, the chief town and administrative headquarters of the Kumaon division of the United Provinces, situated on a mountain ridge of the Himalayas 5,494 ft. above the sea. Pop. (1941) 10,229. The town has a college named for Sir Henry Ramsay, several schools and a large cantonment. The climate is supposed to be particularly kind to sufferers from lung trouble. The town was captured in 1790 by the Gurkhas, who constructed a fort on the eastern extremity of the ridge. Another citadel, Ft. Moira, is situated at the other end of the ridge. Almora is also celebrated as the scene of the British victory which terminated the war with Nepal in 1815.

The district of Almora was constituted in 1891, together with Naini Tal, by a redistribution of the two former districts of Kumaon and the Tarai. It lies among the mountains of Kumaon between the upper waters of the Ganges and the Gogra, here called the Kali. Area, 5,502 sq.mi.; pop. (1941) 687,286. Tea is grown in the district, which includes the military sanatorium of Ranikhet.

ALMORAVIDES, properly *AL-MURĀBITŪN*, *i.e.*, "frontier warriors for the Faith", a Berber confederation from the Sahara which, in the 11th century, founded a dynasty in Morocco. The invading tribes, the most powerful of which was Lamtūna, belonged to the "veiled" Sanhāja of Mauritania, represented today by the Tuareg. Though converted to Mohammedanism in the early times of the Arab conquest, their knowledge of Islam did not go much beyond the formula of the creed—"there is no god but God, and Mohammed is the apostle of God"—and they were ignorant of the law.

Their first military leader, Yahya ibn Omar, gave them a good military organization. Their main force was infantry, armed with javelins in the front ranks and pikes behind, formed into a phalanx and supported by camelmen and horsemen on the flanks.

From the year 1053 the Almoravides began to impose their orthodox and puritanical religion on the inhabitants of the southern Moroccan oases and on the Negro pagans. Yahya was killed in battle in 1056, but the spiritual director of the movement, 'Abdullah ibn Yasin—himself a Sanhāja—named his brother Abu Bakr as chief. In 1061, Abu Bakr, after an outbreak of dissension

among the tribes, made over the command in southern Morocco to his cousin Yūsuf ibn Tashfin, as viceroy, resigning to him also his favourite wife Zainab.

After founding the city of Marrakesh in 1062 as a base of operations, Ibn Tashfin brought the whole of Morocco under his control and, on Zainab's advice, asserted his independence of Abu Bakr. In 1080 he conquered the kingdom of Tlemcen and founded the present city of that name; but having occupied central Algeria he avoided a conflict with the eastern Sanhāja dynasties and returned to the west. In 1086 he was invited by the Mohammedan princes in Spain to defend them against Alphonso VI, king of Castile and Leon.

Yūsuf passed the straits of Algeciras and on Oct. 23 inflicted a severe defeat on the Christians at Sacralias (in Arabic, Zallāka), near Badajoz. A second expedition in 1088 came to nothing because of quarrels between the Spanish Moslems and the Berbers. When Yūsuf returned to Spain in 1090 it was avowedly for the purpose of deposing the Mohammedan princes and annexing their states.

By 1094 he had removed them all, and though he had regained little from the Christians except Valencia, he reunited the Moslem power and gave a check to the reconquest of the country by the Christians.

After friendly correspondence with the caliph at Baghdad, whom he acknowledged as *amir al-mu'minin* ("commander of the faithful"), Yūsuf in 1097 assumed the title of *amir al-muslimin* ("commander of the Moslems"). He died in 1106, being reputed to have reached the age of 100.

The Almoravide power was at its height at Yūsuf's death, when it included all northwest Africa as far as Algiers and all Spain south of the Tagus, with the east coast up to the mouth of the Ebro and the Balearic Islands.

Three years afterward, under Yūsuf's son and successor Ali, Madrid, Saragossa, Lisbon and Oporto were added; and Spain was again invaded in 1119 and 1121. But the tide had turned, and the conquest of Marrakesh by the Almohades (*q.v.*) in 1147 marked the fall of the dynasty, although fragments of the Almoravides survived for a time in Seville, Granada and the Balearics.

The amirs of the dynasty were as follows: Yūsuf ibn Tashfin (1061); Ali ibn Yūsuf (1106); Tashfin ibn Ali (1142); Ibrahim ibn Tashfin (1146); Ishak ibn Ali (1146-47).

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(B. M.; H. A. R. G.)

ALMQVIST, KARL JONAS LUDWIG (1793-1866), Swedish writer, was born at Stockholm in 1793. He became a student at Uppsala, where his father was professor of theology, in 1808, and took his degree in 1815. In 1823 he threw up the position he held in the capital to lead a colony of friends to the wilds of Wermland.

The experiment was a failure, and in 1828 he returned to Stockholm as a teacher in the new elementary school there, of which he became rector in 1829.

The publication of his great series of novels, *The Book of the Thorn-Rose* (1832-35), made him famous, and few writers have equalled Almqvist in productiveness and versatility. Poems, romances, lectures and treatises on many subjects form the most prominent of his countless contributions to modern Swedish literature; and, so excellent was his style, that in this respect he has been considered the first of Swedish writers. His life was as varied as his work. Unstable in all his doings, he passed from one lucrative post to another, at last subsisting entirely on the proceeds of literary labour.

More and more vehemently he espoused the cause of socialism in his brilliant novels and pamphlets; friends were beginning to leave him, when suddenly all minor criticism was silenced by the astounding news that Almqvist, convicted of forgery and charged with murder, had fled from Sweden (1851).

For many years no more was heard of him; but it is now known

that he went over to the U.S. and settled in St. Louis, Mo.

During a journey through Texas he was robbed of all his manuscripts, among which are believed to have been several unprinted novels. Almqvist is said to have appealed in person to President Lincoln, but the robbers could not be traced.

In 1865 he returned to Europe, and his strange existence came to a close at Bremen on Sept. 26, 1866.

It is by his romances that his literary fame will mainly be supported; but his singular history will always point him out as a remarkable figure, even when his works are no longer read.

Almqvist was another Eugene Aram, but of greater genius, and so far more successful that he escaped the judicial penalty of his crime.

See his *Samlade Skrifter* (ed. F. Böök, Stockholm, 1920-23).

ALMS, the giving of relief, and the relief given, whether in goods or money, to the poor, particularly applied to the charity bestowed under a sense of religious obligation. Like "riches" the word is often wrongly treated as a plural.

(See CHARITY.)

ALMSHOUSE: see COUNTY FARM.

ALMUCE, a hooded cape of fur, or fur lined, worn as a choir vestment by certain dignitaries of the western church (late Lat. *almucia*, *almucium*, *armucia*, etc.). It was originally a head covering only, and the German word *Mütze*, "cap," is derived from it. The name of another vestment akin to the almuce—the *mozzetta*—has been by some traced to the word *mutzen*, to dock, cut off, through the Ital. *mozzare* and *mozzo* (but see below).

In numerous documents from the 12th to the 15th century the *almucium* is mentioned, occasionally as identical with the hood, but more often as a sort of cap distinct from it; e.g., in the decrees of the council of Sens (1485)—*non caputia, sed almucia vel bireta tenentes in capite*. In the late 13th century two types of *almucium* were distinguished: (1) a cap coming down just over the ears; (2) a hood-like cap falling over the back and shoulders. This latter was reserved for the more important canons, and was worn over surplice or rochet in choir. The introduction of the biretta (*q.v.*) in the 15th century tended to replace the use of the almuce as a head covering, and the hood now became smaller, while the cape was enlarged till, in some cases, it fell below the elbows. Almuces were occasionally made of silk or wool, but from the 13th century onward usually of fur, the hem being sometimes fringed with tails. Hence they were known in England as "grey amices" (from the ordinary colour of fur), to distinguish them from the liturgical amice (*q.v.*). By the 16th century the almuce had become definitely established as the distinctive choir vestment of canons; but it had ceased to have any practical use, and was often only carried over the left arm as a symbol of office. It has been almost entirely superseded by the *mozzetta*, but is still worn in certain cathedrals. The "grey amice" of the canons of St. Paul's in London was put down in 1549, the academic hood being substituted.

See du Cange, *Glossarium*, s. "Almucia"; Joseph Braun, *Die liturgische Gewandung*, p. 355, etc. (Freiburg im Breisgau, 1907); also the bibliography to the article VESTMENTS.

ALNAGE or **AULNAGE**, the official supervision of the shape and quality of manufactured woollen cloth, the derivation being from Fr. *aune*, ell. It was first ordered in the reign of Richard I that "woollen cloths, wherever they are made, shall be of the same width, to wit, of two ells within the lists, and of the same goodness in the middle and sides." This ordinance is usually known as the Assize of Measures or the Assize of Cloth. Article 35 of Magna Charta re-enacted the Assize of Cloth, and in the reign of Edward I an official called an "alnager" was appointed to enforce it. His duty was to measure each piece of cloth, and to affix a stamp to show that it was of the necessary size and quality. As, however, the diversity of the wool and the importation of cloths of various sizes from abroad made it impossible to maintain any specific standard of width, the rules as to size were repealed in 1353.

The increased growth of the woollen trade and the introduction

of new and lighter drapery in the reign of Queen Elizabeth compelled a revision of the old standards. A statute was passed in 1665 creating the office of alnager of the new drapery and defining the sizes to which cloth should be woven. The objects of the statute were to prevent people being deceived by buying spurious woollen cloth and to provide against fraud and imposition. Alnage duties and the office of alnager were abolished in 1699.

See W. J. Ashley, *Economic History*; and W. Cunningham, *Growth of English Industry and Commerce*.

ALNWICK, urban district and county-town of Northumberland, England, 309 mi. N. by W. from London, on a branch of the L.N.E.R.; Pop. (est. 1938) 6,875. Area, 7.47 sq.mi. It is beautifully situated on the small river Aln, in a hilly district near the sea. Above the town on the south bank of the river stands the castle, held by the Percys from 1309, and long before this an important border stronghold. A gateway of c. 1350 and a fine Norman arch of the middle of the 12th century are among noteworthy ancient portions. The castle has been extensively renovated and has largely lost its historic character. The town evidently grew up round the castle, and tradition states that it received its borough charter from King John, but it is first definitely mentioned as a borough in a charter given by William de Vescy in the reign of Henry II. According to an inquiry of 1291 a market and fair were held in Alnwick from time immemorial. Edward I, in addition, granted the bishop of Durham a market on Saturday, and a fair on March 17 and six following days. By charters of Henry VI the burgesses received license to enclose their town with a wall, to have a free port at Alnmouth, a market on Wednesday as well as Saturday and two new fairs. Tanning and weaving were formerly the principal industries carried on in Alnwick, and in 1646 there were 22 tanneries there.

Remains of the town wall are visible, and one of the four gates, the Bondgate, stands, dating from the early part of the 15th century. The church of St. Michael has Norman remains, but is principally Perpendicular. Within the confines of the park are ruins of two abbeys. Alnwick abbey was a Premonstratensian foundation of 1147; only a gateway tower stands. Three miles from the town are more extensive remains of Hulne abbey (1240), an early Carmelite monastery. The long narrow church remains unroofed; there are also a gateway tower, and portions of the chapter house and cloisters. The Norman chapel of the hospital of St. Leonard, and Alnwick abbey, were founded by Eustace FitzJohn. Howick mansion, built in the 18th century, has a fine situation near the coast to the northeast. Not far away are the ruins of Dunstanborough castle; it dates from the 14th century, though the site was probably occupied as a stronghold from earlier times.

The chief industries are brewing, tobacco and fishing tackle making. Alnwick is under an urban district council, but is a borough by prescription, and its freemen form a body corporate without authority over the affairs of the town.

ALOE, a genus of plants belonging to the family Liliaceae, with about 180 species growing in the dry parts of Africa, especially Cape Colony, and in the mountains of tropical Africa.

The plants are apparently stemless, bearing a rosette of large, thick, fleshy leaves, or have a shorter or longer (sometimes branched) stem, along which, or toward the end of which and its branches, the generally fleshy leaves are borne. They are much cultivated as ornamental plants, especially in public buildings and gardens, for their stiff, rugged habit. The leaves are generally lance-shaped with a sharp apex and a spiny margin, but vary in colour from gray to bright green, and are sometimes striped or mottled.

The rather small tubular yellow or red flowers are borne on simple or branched leafless stems, and are generally densely clustered.

The juice of the leaves of certain species yields aloes. In some cases, as in *Aloe venenosa*, the juice is poisonous. The American aloe, *Agave americana* (see AGAVE), belongs to a different family, viz., Amaryllidaceae.

Aloes is a medicinal substance used as a purgative and produced

from various species of aloe, such as *A. vera*, *A. barbadensis*, *succotrina*, *chinensis*, and *perryi*. Several kinds of aloes are distinguished in commerce—Barbadoes, Socotrine, hepatic, Indian, and Cape aloes. The first two are those commonly used for medicinal purposes. Aloes is the expressed juice of the leaves of the plant. When the leaves are cut the juice flows out, and is collected and evaporated. From the juice active principles termed *aloin*s are extracted by water.

The *lign-aloës* is quite different from the medicinal aloes. The word is used in the Bible (Numb. xxiv, 6), but as the trees usually supposed to be meant by this word are not native in Syria, it has been suggested that the LXX reading in which the word does not occur is to be preferred. *Lign-aloës* is a corruption of the Lat. *lignum-aloe*, a wood, not a resin. Dioscorides refers to it as *agallochon*, a wood brought from Arabia or India, which was odoriferous but with an astringent and bitter taste. This may be *Aquilaria Agallocha*, a native of east India and China, which supplies the so-called eaglewood or aloeswood, which contains much resin and oil.

ALOIDAE (äl'ô-jêdê), or **ALOADAE**; i.e., Otus and Ephialtes, in ancient Greek legend, the twin sons of Aloeus or Poseidon, celebrated for their extraordinary stature and strength. According to Homer (*Od.*, xi, 305), they made war upon the Olympian gods and endeavoured to pile Pelion upon Ossa in order to storm heaven itself, but Apollo destroyed them before they reached manhood. In the *Iliad* (v, 365) Ares is imprisoned by them, but delivered by Hermes. They sought Artemis and Hera in marriage, whereupon Artemis appeared between them in the shape of a stag, which they endeavoured to kill, but slew each other. The Aloidæ (Gr. *alôë*=threshing-floor) represent the spirits of the fertile earth and agriculture.

ALOMPRA, **ALOUNG P'HOURA** (1711-60), founder of the last Burmese dynasty, was chief of the village of Môtshobo; near Ava. Burma was at that time under the rule of Pegu. Alompra raised a small force of men, seized Ava in 1753, and gradually ousted the Peguans and made himself master of the country. For the wars which followed, in which Alompra invaded and subdued Pegu, see BURMA. He was undertaking the subjugation of Siam when he was taken ill, and died on May 15, 1760. Alompra had undoubted military genius and a measure of political sagacity, and he sought to improve the administration of justice. His cruelty and deceitfulness were faults common to the oriental potentates of his time.

ÁLORA, a town of Málaga, southern Spain. Pop. (1940) 5,614 (mun., 13,968). Álorá, an ancient and picturesque town (Rom. *Iluro*) stands at the foot of the *Hacho*, one of a series of tablelands along the line of the structural depression followed by the river Guadalhorce. The fertile *vega* irrigated from this river, and renowned for oranges, lemons and other fruits, is the uppermost part of the semicircular *Hoya de Málaga*, which descends from the defile *El Chorro* to the coast near Málaga. There are hot sulphur springs in the town. Brandy distilling is, after agriculture, the chief local industry.

ALOST (Flem. *Aalst*), Belgium, province of East Flanders, on the left bank of the Dender; the ancient capital of "Imperial Flanders." Pop. (est. 1939) 41,265. In the feudal period when Flanders was a fief of the king of France, there was a small strip extending from Alost to the isles of Zeeland, called Imperial Flanders, the count of which was the vassal of the Holy Roman emperor. The town hall has a fine 15th century belfry, damaged by fire in 1879. In the church of St. Martin, dating from 1498 but unfinished, is a fine Rubens, "St. Roch," said to have been painted in eight days. At Alost, Dirk Maertens (c. 1474) set up one of the first printing presses in Europe. The town is famous for its hop gardens and linen-bleaching industry.

ALOYSIA: see VERBENA.

ALP, a term applied to the summer pastures of the Alps situated just below the snow line, freed from snow each spring. Such mountain pastures are of great antiquity, being mentioned as early as the 8th century, and are found in all parts of the Alpine chain. In German Switzerland, particularly, the alps are the centre round which the pastoral life of the inhabitants turn. The *Alpgemein-*

den, as the Swiss Alpine communes are called, are composed of the persons who have a right to send cattle up to the alps in summer, this right being attached either to certain plots of ground in the valley or certain houses in the village, or to certain persons. In any case the owners of an alp fix the greatest number of cows which it can support during the summer without being permanently damaged. A plot of ground which can support a single cow (or two heifers, three calves or sheep, four pigs or eight goats) is called a *Kuhstoss*. On each alp there are several sets of huts at different levels for the cowherds and cheese makers, the cattle being generally left in the open. These sets of huts, properly called *châlets* or *Sennhütten*—though the former term is also applied to houses in the village below—are used in turn between the end of June and the end of September. The cheese and butter are stored in huts and carried down to the village at the end of the season. Hay is never mown on the true alps save in spots which are not easily accessible to cattle, but it is made on the *Voralpen*, the lowest pastures, situated between the homesteads and the true alps; these *Voralpen* are individual (not communal) property and are grazed, to some extent, during the late spring and early autumn.

ALPACA, one of the two domesticated breeds of S. American camel-like hoofed mammals, derived from the wild guanaco (*q.v.*). Alpacas are kept in flocks on the level heights of the Andes in Chile, Peru and Bolivia, at an elevation of 14,000 to 16,000 ft. above the sea. In appearance the animal resembles a sheep, except for the long head and neck, carried erect. It is kept mainly for the sake of its wool, though the flesh is quite palatable. The alpaca is sheared yearly, the fleece consisting of thick woolly hair, about 8 in. of which is removed from the total length of 2 feet. In colour it is mainly black or dark brown, but lighter hues occur. The fibre is elastic, silky, lustrous and strong, and was used by the Peruvian Indians centuries before its introduction into Europe. It was due to the sagacity of Sir Titus Salt (*q.v.*) that the manufacture of alpaca cloth was successfully started in 1836. However, most of the alpaca cloth of commerce is made from mohair and other types of fibre. (See also *Wool*.)



BY COURTESY OF N.Y. ZOOLOGICAL SOCIETY
THE ALPACA. A DOMESTICATED
ANIMAL BRED BY NATIVES OF THE
ANDES FOR ITS VALUABLE WOOL

The alpaca is the most important of the four kinds of indigenous fibre-bearing animals of South America; the others are the llama, guanaco and vicuña (*q.v.*). The alpaca and llama are domesticated varieties of the guanaco (*Lama guanicoe*); alpacas are bred for their wool, and llamas as beasts of burden. All are members of the camel family (see *TYLOPODA*), but without humps. Llamas numbered more than 700,000 by 1945 while there were some 1,500,000 alpacas. The guanaco and the vicuña run wild. Of the four the alpaca and the vicuña are the most valuable fibre-bearing animals; the alpaca on account of the lustre and quantity, the vicuña on account of the softness, fineness and quality of its fibre. The usual length of alpaca staples appears to be about 12 in., this being a three years' growth; but the length may be little more than about half this, *i.e.*, a one to two years' growth, shearing being in part dependent upon the demand for and price of the fibre. The fleeces are sorted for colour and quality by skilled native women. The colour of the greater proportion of alpaca imported into the British Isles is black and brown, but there is also a fair proportion of white, gray and fawn. It is customary to mix these colours together, thus producing a curious ginger-coloured yarn, which upon being dyed black in the piece takes a fuller and deeper shade than can be obtained by piece-dyeing a solid white wool. In physical structure alpaca is akin to both hair and wool, having scales and some fibres medullated. It is probably a mixture of an outer and under fibre-coat. It is very glossy, and its softness and fineness enable the spinner to produce satisfactory yarns with comparative ease.

Alpaca Industry.—Alpaca is a name given to two distinct things. It is primarily a term applied to the fibre obtained from the alpaca. It is, however, more broadly applied to a style of fabric originally made from the alpaca fibre but now frequently made from allied types of fibres, *viz.*, mohair, Iceland or even from lustrous English wool. In the trade, distinctions are made between alpacas and the several styles of mohairs and lustruses, but so far as the general purchaser is concerned little or no distinction is made.

The Romance of Alpaca.—The history of the manufacture of this fibre into cloth is one of the romances of commerce. Undoubtedly the Indians of Peru employed it in the manufacture of many styles of fabrics for centuries before its introduction into Europe as a commercial product. The first European importations would naturally be into Spain. Spain, however, transferred the fibre to Germany and France. Apparently alpaca yarn was spun in England for the first time about the year 1808. It does not appear to have made any headway, however, and alpaca was condemned as an unworkable material. In 1830 Benjamin Outram, of Greetland, near Halifax, appears to have attempted again the spinning of this fibre, and for the second time alpaca was condemned. These two attempts to use alpaca were failures owing to the style of fabric into which the yarn was woven—a species of camel. It was not until the introduction of cotton warps into the Bradford trade about 1836 that the true qualities of alpaca could be developed in the fabric. Where the cotton warp and mohair or alpaca weft plain-cloth (usually termed "Orleans") came from is not known, but it was this simple yet ingenious structure which enabled Titus Salt (*q.v.*), then a young Bradford manufacturer, to utilize alpaca successfully. Bradford remained the great spinning and manufacturing centre for alpacas, large quantities of yarns and cloths being exported annually to the continent, to the United States, to South America and elsewhere, although the quantities naturally varied in accordance with the fashions in vogue. The typical "alpaca-fabric" was originally a very characteristic "dress-fabric" but later the fibre became chiefly used for linings.

Owing to the success in the manufacture of the various styles of alpaca cloths attained by Sir Titus Salt and other Bradford manufacturers, a great demand for alpaca arose, and this could not be met by the native product, for there never seems to have been any appreciable increase in the number of alpacas available. Unsuccessful attempts were made to acclimatize the alpaca in England, on the European continent and in Australia, and even to cross certain English breeds of sheep with the alpaca. There are two crosses between the alpaca and the llama; the one called *huarizo* with llama sire, the other *misti*, with alpaca sire. The fleeces of these hybrids are less fine than that of the alpaca. Crosses between the alpaca and vicuña have also been made but the fibre is not so soft and fine as that of the vicuña. Both llamas and alpacas cross with the guanaco, but this confers no advantage. Scientific breeding and care of the alpaca offers the most promise. The preparing, combing, spinning, weaving and finishing of alpacas and mohairs are dealt with under *Wool*.

In 1943, exports of alpaca wool from Peru totalled about 6,000,000 lb., valued at about \$5,000,000 (10,800,000 Peruvian soles); the figures for llama wool were 241,000 lb., worth about \$125,000 (257,731 Peruvian soles). From Chile in that year were exported 70,000 lb. of alpaca wool, worth about \$16,500 (82,525 Chilean pesos); also llama wool weighing 35,000 lb. valued at \$3,500 (17,843 pesos). (A. F. B.; J. E. H.)

ALP ARSLAN, MOHAMMED IBN DA'UD (1029?–1072), the second sultan of the line of Great Seljuks (see *SELJUKS*) in Persia, the great-grandson of Seljuk, was born in 1029 or 1032. His Turkish name Alp Arslan means "the lion hero" and was perhaps an epithet. He succeeded his father Da'ud as ruler of Khurasan in 1059 and his uncle Toghrul Beg as sultan of Persia and Iraq in 1064, after his brother Suleiman had been set aside. In consolidating his empire he was assisted by the most famous of Persian viziers, Nizam ul-Mulk.

After defeating his father's cousin Kutulmish in Khurasan, Alp Arslan led a powerful raiding force into Georgia in 1064 and occupied Armenia. After further campaigns in the east he again

invaded Georgia in 1068. In the interval, independent Turkoman hands had begun to raid Asia Minor. The Byzantine emperor Romanus Diogenes, assuming the command in person, met the invaders in Cilicia and Cappadocia.

In three arduous campaigns (1068–70), the first two conducted by the emperor himself, the third by Manuel Comnenus, the Turkomans were defeated in detail and the eastern frontier of the empire re-established. In 1071 Romanus again took the field with 100,000 men, including a contingent of the Turkish tribe of the Uzes and of the French and Normans, under Ursel of Baliol, and advanced into Armenia.

Alp Arslan, abandoning a campaign already begun in Syria, hastened north to meet this unexpected invasion, and the two armies met at Manzikert (*q.v.*) or Malazgird, on the Murad Chai, north of Lake Van. In the ensuing battle, Aug. 26, 1171, the Greeks, after severe losses, were totally routed, a result achieved mainly by the tactics of the Turkish cavalry. Romanus was taken prisoner and conducted into the presence of Alp Arslan, who treated him with generosity and, terms of peace having been settled, dismissed him loaded with presents and respectfully attended by a military guard. Alp Arslan now prepared to march to the conquest of Turkistan, the original home of his ancestors. With a powerful army he advanced to the banks of the Oxus and passed his troops over on an improvised bridge.

Here was brought before him the commander of a captured fortress, named Yūsuf al-Khwarizmi. The sultan ordered him to be unbound and aimed an arrow at him, but missed; Yūsuf, in desperation, drew his dagger and stabbed Alp Arslan, who died within a few hours (Nov. 24, 1072) after proclaiming his son Malik Shah as his heir.

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ALPENA, a city of Michigan, U.S., on Thunder bay, a small arm of Lake Huron, at the mouth of Thunder Bay river, the county seat of Alpena county. It is served by the Detroit and Mackinac railway and is on federal highway 23, with bus and motor freight service. The population in 1950 was 13,053; in 1940 it was 12,808.

The city is built on sandy ground on both sides of the river and has a good harbour, with a controlling depth of 16 ft. The navigation season is usually from April 3 to Dec. 20. The commerce of the port is chiefly in coal, cement, stone and lumber. There are a number of manufacturing establishments. The city has extensive fisheries and is a summer and hunting resort. It occupies the site of an Indian burying ground. A trading post was established there in 1835, a permanent settlement in 1858 and the city was chartered in 1871.

Alpena has a city manager form of government.

ALPENHORN or **ALPHORN**, a musical instrument, consisting of a natural wooden horn of conical bore, having a cup-shaped mouthpiece, used by mountaineers in Switzerland and elsewhere.

The well-known *Ranz des Vaches* is the traditional melody of the alpenhorn, a portion of which is utilized by Beethoven in the finale of the *Pastoral Symphony*. Rossini also introduced the melody in his opera *William Tell*. The Swiss alpenhorn varies in shape according to the locality.

ALPES MARITIMES, department of southeast France, formed in 1860 out of the county of Nice, to which were added the districts of Grasse (formerly in the department of the Var) and of Mentone (purchased from the prince of Monaco). Pop. (1946) 448,973. It is bounded northeast by Italy, south by the Mediterranean sea and west by the departments of Var and Basses Alpes. Area, 1,443 sq.mi. It is composed mainly of the valleys of the Var and its affluents, the Tinée and the Vésubie.

Most of the department is mountainous, Mont Tinibras at the head of the Tinée valley reaching nearly 10,000 ft.

The Italian frontier there is peculiar. The centre of the Roja

valley is French; the upper and lower parts are Italian because they formed part of the county of Ventimiglia; the central section, part of the county of Nice, alone became French in 1860. It is thus impossible to have an Italian railway from Cuneo by the Col de Tenda and down the Roja valley direct to Ventimiglia. From near Isola in the upper Tinée valley southwards the political frontier is not the main Alpine watershed; the reason (it is said) is that in 1860 all the higher valleys of the Maritime Alps (on both sides of the watershed) were expressly excepted from the treaty of cession, in order that Victor Emmanuel II might retain his right of chamois hunting in these parts. The department is divided into two arrondissements (Nice and Grasse), 30 cantons and 161 communes. It forms the bishopric of Nice (the first bishop certainly known is mentioned at the end of the 4th century), which till 1792 was in the ecclesiastical province of Embrun, then (1802) in that of Aix-en-Provence, next in that of Genoa (1814) and finally (1860) in that of Aix again. Its chief town is Nice. The broad-gauge railways in the department cover 56 mi., including the line along the coast, while there are also 82 mi. of narrow-gauge railways. The chief industries are the distilling of perfumes and manufacture of olive oil, of pottery and of tiles, besides a great commerce in cut flowers. To foreigners the department is best known for its winter resorts Nice, Cannes, Mentone, Antibes and Beaulieu; while other important towns are Grasse and Puget Théniers.

ALPHA and **OMEGA** (Α and Ω), the first and last letters of the Greek alphabet used as the self-designation of God (Rev. i, 8; xxi, 6) and of Christ (xxii, 13). The usage is based on passages such as Isa. xli, 4, xlv, 6 and Ps. xc, 2. In rabbinic literature the first and last letters of the Hebrew alphabet are similarly used. The word *Emeth* (truth), composed of the first, middle and last letters of the Hebrew alphabet, is the seal of God.

ALPHABET. The name alphabet is derived from the names of the first two letters of the Greek alphabet, *alpha* and *beta*, and denotes a set of characters, or, as we call them, letters, each of which represents a given sound or sounds. This representation is necessarily rough and of quite a general character. This is easily seen in the case of the first letter of the English alphabet, for example, which represents different sounds in the words *father*, *man* and *take*. But even in cases where a letter is regarded as representing a single sound, it does so roughly, taking no account of differences of intonation, tone or pitch, nor of stress, nor of slight variations of pronunciation which vary not only between one individual speaker and another, but also from time to time in the case of an individual in accordance with the position of a given sound in a word, of a word in a phrase, or with the nature of the phrase to which he is giving utterance. In this connection writing stands in much the same relationship to speech as speech does to thought. If language is not a sufficiently delicate instrument to express the nuances of human thought, writing is a less delicate instrument still, and any attempt to multiply signs and characters to keep pace with the subtle variations of the human voice would only impair their usefulness.

An alphabet is a highly-developed, artificial form of writing. The connection between sound and character is conventional and not essential. This is not the case with all forms. Pictographs (*see* **PICTOGRAPHY**), ideographs (*q.v.*), and hieroglyphs (*q.v.*) are forms of writing, the characters of which bear an essential relationship to what they are intended to represent. Such methods constitute generally speaking an earlier stage in the development of writing than syllabaries and alphabets, which have passed into the conventionalized stage. An earlier stage still may be found in the various devices employed to assist memory, such as the notched stick, notched in the presence of the messenger to whom the significance of each notch is verbally emphasized, a method not far removed from the tying of a knot in the handkerchief (*see* **KNOT SIGNS**). Again there are the Peruvian Quipus (*q.v.*), notched sticks from which are suspended strings of varying colour and length, knotted in various places, each variation having its own significance; or the North American Indian custom of adorning deerskin belts with wampum beads (*see* **WAMPUM**), whose colour

TABLE I.													
	BRAHMI		OLDEST ÆTHIOPIA (NIMYARITIC)	SABÆAN (NIMYARITIC)	NASHKI (ARABIC)	TEMA 500 B.C.	SINDJIRLI 800 B.C.	MOABITE STONE.	PHOENICIAN (CYPRUS)	GREEK INSCRIP. OF THERA	OLDEST LATIN FORUM INSCRIPTION	CYRILLIC	GLAGOLITIC
A	𑀅	𑀆	አ	ሀ	ا	𐤀	𐤁	𐤂	𐤃	ΑΑ	ΑΑΑ	А	Ɑ
B	𑀇	𑀈	በ	ለ	ب	𐤂	𐤃	𐤄	𐤅	ΒΒ	ΒΒΒ	Б	Ɱ
G	𑀉	𑀊	ገ	ሀ	ج	𐤄	𐤅	𐤆	𐤇	ΓΓ	ΓΓΓ	Г	Ɐ
D	𑀋	𑀌	ደ	ዘ	د	𐤆	𐤇	𐤈	𐤉	ΔΔ	ΔΔΔ	Д	Ɒ
E	𑀍	𑀎	የ	ሀ	ه	𐤈	𐤉	𐤊	𐤋	ΕΕ	ΕΕΕ	Е	ⱱ
F(W)	𑀏	𑀐	ቀ	ዐ	و	𐤊	𐤋	𐤌	𐤍	ϜϜ	ϜϜϜ	Ж	Ⱳ
Z	𑀑	𑀒	ሂ	፩	ز	𐤌	𐤍	𐤎	𐤏	ΖΖ	ΖΖΖ	З	ⱳ
H	𑀓	𑀔	ሐ	ሂ	ح	𐤎	𐤏	𐤐	𐤑	ΘΘ	ΘΘΘ	И	ⱴ
TH	𑀕	𑀖	ጠ	ጡ	ط	𐤐	𐤑	𐤒	𐤓	⊖	⊖⊖	Ⱶ	ⱶ
I	𑀗	𑀘	ነ	የ	ع	𐤒	𐤓	𐤔	𐤕	ΙΙ	ΙΙΙ	І	ⱷ
K	𑀙	𑀚	ኀ	ኀ	ك	𐤔	𐤕	𐤖	𐤗	ΚΚ	ΚΚΚ	К	ⱸ
L	𑀛	𑀜	ለ	ነ	ل	𐤖	𐤗	𐤘	𐤙	ΛΛ	ΛΛΛ	Л	ⱹ
M	𑀝	𑀞	መ	፪	م	𐤘	𐤙	𐤚	𐤛	ΜΜ	ΜΜΜ	М	ⱺ
N	𑀟	𑀠	ነ	ኀ	ن	𐤚	𐤛	𐤜	𐤝	ΝΝ	ΝΝΝ	Н	ⱻ
X(SH)	𑀡	𑀢	ሐ	ኀ	𐤌	𐤍	𐤎	𐤏	𐤐	ΞΞ	ΞΞΞ	Х	ⱼ
O	𑀣	𑀤	ዐ	፬	ع	𐤏	𐤐	𐤑	𐤒	ΟΟ	ΟΟΟ	О	ⱽ
P	𑀥	𑀦	፩	ዐ	ف	𐤐	𐤑	𐤒	𐤓	ΠΠ	ΠΠΠ	П	Ȿ
S	𑀧	𑀨	ሀ	፪	س	𐤒	𐤓	𐤔	𐤕	ΡΡ	ΡΡΡ	Р	Ɀ
Q	𑀩	𑀪	ቀ	፫	ق	𐤔	𐤕	𐤖	𐤗	ϞϞ	ϞϞϞ	Ϟ	Ɀ
R	𑀫	𑀬	ረ	ነ	ر	𐤖	𐤗	𐤘	𐤙	ϚϚ	ϚϚϚ	Р	Ɀ
S	𑀭	𑀮	ወ	፬	ش	𐤘	𐤙	𐤚	𐤛	ϜϜ	ϜϜϜ	С	Ɀ
T	𑀯	𑀰	ተ	ኀ	ت	𐤚	𐤛	𐤜	𐤝	ΤΤ	ΤΤΤ	Т	Ɀ
AFTER BÜHLER													
AFTER EUTING													
TABLE Ia-CYRILLIC AND GLAGOLITIC SYMBOLS NOT GIVEN ABOVE.													
Value f(φ), x(h), o. 𐰀, c. 𐰁, 𐰂, 𐰃, 𐰄, y. 𐰅, 𐰆, 𐰇, 𐰈, 𐰉, 𐰊, 𐰋, 𐰌, 𐰍, 𐰎, 𐰏, 𐰐, 𐰑, 𐰒, 𐰓, 𐰔, 𐰕, 𐰖, 𐰗, 𐰘, 𐰙, 𐰚, 𐰛, 𐰜, 𐰝, 𐰞, 𐰟, 𐰠, 𐰡, 𐰢, 𐰣, 𐰤, 𐰥, 𐰦, 𐰧, 𐰨, 𐰩, 𐰪, 𐰫, 𐰬, 𐰭, 𐰮, 𐰯, 𐰰, 𐰱, 𐰲, 𐰳, 𐰴, 𐰵, 𐰶, 𐰷, 𐰸, 𐰹, 𐰺, 𐰻, 𐰼, 𐰽, 𐰾, 𐰿, 𐱀, 𐱁, 𐱂, 𐱃, 𐱄, 𐱅, 𐱆, 𐱇, 𐱈, 𐱉, 𐱊, 𐱋, 𐱌, 𐱍, 𐱎, 𐱏, 𐱐, 𐱑, 𐱒, 𐱓, 𐱔, 𐱕, 𐱖, 𐱗, 𐱘, 𐱙, 𐱚, 𐱛, 𐱜, 𐱝, 𐱞, 𐱟, 𐱠, 𐱡, 𐱢, 𐱣, 𐱤, 𐱥, 𐱦, 𐱧, 𐱨, 𐱩, 𐱪, 𐱫, 𐱬, 𐱭, 𐱮, 𐱯, 𐱰, 𐱱, 𐱲, 𐱳, 𐱴, 𐱵, 𐱶, 𐱷, 𐱸, 𐱹, 𐱺, 𐱻, 𐱼, 𐱽, 𐱾, 𐱿, 𐲀, 𐲁, 𐲂, 𐲃, 𐲄, 𐲅, 𐲆, 𐲇, 𐲈, 𐲉, 𐲊, 𐲋, 𐲌, 𐲍, 𐲎, 𐲏, 𐲐, 𐲑, 𐲒, 𐲓, 𐲔, 𐲕, 𐲖, 𐲗, 𐲘, 𐲙, 𐲚, 𐲛, 𐲜, 𐲝, 𐲞, 𐲟, 𐲠, 𐲡, 𐲢, 𐲣, 𐲤, 𐲥, 𐲦, 𐲧, 𐲨, 𐲩, 𐲪, 𐲫, 𐲬, 𐲭, 𐲮, 𐲯, 𐲰, 𐲱, 𐲲, 𐲳, 𐲴, 𐲵, 𐲶, 𐲷, 𐲸, 𐲹, 𐲺, 𐲻, 𐲼, 𐲽, 𐲾, 𐲿, 𐳀, 𐳁, 𐳂, 𐳃, 𐳄, 𐳅, 𐳆, 𐳇, 𐳈, 𐳉, 𐳊, 𐳋, 𐳌, 𐳍, 𐳎, 𐳏, 𐳐, 𐳑, 𐳒, 𐳓, 𐳔, 𐳕, 𐳖, 𐳗, 𐳘, 𐳙, 𐳚, 𐳛, 𐳜, 𐳝, 𐳞, 𐳟, 𐳠, 𐳡, 𐳢, 𐳣, 𐳤, 𐳥, 𐳦, 𐳧, 𐳨, 𐳩, 𐳪, 𐳫, 𐳬, 𐳭, 𐳮, 𐳯, 𐳰, 𐳱, 𐳲, 𐳳, 𐳴, 𐳵, 𐳶, 𐳷, 𐳸, 𐳹, 𐳺, 𐳻, 𐳼, 𐳽, 𐳾, 𐳿, 𐴀, 𐴁, 𐴂, 𐴃, 𐴄, 𐴅, 𐴆, 𐴇, 𐴈, 𐴉, 𐴊, 𐴋, 𐴌, 𐴍, 𐴎, 𐴏, 𐴐, 𐴑, 𐴒, 𐴓, 𐴔, 𐴕, 𐴖, 𐴗, 𐴘, 𐴙, 𐴚, 𐴛, 𐴜, 𐴝, 𐴞, 𐴟, 𐴠, 𐴡, 𐴢, 𐴣, 𐴤, 𐴥, 𐴦, 𐴧, 𐴨, 𐴩, 𐴪, 𐴫, 𐴬, 𐴭, 𐴮, 𐴯, 𐴰, 𐴱, 𐴲, 𐴳, 𐴴, 𐴵, 𐴶, 𐴷, 𐴸, 𐴹, 𐴺, 𐴻, 𐴼, 𐴽, 𐴾, 𐴿, 𐵀, 𐵁, 𐵂, 𐵃, 𐵄, 𐵅, 𐵆, 𐵇, 𐵈, 𐵉, 𐵊, 𐵋, 𐵌, 𐵍, 𐵎, 𐵏, 𐵐, 𐵑, 𐵒, 𐵓, 𐵔, 𐵕, 𐵖, 𐵗, 𐵘, 𐵙, 𐵚, 𐵛, 𐵜, 𐵝, 𐵞, 𐵟, 𐵠, 𐵡, 𐵢, 𐵣, 𐵤, 𐵥, 𐵦, 𐵧, 𐵨, 𐵩, 𐵪, 𐵫, 𐵬, 𐵭, 𐵮, 𐵯, 𐵰, 𐵱, 𐵲, 𐵳, 𐵴, 𐵵, 𐵶, 𐵷, 𐵸, 𐵹, 𐵺, 𐵻, 𐵼, 𐵽, 𐵾, 𐵿, 𐶀, 𐶁, 𐶂, 𐶃, 𐶄, 𐶅, 𐶆, 𐶇, 𐶈, 𐶉, 𐶊, 𐶋, 𐶌, 𐶍, 𐶎, 𐶏, 𐶐, 𐶑, 𐶒, 𐶓, 𐶔, 𐶕, 𐶖, 𐶗, 𐶘, 𐶙, 𐶚, 𐶛, 𐶜, 𐶝, 𐶞, 𐶟, 𐶠, 𐶡, 𐶢, 𐶣, 𐶤, 𐶥, 𐶦, 𐶧, 𐶨, 𐶩, 𐶪, 𐶫, 𐶬, 𐶭, 𐶮, 𐶯, 𐶰, 𐶱, 𐶲, 𐶳, 𐶴, 𐶵, 𐶶, 𐶷, 𐶸, 𐶹, 𐶺, 𐶻, 𐶼, 𐶽, 𐶾, 𐶿, 𐷀, 𐷁, 𐷂, 𐷃, 𐷄, 𐷅, 𐷆, 𐷇, 𐷈, 𐷉, 𐷊, 𐷋, 𐷌, 𐷍, 𐷎, 𐷏, 𐷐, 𐷑, 𐷒, 𐷓, 𐷔, 𐷕, 𐷖, 𐷗, 𐷘, 𐷙, 𐷚, 𐷛, 𐷜, 𐷝, 𐷞, 𐷟, 𐷠, 𐷡, 𐷢, 𐷣, 𐷤, 𐷥, 𐷦, 𐷧, 𐷨, 𐷩, 𐷪, 𐷫, 𐷬, 𐷭, 𐷮, 𐷯, 𐷰, 𐷱, 𐷲, 𐷳, 𐷴, 𐷵, 𐷶, 𐷷, 𐷸, 𐷹, 𐷺, 𐷻, 𐷼, 𐷽, 𐷾, 𐷿, 𐸀, 𐸁, 𐸂, 𐸃, 𐸄, 𐸅, 𐸆, 𐸇, 𐸈, 𐸉, 𐸊, 𐸋, 𐸌, 𐸍, 𐸎, 𐸏, 𐸐, 𐸑, 𐸒, 𐸓, 𐸔, 𐸕, 𐸖, 𐸗, 𐸘, 𐸙, 𐸚, 𐸛, 𐸜, 𐸝, 𐸞, 𐸟, 𐸠, 𐸡, 𐸢, 𐸣, 𐸤, 𐸥, 𐸦, 𐸧, 𐸨, 𐸩, 𐸪, 𐸫, 𐸬, 𐸭, 𐸮, 𐸯, 𐸰, 𐸱, 𐸲, 𐸳, 𐸴, 𐸵, 𐸶, 𐸷, 𐸸, 𐸹, 𐸺, 𐸻, 𐸼, 𐸽, 𐸾, 𐸿, 𐹀, 𐹁, 𐹂, 𐹃, 𐹄, 𐹅, 𐹆, 𐹇, 𐹈, 𐹉, 𐹊, 𐹋, 𐹌, 𐹍, 𐹎, 𐹏, 𐹐, 𐹑, 𐹒, 𐹓, 𐹔, 𐹕, 𐹖, 𐹗, 𐹘, 𐹙, 𐹚, 𐹛, 𐹜, 𐹝, 𐹞, 𐹟, 𐹠, 𐹡, 𐹢, 𐹣, 𐹤, 𐹥, 𐹦, 𐹧, 𐹨, 𐹩, 𐹪, 𐹫, 𐹬, 𐹭, 𐹮, 𐹯, 𐹰, 𐹱, 𐹲, 𐹳, 𐹴, 𐹵, 𐹶, 𐹷, 𐹸, 𐹹, 𐹺, 𐹻, 𐹼, 𐹽, 𐹾, 𐹿, 𐺀, 𐺁, 𐺂, 𐺃, 𐺄, 𐺅, 𐺆, 𐺇, 𐺈, 𐺉, 𐺊, 𐺋, 𐺌, 𐺍, 𐺎, 𐺏, 𐺐, 𐺑, 𐺒, 𐺓, 𐺔, 𐺕, 𐺖, 𐺗, 𐺘, 𐺙, 𐺚, 𐺛, 𐺜, 𐺝, 𐺞, 𐺟, 𐺠, 𐺡, 𐺢, 𐺣, 𐺤, 𐺥, 𐺦, 𐺧, 𐺨, 𐺩, 𐺪, 𐺫, 𐺬, 𐺭, 𐺮, 𐺯, 𐺰, 𐺱, 𐺲, 𐺳, 𐺴, 𐺵, 𐺶, 𐺷, 𐺸, 𐺹, 𐺺, 𐺻, 𐺼, 𐺽, 𐺾, 𐺿, 𐻀, 𐻁, 𐻂, 𐻃, 𐻄, 𐻅, 𐻆, 𐻇, 𐻈, 𐻉, 𐻊, 𐻋, 𐻌, 𐻍, 𐻎, 𐻏, 𐻐, 𐻑, 𐻒, 𐻓, 𐻔, 𐻕, 𐻖, 𐻗, 𐻘, 𐻙, 𐻚, 𐻛, 𐻜, 𐻝, 𐻞, 𐻟, 𐻠, 𐻡, 𐻢, 𐻣, 𐻤, 𐻥, 𐻦, 𐻧, 𐻨, 𐻩, 𐻪, 𐻫, 𐻬, 𐻭, 𐻮, 𐻯, 𐻰, 𐻱, 𐻲, 𐻳, 𐻴, 𐻵, 𐻶, 𐻷, 𐻸, 𐻹, 𐻺, 𐻻, 𐻼, 𐻽, 𐻾, 𐻿, 𐼀, 𐼁, 𐼂, 𐼃, 𐼄, 𐼅, 𐼆, 𐼇, 𐼈, 𐼉, 𐼊, 𐼋, 𐼌, 𐼍, 𐼎, 𐼏, 𐼐, 𐼑, 𐼒, 𐼓, 𐼔, 𐼕, 𐼖, 𐼗, 𐼘, 𐼙, 𐼚, 𐼛, 𐼜, 𐼝, 𐼞, 𐼟, 𐼠, 𐼡, 𐼢, 𐼣, 𐼤, 𐼥, 𐼦, 𐼧, 𐼨, 𐼩, 𐼪, 𐼫, 𐼬, 𐼭, 𐼮, 𐼯, 𐼰, 𐼱, 𐼲, 𐼳, 𐼴, 𐼵, 𐼶, 𐼷, 𐼸, 𐼹, 𐼺, 𐼻, 𐼼, 𐼽, 𐼾, 𐼿, 𐽀, 𐽁, 𐽂, 𐽃, 𐽄, 𐽅, 𐽆, 𐽇, 𐽈, 𐽉, 𐽊, 𐽋, 𐽌, 𐽍, 𐽎, 𐽏, 𐽐, 𐽑, 𐽒, 𐽓, 𐽔, 𐽕, 𐽖, 𐽗, 𐽘, 𐽙, 𐽚, 𐽛, 𐽜, 𐽝, 𐽞, 𐽟, 𐽠, 𐽡, 𐽢, 𐽣, 𐽤, 𐽥, 𐽦, 𐽧, 𐽨, 𐽩, 𐽪, 𐽫, 𐽬, 𐽭, 𐽮, 𐽯, 𐽰, 𐽱, 𐽲, 𐽳, 𐽴, 𐽵, 𐽶, 𐽷, 𐽸, 𐽹, 𐽺, 𐽻, 𐽼, 𐽽, 𐽾, 𐽿, 𐾀, 𐾁, 𐾂, 𐾃, 𐾄, 𐾅, 𐾆, 𐾇, 𐾈, 𐾉, 𐾊, 𐾋, 𐾌, 𐾍, 𐾎, 𐾏, 𐾐, 𐾑, 𐾒, 𐾓, 𐾔, 𐾕, 𐾖, 𐾗, 𐾘, 𐾙, 𐾚, 𐾛, 𐾜, 𐾝, 𐾞, 𐾟, 𐾠, 𐾡, 𐾢, 𐾣, 𐾤, 𐾥, 𐾦, 𐾧, 𐾨, 𐾩, 𐾪, 𐾫, 𐾬, 𐾭, 𐾮, 𐾯, 𐾰, 𐾱, 𐾲, 𐾳, 𐾴, 𐾵, 𐾶, 𐾷, 𐾸, 𐾹, 𐾺, 𐾻, 𐾼, 𐾽, 𐾾, 𐾿, 𐿀, 𐿁, 𐿂, 𐿃, 𐿄, 𐿅, 𐿆, 𐿇, 𐿈, 𐿉, 𐿊, 𐿋, 𐿌, 𐿍, 𐿎, 𐿏, 𐿐, 𐿑, 𐿒, 𐿓, 𐿔, 𐿕, 𐿖, 𐿗, 𐿘, 𐿙, 𐿚, 𐿛, 𐿜, 𐿝, 𐿞, 𐿟, 𐿠, 𐿡, 𐿢, 𐿣, 𐿤, 𐿥, 𐿦, 𐿧, 𐿨, 𐿩, 𐿪, 𐿫, 𐿬, 𐿭, 𐿮, 𐿯, 𐿰, 𐿱, 𐿲, 𐿳, 𐿴, 𐿵, 𐿶, 𐿷, 𐿸, 𐿹, 𐿺, 𐿻, 𐿼, 𐿽, 𐿾, 𐿿, 𐻀, 𐻁, 𐻂, 𐻃, 𐻄, 𐻅, 𐻆, 𐻇, 𐻈, 𐻉, 𐻊, 𐻋, 𐻌, 𐻍, 𐻎, 𐻏, 𐻐, 𐻑, 𐻒, 𐻓, 𐻔, 𐻕, 𐻖, 𐻗, 𐻘, 𐻙, 𐻚, 𐻛, 𐻜, 𐻝, 𐻞, 𐻟, 𐻠, 𐻡, 𐻢, 𐻣, 𐻤, 𐻥, 𐻦, 𐻧, 𐻨, 𐻩, 𐻪, 𐻫, 𐻬, 𐻭, 𐻮, 𐻯, 𐻰, 𐻱, 𐻲, 𐻳, 𐻴, 𐻵, 𐻶, 𐻷, 𐻸, 𐻹, 𐻺, 𐻻, 𐻼, 𐻽, 𐻾, 𐻿, 𐼀, 𐼁, 𐼂, 𐼃, 𐼄, 𐼅, 𐼆, 𐼇, 𐼈, 𐼉, 𐼊, 𐼋, 𐼌, 𐼍, 𐼎, 𐼏, 𐼐, 𐼑, 𐼒, 𐼓, 𐼔, 𐼕, 𐼖, 𐼗, 𐼘, 𐼙, 𐼚, 𐼛, 𐼜, 𐼝, 𐼞, 𐼟, 𐼠, 𐼡, 𐼢, 𐼣, 𐼤, 𐼥, 𐼦, 𐼧, 𐼨, 𐼩, 𐼪, 𐼫, 𐼬, 𐼭, 𐼮, 𐼯, 𐼰, 𐼱, 𐼲, 𐼳, 𐼴, 𐼵, 𐼶, 𐼷, 𐼸, 𐼹, 𐼺, 𐼻, 𐼼, 𐼽, 𐼾, 𐼿, 𐽀, 𐽁, 𐽂, 𐽃, 𐽄, 𐽅, 𐽆, 𐽇, 𐽈, 𐽉, 𐽊, 𐽋, 𐽌, 𐽍, 𐽎, 𐽏, 𐽐, 𐽑, 𐽒, 𐽓, 𐽔, 𐽕, 𐽖, 𐽗, 𐽘, 𐽙, 𐽚, 𐽛, 𐽜, 𐽝, 𐽞, 𐽟, 𐽠, 𐽡, 𐽢, 𐽣, 𐽤, 𐽥, 𐽦, 𐽧, 𐽨, 𐽩, 𐽪, 𐽫, 𐽬, 𐽭, 𐽮, 𐽯, 𐽰, 𐽱, 𐽲, 𐽳, 𐽴, 𐽵, 𐽶, 𐽷, 𐽸, 𐽹, 𐽺, 𐽻, 𐽼, 𐽽, 𐽾, 𐽿, 𐾀, 𐾁, 𐾂, 𐾃, 𐾄, 𐾅, 𐾆, 𐾇, 𐾈, 𐾉, 𐾊, 𐾋, 𐾌, 𐾍, 𐾎, 𐾏, 𐾐, 𐾑, 𐾒, 𐾓, 𐾔, 𐾕, 𐾖, 𐾗, 𐾘, 𐾙, 𐾚, 𐾛, 𐾜, 𐾝, 𐾞, 𐾟, 𐾠, 𐾡, 𐾢, 𐾣, 𐾤, 𐾥, 𐾦, 𐾧, 𐾨, 𐾩, 𐾪, 𐾫, 𐾬, 𐾭, 𐾮, 𐾯, 𐾰, 𐾱, 𐾲, 𐾳, 𐾴, 𐾵, 𐾶, 𐾷, 𐾸, 𐾹, 𐾺, 𐾻, 𐾼, 𐾽, 𐾾, 𐾿, 𐿀, 𐿁, 𐿂, 𐿃, 𐿄, 𐿅, 𐿆, 𐿇, 𐿈, 𐿉, 𐿊, 𐿋, 𐿌, 𐿍, 𐿎, 𐿏, 𐿐, 𐿑, 𐿒, 𐿓, 𐿔, 𐿕, 𐿖, 𐿗, 𐿘, 𐿙, 𐿚, 𐿛, 𐿜, 𐿝, 𐿞, 𐿟, 𐿠, 𐿡, 𐿢, 𐿣, 𐿤, 𐿥, 𐿦, 𐿧, 𐿨, 𐿩, 𐿪, 𐿫, 𐿬, 𐿭, 𐿮, 𐿯, 𐿰, 𐿱, 𐿲, 𐿳, 𐿴, 𐿵, 𐿶, 𐿷, 𐿸, 𐿹, 𐿺, 𐿻, 𐿼, 𐿽, 𐿾, 𐿿, 𐻀, 𐻁, 𐻂, 𐻃, 𐻄, 𐻅, 𐻆, 𐻇, 𐻈, 𐻉, 𐻊, 𐻋, 𐻌, 𐻍, 𐻎, 𐻏, 𐻐, 𐻑, 𐻒, 𐻓, 𐻔, 𐻕, 𐻖, 𐻗, 𐻘, 𐻙, 𐻚, 𐻛, 𐻜, 𐻝, 𐻞, 𐻟, 𐻠, 𐻡, 𐻢, 𐻣, 𐻤, 𐻥, 𐻦, 𐻧, 𐻨, 𐻩, 𐻪, 𐻫, 𐻬, 𐻭, 𐻮, 𐻯, 𐻰, 𐻱, 𐻲, 𐻳, 𐻴, 𐻵, 𐻶, 𐻷, 𐻸, 𐻹, 𐻺, 𐻻, 𐻼, 𐻽, 𐻾, 𐻿, 𐼀, 𐼁, 𐼂, 𐼃, 𐼄, 𐼅, 𐼆, 𐼇, 𐼈, 𐼉, 𐼊, 𐼋, 𐼌, 𐼍, 𐼎, 𐼏, 𐼐, 𐼑, 𐼒, 𐼓, 𐼔, 𐼕, 𐼖, 𐼗, 𐼘, 𐼙, 𐼚, 𐼛, 𐼜, 𐼝, 𐼞, 𐼟, 𐼠, 𐼡, 𐼢, 𐼣, 𐼤, 𐼥, 𐼦, 𐼧, 𐼨, 𐼩, 𐼪, 𐼫, 𐼬, 𐼭, 𐼮, 𐼯, 𐼰, 𐼱, 𐼲, 𐼳, 𐼴, 𐼵, 𐼶, 𐼷, 𐼸, 𐼹, 𐼺, 𐼻, 𐼼, 𐼽, 𐼾, 𐼿, 𐽀, 𐽁, 𐽂, 𐽃, 𐽄, 𐽅, 𐽆, 𐽇, 𐽈, 𐽉, 𐽊, 𐽋, 𐽌, 𐽍, 𐽎, 𐽏, 𐽐, 𐽑, 𐽒, 𐽓, 𐽔, 𐽕, 𐽖, 𐽗, 𐽘, 𐽙, 𐽚, 𐽛, 𐽜, 𐽝, 𐽞, 𐽟, 𐽠, 𐽡, 𐽢, 𐽣, 𐽤, 𐽥, 𐽦, 𐽧, 𐽨, 𐽩, 𐽪, 𐽫, 𐽬, 𐽭, 𐽮, 𐽯, 𐽰, 𐽱, 𐽲, 𐽳, 𐽴, 𐽵, 𐽶, 𐽷, 𐽸, 𐽹, 𐽺, 𐽻, 𐽼, 𐽽, 𐽾, 𐽿, 𐾀, 𐾁, 𐾂, 𐾃, 𐾄, 𐾅, 𐾆, 𐾇, 𐾈, 𐾉, 𐾊, 𐾋, 𐾌, 𐾍, 𐾎, 𐾏, 𐾐, 𐾑, 𐾒, 𐾓, 𐾔, 𐾕, 𐾖, 𐾗, 𐾘, 𐾙, 𐾚, 𐾛, 𐾜, 𐾝, 𐾞, 𐾟, 𐾠, 𐾡, 𐾢, 𐾣, 𐾤, 𐾥, 𐾦, 𐾧, 𐾨, 𐾩, 𐾪, 𐾫, 𐾬, 𐾭, 𐾮, 𐾯, 𐾰, 𐾱, 𐾲, 𐾳, 𐾴, 𐾵, 𐾶, 𐾷, 𐾸, 𐾹, 𐾺, 𐾻, 𐾼, 𐾽, 𐾾,													

AFTER BÜHLER

AFTER EUTING

TABLE Ia.—CYRILLIC AND GLAGOLITIC

SYMBOLS NOT GIVEN ABOVE.

Value f(φ), x(h), o, st, c, ē, δ, ū, y, ȳ, ē, jū, ja, je, (ε), g, je, jē, x(ε), p(ψ), θ.

CYRILLIC Φ Χ Ψ Ω Π Ц Ч Ш Ъ Ы Ь Н Ь К Ю І І І А А А Х І І І З Ψ Θ

GLAGOLITIC Ɑ Ɱ Ɐ Ɒ ⱱ Ⱳ ⱳ ⱴ Ⱶ ⱶ ⱷ ⱸ ⱹ ⱺ ⱻ ⱼ ⱽ Ȿ Ɀ

CHART ILLUSTRATING THE PRESUMED DEVELOPMENT OF THE MODERN EUROPEAN ALPHABET FROM THE BRAHMI LETTERS OF INDIA

and position were employed to describe historical events such as battles, or even the terms of treaties, with remarkable accuracy to those who knew the secret of their elucidation. There are thus three distinct stages in the growth of writing, though they need not necessarily be thought of as hard and fast chronological stages.

Picture-writing or the use of the ideograph is the intermediate of the three stages. An ideograph (*q.v.*) is a drawing representing not a sound, nor even a word, but an idea. Thus the drawing of a man with protruding ribs represents famine; or an eye with tears dropping from it, sorrow. Till recently such methods of communication were in use among certain tribes of North American Indians. They appear to have been so among many races in various regions.

In this connection should be mentioned the writing known as Nsibidi or Nchibiddi in use among a secret society or club among the Ekoi people of southern Nigeria. The writing is purely ideographic, but the symbols are conventional, fixed in form and

meaning. The script is jealously guarded by the members of the secret society. Its origin is unknown; but certain resemblances have been detected to the Egyptian hieroglyphic system, one of the most remarkable being that the Nsibidi picture-symbol for *house* is rectangular in shape, whereas all dwellings among the people who use it to-day are, and have been for centuries, round. Moreover the Ekoi people are semi-Bantu in descent, and there is reason to suppose that the Bantu peoples migrated from the lower Nile regions. (For an account of this writing see *In the Shadow of the Bush* by P. Amaury Talbot, Appendix G. p. 447 ff.)

Six different peoples in various parts of the world developed a system of writing usually known as transitional, that is to say, they continued the use of the ideograph, but added symbols of a purely phonetic value, and made use of the two side by side. These peoples were the Sumerians and Babylonians, whose cuneiform was a script of this nature, the Egyptians, the Hittites, the Chinese in the Far East, and in America the Mayas and Aztecs.

The method by which this change took place was, generally speaking, that the picture-symbol representing any given object, an eye, for example, came to represent the same sound under all circumstances, as if for instance the drawing of an eye came to stand not only for the meaning *eye*, but also for the pronoun *I*, which has the same phonetic value. This could be the case not only when the sound constituted a whole word, but when it occurred as a single syllable within a word. Even in purely pictographical writing something of the sort occasionally took place. The Mexican name *itz-coatl* meaning literally *snake-knife* and represented by the drawing of a snake surrounded by knives, occasionally occurs as *itz-co-atl* with a different picture, *co* meaning a pot. Though this process is of a different nature, it serves as an illustration of the tendency to connect the drawing not only with the object it essentially represented but also with any homonym of that object. This being so, it became the custom to draw or write the picture with greater haste and carelessness, time being more important than accuracy, so soon as the symbol came to represent not an object but a sound. A badly-drawn eye, for example, will serve perfectly well for a sound that covers both words *eye* and *I*. There is no longer need for the drawing to be recognizable as an *eye* when it is no longer required to represent the object to the sight, but only a sound which itself carries meaning to the ear. Thus picture-writing degenerated, the process being a distinct gain in ease of communication. It was in this way that the Egyptian hieratic and demotic scripts came into existence, although so strong was the habit of writing hieroglyphs that for many centuries both were employed side by side, even literally so in the same piece of writing, the hieroglyph sometimes actually following the phonetic symbol in order, as it were, that the meaning might be doubly assured.

The Chinese ideographic system exhibits peculiarities which depend upon the language that it was formed to represent. So soon as the symbols attained a phonetic value, serious difficulty arose from the fact that a single monosyllabic word might have many distinct meanings, distinguished in speech only by intonation which it was, for a time, impossible to represent in writing. The difficulty was felt in the spoken language also, and one homonym was distinguished from another by the addition of a second word which made the meaning clear, a kind of compound being thus formed. In the course of time the original pictographs have deteriorated, but they are capable of analysis into their original constituent parts without undue difficulty (*see CHINESE LANGUAGE*).

The Japanese, when they came into contact with Chinese civilization in the 5th century A.D., adopted the Chinese phonographic script and endeavoured to adapt it to their language. Finding, however, that their chief sounds could be comprehended in a syllabary of 47 characters they developed these from Chinese characters. For literary or learned purposes the Chinese phonograms are still in use among them, so that in spite of the utter difference of language the Japanese and Chinese can communicate by means of writing, although each symbol has a totally different phonetic value to the speakers of either language. The neighbouring countries of China, Japan and Korea exhibit three separate modes of writing, ideographic, syllabic and alphabetical, the Koreans having invented an alphabet based on Sanskrit forms.

The syllabary and alphabet are examples of the most highly-developed stage of writing, the conventional stage, when there is no essential connection between sound and symbol. To some peoples the development of a syllabary seemed to come more easily than that of an alphabet. A syllabary existed in Cyprus in ancient times. In the case of a language that for reasons of phonetic decay or otherwise has multiplied consonants in a single syllable the syllabary is a cumbersome mode of writing. The word *strength*, for example, would have to be written *as-at-ar-eng-ath*, or *sa-ta-re-nga-tha* and this is obviously a representation of the sounds composing the word that is far from adequate. It will also be readily seen that a much greater number of symbols is required for a syllabary than is the case with the far more convenient alphabet.

The alphabet then is the form of writing that to those peoples

who have developed, borrowed or adopted it has been found the most convenient and adaptable. Its use is acquired in childhood with ease, which is far from being the case with the Chinese phonograms, for instance. It may also be passed from one language to another without difficulty. The history of our own alphabet, which has survived as an alphabet with, all things considered, surprisingly little change for nearly 3,000 years and is

EGYPTIAN HIEROGLYPH	SINAI SCRIPT	MOABITE STONE	SABAEAN	LIBYANIC	THAMUD- ENIC	SAFAHITIC	EARLY GREEK	GK NAME OF LETTER
								ALPHA
								BETA
								GAMMA
								DELTA
								E
								ZETA
								ETA
								THETA
								IOTA
								KAPPA
								LAMBDA
								MU
								NU
								SIGMA
								OMICRON
								PI
								KOPPA
								RHO
								SAN
								TAU

CHART SHOWING THE EVOLUTION OF THE ALPHABETIC SYMBOLS FROM HIEROGLYPHIC SIGNS TO EARLY GREEK LETTERS

still vigorous, untouched by the introduction of printing or of the typing machine, demonstrates its suitability to the needs of the many languages it has served.

The story of our alphabet from the time that we first find it employed in the earliest known Greek inscriptions is not hard to trace. It is its history in its pre-Greek days that is still wrapped in doubt. The Greek names for its letters, *alpha*, *beta*, *gamma*, *delta*, etc., demonstrate its Semitic origin, for though the names may not in every case have a Semitic etymology, they correspond closely with the Semitic names (*cf.* the Hebrew *aleph*, *beth*, *gimel*, *daleth*). Two questions have hitherto remained unanswered. How did the Greeks obtain it from the Semites? And what was its pre-Semite history? In recent years decided advances have been made towards a solution of either question.

Until the second decade of the 20th century the earliest known examples of the Semitic alphabet were what is known as the Moabite Stone, an inscription of Mesha king of Moab dating from the 9th century B.C., and a votive inscription to Baal-Lebanon discovered in Cyprus. Various theories have been current as to

the origin of the Semitic alphabet, the earliest being the view of Lenormant, published by De Rougé in 1874, that Egypt was its starting-place. Others attempted to connect it with Babylonian cuneiform, with the Cyprian syllabary, or with the Minoan writing of Crete. The latter is the view of Sir Arthur Evans who, in his great work *Scripta Minoa*, develops the theory that the alphabet was taken from Crete to Palestine by the Philistines and from

The Safahitic inscriptions come from rocks in the district of Safah near Damascus. Most of the south Semitic inscriptions read from right to left but a few are written *βουστροφῆδον*, as the Greeks said, that is to say, from right to left and left to right in alternate lines. There are 29 letters in the Sabaeen alphabet. The date of the earliest Sabaeen inscriptions appears to be about the 6th century B.C., and most of those who have noticed them are agreed that this alphabet descends not from that of the Moabite Stone but from an older source common to both. Dr. Alan Gardiner sees this source in the alphabet of the Sinai inscriptions. Two or three of the signs, notably that for *beth*  in Sabaeen, for *phe*  in Sabaeen, and for *thau*  in Thamudenic and Safahitic resemble symbols of the Sinai script. But it would be difficult to derive most of the signs from any found there. Further, Dr. Gardiner's identification of the Sinai symbols does not rest upon a completely sure basis in the absence of a certain interpretation of the inscriptions. Dr. Gardiner sees the most important line of evidence in the names of the letters. Of the 22 letters of the Semitic alphabet 17 have Semitic names, which are the names of ordinary objects. Five are unintelligible. It is obvious that the simplest interpretation of the fact of these names is that the letters were once picture-symbols representing the object whose name the alphabetical symbol has retained. In 15 cases symbols appear on the Sinai inscriptions which evidently represent objects to which these names belong. It is therefore no far-fetched conclusion to regard these symbols as prototypes of the alphabetical symbols which continued to bear the names of the objects they represent. There is also no doubt of the close connection of the symbols of the Sinai script with certain Egyptian hieroglyphics, and it is scarcely probable that identical picture symbols would have developed independently in Egypt and so near to its borders as to be in use in the Sinai peninsula. The close intercourse between Egypt and regions lying beyond Sinai render complete independence of script unlikely. On the other hand, of 32 separate characters apparently employed in the Sinai inscriptions, 17 are unintelligible, not being found to correspond sufficiently closely either with Egyptian hieroglyphic characters on the one hand nor letters of the Semitic alphabets on the other. The accompanying table, taken from that drawn up by Dr. Alan Gardiner to illustrate his article shows the relationship between the Egyptian hieroglyphs, the Sinai script, the alphabet of the Moabite Stone, the south Semitic alphabets, and that of early Greece. While Dr. Gardiner's interpretation of this script cannot be said to have proved that Egypt was the original home of the Semitic alphabets, it has directed attention to Egypt as deserving serious consideration as a claimant to this honour.

A different view of the origin of both the Phoenician and Greek alphabets is offered by Prof. Sir W. Flinders Petrie who in 1912 published his book *The Formation of the Alphabet*. In this he argues that both these alphabets together with those of Asia Minor, the south Semitic, Cyprian and certain Egyptian scripts developed from a series of conventional marks or signs employed for commercial purposes throughout the Mediterranean area from earliest times. "In Egypt, especially," he says, "the monumental evidence shows two entirely different sources of conventional marks. In late times the picture writing passed through many stages, until it became the complex grouping of slightly varying strokes in the demotic writing. But far before all this there had existed, from the beginning of the prehistoric ages, a totally different system of linear signs, full of variety and distinction. This early system was certainly in its decadence long before any hieroglyphs were used in Egypt. Similarly in Crete a system of linear signs precedes the pictographic records." But Professor Petrie is alone, or practically so, in supposing that the early marks to which he refers had any significance, and his theory of the development of various local alphabets from such marks has not found general acceptance. Too many links are missing in the chain of proof. The fact that identical alphabetical symbols occur in widely distant regions of the Mediterranean area, which he stresses, is capable of other explanations.

The most important fact ignored by any theory that would derive the Greek and Phoenician alphabets independently from a

TABLE III.

	MOABITE STONE	ABU-SINDEL	MILETUS	THERA	ATTICA	CORINTH	CHALCIS	LYDIAN*
A								
B								
G								
D								
E								
F(W)								
Z								
H								
TH								
I								
K								
L								
M								
N								
X(SH)								
O								
P								
S								
Q								
R								
S								
T								
U								
P-H								
KH								
PS								
δ								
* ADDL. CHARS:								

CHART SHOWING ILLUSTRATIONS OF DIFFERENT GREEK FORMS OF ALPHABETIC LETTERS AS DEVELOPED FROM THE MOABITE STONE SYMBOLS

them borrowed by the Phoenicians. The Egyptian view was revived in 1916 in a paper published in the *Journal of Egyptian Archaeology*, vol. iii. (1916) p. 1 ft., by Dr. Alan Gardiner. This paper deals with certain inscriptions discovered in 1906 by Sir W. Flinders Petrie in the Sinaitic peninsula, in which Dr. Gardiner sees a stage of writing intermediate between Egyptian hieroglyphic and the Semitic alphabet. The script appears to be fully alphabetic, and the date of the inscriptions is not later than 1500 B.C. These inscriptions have also been dealt with by Hans Bauer (*Zur Entzifferung der neuentdeckten Sinaitischen Schrift*, Halle, 1918), who is inclined to see in the script a prototype of the Semitic alphabets, independent of Egypt.

For a solution of the question the evidence of the four south Semitic alphabets must be considered. These are known as Sabaeen, Lihyanic, Thamudenic and Safahitic. Inscriptions in these south Semitic alphabets were discovered in considerable numbers during the course of the 19th century. Those in the Sabaeen alphabet come from the district of Yemen in south Arabia, the Lihyanic from El-Ola in the north of the Hejaz.

source older than either is that the names of the letters, as far as they have a known etymology or meaning, are Semitic. Hebrew *aleph*, *beth*, *gimel*, *daleth*, etc., correspond unmistakably with Greek *alpha*, *beta*, *gamma*, *delta*. The Semitic names are words in the Semitic languages. The Greek names are meaningless in Greek. It has indeed been argued that the Greek names were the original ones, meaningless, and taken in the first instance simply from the sounds represented by the letters; that the Phoenicians took over the alphabet together with the names from the Greeks and adapted the names by the process known as folk-etymology. But the Sinai inscriptions, discussed above, may be said to have rendered this theory untenable. If they do not represent a link between the hieroglyphic system of Egypt and the Phoenician alphabet, they represent a prototype of the latter, appearing at a date and at a place that render any theory of borrowing from Greek sources highly improbable. It is reasonably certain that the Greeks derived their alphabet from Semitic sources, taking over the names with the letters. The names are not identical. The Greek names end with a vowel—*alpha* for *aleph*, *beta* for *beth*, etc. The vocalization has been explained merely as being more in agreement with Greek morphology, but this is not a very definite or satisfactory explanation. Isaac Taylor had already pointed out in the *History of the Alphabet* (1883) vol. ii. p. 27 that the Greek forms are taken from Aramaic, Aramaic showing an emphatic form of the root which ends in a vowel and drops the vowel in the preceding syllable. He postulated two separate borrowings of the alphabet by Greeks, the earlier being the Chalcidic alphabet borrowed with the Babylonian system of weights and coinage from Aramaic peoples in the south-eastern extremity of Asia Minor, possibly through Lydia; the second the borrowing by the Ionians directly from Phoenician traders. The Aramaic names came with the first borrowing and were carried on and applied by the later borrowers. These two forms of the alphabet, Chalcidic and Ionic, generally known as western and eastern, represent two different borrowings, but we may probably rule out the theory of any direct borrowing from Phoenician sources. The tradition that this was so comes from Herodotus, who refers only to Boeotia, and it is probable that the name *Phoenices* was a vague term for eastern foreigners. The Achaeans were a naval power settled in the eastern Aegean in the 15th century B.C. There is therefore no difficulty in concluding that they borrowed the alphabet from peoples with whom they were in close contact in western and southern Asia Minor at a considerably earlier date than has hitherto been supposed; nor that, independent as Greek States were, there were separate borrowings and separate adaptations.

The chief adaptations made by the Greeks were the allocation of certain of the 22 Semitic letters to vowel-sounds, and the addition of certain letters. The oldest extant Greek inscriptions are those found in 1896 in the island of Thera, which date from the 8th, possibly even the 9th, century B.C., the inscriptions from Abu Simbel in Upper Egypt, dating from the 7th century, a Corinthian and an Athenian inscription of the 6th century. In Thera the oldest inscriptions are written from right to left, others are *βουστροφῆδον*, others still later read from left to right. In the Lydian alphabet, known to us by inscriptions found at Sardis in the beginning of the present century, these symbols also represent vowels. Most Greek States developed local variations either in the forms of certain letters, or in the representation of sounds not represented by any of the 22 letters taken over. The two main divisions, eastern and western, however, remain till the 4th century B.C., when in the main uniformity of alphabet was attained throughout Greece. The early inscriptions from Thera show a remarkably close resemblance to the forms of the Semitic alphabet as represented on the Moabite Stone or the Baal-Lebanon inscription from Cyprus. The alphabet of Abu-Simbel is of the Ionic type.

The two main divisions, eastern and western, again sub-divide into two, the cities of Asia Minor and the adjacent islands with their colonies using forms showing in some cases slight differences from those in use in the Cyclades and Attica. Again the alphabets of Megara, Corinth, Sicyon, Phlius and western Argolis with

their colonies differ from the west which includes Euboea, Boeotia, Phocis, Locris, Thessaly and the rest of the Peloponnese. Throughout all Greek alphabets the Semitic letters *aleph*, *he* and *ayin*, which represented breathings, were adapted to represent vowels. *Alpha* (*aleph*) was consistent throughout. The letter corresponding to Semitic *he* (later *epsilon*) represented both the short and long vowel *e* in those cases where *eta* represented the rough breathing. Generally speaking *eta* represented the vowel-sound in the eastern alphabet, the breathing in the western. Thus in the west the symbol *Ε* or *Ε* is used for the two sounds represented in Attic by *ε* and *η*; in the east it more usually represents the short vowel alone. In addition to this, however, it is occasionally used throughout to represent the long close *ē* (the long *ē* represented by *eta* was open), which in Attic is written as if it were a diphthong, *eu*. The Corinthian alphabet is peculiar in using (up to the 6th century and later in outlying regions) the sign *Β* or *Β* to represent *e*, the long close vowel being written *ΒΣ*. Sicyon uses a symbol with the form *Σ*. Semitic *cheth*, Greek *eta*, was

CHALCIDIC	ETRUSCAN	UMBRIAN	OSCAN	FALISCAN	LATIN
Α Δ Α	Α	Α Α	Ν	Я	Α Λ Α
Β	Β Β Β	Β	Β		Β Β
Γ Λ	Γ < Γ		>	⊃	< Γ Γ
Δ Δ Δ	Δ Δ	Δ	Я	Δ	Δ Δ
Ε Ε Ε	Ε Ε Ε	Ε Ε	Ε	Ε	Ε
Ζ	Ζ Ε Ζ	Ζ Ζ	Ζ	↑	Ζ
	Ι	≠ ↓	Ι	≠	
Θ Η	Θ Θ	Θ	Θ	Θ Η	Η
⊗ ⊕	⊗ ⊕	⊙			
Ι	Ι	Ι	Ι Ι	Ι	Ι
Κ Κ	Κ Κ	Κ	Κ		Κ
Λ Λ	Λ Λ	Λ	Λ	Λ Λ Λ	Λ Λ
Μ	Μ Μ	Μ Λ	Μ	Μ	Μ
Ν Ν	Ν Ν	Ν Λ	Ν	Ν	Ν Ν
+	Θ Θ				
Ο	Ο Ο			Ο	Ο
Ρ Ρ	Ρ Ρ	Ι	Π	Ρ Ρ	Ρ Ρ
	Μ Μ	Μ			
Φ	Φ				Φ Φ
Ρ Ρ Ρ	Δ Ρ	Δ	Δ	Я	Ρ Ρ Ρ
Σ Σ Σ	Σ Σ	Σ	Σ	Σ Σ	Σ Σ
Τ	Τ Τ	Χ	Τ	Τ Τ	Τ
Υ Υ	Υ	Υ	Υ	Υ	Υ Υ
	Χ			Χ	Χ
Φ	Φ				
Ψ	Υ				

CHART SHOWING VARIOUS ROMAN FORMS OF THE ALPHABET

used, as we have seen, in the east generally speaking as a vowel, in the west as the rough breathing. In the Thera inscriptions, it occurs in both capacities. The semi-vowel *j* (resembling the sound of English initial *y*) had disappeared from the Greek language in prehistoric times, degenerating into a rough breathing, so that Semitic *yod* was adapted in Greek to represent the vowel *i* (iota). *Koppa* (Ϟ) had disappeared in the eastern alphabets by the 5th century B.C., its place being usurped by *kappa* (κ),

but it lingered in the west and was introduced into the Italic alphabets, as we shall see.

The origin of the *digamma* (F, representing the *w* sound) is obscure. *Vau*, the sixth letter of the Semitic alphabet, was taken by the Greeks for use as a vowel, exactly as they had taken *yod*, and placed at the end of the alphabet following *tau*. But whereas the consonantal *i*-sound did not exist in Greek, the consonantal

The usual manner of expressing this combination in the Aegaeon islands was **XS**. The letter **X**, which often appears in the west as **+**, may be a direct descendant of **Ξ** (*samech*), and quite independent of **X** or **+**, the 26th letter of the Greek alphabet, the origin of which is unknown. The sibilant *s* was expressed by two separate symbols, **Μ** and **Σ** or **Ξ**, the one descended from Semitic *ssade*, the other from Semitic *san*. Both do not appear in the same alphabet. **Μ** appears in Crete, Thera and Melos, in Phocis in the 6th century, elsewhere only in the Peloponnese and its colonies. In two 5th century inscriptions from Teos and Halicarnassus a form **T** appears with the value *σσ*. The unvoiced velar aspirate was expressed by a form **X** or **+**, which became the 26th letter of the alphabet in practically all alphabets except in the western group. The same form was used in the west for the *x*-sound, and here it was probably a descendant of Semitic *samech* **Ξ**. In the west where **X** was used for the *x*-sound and not for the unvoiced velar aspirate (*kh*, **X**), the latter was expressed by a symbol **ψ**. In Boeotia we actually find **ψ** used in combination with **Σ** to represent the *x*-sound, a fact that suggests that there was some consciousness that it was used in the west as a substitute for eastern **X**. **ψ** is used singly to express the *x*-sound in Thera and Melos. In the east, where **X** expressed the *kh*-sound, **ψ** was used (sometimes with the form **ψ**) to express the combination *ps*, a use in which it was later standardized by the spread of the Ionic alphabet.

Other symbols not derived from Semitic were (i.) **Φ** (*phi*) used to express the unvoiced labial aspirate (*ph*) and (ii.) **Ω** the last letter of the Greek alphabet, probably differentiated from **O**. In the west this symbol appears very seldom. In the east it represents the long open *o*. In the Cyclades curiously enough it frequently expresses the close vowel, whether long or short (*o* or *ou*) while **O** represents the open sound.

The origin of the symbols **Φ** and **ψ** is unknown. In the case of **X** or **+** it is probable that we should differentiate **X** derived from **Ξ** and standing for *x* from **X** standing for *kh*. The origin of the latter is however obscure. It is possible that these signs were adapted in Asia Minor from the Cypriote syllabary.

Various local alphabets were in use in Asia Minor that were parallel to the Greek. The Lydian alphabet for instance is known to us from inscriptions dating from the 4th century B.C. A few of these were discovered in the last century, 36 were found by an American expedition in Sardis between the years 1910 and 1913, the rest by J. Keil and von Premerstein in various parts of ancient Lydia between 1906 and 1912. The alphabet consisted of 26 symbols. The parallelism with the Greek and Semitic alphabets is clear, but there are additional symbols the sound of some of which is uncertain in the absence of a completely certain interpretation of the language of the inscriptions. The most interesting fact about this alphabet is the identity of the symbol for *f* **8** with the Etruscan symbol for the same sound.

The western Greek or Chalcidian alphabet was brought to Italian soil by the Greek colonies of Magna Graecia, and until recently it was confidently held that the Latin alphabet, the parent of our own, was derived from this Chalcidic alphabet by contact with the Greek colonies of southern Italy. Too little was made of the influence of Etruria because too little was known of that country and its people. Six Italic alphabets have come down to us. These are the Latin, Faliscan, Etruscan, Umbrian, Oscan and Messapian. The Messapian is purely Greek in origin and was used by a people who were isolated in Calabria and spoke an Illyrian dialect. The Umbrian and Oscan alphabets are derived from the Etruscan. The district in which the Umbrian alphabet was used was east of the Apennines. The Oscan was in Campania. Thus the Latin and Faliscan alphabets were bounded on all three sides by the Etruscan and alphabets derived from it. In these circumstances Etruscan must have exercised a strong influence upon the Latin alphabet, following the impact of Etruscan civilization upon Roman in other directions.

The Etruscan alphabet is known to us from certain tomb inscriptions, from part of an Etruscan book that was used as the

TABLE V.

SABAEAN	BRAHMI	KHAROSTHI	ARAMAIC	NASHKI	HEBREW	PALMYRA	MOD. EUROPEAN
א	𐤀	𐤁	𐤂	𐤃	א	𐤄	A
ב	𐤅	𐤆	𐤇	ב	ב	𐤅	B
ג	𐤈	𐤉	𐤊	ג	ג	𐤈	G
ד	𐤋	𐤌	𐤍	ד	ד	𐤋	D
ה	𐤎	𐤏	𐤐	ה	ה	𐤎	D
ו	𐤑	𐤒	𐤓	ו	ו	𐤑	E
ז	𐤔	𐤕	𐤖	ז	ז	𐤔	F(w)
ח	𐤗	𐤘	𐤙	ח	ח	𐤗	Z
ט	𐤚	𐤛	𐤜	ט	ט	𐤚	H
י	𐤝	𐤞	𐤟	י	י	𐤝	TH
כ	𐤠	𐤡	𐤢	כ	כ	𐤠	I
ל	𐤣	𐤤	𐤥	ל	ל	𐤣	K
מ	𐤦	𐤧	𐤨	מ	מ	𐤦	L
נ	𐤩	𐤪	𐤫	נ	נ	𐤩	M
ס	𐤬	𐤭	𐤮	ס	ס	𐤬	N
ע	𐤯	𐤰	𐤱	ע	ע	𐤯	X(SH)
פ	𐤲	𐤳	𐤴	פ	פ	𐤲	O
צ	𐤵	𐤶	𐤷	צ	צ	𐤵	P
ק	𐤸	𐤹	𐤺	ק	ק	𐤸	S
ר	𐤻	𐤼	𐤽	ר	ר	𐤻	S
ש	𐤾	𐤿	𐥀	ש	ש	𐤾	Q
ת	𐥁	𐥂	𐥃	ת	ת	𐥁	R
י	𐥄	𐥅	𐥆	י	י	𐥄	S
כ	𐥇	𐥈	𐥉	כ	כ	𐥇	T
ל	𐥊	𐥋	𐥌	ל	ל	𐥊	T

COMPARISON OF THE INDIAN AND SEMITIC FORMS OF THE ALPHABET

u-sound (akin to *w*) survived till classical times in certain dialects and needed a symbol to represent it. Thus the *digamma* took the place of *vau* in the order of the alphabet, but opinions differ as to whence it derived its form. Some hold that it was differentiated from the preceding letter by the omission of one of the horizontal strokes, others that it descends from *vau* (Y). The latter view is rendered less difficult by the fact that **N** occurs as a form of the digamma from Oaxos in Crete. In the absence of further evidence it is impossible to reach any definite conclusion.

The treatment of the sibilants of the Semitic alphabet by the Greeks is complicated. *Zain* was taken over as *zeta*, though its pronunciation in early times is not certain and may have varied throughout the dialects between *dž*, *dz*, *ž* and *z*. The 15th letter of the Semitic alphabet was *Samech* the name of which through its Aramaic form *simcha* became in Greek by metathesis *sigma*. The name, however, was transposed to the 21st letter, which in Semitic was *san*. The letter itself was retained in the eastern or Ionic alphabet with the value *ks* (ξ). In Thera, however, in early times it has the value of *ss*, *x* or *ks*, being expressed by **KM**.

The Latin alphabet of 23 letters (including **Y** and **Z** became extended during the course of the middle ages to our own of 26 by the division of **I** into *i* and *j* and the tripartite division of **V** into *u*, *v* and *w*. *J* developed in the 15th century as an initial (more or-

It only remains to consider briefly certain alphabets which derived from the same source as our own. The alphabets of India are offshoots of the stem. All derive from two sources, *Kharosthi* and *Brahmi*. Though attempts have been made to show that the Brahmi alphabet was developed in India itself without connection with outside sources, this contention cannot be maintained. It has a manifest kinship with the Semitic alphabets. Its origin is obscure; but there seems little doubt that it derives from the south Semitic group of alphabets through contact with Sabataean

[illegible]

The alphabets in use in Persia, at least from the time of the

Arsacid dynasty onwards, are based upon the Aramaic. Cuneiform was the writing of the Achaemenid empire, but after the Greek conquest Aramaic was introduced and became general. The Pahlavi is the alphabet of the Sassanid kings. The Arsacid and Sassanian alphabets are found together in the liturgical inscription of Hadji-abad, as well as in the Paikuli inscription dating from about 300 B.C. Ernst Herzfeld dates the commencement of Pahlavi in the time of Darius the Great (vd. *Paikuli* p. 73).

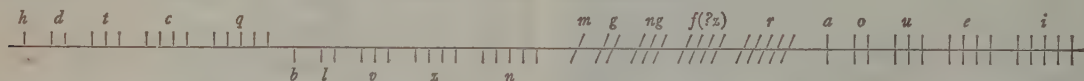
Modern Arabic writing has developed from a form of Aramaic used in the land of the Nabataeans, an Arabian people. The oldest record of it now extant is a stèle from Tema, in north-west Arabia, dating from the 5th century B.C. or perhaps earlier. Later inscriptions, known as Nabataean, belong to the period between 9 B.C. and A.D. 75. The *graffiti* on the rocks of Mount Sinai carry the record of the development of this alphabet down to the 3rd century A.D. In the early Mohammedan period two types of Arabic writing existed, known as the *Cufic* and the *nashki*. The former was discontinued except for formal purposes, where cursive writing could not be employed. The *nashki* is the parent of modern Arabic writing, in which many characters have become so similar owing to the degeneration of the cursive script that it is necessary to distinguish them by diacritical points. The Christians of northern Syria employed a form of Arabic alphabet, known as Estrangelo, and this was taken by Nestorian missionaries into central Asia, becoming the ancestor of a great number of alphabets which spread as far east as Manchuria.

The earliest records of Aramaic go back to about 800 B.C. and were found at Sindjirli in northern Syria. The alphabet at this time differs little from that of the Moabite Stone. Aramaic became by far the most important and widespread of the north Semitic alphabets. It was used in Assyria as a cursive script side by side with cuneiform. It is marked by two distinct tendencies: (i.) the opening of the heads of the letters, *beth* (𐤁) becoming *y*, *daleth* (𐤃) *y* and *resh* (𐤅) *y*. *o* became *u*, then *v*; (ii.) angles became rounded and ligatures developed. These tendencies were completed during the Persian period, and they are emphasized in the Aramaic writing on papyrus employed in Egypt between 500 and 200 B.C. Other developments of Ara-

Greek, and an Armenian Christian literature thus arose. It is likely that the origin is Greek, a few Persian characteristics that appear being due to the influence of the dominating power.

In all Teutonic countries are found inscriptions in the alphabet known as Runic. The affinities of this alphabet with the Greek are apparent, but there has been dispute as to whether it is derived directly from Greek or through an Italic alphabet. The strongest argument in favour of a Latin derivation is the fact that the value of the letter *W* is *f*, not *w*. L. F. A. Wimmer in his book *Die Runenschrift* (1887) contended strongly for a Latin origin. He believed that the Runes developed from the Latin alphabet at the end of the 2nd century A.D. This can scarcely be the case however, for the Romans had been in contact with the Germanic tribes for some time before this date, and the alphabet, if borrowed from them, would thus have been borrowed sooner. Again many Runic inscriptions are written from right to left or *βουστrophηδόν* and this would have been impossible had the alphabet been borrowed from one uniformly written from left to right. Others have concluded with more probability that the Runes are derived directly from a western Greek alphabet resembling that which appears on the Formello abcdaria. It is possible that knowledge of such an alphabet reached northern Europe from Italy through the medium of Etruscan traders. This might account for the value of *W*; Isaac Taylor's view was that the alphabet was derived from a Greek colony on the Black Sea about 600 B.C. Of the two views this is perhaps the more probable. It may even be that the alphabet was derived in the region of the Black Sea not directly from a Greek, but from an Asianic source, closely parallel with the Greek developments, as we have already seen the Etruscan alphabet probably to have had its origin. There is some, but not conclusive, evidence that the alphabet was borrowed previous to the Teutonic sound-shift.

An outcome of the Runic alphabet was the cryptographic Ogham writing employed by Celtic peoples in Britain and Ireland (see OGHAM LANGUAGE). In this the several letters of the alphabet were represented by strokes differing in number (from one to five) and in position on either side, or on both sides, of a straight horizontal line.



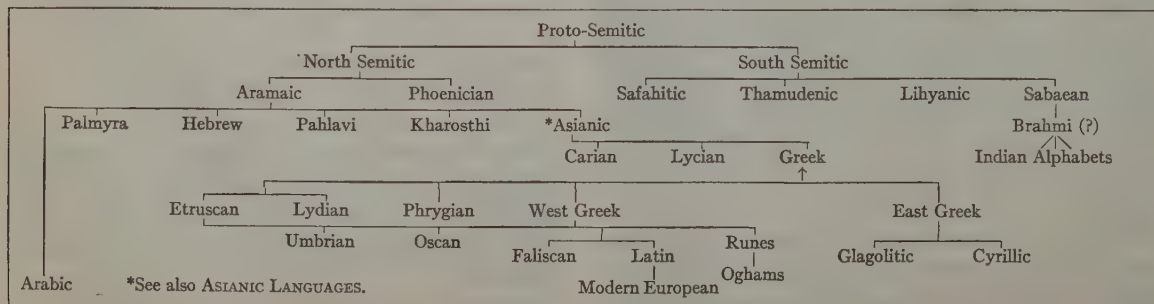
maic are modern square Hebrew and the alphabet of Palmyra.

A group of alphabets arose in Asia Minor during the first half of the first millennium B.C. deriving from a common source, probably an early stage of Aramaic. The Greek alphabet in its two varieties was one of these. The Carian alphabet was another, as also the Lycian. These both seem parallel to Greek, not offshoots of it. The Phrygian on the other hand seems to be derived from the Greek, and from the western variety.

The Armenian alphabet owes its origin to Bishop Mesrob late in the 4th century A.D. Both an Iranian and a Greek origin have been claimed for it, Isaac Taylor contending for the former, Gardthausen and Hübschmann for the latter. The country had been divided between Persia and the Byzantine empire. The larger share fell to the Persians who discouraged the study of

The date of these inscriptions in Wales is the 5th and 6th centuries A.D.

Finally must be mentioned the two Slavonic alphabets, Cyrillic and Glagolitic, both according to tradition the invention of Cyril, the missionary to the Slavs, in the 9th century A.D. Each is taken from the Greek alphabet of that period, Glagolitic from the cursive writing, Cyrillic from uncial, when the value of *B* had become the spirant *v*, that of *H* *i*, of *Φ* *f* and of *Σ* the sound of Scotch *ch*. Several additional symbols were invented to express those sounds of the Slavonic language which could not be comprised within the compass of the Greek alphabet. Glagolitic survived in Croatia till the 17th century. Cyrillic has for long been the alphabet in which the Slavonic languages are normally expressed.



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(B. F. C. A.)

ALPHA PARTICLES, also called α -rays, the positively charged particles that are ejected by certain radioactive substances. (See RADIOACTIVITY, ARTIFICIAL; RADIOACTIVITY, NATURAL.) They are helium atoms (see ATOM) which have lost two electrons (see ELECTRON) and are identical with doubly ionized helium, which is produced by an electric discharge through this gas. (See POSITIVE RAYS and ELECTRICITY, CONDUCTION OF: Conduction in Gases.)

'AL-PHASI, ISAAC (1013-1013), Jewish rabbi and codifier, known as *Riph*, was born near Fez, and died at Lucena. He settled in Spain. His fame rests on his Talmudical digest, which omitted all homiletical passages and also passages relating to religious duties practicable only in Palestine. He occupies an important place in the development of the Spanish method of studying the Talmud. As opposed to the French rabbis, the Spanish sought to simplify the Talmud, and to free it from casuistical detail. His digest was the forerunner of the great codes of Maimonides and of Joseph Oaro.

ALPHEGE (AELFHEAH), ST. (954-1012), archbishop of Canterbury. He was a monk at Deerhurst, and then became an anchorite at Bath. His piety and austerities led to his election as abbot. In 984 he was appointed through Dunstan's influence to the bishopric of Winchester, and in 1006 he succeeded Aelfric as

archbishop of Canterbury. At the sack of Canterbury by the Danes in 1011 Aelfheah was captured and kept in prison for seven months. Refusing to pay a ransom he was barbarously murdered at Greenwich on April 19, 1012. He was buried in St. Paul's, whence his body was removed by Canute to Canterbury with all the ceremony of a great act of state in 1023.

Lives of St. Alphege in prose (which survives) and in verse were written by command of Lanfranc by the Canterbury monk Osbern (d. c. 1090).

ALPHEUS ($\Lambda\lambda\phi\epsilon\upsilon\omicron\varsigma$; mod. *Ruphia*), the chief river of Peloponnesos. The Alpheus proper rises near Asea in central Arcadia, but its passage thither by subterranean channels from the Tegean plain, and its union with the Eurotas, are probably mythical (W. Loring, *Journ. Hell. Studies*, vol. xv, p. 67). The shallow and rapid stream occupies but a small part of its broad, stony bed. Leaving the plain of Megalopolis by a rugged gorge, it receives above Olympia two large tributaries, Erymanthus and Ladon, from the northeast and empties itself into the Ionian sea. Strictly, *Ruphia* is the modern name for the Ladon, but the name has been given to the whole river. Pliny states that it was navigable for 6 Roman mi. from its mouth. Alpheus was recognized as the typical river-god in the Peloponnesos, as was Achelous (*q.v.*) in northern Greece.

His waters were said to pass beneath the sea and rise again in the fountain Arethusa at Syracuse.

ALPHONSE I (1103-1148), count of Toulouse, son of Raymond IV by his third wife, Elvira of Castile, was born in the castle of Mont-Pelerin at Tripoli in the Lebanon and was surnamed Jourdain, having been baptized in the Jordan. He was taken to France in 1107 by William V of Montpellier; and in 1112, on the death of his brother Bertrand, he succeeded to the whole countship of Toulouse and marquisate of Provence, which had been first divided between Bertrand and him. But Toulouse was taken from him by William IX, duke of Aquitaine, in 1114; and for a number of years Alphonse had to live in Provence. He recovered part of his county in 1119 and continued to fight for his possessions until 1123, when Toulouse was reconquered. He next fought for the sovereignty of Provence against Raymond Berengar I (III of Barcelona) and, by a peace reached in Sept. 1125, became master of Haute-Provence. He occupied Narbonne in 1134 and held it till 1143.

Alphonse did much to quell his troublesome vassals and to protect the towns (charters of 1141 and 1147 to Toulouse); his great work was the founding of Montauban (1144). In Spain he arbitrated several times between princes. In 1141 he was attacked by Louis VII, who besieged Toulouse, on the pretext of rights due to his wife, Eleanor of Aquitaine. Alphonse was twice excommunicated, but took the cross in 1146 at Vézelay and embarked for the east in Aug. 1147, reaching Acre in 1148. He was poisoned at Caesarea in April 1148, at the instigation either of Eleanor or of the mother of the king of Jerusalem.

ALPHONSE (1200-1271), count of Poitiers and Toulouse, the son of Louis VIII, king of France, and brother of St. Louis, was born on Nov. 11, 1220. He joined the county of Toulouse to his appanage of Poitou and Auvergne on the death, in Sept. 1249, of Raymond VII, whose daughter Joan he had married in 1237. He took the cross with his brother, St. Louis, in 1248 and 1270. On the death of his mother, Blanche of Castile, in 1252 he became joint regent with Charles of Anjou until the return of St. Louis and took a great part in the negotiations which led to the treaties of Abbeville and of Paris (1258-59). His main work was on his own estates. There he repaired the evils of the Albigenian war; created and developed privileged settlements known as *bastides* (*q.v.*); kept a suspicious eye on the towns, in which he endeavored to maintain the social peace; and from Paris superintended a rather numerous administrative staff, thus preparing the way for union with the crown. He died without heirs on his return from the eighth crusade, in Italy, probably at Savona, on Aug. 21, 1271.

See A. Molinier, ed., *Correspondance administrative d'Alphonse de Poitiers*, 2 vol. (Paris, 1884-1900).

ALPHONSINE TABLES, astronomical tables produced at Toledo in 1252 by 50 astronomers under the patronage of Alfonso (Alfonso) X of Castile.

ALPHONSO, the common English spelling of Affonso, Alonso and Alfonso, which are respectively the Galician, the Leonese, and the Castilian forms of Ildefonso (Ildefonsus), the name of a saint and archbishop of Toledo in the 7th century. The name has been borne by a number of Portuguese and Spanish kings.

ALPHONSO I. (1104-1134), King of Aragon, is sometimes counted the seventh in the line of the kings of Leon and Castile. A passionate fighting-man (he fought 29 battles against Christian or Moor), he was married to Urraca, widow of Raymond of Burgundy, a very dissolute and passionate woman. The marriage had been arranged by Alphonso VI., in 1106, to unite the two chief Christian states against the Almoravides, and to supply them with a capable military leader. But Urraca was tenacious of her right as proprietary queen, and had not learnt chastity in the polygamous household of her father. Husband and wife quarrelled with the brutality of the age, and came to open war. Alphonso had the support of one section of the nobles who found their account in the confusion. Being a much better soldier than any of his opponents he gained victories at Sepúlveda and Fuente de la Culebra, but his only trustworthy supporters were his Aragonese, who were not numerous enough to keep down Castile and Leon. The marriage of Alphonso and Urraca was declared null by the pope, as they were third cousins. The king quarrelled with the Church, and particularly with the Cistercians, almost as violently as with his wife. As he beat her, so he drove Archbishop Bernard into exile and expelled the monks of Sahagun. He was finally compelled to give way in Castile and Leon to his stepson, Alphonso, son of Urraca and her first husband. The intervention of Pope Calixtus II. brought about an arrangement between the old man and the young. Alphonso the Battler won his great successes in the middle Ebro, where he expelled the Moors from Saragossa; in the great raid of 1125, when he carried away a large part of the subject-Christians from Granada; and in the south-west of France, where he had rights as king of Navarre. Three years before his death he made a will leaving his kingdom to the Templars, the Hospitallers, and the Knights of the Sepulchre; this his subjects refused to carry out. He was a fierce soldier and nothing else; his piety was wholly militant; but, though he died in 1134 after losing to the Moors at Braga, he has a great place in the reconquest.

ALPHONSO II., King of Aragon (1162-1196) was the son of Raymond Berenger, count of Barcelona, and of Petronilla, niece of Alphonso the Battler, and daughter of Ramiro, surnamed the Monk. He succeeded to the county of Barcelona in 1162 on the death of his father, at the age of 11, and in 1164 his mother renounced her rights in Aragon in his favour. Though christened Ramon (Raymond), the favourite name of his line, he reigned as Alphonso out of a wish to please his Aragonese subjects, to whom the memory of the Battler was dear. As king of Aragon he took a share in the work of the reconquest, by helping his cousin, Alphonso VIII. of Castile, to conquer Cuenca, and to suppress one Pero Ruiz de Azagra, who was endeavouring to carve out a kingdom for himself in the debatable land between Christian and Mohammedan. But his double position as ruler, both north and south, of the eastern Pyrenees, distracted his policy. In character and interests he was rather Provençal than Spanish, no enemy of the Albigensian heretics, a favourer of the troubadours and himself a poet in the southern French dialect.

ALPHONSO III. of Aragon (1285-1291), the insignificant son of the notable Peter III., succeeded to the Spanish and Provençal possessions of his father, but his short reign did not give him time even to marry. His inability to resist the demands of his nobles and his recognition of their right to rebel in the articles called the Union helped to make anarchy permanent in Aragon.

ALPHONSO IV. of Aragon (1327-1336) was a weak man whose reign was insignificant.

ALPHONSO V. of Aragon (1416-1458), surnamed the Magnanimous, who represented the old line of the counts of Barcelona only through women, and was, on his father's side, descended from the Castilian house of Transtamara, is one of the most conspicuous figures of the early Renaissance. No man of his time had a larger share of the quality called by the Italians of the day "virtue." By

hereditary right king of Sicily, by the will of Joanna II. and his own sword king of Naples, he fought and triumphed amid the exuberant development of individuality which accompanied the revival of learning and the birth of the modern world. When a prisoner in the hands of Filippo Maria Visconti, duke of Milan, in 1435, Alphonso persuaded his ferocious and crafty captor to let him go by making it plain that it was the interest of Milan not to prevent the victory of the Aragonese party in Naples. Like a true prince of the Renaissance he favoured men of letters, whom he trusted to preserve his reputation to posterity. His devotion to the classics was exceptional even in that time. He halted his army in pious respect before the birthplace of a Latin writer, carried Livy or Caesar on his campaigns with him, and his panegyrist Panormita did not think it an incredible lie to say that the king was cured of an illness by having a few pages of Quintus Curtius read to him. The classics had not refined his taste, for he was amused by setting the wandering scholars, who swarmed to his court, to abuse one another in the indescribably filthy Latin scolding matches which were then the fashion. Alphonso founded nothing, and after his conquest of Naples in 1442 ruled by his mercenary soldiers, and no less mercenary men of letters. His Spanish possessions were ruled for him by his brother John. He left his conquest of Naples to his bastard son Ferdinand, his inherited lands, Sicily and Sardinia, going to his brother John.

ALPHONSO I. (1094-1185), the first of the PORTUGUESE KINGS, son of Henry of Burgundy, count of Portugal, and Teresa of Castile, succeeded his father in 1112, and was placed under the tutelage of his mother. Being proclaimed sole ruler of Portugal in 1128, he defeated his mother's troops near Guimaraes, making her at the same time his prisoner. He also vanquished Alphonso Raymond of Castile, his mother's ally, and thus freed Portugal from dependence on the crown of Leon. Next turning his arms against the Moors, he obtained, on July 26, 1139, the victory of Ourique, and immediately after was proclaimed king by his soldiers. He assembled the Cortes of the kingdom at Lamego, where he received the crown from the archbishop of Braganza; the assembly also declared that Portugal was no longer a dependency of Leon. Alphonso wrested from the Moors Santarem in 1146, and Lisbon in 1147. Some years later he became involved in a war that had broken out among the kings of Spain; and in 1167 he was made prisoner by the soldiers of the king of Leon, and was obliged to surrender as his ransom almost all the conquests he had made in Galicia. In 1184, in spite of his great age, he had still sufficient energy to relieve his son, Sancho, who was besieged in Santarem by the Moors. He died shortly after, in 1185. Alphonso was a man of gigantic stature, being, according to some authors, 7 ft. tall. He is revered as a saint by the Portuguese, both on account of his personal character and as the founder of their kingdom.

ALPHONSO II., "the Fat" (1185-1223), succeeded his father, Sancho I. in 1211. He gained a victory over the Moors at Alcácer do Sal in 1217. He was excommunicated by Honorius III. for trying to seize part of the Church revenues for public purposes.

ALPHONSO III. (1210-1279), son of Alphonso II., succeeded his brother, Sancho II., in 1248. Besides making war upon the Moors, he was, like his father, frequently embroiled with the Church. In his reign Algarve became part of Portugal.

ALPHONSO IV. (1290-1357) succeeded his father, Dionis, whose death he had hastened by his intrigues and rebellions, in 1325. Alphonso connived at the barbarous murder of Inez de Castro, who had secretly married his son, Peter. In revenge Peter devastated the whole of the country between the Douro and the Minho before he was reconciled to his father.

ALPHONSO V., "Africano" (1432-1481) succeeded his father, Edward, in 1438. During his minority he was placed under the regency, first of his mother, and latterly of his uncle, Dom Pedro. In 1448 he assumed the government and married Isabella, Dom Pedro's daughter. Next year, being led by what he afterwards discovered to be false representations, he declared Dom Pedro a rebel and defeated his army in a battle at Alfarrobeira, in which his uncle was slain. In 1458, and with more numerous forces in 1471, he invaded the territories of the Moors in Africa and by his successes there acquired his surname of "the African." On his

return to Portugal in 1475 he invaded Castile, where two princesses were disputing his succession to the throne. Alphonso was betrothed to the princess Juana, and was proclaimed king of Castile and Leon; but in 1476 he was defeated at Toro by Ferdinand, the husband of Isabella of Castile. He sought in vain the assistance of Louis XI., and was compelled to abdicate in favour of his son John. John refused the crown, and Alphonso ruled for two years longer. He then retired into a monastery at Cintra.

ALPHONSO VI. (1643-1683), the second king of the house of Braganza, succeeded his father in 1656. In 1667 he was compelled by his wife and brother to abdicate, and was banished to the island of Terceira. These acts, which the vices of Alphonso had rendered necessary, were sanctioned by the Cortes in 1668.

ALPHONSO I. (739-757), the first of the Kings of Spain, is said to have married Ormesinda, daughter of Pelayo, who was raised on the shield in Asturias as king of the Goths after the Arab conquest. He is also said to have been the son of Peter, duke of Cantabria. It is not improbable that he was, in fact, an hereditary chief of the Basques, but no contemporary records exist. His title of "the Catholic" itself may very well have been the invention of later chronicles.

ALPHONSO II. (789-842), his reputed grandson, bears the name of "the Chaste." The Arab writers who speak of the Spanish kings of the north-west as the Beni-Alfons, appear to recognize them as a royal stock derived from Alphonso I. The events of his reign are in reality unknown. Poets of a later generation invented the story of the secret marriage of his sister Ximena with Sancho, count of Saldaña, and the feats of their son, Bernardo del Carpio. Bernardo is the hero of a *cantar de gesta* (*chanson de geste*) written to please the anarchical spirit of the nobles.

The first glimmerings of mediaeval Spanish history begin with ALPHONSO III. (866-914) surnamed "the Great." Of him nothing is really known except the bare facts of his reign, and of his comparative success in consolidating the kingdom known as "of Galicia," or "of Oviedo," during the weakness of the Omayyad princes of Cordova. ALPHONSO IV. (924-931) has a faint personality. He resigned the crown to his brother, Ramiro, and went into a religious house. A certain instability of character is revealed by the fact that he took up arms against Ramiro, having repented of his renunciation of the world. He was defeated, blinded, and sent to die in the cloister of Sahagun. It fell to ALPHONSO V. (999-1028) to begin the work of reorganizing the Christian kingdom of the northwest after a most disastrous period of civil war and Arab inroads. Enough is known of him to justify the belief that he had some of the qualities of a soldier and a statesman. His name, and that of his wife Geloria (Elvira), are associated with the grant of the first franchises of Leon. He was killed while besieging the town of Viseu in northern Portugal, then held by the Mohammedans. (See also SPAIN: *From A.D. 406 to the Conquest of Granada.*)

With ALPHONSO VI. (1065-1109) we come to a sovereign of strong personal character. Much romance has gathered round his name. In the *cantar de gesta* of the Cid he plays the part attributed by mediaeval poets to the greatest kings, to Charlemagne himself. He is alternately the oppressor and the victim of heroic and self-willed nobles—the idealized types of the patrons for whom the jongleurs and troubadours sang. (See SPAIN: *From A.D. 406 to the Conquest of Granada.*) He is the hero of a *cantar de gesta* which, like all but a very few of the early Spanish songs, e.g., the *cantar* of Bernardo del Carpio, and the *Infantes* of Lara, exists now only in the fragments incorporated in the chronicle of Alphonso the Wise, or in ballad form. His flight from the monastery of Sahagun, where his brother Sancho endeavoured to imprison him, his chivalrous friendship for his host Almamun of Toledo, *caballero aunque mon*, a gentleman although a Moor, the passionate loyalty of his vassal, Peranzules, and his brotherly love for his sister, Urraca of Zamora, may owe something to the poet who took him for hero. They are the answer to the poet of the nobles who represented the king as having submitted to take a degrading oath at the hands of Ruy Diaz of Bivar (the Cid), in the church of Santa Gadea at Burgos, and as having then persecuted the brave man who defied him. When every allowance is made, Alphonso VI. stands out as a strong man fighting for his own hand, which in his

case was the hand of the king whose interest was law and order, and who was the leader of the nation in the reconquest. On the Arabs he impressed himself as an enemy very fierce and astute, but as a keeper of his word. A story of Mohammedan origin, which is probably no more historical than the oath of Santa Gadea, tells of how he allowed himself to be tricked by Ibn Ammar, the favourite of Al Motamid, the king of Seville. They played chess for an extremely beautiful table and set of men, belonging to Ibn Ammar. Table and men were to go to the king if he won. If Ibn Ammar gained he was to name the stake. The latter did win and demanded that the Christian king should spare Seville. Alphonso kept his word. Whatever truth may lie behind the romantic tales of Christian and Mohammedan, we know that Alphonso represented in a remarkable way the two great influences then shaping the character and civilization of Spain. At the instigation, it is said, of his second wife, Constance of Burgundy, he brought the Cistercians into Spain, established them in Sahagun, chose a French Cistercian, Bernard, as the first archbishop of Toledo after the reconquest in 1085, married his daughters, legitimate and illegitimate, to French princes, and in every way forwarded the spread of French influence—then the greatest civilizing force in Europe. He also drew Spain nearer to the papacy, and it was his decision which established the Roman ritual in place of the old missal of Saint Isidore—the so-called Mozarabic. On the other hand he was very open to Arabic influence. He protected the Mohammedans among his subjects and struck coins with inscriptions in Arabic letters. After the death of Constance he perhaps married, and he certainly lived with Zaida, said to have been a daughter of "Benabet" (Al Motamid), Mohammedan king of Seville. Zaida, who became a Christian under the name of Maria or Isabel, bore him the only son among his many children, Sancho, whom Alphonso designed to be his successor, but who was slain at the battle of Uclés in 1108. Women play a great part in Alphonso's life.

ALPHONSO VII., "the Emperor" (1126-1157), is a dignified and somewhat enigmatical figure. A vague tradition had always assigned the title of emperor to the sovereign who held Leon as the most direct representative of the Visigoth kings, who were themselves the representatives of the Roman empire. But though given in charters, and claimed by Alphonso VI. and the Battler, the title had been little more than a flourish of rhetoric. Alphonso VII. was crowned emperor in 1135, after the death of the Battler. The weakness of Aragon enabled him to make his superiority effective. He appears to have striven for the formation of a national unity, which Spain had never possessed since the fall of the Visigoth kingdom. The elements he had to deal with could not be welded together. Alphonso was at once a patron of the Church and a protector if not a favourer of the Mohammedans, who formed a large part of his subjects. His reign ended in an unsuccessful campaign against the rising power of the Almohades. Though he was not actually defeated, his death in the Pass of Muradel in the Sierra Morena, while on his way back to Toledo occurred in circumstances which showed that no man could be what he claimed to be—"king of the men of the two religions." His personal character does not stand out with the emphasis of those of Alphonso VI. or the Battler. Yet he was a great king, the type and, to some extent, the victim of the confusions of his age—Christian in creed and ambition, but more than half oriental in his household.

ALPHONSO VIII. (1158-1214), king of Castile only, and grandson of Alphonso VII., is a great name in Spanish history, for he led the coalition of Christian princes and foreign crusaders which broke the power of the Almohades at the battle of the Navas de Tolosa in 1212. The events of his reign are dealt with under SPAIN. His personal history is that of many mediaeval kings. He succeeded to the throne on the death of his father, Sancho, at the age of a year and a half. Though proclaimed king, he was regarded as a mere name by the unruly nobles to whom a minority was convenient. The devotion of a squire of his household, who carried him on the pommel of his saddle to the stronghold of San Esteban de Gormaz, saved him from falling into the hands of the contending factions of Castro and Lara, or of his uncle, Ferdinand of Leon, who claimed the regency. The loyalty of the town of Avila pro-

tected his youth. He was barely 15 when he came forth to do a man's work by restoring his kingdom to order. It was only by a surprise that he recovered his capital, Toledo, from the hands of the Laras. His marriage with Leonora of Aquitaine, daughter of Henry II. of England, brought him under the influence of the greatest governing intellect of his time. Alphonso VIII. was the founder of the first Spanish university, the *studium generale* of Palencia, which, however, did not survive him.

ALPHONSO IX. (1188-1230) of Leon, first cousin of Alphonso VIII. of Castile, and numbered next to him as being a junior member of the family (see the article SPAIN for the division of the kingdom and the relationship), is said by Ibn Khaldun to have been called the "Baboso" or Slobberer, because he was subject to fits of rage, during which he foamed at the mouth. Though he took a part in the work of the reconquest, this king is chiefly remembered by the difficulties into which his successive marriages led him with the pope. He was first married to his cousin, Teresa of Portugal who bore him two daughters and a son who died young. The marriage was declared null by the pope, to whom Alphonso paid no attention till he was presumably tired of his wife. It cannot have been his conscience which constrained him to leave Teresa, for his next step was to marry Berengaria of Castile, who was his second cousin. For this act of contumacy the king and kingdom were placed under interdict. The pope was, however, compelled to modify his measures by the threat that if the people could not obtain the services of religion they would not support the clergy, and that heresy would spread. The king was left under interdict personally, but to that he showed himself indifferent, and he had the support of his clergy. Berengaria left him after the birth of five children, and the king then returned to Teresa, to whose daughters he left his kingdom by will.

ALPHONSO X., *El Sabio*, or "the Learned" (1252-1284), is perhaps the most interesting, though he was far from being the most capable, of the Spanish kings of the middle ages. (For his merits as a writer see SPANISH LANGUAGE AND LITERATURE.) His scientific fame is based mainly on his encouragement of astronomy. As a ruler he showed legislative capacity, and a very commendable wish to provide his kingdoms with a code of laws and a consistent judicial system. The *Fuero Real* was undoubtedly his work, and he began the code called the *Siete Partidas*, which, however, was only promulgated by his great-grandson. His descent from the Hohenstaufen, through his mother, a daughter of the emperor Philip, gave him claims to represent the Suabian line. The choice of the German electors, after the death of Conrad IV. in 1254, misled him into wild schemes which never took effect, but caused immense expense. To obtain money he debased the coinage, and then endeavoured to prevent a rise in prices by an arbitrary tariff. The little trade of his dominions was ruined, and the burghers and peasants were deeply offended. His nobles, whom he tried to cow by sporadic acts of violence, rebelled against him. His second son, Sancho, enforced his claim to be heir, in preference to the children of Ferdinand de la Cerda, the elder brother, who died in Alphonso's life. Son and nobles alike supported the Moors, when he tried to unite the nation in a crusade; and when he allied himself with the rulers of Morocco they denounced him as an enemy of the faith. A reaction in his favour was beginning in his later days, but he died defeated and deserted at Seville, leaving a will by which he endeavoured to exclude Sancho.

ALPHONSO XI. (1312-1350) is variously known among Spanish kings as the Avenger or the Implacable, and as "he of the Rio Salado." The first two names he earned by the ferocity with which he repressed the disorder of the nobles after a long minority; the third, by his victory over the last formidable African invasion of Spain in 1340. The chronicler who records his death prays that "God may be merciful to him, for he was a very great king." The mercy was needed. Alphonso XI. never went to the insane lengths of his son, Peter the Cruel, but he could be abundantly sultanesque in his methods. He killed for reasons of state, without form of trial, while his open neglect of his wife, Maria of Portugal, and his ostentatious passion for Leonora de Guzman, who bore him a large family of sons, set Peter an example which he did not fail to better. It may be that his early death, during the great

plague of 1350, at the siege of Gibraltar, only averted a desperate struggle with his legitimate son, though it was a misfortune in that it removed a ruler of eminent capacity, who understood his subjects well enough not to go too far.

BIBLIOGRAPHY.—The lives of all the early kings of Spain will be found in the general histories (see the article SPAIN: *Bibliography*), of which the most trustworthy is the *Anales de la Corona de Aragón*, by Gerónimo Zurita (Saragossa, 1610). See also the *Chronicles of the Kings of Castile in the Biblioteca de Autores Españoles de Riva deneira* (1846-80, vols. lxxvi., lxxviii., lxx.). (D. H.)

ALPHONSO XII. (1857-1885), first of the Kings of ALL SPAIN, son of Isabella II, was born on Nov. 28, 1857. When Queen Isabella and her husband, Maria Fernando Francisco de Assisi, eldest son of the duke of Cadiz, were forced to leave Spain by the revolution of 1868, he accompanied them to Paris, and from thence he was sent to the Theresianum at Vienna to continue his studies. On June 25, 1870, he was recalled to Paris, where his mother abdicated in his favour, in the presence of a number of Spanish nobles who had followed the fortunes of the exiled queen. He assumed the title of Alphonso XII.; for although no king of united Spain had previously borne the name, the Spanish monarchy was regarded as continuous with the more ancient monarchy, represented by the 11 kings of Leon and Castile already referred to. Shortly afterwards he proceeded to Sandhurst to continue his military studies, and while there he issued, on Dec. 1, 1874, in reply to a birthday greeting from his followers, a manifesto proclaiming himself the sole representative of the Spanish monarchy. At the end of the year, when Marshal Serrano left Madrid to take command of the northern army, General Martinez Campos entered Valencia in the king's name. Thereupon the president of the council resigned, and power was transferred to the king's plenipotentiary and adviser, Canovas del Castillo. In 1876 a vigorous campaign against the Carlists, in which the young king took part, resulted in the defeat of Don Carlos and his abandonment of the struggle. Early in 1878 Alphonso married his cousin, Princess Maria de las Mercedes, daughter of the duc de Montpensier, but she died within six months of her marriage. Towards the end of the same year a young workman of Tarragona, Oliva Marcousi, fired at the king in Madrid. On Nov. 29, 1879, he married Maria Christina, daughter of the archduke Charles Ferdinand. During the honeymoon a pastrycook named Otero fired at the young sovereigns as they were driving in Madrid. The children of this marriage were Maria de las Mercedes, titular queen from the death of her father until the birth of her brother, born on Sept. 11, 1880, married on Feb. 14, 1901, to Prince Carlos of Bourbon, died on Oct. 17, 1904; Maria Teresa, born on Nov. 12, 1882, married to Prince Ferdinand of Bavaria on Jan. 12, 1906; and Alphonso. In 1881 the king refused to sanction the law by which the ministers were to remain in office for a fixed term of 18 months, and upon the consequent resignation of Canovas del Castillo, he summoned Sagasta, the Liberal leader, to form a cabinet. Alphonso died of phthisis on Nov. 24, 1885. Coming to the throne at such an early age, he had served no apprenticeship in the art of ruling, but he possessed great natural tact and a sound judgment ripened by the trials of exile. In his short reign peace was established both at home and abroad, the finances were well regulated, and the various administrative services were placed on a basis that afterwards enabled Spain to pass through the disastrous war with the United States without even the threat of a revolution.

ALPHONSO XIII. (1886-1941), king of Spain, was born in Madrid, May 17 1886, the posthumous son of Alphonso XII. Belonging to the House of Bourbon-Habsburg, he was baptized as Leon Fernando Maria Jaime Isidoro Pascual Antonio. Born a king, he was proclaimed at birth sovereign under the regency of his mother. Great care was taken to remedy the delicacy of his physique, with the result that in his 16th year he was hale and vigorous. His education was not neglected. He mastered thoroughly English, French and German and acquired a fair knowledge of history and the elements of agriculture.

On coming of age in 1902 Alphonso XIII. endeavoured to get into touch with his subjects in various provinces of his realm, entered into personal relations with the representatives of science,

art, and labour and sought everywhere to awaken enterprise and encourage effort. In 1905 he visited Austria, Germany, England and France. One day while driving in Paris, with the president of the French republic, he narrowly escaped death from the bomb of an unknown criminal.

On May 31 1906, Alphonso married Victoria Eugénie, daughter of Princess Henry of Battenberg, and granddaughter of Queen Victoria. On the same day a bomb was thrown at their carriage by Mateo Morral, but happily neither of the sovereigns was injured. After the birth of his eldest son Alphonso (1907-1938), who was proclaimed prince of the Asturias, the king renewed his travels in Spain, France and England, and at the close of the undecided African campaign of 1909 visited Melilla, where he familiarized himself with the scenes of the fighting. At the funeral of his murdered premier, Canalejas, Alphonso XIII. fearlessly followed the coffin on foot amid a great concourse of people. In April 1913, when returning from the ceremony of the oath to the national flag in Madrid, the king was fired at three times and again he escaped unhurt. His coolness and dignified behaviour on this occasion won for him enthusiastic ovations, and the generosity that prompted him to commute the death sentence on his would-be assassin intensified his popularity.

In the early days Alphonso had been singled out as the innocent symbol of an odious régime, but later he was charged with being the fomentor of a shameful system of favouritism. The Melilla campaign brought home the evils of bad government alike to the listless masses, who furnished the blood and money to carry it on, and to the officers' corps, who complained that rewards and promotion were lavished on drones while those who bore the brunt of the struggle were systematically ignored; and the monarch's popularity began to decline. By way of lessening the dissatisfaction the king, after a visit to President Poincaré, announced Spain's adherence to the Franco-Anglo-Russian entente respecting Morocco (1913) and in the same year he strove to settle the Catalan difficulty by adopting decentralization and bestowing a large measure of autonomy on various provinces for administrative purposes. But the Morocco problem seemed perennial and the concession of home rule failed to satisfy the extremists in Catalonia, who forthwith clamoured for a degree of political independence incompatible with Spanish unity and destructive of their own economic prosperity.

Then it was that Antonio Maura (*q.v.*), having outgrown parties and factions, emerged as one of the few genuine statesmen produced by Spain in modern times. His measures of reform were root-reaching, but he was thwarted by the machinations of his adversaries, the perfidy of his partisans, and his own lack of peremptory energy, and was therefore unable to enforce the restraints prescribed by the Constitution. With the failure of Maura's experiment the last flicker of hope for Spain seemed extinguished. The position of the king became increasingly difficult, notwithstanding his efforts to better it. At the outbreak of the Portuguese revolution his official attitude, despite his dream of an Iberian union and the temptation to realize it, was irreproachable, and during the War of 1914-18, when Spain's position was superlatively difficult, the king remained scrupulously neutral and rendered immense services to the cause of humanity.

At home, he was less fortunate. The war, by depriving the Rif tribes of arms and ammunitions, had placed them at the mercy of Spain, but the parliamentarians allowed the opportunity to slip and the Moors bled the nation white (*see* articles, MOROCCO and SPAIN). The monarch was held partly responsible for this disaster and also for the serious abuses prevalent throughout the army and the Government. Education was almost non-existent; the army was inefficient; the navy a fiction; justice itself was a sham and a snare, and the nation was but a shuttlecock in the hands of two parties tossed between hopeless ineptitude and insatiable greed. Discerning no prospect of redress, the officers' corps, which was the only organ of remedial action in the peninsula, drafted a reform program and through the intermediary of the Infantry Union summoned the Government in June 1917 to accept it without restriction or delay. The arrest of its spokesmen only served to reveal the solidarity of the army while the

impotence of the cabinet and the triumph of the officers dealt a blow to parliamentary government from which it did not recover. But before its final collapse the rulers allowed a tidal wave of syndicalist terrorism to invade Catalonia and render normal existence impossible there.

At this juncture Gen. Primo de Rivera (*q.v.*), aided by a group of resolute comrades and trusting in the king's official acquiescence in an accomplished fact, seized the reins of power, dismissed the cabinet, proclaimed the directorate, suspended the Constitution, introduced censorship, and suppressed for the time syndicalism, separatism, and wholesale assassination. After two years' tenure of office he lost the support of some of his partisans and aroused the active hostility of many passive adversaries, while conspiracies were hatched in Paris, Barcelona and Madrid, some for the purpose of assassinating the king, in June 1925, others with the object of overturning the directorate in Nov. 1925. In Sept. 1927 the king authorized Primo de Rivera to convene a consultative national assembly consisting mainly of supporters of the dictator, for the purpose of drawing up a Constitution. Primo de Rivera tried to inaugurate a less dictatorial régime but was forced to resign, Jan. 28, 1930, before he could bring it into effect. When the Republicans secured a great majority in the 1931 elections, Alphonso, refusing to abdicate, was outlawed and fled the country. He never returned in his lifetime to Spain, though Gen. Francisco Franco re-instated him as a Spanish citizen and, by a decree of April 24, 1939, restored his property which had been confiscated in 1932 by the Republican government. He died Feb. 28, 1941 at Rome, and was buried in the Escorial. (E. J. D.; X.)

ALPHONSUS A SANCTA MARIA, or ALPHONSO DE CARTAGENA (1396-1456), a Spanish historian, was born at Carthagena, succeeded his father, Paulus, as bishop of Burgos, and was sent by John II. of Castile to the Council of Basle in 1431.

His principal work is *Rerum Hispanorum Romanorum imperatorum, summorum pontificum, nec non regum Francorum anacephaleosis*, a history of Spain from the earliest times down to 1456; it was printed at Granada in 1545, and in the *Rerum Hispanicarum Scriptores aliquot*, by R. Bel (Frankfort, 1579).

ALPINI, PROSPERO, or PROSPER ALPINUS (1553-1617), Italian physician and botanist, was born at Marostica, in the republic of Venice. During a three years' residence in Egypt as physician to the Italian consul in Cairo he studied the palm-tree, and he seems to have deduced the doctrine of the sexual difference of plants, which was adopted as the foundation of the Linnæan system. He says that "the female date-trees or palms do not bear fruit unless the branches of the male and female plants are mixed together; or, as is generally done, unless the dust found in the male sheath or male flowers is sprinkled over the female flowers." In 1593 he was appointed professor of botany at Padua. He was succeeded in the botanical chair by his son Alpino Alpini (d. 1637). His best-known work is *De Plantis Aegypti liber* (Venice, 1592). His *De Medicina Egyptiorum* (Venice, 1591) is said to contain the first account of the coffee plant published in Europe.

ALPS, the collective name for one of the great mountain systems of Europe stretching from the Gulf of Genoa to Vienna, and rising between the plains of northern Italy and of southern Germany. The Alps do not present so continuous a barrier as the Himalayas, the Andes or even the Pyrenees. They are less extensive than the Urals or the Scandinavian highlands. They are formed of numerous ranges, divided by comparatively deep valleys. This mountain mass forms a broad band, convex towards the north, while most of the valleys lie between the directions west to east and south-west to north-east. Many deep transverse valleys intersect the prevailing direction of the ridges and facilitate the passage of man, animals and plants, as well as of currents of air which mitigate the contrast that would otherwise be found between the climates of the opposite slopes. The derivation of the name Alps is uncertain; in all parts of the great chain itself the term *Alp* (or *Alm* in the Eastern Alps) is strictly applied to the high mountain pastures (*see* ALP), and not to the peaks and ridges of the chain.

Limits of the Alps.—If we merely desire to distinguish the Alps from minor ranges the best limits are on the west (strictly speaking, south), the Col d'Altare or di Cadibona (1,624ft.), leading from Turin to Savona and Genoa, and on the east the line of the railway over the Semmering Pass (3,215ft.) from Vienna to Marburg in the Mur valley, and on by Laibach to Trieste. An Italian commission in 1926 placed the limit on the east at a line from Vienna through Graz to Fiume. But if we confine the term to those parts where the height is sufficient to support perpetual snow, the limit to the west will be the Col di Tenda (6,145ft.), leading from Cuneo (*Coni*) to Ventimiglia, while on the east our line will be the route over the Radstädter Tauern (5,702ft.) and the Katschberg (5,384ft.) from Salzburg to Villach in Carinthia, and thence by Klagenfurt to Marburg and so past Laibach in Carniola on to Trieste.

On the north side, the Alps (in either sense) are definitely bounded by the Rhine from Basle to the Lake of Constance, the plain of Bavaria and the low foot-hills from Salzburg to the neighbourhood of Vienna. The waters of the northern slope of the Alps find their way either into the North sea through the Rhine, or into the Black sea by means of the Danube, not a drop reaching the Baltic sea. On the south side the mountains from near Turin to near Trieste subside into the great plain of Piedmont, Lombardy and Venetia. The true west section of the Alps runs, from near Turin to the Col di Tenda, in a southerly direction, then bends east to the Col d'Altare, which divides it from the Apennines.

Divisions.—The Alps consist of a main chain, with ramifications, and of several minor chains. They form a single connected whole as contrasted with the plains at their base, the only breaks in them being mountain passes at high altitudes. For the sake of convenience the best marked passes have long been used to serve as limits within the chain, whether to distinguish several great divisions or to break up these into smaller ones. W. A. B. Coolidge's system considers only its topographical aspect. The divisions given lie between the Col di Tenda and the route over the Radstädter Tauern. Three main divisions are generally distinguished: the Western Alps, extending from the Col di Tenda to the Simplon Pass; the Central Alps from the Simplon Pass to the Reschen Scheideck Pass, and the Eastern Alps from the latter to the Radstädter Tauern route, with a bend outwards towards the south-east in order to include the higher summits of the South-Eastern Alps. Assuming these divisions, it is found convenient to subdivide the whole mountain system into 18 smaller groups—5 in the Western Alps, 7 in the Central Alps and 6 in the Eastern Alps. These, with the limits of each subdivision, are as follow:—

Western Alps.—The Maritime Alps (from the Col di Tenda to the Col de l'Argentiére). The Cottian Alps (from the Col de l'Argentiére to the Mont Cenis Pass and west to the Col du Galibier). The Dauphiné Alps (from the Col du Galibier, westwards and southwards). The Graian Alps (from the Mont Cenis to the Little St. Bernard Pass). These are usually divided into three groups, the Centrak (the watershed between the two passes named), the Western or French, and the Eastern or Italian. The Pennine Alps (from the Little St. Bernard to the Simplon Pass).

Central Alps.—The Bernese Alps (from Lake Geneva to the Furka Pass, the Reuss valley and Lake Lucerne). The Lepontine Alps (from the Simplon to the Splügen and south to the Furka and the Oberalp Passes). The eastern portion of this range is sometimes named the Adula Alps (from the St. Gotthard to the Splügen Pass). The Tödi Range (from the Oberalp to the Klausen Pass). The Glarus Alps (north of the Klausen Pass). The Bernina Alps (from the Maloja to the Reschen Scheideck and the Stelvio, south and east of the Val Bregalia and of the Engadine and north of the Valtellina). The Albula Range (from the Splügen to the Flüela Pass, north and west of the Val Bregalia and of the Engadine). The Silvretta and Rätikon Ranges (from the Flüela to the Reschen Scheideck and the Arlberg Pass).

Eastern Alps.—The Alps of Bavaria. Vorarlberg and Salzburg (north of the Arlberg Pass, Innsbruck, the Pinzgau and the Enns valley). The Central Tirol Alps (from the Brenner to the Radstädter Tauern Pass, north of the Drave valley and south

of the Pinzgau and the Enns valley). This includes the Zillertal and the Tauern ranges. The Ortler, Stubai and Oetzthal ranges (from the Reschen Scheideck and the Stelvio to the Brenner Pass, south of the Inn valley, and north of the Tonale Pass). The Lombard Alps (from Lake Como to the Adige valley, south of the Valtellina and the Aprica and the Tonale Passes). This division includes the Adamello, Presanella, Brenta and Bergamasque ranges. The Dolomites of south Tirol (from the Brenner to the Monte Croce Pass, and south of the Pusterthal). The South-Eastern Alps (east of the Monte Croce Pass). This division includes the Julian, Carnic and the Karawanken Alps.

In 1926 an Italian commission considered the subdivision of the Alps and their suggestions embodied several modifications of the above. (*See* Douglas W. Freshfield, *Geog. Journ.* Jan. 1928, p. 37.)

Geology and Structure.—The Alps form but a small portion of a great zone of crumpling which stretches in a series of curves from the Rif mountains of Morocco to beyond the Himalayas. The whole group of mountains may be conveniently called the Alpine-Himalayan group. Within this zone the crust of the earth has been ridged up into a complex series of creases and folds, out of which the great mountain chains of southern Europe and Asia have been carved by atmospheric and other agencies. Superficially, the continuity of the zone is broken at intervals by gaps of greater or less extent; these are due in part at least to the subsidence of portions of the folded belt and their subsequent burial by more recent accumulations. Such a gap is that between the Alps and the Carpathians.

This mountain system, which stretches a quarter of the way across the globe, is formed not of a single fold of the crust but of a number of such, often parallel to one another and to the general direction (trend) of the chain. The mountains of southern Europe are an exception to the last statement, for we find that five great mountain systems radiate from the Alps themselves. One arm stretches east through the Carpathians and another to the south-east through the Dinaric Alps. The latter passes through Candia and Rhodes into the Taurus mountains, where it is joined by the continuation of the Carpathian branch, and east into the Iran Plateau and the Himalayas. This arm appears to cross southern China whilst there is a loop to the south forming the Burmese-Malayan arc. The third arm stretches west from the mountains of Provence into the Pyrénées and the northern Spanish highlands; a fourth through Liguria, Corsica, Elba, the Apennines, Sicily, the Balearic Islands, the Baetic Cordillera, across the Strait of Gibraltar and into the Rif mountains of Morocco. This latter demarcation of the fourth arm is according to Staub, but Kober considers the Baetic Cordillera as part of the Provence-Pyrenees branch, and thinks that the Apennines branch continues by way of Sicily directly into the Rif mountains. A fifth narrow chain stretches from Grenoble into the Jura mountains. These several chains, forming one great mountain system, were uplifted during the same period of earth-movement and by the same set of causes. Each branch is in a certain sense a separate unit but each is represented in the Alps which is the narrowest portion of the whole mountain belt, and in consequence every aspect of the geology of the Alps is of paramount importance when the whole chain is considered.

Sedimentary rocks form a large part of the Alps. These range from the Trias to the Miocene, but older rocks (Permian, Carboniferous, Devonian, Silurian and possibly Cambrian) also occur and are of considerable importance, especially in the Eastern Alps. Crystalline gneisses and schists and igneous rocks also occur. There are many rock types of local importance which need special mention. Here we find the characteristic Tertiary rocks, Molasse, Nagelfluh and Flysch. The former consists of a remarkably uniform series which crops out along the northern border of the Alps in the Great Swiss plateau. To the south of this is the Flysch zone which attains more important dimensions in the east than in the west. Other types which have commanded universal interest are the Gosau beds, Verrucano and Schistes Lustrés. An intensive study of the geology and structure of the Alps has been carried out during the last decade.

The Alps stand upon the site of a geosyncline which, from late Carboniferous times, through the whole of the Mesozoic period until the Miocene period, existed between the Eurasian (Foreland) landmass to the north and the African (Hinterland) landmass to the south. The sea which occupied this depression has been called by Suess and others the "Tethys." Great thicknesses of deposits were laid down in it, causing the floor to sink and thus enabling the sediments to be deposited at approximately the same depth below the sea level. Termier compared this geosyncline to a huge vice, the jaws of which moved slowly inwards concurrently as deposition was taking place between them. The Hinterland moved northward toward the Foreland. Argand has suggested that, by this movement two geanticlines (arches) arose within the geosyncline, thus bringing about the following subdivision:—the Valais Geosyncline (north), the Briançonnais Geanticline, the Piedmont Geosyncline, the Dolin Geanticline and the Canavese Geosyncline. The two geanticlines continued to increase in size as compression proceeded during the whole of the Mesozoic period until the culmination of the movement in the Miocene. The compression was so great that the geanticlines rose completely out of the Tethys and were driven northward on to the Foreland in the form of huge recumbent folds, to which the name of "Nappes" is given. The geanticlines can now be identified in the Pennine Alps as the Great St. Bernard Nappe and the Dent Blanche Nappe. Further, the rise of these two structures also brought about the formation of other structures within the Alpine geosynclines; the Great St. Bernard Nappe forcing upward and forward the three Simplon Nappes which lie beneath it, and the Dent Blanche Nappe similarly bringing into being the Monte Rosa Nappe. There are thus in the Pennine Alps six major tectonic elements which arose from the Alpine geosyncline.

Apart from these, the Foreland and the Hinterland both played important rôles and large tracts of the mountains belong to these divisions. Sedimentary rocks were laid down in epicontinental seas upon the peneplained Hercynian surfaces of these continental masses and these rocks, as well as the fundamental crystalline rocks, were affected by the Alpine earth-movements. The northward movement of the Hinterland was so great that portions of it were driven completely over the geosynclinal rocks on to the Foreland itself. Sedimentary rocks of the same age belong to the Foreland, the Hinterland and the Geosyncline, but there are distinct differences in facies between them as well as differences within each group. Recumbent folding and overthrusting are common throughout the whole of the Alps, but the particular type of structure found in any locality depends upon the nature of the rocks and their location in one or other of the main divisions.

From a geological point of view it is convenient to divide the Alps into Western Alps and Eastern Alps along the Rhine-line (a north-south line through the Lake of Constance, Coire and the Septimer Pass). The following is a summary of the chief tectonic divisions:—

Western Alps.—(a) The Jura mountains; (b) the great Swiss plateau of Tertiary rocks; (c) the Prealps, with exotic Palaeozoic, Mesozoic and Tertiary rocks; (d) the zone of the high Calcareous Alps of Switzerland (the Helvetic zone of Staub); (e) the "zone of Mont Blanc" in which are the crystalline Hercynian massifs, Mercantour, Pelvoux and Belledonne, Mont Blanc and Aiguilles Rouges, Gotthard, Aar and Gastern-Erstfeld (the Autochthonous massifs of Heim); (f) the Pennine zone, in which occur the Pennine Nappes (Pennides of Staub); (g) the zone of the "Inner Roots," containing the "roots" of the Pennine, Austride and Dinaride Nappes.

Eastern Alps.—(a) The great Swiss plateau with Tertiary rocks; (b) the northern Flysch zone (the East Alpine equivalent of the zone of the high Calcareous Alps); (c) the zone of the Eastern Alps; (1) the northern Limestone zone of Triassic, Jurassic and Cretaceous rocks; (2) the Greywacke zone of schists and limestones of Palaeozoic age; (3) the central zone, forming the chief mountain tracts of the Eastern Alps and built up chiefly of Austride Nappes; (4) the Pennine "windows" which occur within the central zone and in which Pennine Nappes are found; (d) the Dinaride zone in which the Dinaride Nappes occur and which is

formed of Palaeozoic and Mesozoic rocks and several plutonic intrusions.

Of these divisions the Jura mountains, the great Swiss plateau, the zone of the high Calcareous Alps, the northern Flysch zone and the "zone of Mont Blanc" belong to the Foreland; the Pennine zone, the Pennine "windows" and part of the zone of the "Inner Roots" belong to the Alpine geosyncline, whilst the northern Limestone zone, the Greywacke zone, the central zone, the Prealps, part of the zone of the "Inner Roots" and the Dinaride zone belong to the Hinterland.

Although the Foreland acted as a single unit during the Alpine earth-movements it did not possess a simple homogeneous structure. Some portions of it (e.g., the central plateau of France, the Vosges, the Black Forest, the Bohemian mountains and the massifs of the "zone of Mont Blanc") resisted the northward advance of the folds, and the effect of this is well seen in the trend of the chain. To assist in forming a clear idea of this, a simple illustration will suffice.

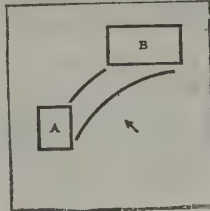


DIAGRAM ILLUSTRATING FORMATION OF THE ALPS. If two books, A and B, are placed on a cloth-covered table, and pressure is exercised on the cloth in direction of the arrow, folds resembling in miniature the "nappes" of the Alps will be produced.

Upon a table covered by a thick cloth lay two books (A and B) in the positions shown in the figure. If the two hands are placed flat upon the table and the cloth pushed in the direction indicated, it will at once be rucked up into a fold which will follow a curve not unlike that of the Alps. The precise form and character of the folds will depend upon the nature of the cloth, position and number of obstructions, and other accidental circumstances. Moreover, if sufficient pressure be exerted, the folds will lie one above the other as in the Alps themselves. Here also there were two sets of obstructions, an outer group comprising the Maures-Esterel massif, central plateau of France, Vosges-Black Forest and Bohemian massifs; and an inner group, the "zone of Mont Blanc." The outer group, well within the Foreland, determined the trend of the chains of the Besses and Dauphiné Alps, the Jura mountains and Swabian Alps. The effect of the "zone of Mont Blanc," nearer the southern edge of the Foreland, is seen in the Pennine and Eastern Alps. Here Staub has identified ten distinct arcs, five in the Eastern Alps and five in the Western Alps. The latter are more distinct than those east of the Rhine-line, for the massifs of the "zone of Mont Blanc" all occur in the Western Alps, but the occurrence of arcs farther east indicates the presence of similar massifs buried beneath the Austrides. The presence of these is further indicated by the occurrence of culminations, which are portions of the true nappe mountains in which the lower elements have been forced to high altitudes, having been driven over elevated portions of the Foreland. Denudation, especially river action, has brought about the removal of much of these upper structures and has revealed different lower units in different districts. Vertical movement, during and since the orogenic period, has made this type of segmentation more marked. Between two culminations a tectonic depression occurs in which, owing to downward sagging, the uppermost tectonic elements have been preserved from denudation. Staub has identified eleven culminations and eleven depressions in the Alps, and in the Western Alps the culminations occur in each case directly behind the individual massifs of the "zone of Mont Blanc."

The massifs of the "zone of Mont Blanc" are, generally speaking, large granitic intrusions (batholiths), surrounded by crystalline schists and gneisses with sedimentary rocks more or less highly metamorphosed. In the Aar, Mont Blanc and Pelvoux massifs "fan" structure has been identified, the granitic rocks being subdivided longitudinally by steep-sided synclines of crystalline schists. The larger massifs of the zone, viz., the Aar-Gotthard, Mont Blanc, Pelvoux and Mercantour, form an inner arc, whilst the smaller ones, viz., the Gastern-Erstfeld, Aiguilles Rouges and Belledonne, form an outer arc. Both arcs are open to the south and adjacent massifs are separated by zones of sedimentary rocks, many of which have been so highly metamorphosed as to be

reduced to paragneisses. The Lötschental zone (paragneisses), the Chamonix sedimentary zone and the zone between the Pelvoux and the Belledonne occur between the two arcs. In the two former zones and in the adjacent massifs the "roots" of the nappes of the high Calcareous Alps are located. The sedimentary cover of the Aiguilles Rouges and the Gastern massifs has been called the Autochthon. This term is also applied by some authorities to all that portion of the sedimentary cover of the Hercynian peneplained surface which has not suffered acute folding, such as is found in the zone of the high Calcareous Alps. Heim further calls the massifs of the "zone of Mont Blanc" the Autochthonous massifs. The Autochthon (in its wider sense) has not suffered acute folding such as is found in the other parts of the Alps, but the rocks are in contact with the surface upon which they were originally deposited.

In the high Calcareous Alps six nappes have been identified. These are called the Helvetides by Staub, but simply the nappes of the high Calcareous Alps by Collet and others. They are named as follows (from the highest to the lowest):—(6) The Oberlaubhorn Nappe, (5) the Mont Bonvin Nappe, (4) the Plaine Morte Nappe, (3) the Wildhorn Nappe, (2) the Diablerets Nappe, (1) the Morcles Nappe.

The Morcles Nappe lies as a great recumbent fold upon the Autochthon, and has its "roots" in the zone of Chamonix. It is composed of sediments ranging from the Trias to the Eocene. Above it lies the Diablerets Nappe, the "roots" of which probably lie in the Mont Blanc massif. This nappe does not possess a reversed limb, this and much of the upper limb having been replaced by a "slide" (Bailey). The Wildhorn Nappe is the greatest of this group and is characterized by a number of digitations in the front of the structure, by disharmonic folding, and a large "involution." Its "roots" probably occur on the south side of the Mont Blanc massif. The three higher nappes (the Ultra-Helvetian Nappes of Heim) crop out in a belt 16 m. long on the south side of the Wildhorn-Wildstrubel range, and again on the north side of the high Calcareous Alps in the "zone of Cols," where they form the Internal Prealps. In Eastern Switzerland (*i.e.*, East of the Hasli-Tal) the following units occur:—The Säntis-Drusberg Unit, the Axen Unit, the Glarner-Mürtschen Unit, the Parautochthonous Nappes.

The upper unit (Säntis-Drusberg) is an eastward extension of the Wildhorn Nappe, the Glarner-Mürtschen unit is homologous to the Diablerets Nappe, and the Parautochthonous Nappes rest upon the Autochthon and are homologous to the Morcles Nappe. The Axen unit is not represented in West Switzerland. Three nappes, digitations of one structure, are distinguished in the Säntis-Drusberg unit, four in the Axen unit and two in the Glarner-Mürtschen unit.

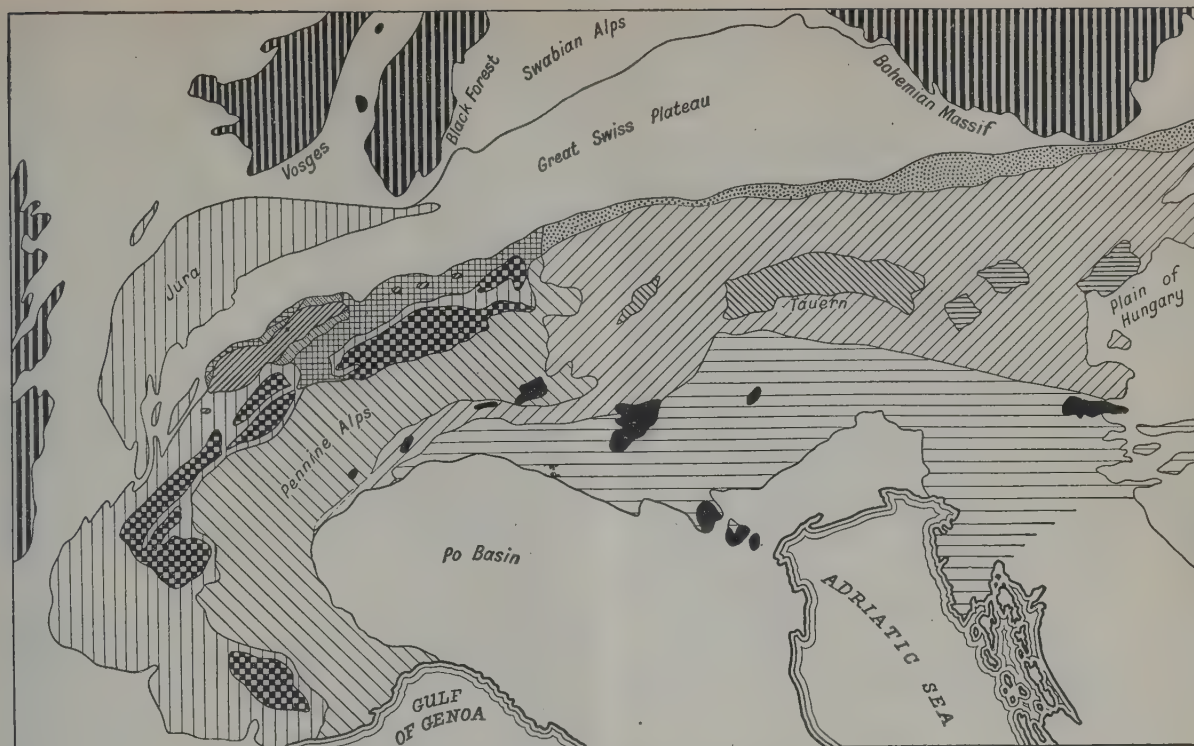
With the exception of the Prealps, the great Swiss plateau bounds the high Calcareous Alps on the north. The plateau is underlain by Tertiary rocks, covered by glacial, fluvio-glacial and alluvial deposits. It forms a wide syncline between the Jura mountains and the Western Alps, and in it are gentle flexures, the most important of which is a central anticline which passes from Lake Constance to Lake Geneva. The sedimentary rocks of the Jura mountains are continuous with those of the Autochthon beneath the Tertiary rocks of the great Swiss plateau, but they do not show the same facies. They have been folded into anticlines and synclines, the trend of which is parallel to that of the Alps, but the folds are bunched together in the neighbourhood of the central plateau of France and the Vosges-Black Forest massifs. In the eastern part of the mountains the folding is complicated by block faulting. This portion is known as the Jura tableland whilst the remainder is called the Folded Juras. The folding has only a superficial character, for it dies out downward, the Anhydrite group (Middle Muschelkalk) not being folded. The beds of this latter horizon acted as a plane along which the folding took place, so producing a "décollement." A study of the tectonics of the Jura mountains reveals a remarkable association between them and the Alps.

The Pennine Nappes (Pennides of Staub), being great recumbent folds which arose out of the Alpine geosyncline, consist of

Palaeozoic rocks as crystalline cores, with envelopes of newer sedimentary rocks now highly metamorphosed and known as "schistes lustrés." The evidence for the age of the schistes lustrés is sufficient to prove that they range from the Lower or Middle Trias to the Nummulitic Limestone (Eocene). They occur in the synclinal structures between the crystalline cores of the nappes and also along the frontal archbends of the latter. The three Simplon Nappes, Monte Leone (III.), Lebendun (II.), Antigorio (I.), crop out in the Ticino district, in the Lepontine culmination brought about by the obstacle of the Aar massif. (The figures I., II., etc., after the names of the nappes indicate the relative position of the structures, I. to VI. being Pennine Nappes and VII.-X. Austrides.) The nappes pass round the culmination and are directly connected in the south with their roots. The schistes lustrés associated with them are not so thick as elsewhere in the Pennine Alps. The Great St. Bernard Nappe (IV.), which arose from the Briançonnais geanticline, occurs above the Simplon Nappes, the latter being regarded as major digitations of the higher structure. The Great St. Bernard Nappe is the most extensive of the Pennine units and stretches in an almost unbroken outcrop from the Gulf of Genoa to the Simplon Pass. Schistes lustrés mark the front of it and also separate it from the crystalline core of the Monte Rosa (V.) Nappe, which forms the massifs of Monte Rosa, Grand Paradis, Ambin and Dora Maira and is in fact a major digitation of the highest Pennine Nappe. The Dent Blanche (VI.) Nappe, which arose from the Dolin geanticline, has suffered considerable denudation and its main outcrop in the Dent Blanche-Weisshorn mountain mass is now isolated from the "roots." Here the nappe is in contact with the Great St. Bernard Nappe, for the Monte Rosa Nappe does not reach so far north and the Great St. Bernard has suffered backward folding.

The country east of the Rhine-line belongs principally to the Hinterland. In it we find several tectonic units, named the Austrides by Staub, who also recognizes two divisions in the group, the Upper (Tirolides) and the Lower (Grisonides), both so named because of the location of their main outcrops. This is Staub's scheme, but Kober uses the name East Alpine Nappes for the Austrides and recognizes in them four main divisions. The Austrides overlie the Pennine Nappes in the Eastern Alps, for where denudation has been great the lower structures are exposed beneath the Austrides in what are known as "windows." In the Lower Engadine window, schistes lustrés occur surrounded by Grisonide elements, whilst in the Hohe Tauern window there are tectonic elements correlated by Staub with the Monte Rosa and the Dent Blanche Nappes as well as schistes lustrés. (Kober considers that the lowest elements here are homologous with the higher Simplon Nappes.) In the Semmering window, denudation has revealed the Grisonides beneath the Tirolides.

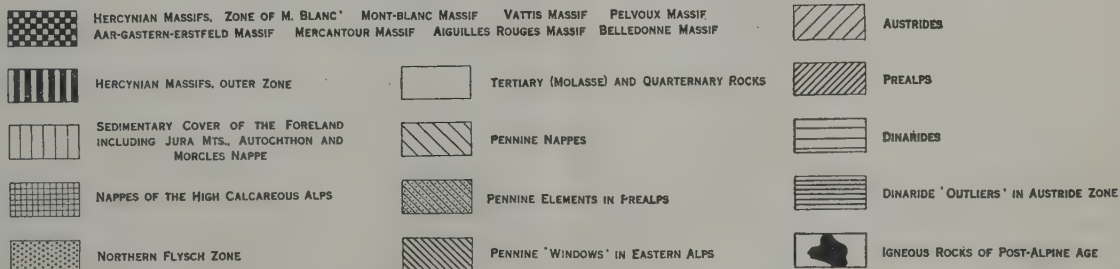
The Grisonides are divided into two major structures, the Campo (VIII.) Nappe and the Err-Bernina (VII.) Nappe, each of which has several digitations in its frontal portion. The lower of the two rests on the Margna (VI.) Nappe, which is homologous to the Dent Blanche Nappe. The Grisonides consist of crystalline cores surrounded by sedimentary rocks, the latter being peculiar in age and facies to each nappe. In the Rhätikon the Grisonides show "schuppen" structure (*i.e.*, slices overthrust one upon another) and parts of them exhibit interesting sedimentary types, which are important in a study of the Prealps. The Tirolides are similarly divided into two major structures, the Oetzal (X.) Nappe and the Silvretta (IX.) Nappe. The latter nappe is the greatest East Alpine structure and, being the lower of the two Tirolide elements, will occur to the north of the Oetzal Nappe in the "root" region, but the sedimentary cover of the latter has been driven over the Silvretta Nappe and forms the northern Limestone zone. The main outcrop of the Oetzal Nappe is in the Mur Alps of Styria, whilst the other forms the Silvretta mountain mass. The northern Limestone zone forms a wide belt from the Rhine-line to Vienna and has the structure of a great pile of overthrust masses of rocks ranging from the Trias to Cretaceous, the dolomite of the Trias being the principal member of the group. North of this zone is the northern Flysch zone, which is the eastern representative of the high Calcareous Alps.



Scale of Miles

0 50 100 150 200

TECTONIC MAP OF ALPS: AFTER STAUB



FROM RUDOLF STAUB'S "TEKTONISCHE CARTE DER ALPEN," BY COURTESY OF THE SCHWEIZ GEOLOGISCHE KOMMISSION, BASEL

MAP OF THE GEOLOGICAL FORMATION OF THE ALPS, SHOWING THE OUTCROPS OF THE CHIEF TECTONIC ELEMENTS

Austride elements occur west of the Rhine-line, in the Prealps, which lie between the great Swiss plateau and the high Calcareous Alps and between the River Arve and the Lake Thun. The following tectonic elements have been identified in this region:— the External Prealps forming the northern portion and being overthrust upon the Molasse of the great Swiss plateau; and the Internal Prealps on the southern margin. The Internal and External Prealps are probably connected and completely underlie the basin-like structure filled by the higher elements of the Prealps. In these two zones the higher units of the high Calcareous Alps occur. Above the Internal Prealps is the Niesen Nappe (chiefly sandstones and conglomerates), which shows Pennine affinities; whilst above the External zone there are similar sandstones, etc., forming the zone of Gurnigel which is considered by some to represent the Niesen Nappe. The Median Prealps Nappe occurs above the zones mentioned and forms the greater part of the Prealps. Above it are the Simme Nappe and the Brèche Nappe. These structures seem to show Austride affinities, and the association between them and the

Austrides is further established by the occurrence of "Klippen" (i.e., frontal portions of nappes isolated by erosion) which have the character of a connecting link, resting upon the Mesozoic rocks of the high Calcareous Alps in the central Swiss region. According to Argand the "roots" of the Simme Nappe occur in the zone of Canavese, south of the Lepontine culmination. These also are west of the Rhine-line, but they are continuous with the "roots" of the other Austride elements farther east. In the zone of Canavese the Dent Blanche Nappe is "rooted" together with the Austrides, and in consequence of this Kober considers that this nappe must belong to the East Alpine group (Austrides) and not to the Pennine chain.

The "roots" of the Pennine Nappes (the "inner roots") lie in a zone which stretches eastward from near Ivrea, through Locarno. The "roots" of the Austrides are in contact with these but on the south side of them. The nappes are vertical in this zone or even overturned toward the south. To the south again are the Dinaride Nappes. The boundary between the Austrides and the Dinarides

(the Dinaric boundary) passes from the neighbourhood of the Italian Lakes to Meran, then east through the Drau Range to the south-east end of Bacher mountains, where it disappears beneath the Hungarian Plain. The tectonics of the Dinarides are comparatively simple. The term "nappes" is still used here by some authorities to designate the tectonic units; but the latter are very different from the nappes of other parts of the Alps, being essentially thrust masses. The extent of the thrusting is never very large. Moreover the units are not so strikingly different from one another in facies as is the case in other parts of the Alps. Kober recognizes four zones here, the Outer Zóde (Adriatic), the Lower Dinaric Nappe, the Upper Dinaric Nappe and the High Dinaric Nappe. The stratigraphy of the Dinaric zone shows an important development of Up. Palaeozoic rocks, Silurian, Devonian, Carboniferous, Permian and Trias. Jurassic, Cretaceous and Flysch are also important in some units. This southern belt of the Alps is noted for its rich development of calcareous rocks. "Klippen" (outliers) of Dinaride elements occur resting upon the Oetzal Nappe in the Mur Alps district. The tectonics of the structures south of the Dinaric boundary show a southward direction of movement. This reverse direction of movement probably indicates one of the latest phases of the Alpine movements. There has been considerable igneous activity in this region, but the intrusions are not all of the same age. The following are affected by Tertiary movements and must therefore belong to an earlier period:—the Kreuz, Iffinger, Brixen, and Riesenferner intrusions. The "Peri-Adriatic Intrusion Zone" (Salomon) contains the following igneous bodies:—Ivrea, Baveno, Bergeller, Adamello, the tonalite of Eisenkappel and the granites of the Bacher mountains. These were not affected by Alpine movements and are, by many authorities, thought to be of slightly later date than those movements.

Main Chain.—Several important mountain groups are situated on one or other side of the watershed of the Alps and form almost independent ranges, connected with the main chain by a kind of isthmus: such are the Dauphiné Alps, the Eastern and Western Graians, the entire Bernese Oberland, etc. The Alps, therefore, are not composed of a single range but of a great "divide," flanked on either side by other important ranges.

Starting from the Col d'Altare or di Cadibona (west of Savona), the main chain extends first south-west, then north-west to the Col di Tenda, though nowhere rising much beyond the zone of coniferous trees. Beyond the Col di Tenda the direction is first west then north-west to the Rocher des Trois Évêques (9,390ft.), just south of the Mont Enchastray (9,695ft.), several peaks of about 10,000ft. rising on the watershed, though the highest of all, the Punta dell'Argentera (10,794ft.) stands a little way to its north. From the Rocher des Trois Évêques the watershed runs due north; of the two loftiest peaks of this region, one, the Aiguille de Chambeyron (11,155ft.), is just to the west and the other, the Monte Viso (12,609ft.), to the east of the watershed. From the head of the Val Pellice the main chain runs north-west and diminishes much in average height till it reaches the Mont Thabor (10,449 ft.), which forms the apex of a salient, which the main chain here presents towards the west. Hence the main watershed extends east, culminating in the Aiguille de Scolette (11,500ft.) but makes a great curve to the north-west and back to the south-east before rising in the Rochemelon (11,605ft.), a re-entering angle in the great rampart by which Italy is guarded. Thence the direction taken is north as far as the east summit (11,693ft.) of the Levanna, the watershed rising in a series of snowy peaks, though the loftiest point of the region, the Pointe de Charbonel (12,336 ft.), stands a little to the west. Once more the chain bends north-west rising in several lofty peaks (the highest is the Aiguille de la Grande Sassièr (12,323ft.), before attaining the considerable depression of the Little St. Bernard Pass (7,179ft.). Thence for a short way the direction is north to the Col de la Seigne (8,242ft.), and then north-east along the crest of the Mont Blanc chain, which culminates in the peak of Mont Blanc (15,782ft.), the loftiest in the Alps. A number of high peaks crown the watershed before it attains the Mont Dolent (12,543ft.). Thence after a short dip south-east, the chain takes near the Great St. Bernard Pass

(8,111ft.) the general easterly direction that it maintains throughout the Pennine Alps till it reaches Monte Rosa, whence it bends north, making one small dip to the east as far as the Simplon Pass. In the Pennine Alps the main chain maintains a greater average height than in any other part, but, though it rises in a number of lofty peaks, such as the Mont Velan (12,353ft.), the Matterhorn (14,782ft.), the Lyskamm (14,889ft.), the Nord End of Monte Rosa (15,132ft.) and the Weissmies (13,226ft.), yet many of the highest points such as the Grand Combin (14,164ft.), the Dent Blanche (14,318ft.), the Weisshorn (14,804ft.), the true summit or Dufourspitz (15,217ft.) of Monte Rosa itself, and the Dom (14,942ft.) rise on its northern slope and not on the main watershed. The chain between the Great St. Bernard and the Simplon sinks at barely half a dozen points below a level of 10,000ft. Eastward from the Simplon (6,592ft.) through the Lepontine Alps so far as the St. Gotthard (6,935ft.) the divide runs north-east, all the higher summits (including the Monte Leone, 11,684ft., and the Pizzo Rotondo, 10,489ft.) rising on it, a curious contrast to the long stretch just described. From the St. Gotthard to the Maloja (5,960ft.) the watershed between the basins of the Rhine and Po runs east as a whole, though making two great dips towards the south first to near the Vogelberg (10,565ft.) and again to near the Pizzo Gallegione (10,201ft.), so that it presents a broken and irregular appearance. Its highest point is the Rheinwaldhorn (11,149ft.).

From the Maloja Pass the main watershed dips south-east for a short distance, and then east and nearly over the highest summit of the Bernina group, the Piz Bernina (13,304ft.) to the Bernina Pass (7,645ft.). Thence to the Reschen Scheideck Pass (4,954ft.) the main chain is ill-defined, though on it rises the Corno di Campo (10,844ft.), beyond which it runs slightly north-east, past the sources of the Adda and the Frael Pass (6,398ft.), sinks to form the depression of the Ofen Pass (7,523ft.), soon bends north and rises once more in the Piz Sesvenna (10,568ft.). The break in the continuity of the Alpine chain marked by the deep valley, the *Vintschgau*, of the upper Adige is one of the most remarkable features in the orography of the Alps. The chief source of the Adige is the little Reschen lake, which is only 13ft. below the Reschen Scheideck Pass (4,902ft.) and but 5m. from the Inn valley. East of this pass the main chain runs north-east to the Brenner Pass along the snowy crest of the Oetzthal and Stubai Alps, the loftiest point on it being the Weisskugel (12,291ft., Oetzthal), for the highest summits both of the Oetzthal and of the Stubai districts, the Wildspitze (12,382ft.) and the Zuckerhütl (11,520ft.), stand a little to the north.

The Brenner (4,495ft.) is almost the lowest of all the great motor road passes across the main chain, and has always been the chief means of road communication between Germany and Italy. For some way beyond it the watershed runs east over the Hochfeiler (11,559ft.) the highest crest of the Zillerthal Alps. A little farther, at the Dreierherrenspitze (11,500ft.), we have to choose between following the watershed south, or keeping due east along the highest crest of the Greater Tauern Alps. (a) The latter course is adopted by many geographers. The watershed (though not the chief Alpine watershed) continues east through the Greater Tauern Alps, culminating in the Gross Venediger (12,008ft.), for the Gross Glockner (12,461ft.) rises to the south. Our chain bends north-east near the Radstädter Tauern Pass (5,702ft.) and preserves that direction through the Lesser Tauern Alps to the Semmering Pass (3,225ft.). (b) On the other hand, from the Dreierherrenspitze the true main watershed of the Alpine chain dips south, passes over the Hochgall (11,287ft.), the culmination of the Rieserferner group, and then sinks to the Toblach Pass (3,967ft.) but a little east of the great Dolomite peak of the Drei Zinnen (9,837ft.) it bends east again and rises in the Monte Cogliano (9,128ft., the monarch of the Carnic Alps). Soon after the watershed makes a last bend to the south-east and culminates in the Terglou (9,400ft.), the highest point of the Julian Alps, though the Grintovec (8,429ft., the culmination of the Karawanken Alps) stands more to the east. Finally the watershed turns south and ends near the great limestone plateau of the Birnbaumerwald, between Laibach and Görz.

Principal Passes.—The Alps have never formed an impassable barrier. The spots at which they are crossed are called passes and are the points at which the great chain sinks to form depressions. Hence the oldest name for such passes is *Mont* (still retained in cases of the Mont Cenis and the Monte Moro); it was long before this term was especially applied to the peaks of the Alps, which, with a few rare exceptions (*e.g.*, the Monte Viso was known to the Romans as Vesulus), were simply disregarded. The native inhabitants of the Alps were naturally the first to use the alpine passes, but to the outer world these passes first became known when the Romans traversed them in order to conquer the world beyond. For obvious reasons the Romans, having once found an easy pass did not trouble to seek for harder routes. The passes known to them were comparatively few; they are, in topographical order from west to east, the Col de l'Argentière, the Mont Genève, the two St. Bernards, the Splügen, the Septimer, the Brenner, the Radstädter Tauern, the Sölscharte, the Plöcken and the Pontebba (or Saifnitz). The Mont Genève and the Brenner were the most frequented, while it will be noticed that in the Central Alps only two passes (the Splügen and the Septimer) were certainly known to the Romans. The Simplon is first certainly mentioned in 1235, the St. Gotthard (without name) in 1236, the Lukmanier in 965, the San Bernardino in 941. Even the Mont Cenis (from the 15th to the 19th century the favourite pass for travellers) is first heard of in 756 only. In the 13th century many hitherto unknown passes came into prominence, even some of the easy glacier passes. In the Western and Central Alps there is but one ridge to cross, to which access is gained by a deep-cut valley, though often it would be shorter to cross a second pass in order to gain the plains, *e.g.*, The Mont Genève, that is most directly reached by the Col du Lautaret. In the Eastern Alps it is generally necessary to cross three distinct ridges between the north and south plains, the central ridge being the highest and most difficult. The passes which crossed a single ridge, and did not involve too great a detour through a long valley of approach, became the most important and the most popular, *e.g.*, the Mont Cenis, the Great St. Bernard, the St. Gotthard, the Septimer and the Brenner. As time went on the travellers who used the great alpine passes could not put up any longer with the bad old mule paths. A few passes (*e.g.*, the Semmering, the Brenner, the Tenda and the Arlberg) can boast of carriage roads constructed before 1800, while those over the Umbrail and the Great St. Bernard were not completed till the early 20th century. Many of the carriage roads across the great alpine passes were constructed in the 19th century, largely owing to the impetus given by Napoleon. As late as 1905, the highest pass over the main chain that had a carriage road was the Great St. Bernard (8,111 ft.). More recently railway lines have been carried over or through the chain—there being the Brenner and Pontebba lines, both over passes, and the Col di Tenda, Mont Cenis, Simplon, St. Gotthard, Lötschen, Arlberg, Albula and Pyhrn through tunnels. There are also schemes for piercing the Splügen and the Hohe Tauern, both on the main ridge. Since the advent of motor-cars several old road-passes have been improved and new ways made.

Glaciers.—Because the Alps were explored and studied earlier than the other mountain systems of the world, the type of glaciation found there has received the name "Alpine Type." It is similar to that of parts of the Himalayas, Andes, Rockies and the mountains of New Zealand but is different from that of Spitzbergen, Greenland, Alaska and the Polar regions (*see GLACIERS*). The main characteristics of the Alpine type consist of an elevated "catchment area" from which valleys pass down to lower altitudes. The highest peaks do not necessarily form the centres from which the largest glaciers radiate, but these latter arise where the topography of the mountain masses is that of numerous depressions and wide hollows separated by rounded snow-capped peaks, as Mont Blanc or by steep-sided frost-eaten peaks and ridges as the Aiguilles. Snow accumulates in these hollows and is compacted into ice which differs in appearance and internal structure from ice formed in the normal way by freezing. It is known as "*névé*" (Fr.) or "*firn*" (Ger.). This ice is forced downward by the weight of the accumulated snow above, or falls down as avalanches into

the valley below, forming the valley glaciers characteristic of the Alps. The boundary between the *névé* and the valley glacier (the *firn*-line) is marked by a change in the character of the surface of the ice. Above the *firn*-line precipitation is greater than melting and so snow covers the surface, but below it the reverse is the case and the ice is exposed. In summer the *firn*-line is quite distinct, but generally some hundreds of feet below the limit of perpetual snow.

It is estimated that there are 1,200 separate glaciers and *névé* fields in the Alps, but many are mere accumulations of snow in small hollows which really form part of larger basins. The largest glacier in the Alps is the Aletsch Glacier which is 16m. long and with its *névé* and catchment area covers an area of over 50sq. miles. The lowest point reached by glaciers varies considerably; it is as low as 3,200ft. above sea-level at Grindelwald, but the height is more often quite 1,000ft. higher than this. The line of perpetual snow lies between 8,000ft. and 9,500 feet. Its exact position varies locally; regions which rise above these limits form centres for the radiation of valley glaciers. The largest of such centres are in the Mont Blanc group, the Bernese Oberland (from Blumlisalp to the Wetterhorn) and in the Pennine Alps (from the Grand Combin to the Mischabel). The main chain boasts of more glaciers and *névé* than the subsidiary chains. Nevertheless, the three longest glaciers of the Alps, the Greater Aletsch (16m.) and the Unteraar and the Viescher (each 10m.), are in the Bernese Oberland. The longest glaciers in the main chain are the Mer de Glace and the Gorner (each 9½m.).

During the Pleistocene Ice Age the whole chain was more than once covered by an ice sheet above which perhaps the main peaks stood out. Penck infers four ice-maxima, Bayer thinks there were only two. One of the intervals, it is generally agreed, witnessed a return of warm temperate conditions. The final retreat of the Pleistocene Ice Sheet proceeded by stages, and it has been suggested there was a serious regrowth of glaciers in early centuries of the last millenium B.C. Each stage was marked by a continuous retreat of the ice front to higher altitudes, no movement or perhaps even a temporary advance occurring in the intervals. During historical times the movement of the fronts has not been very marked. In 1918 a general forward movement was noticed in most Alpine glaciers, the previous great advance commencing in 1818 and finishing in 1822. The smaller glaciers will, of course, show movement more quickly than the larger. This is illustrated in the case of the Aletsch Glacier, which has maintained the same position of its front for many years. In 1823 this glacier suddenly dropped its level (for reasons not understood) causing the level of Lake Märjelen, which is formed by the glacier obstructing the mouth of a tributary stream, to fall.

Lakes and Water Power.—The lakes of the Alps are of several types. (*See LAKE*.) Lakes of the barrier type are formed in various ways, principally by terminal and lateral moraines, in rarer cases by land slides, alluvial fans or a glacier. Lake Zürich shows interesting phases of damming by various moraines; Lake Mattmark is formed by a lateral moraine; Lake Märjelen is a classic example of a glacier acting as a dam. Examples of lakes of tectonic origin are Lake Joux, in the Jura region, which occurs in a syncline, and Lake Fählen near Säntis. Lakes formed by the solution of calcareous rocks are of two types: the "polje" and the "doline" types. Frequently the depressions occupied by these lakes were the sites of former glaciers, as proved by the lining of glacial clay which the lakes now possess. Lakes of these types are quite frequent in the limestone areas and examples are Lakes Dauben, Mitten and Seewli (the latter also being in a corrie). Lakes in depressions in water-bearing strata occur on moraines or on fluvio-glacial material. No rivers feed them and they have no visible effluents. Examples of the formation of two small lakes from a large one by a lacustrine delta are the lakes of Thun and Brienz and of Silser and Silvaplana.

In recent years the Alps have become a most important source of hydro-electric power for industry, railway transport and lighting, and the amount of coal used is diminishing. Nowhere, even in the limestone districts, is the amount of water so small as to warrant the exclusive use of coal or other fuels. As the water is

derived from melting snow and ice, there is no fear of summer shortage, but a winter stoppage may occur. Most of the great lakes of the subalpine region are used as sources of supply, as also are many of the smaller ones; in the latter cases the level of water is frequently raised by a dam. The water is drawn from the bottom of the lake in order to ensure a constant supply in winter. Reservoirs are also constructed in suitable places. The choice of site depends upon several factors, *e.g.*, the impermeable nature of the rocks forming the basin, an adequate supply of water, a minimum amount of deposition of sediment within the basin and the geographical position. Old lake basins have been transformed into reservoirs, *e.g.*, the Barbarine, and many deep gorges have been so utilized. Electric power and lighting are to be found in remote villages.

In the Alps are the sources of the great rivers of western Europe—the Po, Rhone, Rhine and Danube (the actual source of the latter is in the Black Forest, but its main tributaries rise in the Alps). These rivers drain the south, west, north and east slopes respectively, and the Danube also drains the north slope. There exists a very close connection between the direction of the river valleys in the Alps and the geological structure. Most of the valleys are either parallel to or at right angles to the trend of the chains. Examples of the former are the Isère, the Upper Rhone and the Upper Rhine, and of the latter the rivers of the Pennine Alps.

Climate.—It is well known that as we rise from the sea-level into the upper regions of the atmosphere the temperature decreases. Mountain chains cause the prevailing winds to rise to higher altitudes, thus frequently bringing about the precipitation of snow or rain principally upon the windward side. The vast mass of snow, converted into glaciers, maintains a gradation of very different climates within the narrow space that intervenes between the foot of the mountains and their upper ridges; it cools the breezes that are wafted to the plains on either side, but its most important function is to regulate the water-supply of the large region traversed by Alpine streams. Nearly all precipitation during six or seven months is in the form of snow, gradually released by melting in the course of the succeeding summer; even in the hottest and driest seasons the reserves accumulated in the form of glaciers maintain the regular flow of the greater streams. Nor is this all; the lakes that fill several main-valleys on the south side are somewhat above the level of the Lombardy plain, and afford inexhaustible water for that system of irrigation to which it owes its proverbial fertility.

Six regions or zones, which are best distinguished by their characteristic vegetation, are found in the Alps. They are (a) the olive region, (b) the vine region, (c) the mountain region or the region of deciduous trees, (d) the subalpine region or the region of coniferous trees, (e) the Alpine region, (f) the glacial region. Local conditions of exposure to the sun, protection from cold winds or the reverse, as well as height above sea-level, are of primary importance in determining the climate and the corresponding vegetation.

(a) The great plain of Upper Italy is colder in winter than the British Isles. The olive and the characteristic shrubs of the North Mediterranean coasts do not thrive in the open, but olives ripen in sheltered places at the foot of the mountains and along the deeper valleys and the lake shores. The evergreen oak is wild about Lake Garda, and lemons are cultivated on a large scale, with partial protection in winter.

(b) The vine is far more tolerant of cold than the olive, but to produce tolerable wine it demands, at the season of ripening, not much less warmth than the olive, about 68° F average. These conditions are satisfied in the deeper valleys of the Alps, and up to a considerable height on slopes exposed to the sun. Winter snow-covering helps the plant to resist severe and prolonged frosts.

(c) So many varieties of grain are grown under various climatic conditions that their limits of cultivation are less useful for determining zones than are those of the chief deciduous trees—oak, beech, ash and sycamore. These do not reach exactly to the same elevation, nor are they often found growing together; but

their upper limit corresponds accurately enough to the change from a temperate to a colder climate. This limit lies about 4,000 ft. above sea-level on the north side of the Alps, but on the southern slopes it often rises to 5,000 ft., sometimes even to 5,500 feet. The interference of man has in many districts almost extirpated these trees. Their place has been occupied by the Scotch pine and spruce, which suffer less from goats, the worst enemies of trees. The mean annual temperature differs little from that of the British Islands; but snow usually lies for several months, till it gives place to a spring and summer considerably warmer than the average of British seasons.

(d) The Subalpine is the region which mainly determines the manner of life of the peasant population of the Alps. Of the space lying between the summits of the Alps and the low country on either side roughly one-quarter is available for cultivation of which about one-half may be vineyards and corn-fields, while the remainder produces forage and grass. About another quarter is utterly barren, consisting of snow-fields, glaciers, bare rock, lakes and the beds of streams. There remains about one-half, which is divided between forest and pasture, and it is the produce of this half which mainly supports the relatively large population. For a quarter of the year the flocks and herds are fed on the upper pastures; but the true limit of the wealth of a district is the number of animals that can be supported during the long winter, and while one part of the population is engaged in tending the beasts and in making cheese and butter, the remainder is busy cutting hay and storing up winter food for the cattle. The larger villages are mostly in the mountain region, but in many parts of the Alps the villages stand in the subalpine region at heights varying from 4,000 ft. to 5,500 ft. above sea-level, more rarely extending to about 6,000 feet. Coniferous trees, where they have not been artificially kept down, form vast forests. They protect the valleys from destructive avalanches, and, retaining the superficial soil by their roots, they mitigate the destructive effects of heavy rains. On very steep slopes avalanches have frequently torn up the trees, leaving long avenues of varying width through the forests. In such places and in valleys where they have been rashly cut away, and the waters pour down the slopes unchecked, every tiny rivulet becomes a raging torrent, that carries away the soil and subsoil from the grassy slopes and devastates the floor of the valley, covering it with debris and gravel. The prevailing species are the common spruce, the silver fir, the larch and the Scotch pine. The Siberian fir is also found. In the northern Alps the pine forests rarely surpass the limit of 6,000 ft. above the sea, but on the south side they commonly attain 7,000 ft., while the larch, Siberian fir and mughus often extend above that elevation.

(e) Throughout the Teutonic region of the Alps the word *Alp* is used specifically for the upper pastures where cattle are fed in summer, but this region is held to include the whole space between the uppermost limit of trees and the first appearance of permanent snow. Here the characteristic vegetation of the Alps is developed in its full beauty and variety. Shrubs are not wanting. Three species of rhododendron give masses of red or pink flowers; the common juniper rises higher still, along with three species of bilberry; and several dwarf willows attain nearly to the utmost limit of vegetation, the so-called limit of perpetual snow.

(f) On the higher parts of lofty mountains more snow falls in each year than is melted on the spot. A portion of this is carried away by the wind before it is consolidated; a larger portion accumulates in hollows of the surface, and, gradually converted into glacier ice, descends slowly into the deeper valleys, to swell perennial streams. As on a mountain the snow does not lie in beds of uniform thickness, and some parts are more exposed to the sun and warm winds than others, we commonly find beds of snow alternating with exposed slopes covered with brilliant vegetation; and to the observer near at hand there is no appearance in the least corresponding to the term *limit of perpetual snow*, though the case is otherwise when a high mountain-chain is viewed from a distance, for the level at which large snow-beds show themselves along its flanks is approximately horizontal, in so far as conditions are similar. On the opposite sides of the same chain, exposure to sun or to warm winds may cause a wide difference in the level of

permanent snow; but in some cases the increased fall of snow on the side exposed to moist winds may more than compensate increased influence of the sun's rays. Still, even with these reservations, the so-called line of perpetual snow is not fixed. In some parts of the Alps the limit may be set at about 8,000 ft. above the sea, while in others it cannot be placed much below 9,500 feet. As very little or no snow can rest on rocks that lie at an angle exceeding 60°, some steep masses of rock remain bare even near the summits of the highest peaks, but as almost every spot offering the least hold for vegetation is covered with snow, few flowering plants are seen above 11,000 feet. It is, however, want of soil rather than climatic conditions that checks the upward extension of the alpine flora. Increased direct effect of solar radiation compensates for the cold nights, and in the few spots where plants have been found in flower up to a height of 12,000 ft., nothing has indicated that the processes of vegetation were arrested by the severe cold which they must sometimes endure. The climate of the glacial region has often been compared to that of the polar regions, but they are widely different. Here, intense solar radiation by day, which gives the surface when dry a temperature approaching 80° F, alternates with severe night frost. There, a sun which never sets sends feeble rays that maintain a low equable temperature rarely rising more than a few degrees above the freezing-point. Hence the upper region of the Alps sustains a far more varied and brilliant vegetation.

Flora.—The Alps owe the richness and beauty of their plant life partly to their position as the natural boundary between "Baltic" and "Mediterranean" floras, but chiefly to the presence on their heights of a third flora which has but little in common with either of the others. The stronghold of this last, the distinctively "Alpine" flora, is the region above the tree-limit. Its closest relationship is with the flora of the Pyrenees; but an alpine flora is characteristic of all the lofty mountains of central Europe. According to J. Ball, 2,010 well marked species of flowering plants occur within the limits of the Alps. If now we confine our attention to the alpine and higher regions of the Alps and exclude from our list all those plants which are not less abundant in the lowlands, we have left some 700 species. We must observe, as regards the plants of the lower alpine region, that it is the actual presence of a forest vegetation, rather than the theoretical tree-limit, which affects their vertical distribution; so that, e.g., they overflow into the extensive clearings made by man in the primeval mountain forests. Indeed, an analysis of the composition of the alpine flora as a whole leads to the conclusion that the chief bond of union between its members consists in the treeless character of their habitat.

We may broadly distinguish two main geographical elements in the alpine flora, namely, the northern element and the endemic element. This division (which is not, however, strictly exhaustive) directs special attention to what is undoubtedly the most striking feature of the flora, namely, that of its 693 species no less than 271 reappear in the extreme north. This relation of the arctic to the alpine flora is all the more remarkable in view of the very important differences between the arctic and alpine climates. The following circumpolar species are common, and widely diffused throughout the whole of the Alps: *Silene acaulis*, *Dryas octopetala*, *Saxifraga oppositifolia*, *S. aizoides*, *S. stellaris*, *Erigeron alpinus*, *Azalea procumbens*, *Myosotis alpestris*, *Polygonum viviparum*, *Salix retusa*, *S. herbacea*, *Phleum alpinum*, *Juniperus nana*. The proportion of northern forms, as regards both species and individuals, increases until, on islands of rock above the snow-line, it is equal to the endemic element. Northern flowers of the snow-region include *Silene acaulis*, *Eritrichium nanum*, and *Arenaria ciliata*. On the other hand, typical endemic species of this highest zone are *Androsace helvetica*, *A. glacialis*, *Petrocallis pyrenaica*, and *Cherleria sedoides*. All the plants just named are "cushion-plants." Their compact, moss-like growth and general structural peculiarities are analogous adaptations to the dry cold of their habitat. Among the northern plants of the alpine zone, in the narrower sense of the term (i.e., of the region between the tree-limit and the snow-line), there is a marked predominance of species that affect moist localities; and, conversely, the majority

of alpine flowers of wet habitat are found also in the north. For example, in the genus *Primula*, a highly characteristic genus of the alpine flora, whose members are among the most striking ornaments of the rocks, the single northern species, *P. farinosa*, grows only in marshy meadows. On the whole, then, adaptation to cold and wet is the note of the northern element.

During the glacial period, in the ice-free belt, between the northern ice-sheet and the vastly extended glaciers of the Alps, the two floras found refuge and congenial conditions; fossils confirm this view. With the return of a milder climate, the so-called northern forms of the present alpine flora were split in two, one portion following close on the northern ice in its gradual retreat to the Arctic, the other following the shrinking glaciers till the plants were able to establish (or re-establish) themselves on the slopes of the Alps. The same explanation covers the case of the similarity of the flora (not merely as regards the northern element) on all the high mountains of central Europe. Beyond this, disagreement begins between the most eminent writers on the subject. While some (e.g., Sir J. D. Hooker, Heer) regard the Arctic, and some (e.g., Wettstein) the Alps, as the original home of the bulk of the "northern" element, others (e.g., Ball, Christ) locate this in the highlands of temperate Asia. For it is a remarkable fact that, of the 230 northern species which are most typical of the far north, 182 are found also in the Altai (taking this as a collective name for the mountains that form the southern boundary of Siberia). In any case, however, the migration of these plants to the Alps must for the most part have taken place via the Arctic. The possibility of any extensive east to west migration having taken place direct from the Altai to the Alps seems excluded by the fact that 50% of the arctico-altaic alpine plants are absent from the Caucasus. On the whole, a common origin in the north for at least the arctico-altaic group of alpine plants seems to be the most reasonable hypothesis. A score of species are common to Alps and Altai, but a larger number of arctic-alpine forms are absent from the Altai.

Side by side with the northern element we find a group of species usually spoken of as the xerothermic or meridional element. These do not, however, form an "element," in the strict geographical sense in which this term is otherwise used here. They are those species which, on general phyto-geographical grounds, must be regarded as having originated under steppe-like conditions. Their affinities are chiefly, with the present Mediterranean flora—about 50 are of presumably Mediterranean origin—and a large proportion of them are restricted to the southern slopes of the Alps. The following, however, among others, are distributed throughout the whole, or a great part, of the range:—*Colchicum alpinum*, *Crocus vernus*, *Orchis globosa*, *Petrocallis pyrenaica*, *Astragalus depressus*, *A. aristatus*, *Oxytropis Halleri*, *Eryngium alpinum*, *Erica carnea*, *Linaria alpina*, *Globularia nudicaulis*, *G. cordifolia*, *Leontopodium alpinum*. The last named (the well-known "edelweiss") is at the present day characteristic of the Siberian steppes. The presence of these plants among the alpine flora is traceable to the steppe-like conditions which prevailed in central Europe both during the warmer inter-glacial periods and (probably) for a time after the close of the ice-age. Subsequently, as the climate of the plains assumed a colder and more humid character, they retired before the invading forests to the high mountains. Here, in the intenser insolation which they enjoy, they seem to find a compensation for the drawbacks incidental to the altitude.

As regards the endemic element as a whole, the question as to the time and place of its origin is of a highly complicated and controversial nature. The question, too, in the case of this element, is necessarily of genetic rather than purely geographical scope. It must suffice to say that the weight of scientific opinion inclines to the view that at least the majority of endemic species are of pre-glacial origin, and are either strictly indigenous or products of the neighbouring lowlands. About 40% of the endemic element in the alpine flora are endemic also in the narrower sense, i.e., they are confined to the Alps. The following is a list of the most thoroughly characteristic alpine plants—all of them *ipso facto* members of the endemic element—which are at once peculiar to the Alps (or practically so) and widely distributed within the limits

of the chain. These are:—*Festuca pulchella*, *Carex microstyla*, *Salix caesia*, *Rumex nivalis*, *Alsine aretioides*, *Aquilegia alpina*, *Thlaspi rotundifolium*, *Saxifraga seguieri*, *S. aphylla*, *Astragalus leontinus*, *Daphne striata*, *Eryngium alpinum*, *Bupleurum stellatum*, *Androsace helvetica*, *A. glacialis*, *Gentiana bavarica*, *Phyteuma humile*, *Campanula thyrsoidea*, *C. cenisia*, *Achillea atrata*, *Cirsium spinosissimum*, *Crepis terglouensis*.

Fauna.—The fauna of the lower zones in the Alps is, on the northern side of the chain, practically identical with that of central Europe, and on the southern side with that of the Mediterranean basin. But in the higher regions it presents many features of special interest. It seems, therefore, best to treat here principally of the animal inhabitants of the high Alps.

Though among mammalia—as also birds—there are but few forms peculiar to the Alps, many interesting animals have found in the high mountains at least, a temporary refuge from man. The European bison, the urus, the elk, the wolf and the wild swine have disappeared. But the lynx (*Lynx lynx*) lingers in remote parts, as also the brown bear (*Ursus arctos*) in the dense forests of the Lower Engadine. The fox (*Vulpes vulpes*), the stone-marten (*Martes foina*) and the stoat or ermine (*Putorius erminea*) range in summer above the tree-limit. The Ungulata are represented by a few chamois (*Rupicapra tragus*) and a rare bouquetin or steinbock (*Capra ibex*). The former—the sole representative, in western Europe, of the antelopes—is found elsewhere only in the Pyrénées, Carpathians, Caucasus and the mountains of eastern Turkey; the latter survives only in the eastern Graian Alps. Of the Rodentia the most interesting and conspicuous is the marmot (*Arctomys marmota*), which lives in colonies close to the snow-line. The snow-mouse (*Arvicola nivalis*) is confined to the alpine and snow regions, and is abundant at these levels throughout the whole chain of the Alps. The mountain hare (*Lepus variabilis*) replaces the common hare (*Lepus europaeus*) in the higher regions; though absent from the intervening plains it again appears in the north of Europe and in Scotland. Among the Insectivora, the alpine shrew (*Sorex alpinus*) is restricted to the Alps. Of the Chiroptera (bats) only *Vesperugo maurus* is characteristically alpine.

The birds of the Alps are proportionately very numerous. The lammergeyer (*Gypaetus barbatus*), once common, is now extremely rare, but the golden eagle (*Aquila chrysaetos*) still holds its own. Some of the smaller birds of prey are not uncommon, but there is none that can be regarded as specially characteristic either of the Alps as a whole or of the alpine region. As characteristic birds of the snow-region may be mentioned the alpine chough (*Pyrrhocorax alpinus*), which is frequently seen at the summits even of the loftiest mountains, the alpine swift (*Apus melba*), the wall-creeper (*Tichodroma muraria*), snow-finch (*Montifringilla nivalis*) and ptarmigan (*Lagopus mutus*); the geographical distribution of this last being similar to that of the mountain hare. The black redstart (*Ruticilla titys*), though common in the lower regions, is also met with in fair numbers almost up to the snow-line. The raven (*Corvus corax*) is fairly common in the alpine and sub-alpine regions. On the highest pastures we find, further, the alpine accentor (*Accentor collaris*) and the alpine pipit (*Anthus spioletta*). The crag-martin (*Cotyle rupestris*) haunts lofty cliffs. On the upper verge of the pine forests, or in the scrubby vegetation just beyond, the following are not uncommon:—black woodpecker (*Picus martius*), ring-ousel (*Turdus torquatus*), Bonelli's warbler (*Phylloscopus bonellii*), crested tit (*Parus cristatus*), citril finch (*Citrinella alpina*), siskin (*Chrysomitris spinus*), crossbill (*Loxia curvirostra*), nutcracker (*Nucifraga caryocatactes*), blackcock (*Tetrao tetrix*) and the alpine varieties of the marsh-tit (*Parus balustris borealis*) and tree-creeper (*Certhia familiaris costae*).

The remaining classes of Vertebrata are sparsely represented in the high Alps, and what species occur are mostly common to the plains as well. Among the remaining land vertebrates only the black salamander (*Salamandra atra*) is exclusively alpine. This animal, though a member of the Amphibia, is terrestrial and viviparous.

The former connection between the Arctic and the Alps, which

has left such unmistakable traces in the present alpine flora, affords, as regards the fauna also, the only possible explanation of the present geographical distribution of many alpine forms; but it is chiefly among the Invertebrata that we find this collateral testimony to the influence of the glacial period. In this respect we may note that two small crustaceans, *Diaptomus bacillifer* and *D. denticornis*, swarm in the ice-cold waters of the highest alpine tarns throughout the entire chain; and the former of these is also a characteristic inhabitant of pools formed from melting snow in the extreme north. Among the remaining divisions of Invertebrata special mention may be made of the air-breathing Arthropoda—on the whole the most important and interesting group. About one-third of the animals belonging thereto that occur in the higher regions are exclusively alpine (or alpine and northern); these characteristically alpine forms being furnished chiefly by the spiders, beetles and butterflies. Most numerous are the beetles. Those of the highest zone are remarkable for the great predominance of predaceous species and of wingless forms. In this last respect they present a striking analogy with the endemic coleopterous fauna of oceanic islands. As for the butterflies, not more than one-third of the species found in the alpine region occur in the neighbouring lowlands. The relations between alpine butterflies and plants are especially interesting, as regards not only their bionomic interdependence but also the analogies of their geographical distribution. It should be noted that butterflies are the chief agents in securing the continued existence of such alpine flowers as depend on insect fertilization, the other insect fertilizers being mostly wanting at great heights.

Inhabitants of the Alps.—From ancient times we have only scanty mention of Alpine peoples by classical writers, with a few references to conquests by Augustus and to later movements of Teutonic tribes of the 5th and 6th centuries. To them, as to Frankish kings and emperors, the Alps offered a route rather than a residence. In the case of the Western Alps (minus the bit from the chain of Mont Blanc to the Simplon, which followed the fortunes of the Valais), a prolonged struggle for the Alpine region took place between the feudal lords of Savoy, the Dauphiné and Provence. In 1349 the Dauphiné fell to France, while in 1388 the county of Nice passed from Provence to the house of Savoy, which also held Piedmont as well as other lands on the Italian side of the Alps. The struggle henceforth was limited to France and the house of Savoy, but little by little France succeeded in pushing back the house of Savoy across the Alps, thus forcing it to become a purely Italian power. One turning-point in the rivalry was the treaty of Utrecht (1713), by which France gave up to Savoy the districts (all forming part of the Dauphiné and lying on the Italian slope of the Alps) of Exilles, Bardonnèche, Oulx, Fénestrelles and Château Dauphin, while Savoy handed over to France the valley of Barcelonnette, situated on the western slope of the Alps and forming part of the country of Nice. The final act in the long-continued struggle took place in 1860, when France obtained by cession the rest of the county of Nice and also Savoy, thus remaining sole mistress on the western slopes of the Alps.

In the Central Alps the chief event, on the north side of the chain, is the gradual formation from 1291 to 1815 of the Swiss Confederation and the independent confederations of the Grisons and the Valais, which became full members of the Swiss Confederation only in 1803 and 1815 respectively. The Forest Cantons in the 15th century won the Val Leventina as well as Bellinzona and the Val Blenio (though the Ossola valley was held for a time only), while the Grisons added to the Val Bregaglia (which had been given to the bishops of Coire in 960 by the emperor Otto I.) the valleys of Mesocco and of Poschiavo. Further, in 1512, the Swiss Confederation won the valleys of Locarno with Lugano, which, combined with the 15th century conquests by the Forest Cantons were formed in 1803 into the new Canton of Ticino or Tessin. On the other hand, the Grisons won in 1512 the Valtellina, with Bormio and Chiavenna, but in 1797 these regions were finally lost to it as well as to the Swiss Confederation, though the Grisons retained the valleys of Mesocco, Bregaglia and Poschiavo, while in 1762 it had bought the upper bit of the valley of Münster that lies on the southern slopes of the Alps.

In the Eastern Alps the political history relates simply to the advance or retreat of the house of Habsburg. The Habsburgers' ruined castle still stands in the lower valley of the Aar; they lost this district to the Swiss in 1415, and won the duchy of Austria with Styria in 1282, Carinthia and Carniola in 1335, Tirol in 1363 and the Vorarlberg in bits from 1375 to 1523, not to speak of minor "rectifications" of frontiers on the northern slope of the Alps. But on the other slope their progress was slower, and finally less successful. It is true that they early won Primiero (1373), as well as (1517) the Ampezzo valley and several towns to the south of Trent. In 1797 they obtained Venetia proper, in 1803 the secularized bishoprics of Trent and Brixen (as well as that of Salzburg, more to the north) besides the Valtellina region, and in 1815 the Bergamasque valleys, while the Milanese had belonged to them since 1535. But in 1859 they lost to the house of Savoy both the Milanese and the Bergamasca, and in 1866 Venetia proper also, and in 1918-19 the Trentino. The gain of the Milanese in 1859 by the future king of Italy (1861) meant that Italy then won the valley of Livigno (between the Upper Engadine and Bormio), besides the county of Tenda (obtained in 1575, and not lost in 1860), with the heads of certain glens in the Maritime Alps, reserved in 1860 for reasons connected with hunting. After a decisive plebiscite, Vorarlberg requested to be admitted into the Swiss Confederation in 1919, but the request was not granted in the Treaty of St. Germain. By this same treaty, a large portion of the Southern Alps, much of which was held by them at the close of the World War (1914-18), passed into the legal possession of Italy, and the boundary between that country and Austria was readjusted. The southern frontier of Austria was not altered along the Swiss section, but eastward from Gruben it now passes through Dreiherrn Spitz, then south-east of Helm Spitz and along the summit ridge of the Carnic Alps to Grintove, and northward to Unter Drauberg, where it again turns east, and on to Spielfeld. The frontier between Italy and Yugoslavia branches off and passes southward from Tarvis (south-west of Villach). By the addition of this territory of German-speaking peoples to Italy the number of sections of the Alps in which the natives do not speak the tongue of the country was increased. In Italy there are also some French-speaking districts (the Waldensian valleys as well as the Aosta and Oulx valleys). In Switzerland there are Italian-speaking regions, as well as some spots (in the Grisons) where the old Romance dialect of Romansch or Ladin survives; while in Austria, besides German, Italian and Ladin, we have a Slavonic-speaking population in the South-Eastern Alps. The highest permanently inhabited village in the Alps is Juf, 6,998ft. (Grisons); while in the French Alps, L'Écot, 6,713ft. (Savoy), and St. Véran, 6,726ft. (Dauphiné), are rivals; the Italian Alps boast of Trepalle, 6,788ft. (between Livigno and Bormio), and the Tirolese Alps of Ober Gurgl, 6,322ft., and Fend, 6,211ft. (both in the Oetzthal).

Exploration of the High Alps.—About 20 glacier passes were certainly known before 1600, about 25 more before 1700 and yet another score before 1800; but though the attempt of P. A. Arnod (an official of the duchy of Aosta) in 1689 to "re-open" the Col du Géant may be counted as made by a non-native, we do not come upon another case of the kind till the last quarter of the 18th century. The two earliest recorded ascents of high peaks were due to non-natives, that of the Rochemelon in 1358 having been undertaken in fulfilment of a vow and that of the Mont Aiguille in 1492 by order of Charles VIII. of France, in order to destroy its reputation for inaccessibility; in 1555 Conrad Gesner climbed the grassy mound of the Gnepfstein, the lowest and the most westerly of the seven summits of Pilatus. The two first men who really systematically explored the regions of ice and snow were H. B. de Saussure (1740-99), as regards the Pennine Alps, and the Benedictine monk of Disentis, Placidus à Spescha (1752-1833, most of whose ascents were made before 1806), in the valleys at the sources of the Rhine. In the early 19th century the Meyer family of Aarau conquered in person the Jungfrau (1811) and by deputy the Finsteraarhorn (1812), besides several glacier passes, their energy being entirely confined to the Bernese Oberland. Their pioneer work was continued, by a number of Swiss, among whom

were Gottlieb Studer (1804-90) of Bern, and Edouard Desor (1811-82) of Neuchâtel. The first-known English climber in the Alps was Colonel Mark Beaufoy (1764-1827), who in 1787 made an ascent (the fourth) of Mont Blanc, a mountain to which his fellow-countrymen long exclusively devoted themselves, with a few noteworthy exceptions, such as Principal J. D. Forbes (1809-68), A. T. Malkin (1803-88), John Ball (1818-89) and Sir Alfred Wills (1828-1912). Around Monte Rosa the Vincent family, Josef Zumstein (1783-1861) and Giovanni Guifetti (1801-67) did good work during the half century between 1778 and 1842, while in the Eastern Alps the Archduke John (1782-1859), Prince F. J. C. von Schwarzenberg, archbishop of Salzburg (1809-85), Valentine Stanig (1774-1847), Adolf Schaubach (1800-50), above all, P. J. Thurwieser (1789-1865), deserve to be recalled as pioneers in the first half of the 19th century. The English Alpine Club was founded in the winter of 1857-58 followed in 1862 by the Austrian Alpine Club (which in 1873 was fused, under the name of the German and Austrian Alpine Club, with the German Alpine Club, founded in 1869), in 1863 by the Italian and Swiss Alpine Clubs and in 1874 by the French Alpine Club. These clubs have explored the peaks, built huts, trained guides and published journals. The two sub-joined lists give the dates of the conquest of about 50 of the greater peaks (apart from the two climbed in 1358 and in 1492, see above), achieved before and after Jan. 1, 1858.

(1) Before Jan. 1, 1858:—Titlis (1744), Ankogel (1762), Mont Vêlan (1779), Mont Blanc (1786), Rheinwaldhorn (1789), Gross Glockner (1800), Ortler (1804), Jungfrau (1811), Finsteraarhorn (1812), Zumsteinspitz (1820), Tödi (1824), Altels (1834), Piz Linard (1835), Gross Venediger (1841), Signalkuppe (1842), Wetterhörner (1844-45), Mont Pelvoux (1848), Diablerets and Piz Bernina (both in 1850), highest point of Monte Rosa (1855), Laquinhorn (1856) and Pélmo (1857).

(2) After Jan. 1, 1858:—Dom (1858), Aletschhorn, Bietschhorn and Grand Combin (all in 1859), Grand Paradis and Grande Casse (both in 1860), Weisshorn, Monte Viso, Gross Schreckhorn, Lyskamm and Wildspitze (all in 1861), Dent Blanche, Monte della Disgrazia and Täschhorn (all in 1862), Marmolata, Presanella, Pointe des Ecrins and Zinal Rothorn (all in 1864), Matterhorn, Ober Gabelhorn, Aiguille Verte and Piz Roseg (all in 1865), Langkofel (1869), Cimon della Pala (1870), Rosengarten (1872), Meije (1877), Aiguille du Dru (1878), Punta dell' Argentera (1879), Aiguille des Charmoz (1880), Aiguille de Grépon (1881) and Aiguille du Géant (1882).

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ALPS, AUSTRALIAN, term applied somewhat loosely to the mountain massif which occupies the south-easternmost corner of Australia (eastern Victoria and south-eastern New South Wales). In a more localized sense it is applied to the higher ranges which stretch across the Victoria–New South Wales boundary and form the water-shed between the upper Murray system (Ovens, Mitta-Mitta, Indi rivers) on the north-west, and the streams (Tambo, Snowy river) flowing to the Pacific on the south-east, the upper Murrumbidgee, owing probably to events of tectonic history, partaking of both characters. The term "Alps" as applied to these mountains denotes their general characteristics as massive and seasonally snow-clad highlands rather than their special structural features. In this latter sense they are not "Alpine" mountains, being a powerfully developed "block" massif composed of elevated "horsts" and down-faulted areas (Senkungsfelder). This faulting affected an area of comparatively homogeneous topography—a peneplated surface developed on granitic and Palaeozoic rocks—and diversified it into a series of massive flattish uplands and comparatively roomy depressions. These movements, continuing into late Tertiary times or later (late Pliocene–early Pleistocene) were followed by a local glaciation (Pleistocene–Kosciusko ice age) which further emphasized the flatness of the summit topography. The result is an upper surface of broad undulating highlands upon which the highest elevations (Kosciusko, 7,340ft.; a series of heights variously named: 5,000–6,500ft.) are not distinctly remarkable. The areas of depression (e.g., Monaro) are occupied by the headwaters of streams, which, owing to the spasmodic nature of the uplifts, have worked out characteristic "valley-in-valley" forms. There are also evidences of extensive river piracy.

The highlands are snow-clad in winter, though the tree-line lies at 5,000ft. and the area of Alpine flora is small. The rocks of these highlands are extensively, if not richly, mineralized and a good deal of mining mainly in small and scattered workings (e.g., Kiandra [alt. 4,640ft.], the highest settlement in Australia; Araluen) is carried on. The valleys and basins have considerable possibilities for closer agricultural settlement, but they and the lower uplands have so far been utilized mainly for pastoral purposes. There are numerous fine sheep-stations and in the Monaro uplands in particular (Cooma: alt. 2,657 ft.; pop. c. 3,000) are good cattle, grain and fruit lands. The chief importance, however, of the Australian Alps is as a source of water-supply. The snows feed perennially the streams of south-east Australia and are thus the basis of the present and potential development of irrigation agriculture, and of inland navigation, in the adjoining areas. Physical features also—particularly the presence of long narrow valleys cut in hard rocks—have facilitated water conservation on a large scale and form thus a foundation of permanent wealth.

In addition, this area is becoming increasingly a national playground and health-resort. Kosciusko is approached chiefly from the Monaro side (Cooma is a growing tourist centre), and the cor-

responding Victorian district is the Wangaratta-Bright-Mt. Buffalo tourist route.

ALPUJARRAS, THE, a district of southern Spain, in the provinces of Granada and Almería, from the Nevada to the coast between Motril and Almería. A structural depression between the Nevada and the coastal sierras contains the midcourses of Nevada streams which have wild gorges above and below. These midcourses are in beautiful, fertile, secluded valleys with villages often on ledges overhanging the streams, and to them the name Alpujarras is often exclusively applied.

The vegetation ranges from sugar cane and palm in the valleys to Alpine flora on the heights through belts of orange, lemon and fig, of vine and olive, of chestnut and walnut and of oak, and has no parallel in Europe.

The treaty of Granada assigned the district to Boabdil but it was not observed. The descendants of the Moors were removed in 1570 after long rebellions, and colonists, especially from Estremadura, came in. An Alpujarras militia for coast defense was dependent on Veléz-Málaga. Ugíjar was formerly the capital; Orgiba is another town; Lanjarón has a castle and chalybeate baths; Trevelez is the highest village.

See *Boletín de la Real Soc. Geogr. Madrid*, xlviii, pp. 426-499 (1906).

'ALQAMA IBN 'ABADA, generally known as **'ALQAMA AT-FAHL**, an Arabian poet of the tribe Tamim, who flourished in the second half of the 6th century. His diwan consists of 3 qasidas (elegies) and 11 fragments. Asma'i considered three of the poems genuine.

The poems were edited by A. Socin with Latin translation as *Die Gedichte des 'Alkama Alfahl* (Leipzig, 1867), and are contained in W. Ahlwardt's *The Divans of the Six Ancient Arabic Poets* (1870); cf. W. Ahlwardt's *Bemerkungen über die Aechtheit der alten arabischen Gedichte*, pp. 65-71 and 146-168 (Greifswald, 1872).

ALS, a Danish island in the Baltic, off the coast of Slesvig, in the Little Belt. It was Danish property until 1864, when it was incorporated with Germany; it returned to Denmark in 1919, and was occupied again by Germany in World War II. It was of strategic importance as it guarded an approach from the North sea to the Baltic. The island is fertile and well wooded and Sonderborg, the capital, has a good harbour. Most of the inhabitants speak Danish.

Area, 121 sq.mi. Pop. (1945) 34,294.

ALSACE, EARLY OPERATIONS IN: see FRONTIER, BATTLES OF THE.

ALSACE-LORRAINE, in German **ELSASS-LOTHRINGEN**, is the 5,607 sq.mi. of territory ceded by France to Germany in 1871, retroceded to France in 1919, annexed by Germany in 1940 and recovered by France in 1945. After 1871 Germany divided it into three administrative units—Upper and Lower Alsace and Lorraine. The French made three departments out of it—Haut-Rhin, Bas-Rhin and Moselle. The third Reich added part of it to Baden and part of it to the Westmark. Alsace has more definite natural boundaries (the Rhine river and the Vosges mountains) and a more homogeneous population than the more highly industrialized Lorraine, which in the 20th century attracted much foreign labour. The population of the region was 1,767,131 in 1946 (cf. 1,915,627 in 1936), of whom about 70% declared that they could speak French, in addition, in most cases, to the Alsatian dialect (a German dialect similar to the Swiss of the region of Basle); while the rest, representing the older generation, spoke the dialect and German. There were 1,500,000 Catholics, 400,000 Protestants and 28,000 Jews according to the 1931 census; the census of 1946 gave no figures for religions, but it may be assumed that the numerical relation of Catholics and Protestants had remained about the same while Jews were probably fewer as a result of nazi persecution. Though Alsace produces petroleum and potash, it is much more important for its agricultural products, textiles and textile and other machinery. The great importance of Lorraine is a result of its coal and iron, which make it significant in the military and industrial balance of power in Europe. These facts alone indicate the great importance of the region, but the further fact that it lies across the paths of the great routes of commerce and communication—the Rhine, the Saverne pass and

the Burgundian gate—makes it a prize for either France or Germany. For the 2,000 years of its recorded history it has generally been an apple of discord in European politics (see LORRAINE), and after 1870 it played a similar role in world politics. Great scholars have attempted to prove that the natives belong to the French or the German nationality. The careful observer who speaks and understands the dialect is likely to conclude that the Alsatian is above all else an Alsatian particularist.

History to French Revolution.—In 58 B.C., after having defeated the Helvetians, Julius Caesar met and defeated the Germanic tribes who, under their chieftain Ariovistus, had crossed the Rhine near the mouth of the Neckar and had taken possession of the Alsatian plain. Tradition places the site of the bloody battle on the "Ochsenfeld" near Cernay (Sennheim) and attributes the infertility of the soil to the curse of heaven imposed because of the bloodshed of that day. The victorious Romans dominated the region, in spite of the efforts of the Alemanni, for four centuries. The Rhine was not an effective military frontier, as Caesar soon discovered. In A.D. 357 a second notable encounter (the battle of Strasbourg) left the Romans in possession, but while they were defeating the Alemanni another Germanic tribe, the Franks, moved into the region of the Meuse, Scheldt and Sambre valleys; thus Lorraine entered as a second area of border conflict. Two decades later the Alemanni were defeated again in a battle near Colmar. The terrors of Attila and his Huns led Romans, Celts and Germans to unite to drive out the invader, or at least to check him at Châlons in 451. In the wake of the retreating Huns, the Alemanni, taking advantage of the declining strength of the Romans, moved into Alsace-Lorraine and fixed the linguistic boundary almost as it was when the armies of the third Reich took possession in 1940.

The rise of the Frankish kingdom and the later empire brought Alsace-Lorraine into the heart of a great political organization. Though the favourite residences of Charlemagne were at Aachen and Ingelheim, he resided at times at Colmar and Schlettstadt (Sélestat) in Alsace. The Rhine was the centre of his great empire. When that empire was divided under the treaty of Verdun in 843, the middle portion, which fell to the emperor Lothair I, included Alsace-Lorraine. In the second division, under the treaty of Mersen in 870, Alsace-Lorraine became a part of the kingdom of Louis the German. In the centuries following, the region was broken up into small ecclesiastical and political units. (See LORRAINE.)

An important influence in the development of Alsace under the Holy Roman empire was the evolution of the free towns—Haguenau, Landau, Colmar, Schlettstadt, Wissembourg, Obernheim (Obernai), Rosheim, Kayersberg, Turkheim and Munster. Nominally they were under a prefect residing in Haguenau and representing the house of Habsburg, but to a great extent they were little republics. Strasbourg, an episcopal see, was also a republic directly under the empire. Mulhouse was a republic associated with the Swiss confederation from the 16th century until 1798 when the confederation was dissolved by the French conquerors. During the French Revolution the French market was closed to Mulhouse, a reversal of a former policy. Under those conditions it voted to join France. The Swiss version of that event is that it was forcibly annexed by France; the French version, that it joined voluntarily and by a large vote. During the 15th century Charles the Bold of Burgundy hoped to restore the middle kingdom and actually obtained a mortgage on the Habsburg rights in Alsace. His ambitions led to the co-operation of the Swiss, Alsations and Lorrainers, who ended his dream on the field of battle at Nancy in 1477, where Charles was defeated and killed. The Alsations with the help of the Swiss had already tried, condemned and executed his governor in that region.

The religious and dynastic wars of the 17th century furnished the opportunity for great soldiers and military engineers to make enviable reputations by bringing death and devastation into the region. By 1700 France had conquered Alsace-Lorraine and all but brought about the dissolution of the Holy Roman empire. The peace of Westphalia in 1648, which confirmed France in its possession of the three bishoprics of Lorraine (Metz, Toul and Verdun), had marked the end of the long era of German domina-

tion and the beginning of the French era for Alsace-Lorraine. Louis XIV recognized the particularism of the region by permitting political, social, economic and ecclesiastical institutions to continue much as before. The Protestants were given much more freedom than those of France proper. Even the municipal system, a result of the free imperial towns, was not radically changed. A very small circle of bourgeois aristocrats spoke French and drew cultural inspiration from France, while the masses spoke their dialect and saw to it that their aristocracy continued to be the "poorest and the purest" in the realm. The language, habits and institutions were German. A feeling of loyalty to the French monarchy gradually linked together Alsace and France. Lorraine was incorporated into the kingdom of France on the death of Stanislaus I (Leszczyński) in 1766.

About the middle of the 18th century three men organized a company for calico printing in Mulhouse. Out of that beginning grew one of the important textile industries on the continent of Europe. Apparently the industry was learned from Swiss and south German workmen, and at least one of the original organizers was himself a Swiss from a Zürich family. Another had Swiss connections and may have been from that country. The two families—the Koechlings and the Dollfuses—made an enviable record in industry, science, letters, art, politics and philanthropy. They were carriers of the liberal tradition of the Swiss. Whenever Alsations were called to Paris or Berlin they usually found themselves with a rather small liberal or progressive minority on social, economic and political issues.

From 1789 to 1919.—The French Revolution aroused a keen interest in the region, partly because it was the application of much of the philosophy of the inhabitants. It also aroused a strong anti-German feeling, because the fiercest opponents to the Revolution were German feudal lords who owned estates in Alsace and endeavoured to recover their privileges there. The attack on the church and its property raised some doubts until Napoleon concluded the concordat of 1801 with Rome. It is not without significance that, though the "Marseillaise" originated in Strasbourg, the municipality tried to keep all of its special political and economic privileges. In general, the liberalism of the Revolution appealed to the Alsations much more than the centralization. An unusually large proportion of the great military leaders of the era came from the region. The industrial leaders who needed a bigger market favoured Napoleon's policy of breaking down customs barriers and integrating Europe into greater units. Alsace had a conspiracy trial, and at least one execution, about 1820. It had another involving 40 Alsatian Republicans in 1849. In the first conspiracy an Alsatian member of the chamber of deputies was involved—a member of the prominent Koechlin family. Upon his return to his constituents he was given a reception and in due time he was re-elected to take his place next to the marquis de la Fayette, with the extreme Left. The Republicans tried in 1849 were enthusiastically received upon their return from the trial at Besançon. The Cobden-Chevalier treaty appealed to the industrialists of Mulhouse, but Napoleon III, who had attempted a coup against the July monarchy in Strasbourg in 1836, never won the elections in Strasbourg, Mulhouse or Upper Alsace. His effort to popularize the French language met with little success.

The rise of Germany after 1815 created a difficult problem for French statesmen who saw in it a threat to the dominant position of France. In 1830 the prime minister, the prince de Polignac, suggested a scheme for the annexation of Belgium, Luxembourg, the Saar basin and the southern Palatinate, to maintain the balance in favour of France. Napoleon III's ambitions in the same region were exploited by Bismarck in his preparations for the Franco-German War and the overthrow of the Second Empire. The third republic, for which the inhabitants of Alsace-Lorraine were enthusiastic, transferred the region to the new German empire. The delegation from the region made a strong protest in the French assembly but it was in vain.

The first delegation to the German *Reichstag* carried its protest to that body in 1874. Practically every delegation to the *Reichstag* until 1890 was unanimously opposed to the German regime. Many of the irreconcilables left the region and went to France

or other countries. Bismarck seemed to have high hopes for an early assimilation of the German-speaking majority, but under the circumstances he was practically compelled to govern Alsace-Lorraine as a conquered province. The early recovery of France together with the fact that French statesmen flirted with the policy of revenge added to Bismarck's troubles. A local consultative committee (*Landesausschuss*) was granted in 1874 and was given three years later some power to initiate legislation. In 1879 a resident *Statthalter*, representing the imperial chancellor, was appointed. There could be no effective self-government until 1902, as the *Statthalter* had, until that time, the power to declare martial law whenever he saw fit.

However, from the time of the Dreyfus case onward, the French government embarked on an increasingly anticlerical policy that alienated many of the inhabitants of Alsace-Lorraine. By 1905 the anticlerical legislation had been passed and the clerical party, the strongest single party in Alsace-Lorraine, sought a new orientation. Bismarck (despite his *Kulturkampf*) and the German statesmen who succeeded him after 1890 never interfered with the concordat of 1801 in the province. The eventual German compromise with the church appealed to the clericals in comparison with the French anticlericalism. After 1900 the clericals in Alsace-Lorraine looked forward to an autonomous Alsace-Lorraine in the German empire. This left the irreconcilables in a desperate position. They redoubled their efforts to maintain the maximum of French culture in the region but many of them recognized that their struggle was all but hopeless. By 1911 a new constitution was granted which opened the way for the Reichsland, as it was called, to become an equal among the members of the empire. Provision was made for a bicameral *Landtag* and a vote in the imperial federal council. There was still plenty of dissatisfaction but the first election seemed to indicate that the government party had the majority.

The irreconcilables, however, were reinforced from a strange quarter. After the fall of Bismarck, German statesmen moved in the direction of pan-Germanism and imperialism. The new policy together with its repercussions abroad called for a tremendous increase in the military and naval budgets and these were opposed by the members of the *Reichstag* from Alsace-Lorraine. The inhabitants of the region saw nothing to be gained but very much to be ventured by war. As an exposed part of the empire, they were heavily garrisoned. Clashes between the civilians and the military authorities were inevitable. The most notorious was the incident at Saverne (*q.v.*) in 1913, in which it seemed clear that the military showed a woeful lack of discipline; the local diet, under the presidency of Eugène Ricklin, placed the blame directly on the military authorities. Such incidents caused the tide to turn against the German regime although it was not until 1916, after World War I had been going on for two years, that the majority was against the government. To meet that situation it was proposed to dismember the province and partition it among several German states. Before that was accomplished the exigencies of the war demanded radical action. The former policy was completely reversed; Alsace-Lorraine was to have a more autonomous government headed by Rudolf Schwander, former mayor of Strasbourg. The local politicians, however, were too shrewd to attempt to form a cabinet. The natives rejoiced as the German armies retreated across the Rhine.

After 1919.—The treaty of Versailles recognized "the moral obligation to redress the wrong done by Germany in 1871 both to the rights of France and to the wishes of the population." A preferable version, even in 1919, would have been "to the rights of the population and to the wishes of France," if the Alsations had been consulted. The tumultuous welcome given to the French was the result, in a measure, of war weariness. More important was the fact that the French officers had made it clear that customs, traditions and liberties would be respected. The fact that French officials almost immediately afterward began to speak of "assimilating" the reconquered provinces to France tempts one to conclude that they did not understand the implications of their own promise. They hoped to blot out forever the name Alsace-Lorraine, which in fact was a German creation, without any root

in previous history, by simply resurrecting the Haut-Rhin, Bas-Rhin and Moselle of the earlier period. A commissioner-general was appointed with three commissioners, one for each department, but no sovereign power was recognized except the central government of France. Even the functions of the transitional commissariat-general were transferred to Paris in 1925 as though the period of transition had terminated. The Edouard Herriot ministry (1924-25) raised some doubts when it declared for the introduction of "the whole of the republican legislation" into Alsace-Lorraine. A suggestion to make some changes in the confessional schools was taken as evidence that the concordat of 1801 was to be attacked.

At that stage, Eugène Ricklin, who had been a leading autonomist during the German regime, together with several others founded a newspaper and the Heimatbund (League for Home Rule). Their program called for complete autonomy "within the French state." The issue was between "the whole of the republican legislation" and "complete autonomy," or between centralization and particularism. Raymond Poincaré, at the head of a new ministry (1926), resorted to drastic action, suppressing newspapers on the ground that they were in a foreign tongue, in spite of the fact that German was the written language of 75% of the population. The crowning event came on Christmas Eve 1927 when wholesale searches, seizures and arrests were made. Two of those held were elected to the chamber of deputies before the time of the trial. Only those who could speak French were eligible for jury duty, a fact which led the public to discredit the whole procedure and to conclude that there was no justice to be had in France. Among those found guilty were the two who had been elected to the chamber. Since they were denied the right to their seats, a second election gave the voters the opportunity to elect two other autonomists. The trend of events taught Poincaré and his ministers that repression was not the solution, so they reversed themselves and resorted to a more conciliatory policy. The matter was debated in the chamber of deputies early in 1929, Poincaré himself speaking ten hours on the subject. The ministry attempted to maintain that separation must be the aim and purpose of those who oppose the "one and indivisible" theory of the French government, and separation obviously was treason. The incomplete dichotomy did not silence the autonomists, who pointed to the fact that the minister of the interior himself was working out a plan for administrative decentralization. Moreover, they insisted that the "one and indivisible" theory was a contradiction of the promise to respect the liberties, traditions and customs of Alsace-Lorraine. Language, religion, education, civil service, municipal institutions—all these were elements in their traditions for which they demanded respect. They wanted no official class that spoke only French and no atheistic French teachers for their religious schools. The harmless resolution by which the long debate was terminated found many of the members from Alsace-Lorraine in the opposition. The conciliatory policy did not cause the autonomists to disband. They had won more than a hearing in the first round.

The rise of the third reich gave both nationalists and autonomists in France other matters to occupy their minds after 1929. The coming of World War II brought another wave of arrests and at least one execution among the small group of definitely pro-German autonomists. Among the members of the chamber arrested were at least two of those involved in the chamber elections and arrests of 1929. The Germans, on occupying Alsace-Lorraine in 1940, resorted to wholesale deportations of the French-speaking inhabitants and also of a great number of others. But their attempts to germanize Alsace-Lorraine were a complete failure. Those of the autonomist leaders who suddenly revealed themselves as convinced nazis and even held offices in the new German civil service and hierarchy were completely discredited in the eyes of the population.

In 1945 Alsace-Lorraine became French again. Problems subsequently became much less acute than they had been before the war. The local legislation and particularly the concordat remained in force. The autonomist movement disappeared. None of the parties in Alsace-Lorraine (of which the clerical M.R.P. [Mouvement

Républicain Populaire] and the Gaullist R.P.F. [Rassemblement du Peuple Français] were the most prosperous) had a home-rule program. If probably the greater part of the natives would still call themselves Alsatian, very few, if any at all, would accept being labelled Germans. An increasing number among the younger generations considered themselves French, with a slight nuance, but without any restriction.

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ALSATIA (the old French province of Alsace), long a "debatable ground" between France and Germany, and hence a name applied in the 17th century to the district of Whitefriars, between the Thames and Fleet street, in London, which gave sanctuary (*q.v.*) to debtors and criminals. The privileges were abolished in 1607.

ALSBERG, CARL LUCAS (1877-1940), U.S. biochemist, was born in New York city on April 2, 1877. He graduated from Columbia university in 1896 and from the College of Physicians and Surgeons in 1900. Following three years' study in 1900-03 in Germany, he was an assistant and instructor at Harvard university until 1908. From 1908 to 1912 he was chemical biologist in the bureau of plant industry and from 1912 to 1920 he was chief of the bureau of chemistry in the U.S. department of agriculture.

In 1920 he was made director of the Stanford Food Research institute, Stanford university, California, and in 1937 director of the Giannini Foundation of Agricultural Economics, University of California. His researches included investigations on the biology and toxicology of moulds, cyanogenesis in plants, poisonous plants, phosphoric acid, metabolism, nucleic acids, proteins, cystinuria, enzymes and the chemistry of foods.

ALSIETINUS LACUS (mod. LAGO DI MARTIGNANO), small lake, south Etruria, 15 mi. due N.N.W. of Rome, in an extinct crater. Augustus drew from it the Aqua Alsietina; the water was hardly fit to drink, and was mainly intended to supply his nautachia (lake made for a sham naval battle) at Rome, near S. Francesco a Ripa, on the right bank of the Tiber. The aqueduct, mainly subterranean, is practically untraced. Frontinus tells us that it received water from the lake of Bracciano near Careiae (Galera); an inscription relating to it has been found in this district, while the only known remains of the channel were found on the Janiculum in 1927.

ALSIKE CLOVER, the common name of *Trifolium hybridum*. It is of agricultural importance for hay, pasture and soil improvement in cool humid climates of North America and Europe. Botanically, alsike clover is a perennial, but under many agricultural conditions it behaves as a biennial. The flower colour is white or pinkish white. A native of Europe or Asia Minor, alsike clover has become widely naturalized in the United States, with the first known seed introductions occurring in 1839. It is probable that it had been previously introduced by chance.

ALSIMUM (mod. PALO), ancient town, Etruria, on the Via Aurelia, about 22 mi. from Rome. It was one of the oldest cities of Etruria, colonized by Rome in 247 B.C., but was of importance only as a resort of wealthy Romans, many of whom (*e.g.*, Pompey and the Antonine emperors) had villas there, considerable remains of which exist. The mediaeval castle belongs to the Odiscalchi family.

ALSOP, VINCENT (c. 1630-1703), English Nonconformist divine, was ejected from his living under the Act of Uniformity in 1662. He had a great reputation as a pamphleteer in his day. Even with Goodman and Edward Stillingfleet as opponents he held his own. His *Mischief of Impositions* (1680), in answer to Stillingfleet's *Mischief of Separation*, and his *Melius Inquirendum* (1679), in answer to Goodman's *Compassionate Inquiry*, remain historical landmarks in the history of Nonconformity.

See Wood's *Athenae* (Bliss) iv, 106; Calamy's *Life of Baxter*, ii, 487; Wilson's *History and Ant. of Dissenting Churches*, iv, 63-66.

ALSTED, JOHANN HEINRICH (1588–1638), German Protestant divine. He was sometime professor of philosophy and theology at Herborn, in Nassau, and afterwards at Weissenburg in Transylvania, where he remained till his death in 1638. He was a marvellously prolific writer. His *Encyclopaedia* (1630) was long held in high estimation.

ALSTON, JOSEPH (c. 1779–1816), American planter and governor of South Carolina, was born probably in All Saints' parish, S.C., about 1779. He was educated at Princeton but left in his senior year and studied law in the office of Edward Rutledge. He was elected to the South Carolina legislature in 1802, and continued to serve until 1812, being speaker from 1805 to 1809. In 1812 he was elected governor and his administration, 1813–15, was noted for its energetic support of the War of 1812. In 1801 Alston married Theodosia Burr (*q.v.*), brilliant daughter of Aaron Burr (*q.v.*). Through this marriage Alston was drawn into a minor connection with the so-called "Burr Conspiracy," and the fact hampered his political career. It was but natural that he should have aided Burr during the trial to establish his innocence, and it has been established that he was the author of the pamphlet *Agrestis* which then appeared. Alston's only child died in 1812 and in 1813 Theodosia was lost at sea. Alston, himself of frail health, survived these tragedies but a few years, dying on Sept. 10, 1816.

ALSTONITE, a member of the aragonite group of minerals. It consists of an isomorphous mixture of calcium and barium carbonates in various proportions ($(\text{Ca,Ba})\text{CO}_3$), and thus differs chemically from barytocalcite (*q.v.*) which is a double salt of these carbonates in equal molecular proportions. Being isomorphous with aragonite, it crystallizes in the orthorhombic system, but simple crystals are not known. The crystals are invariably complex twins and have the form of doubly terminated pseudo-hexagonal pyramids, like those of witherite but more acute. The crystals are translucent and white, sometimes with a shade of pink. Sp. gr. 3.706; hardness 4–4½. The mineral has been found at only three localities, all of which are in the north of England. It takes its name from Alston in Cumberland, where it occurs in veins of lead ore.

ALSTRÖMER, JONAS (1685–1761), pioneer of Swedish industrialism, was born at Alingsås in Västergötland, Jan. 7, 1685. He left his native village at an early age, and in 1707 became clerk to Alberg, a merchant of Stockholm, whom he accompanied to London. After carrying on business for three years, Alberg failed, and Alströmer (who changed his name from Alström on receiving letters of nobility) engaged in the business of shipbroker on his own account. He returned to Alingsås, and in 1724 established a woollen factory there. After preliminary difficulties it became a very profitable business. He next established a sugar refinery at Gothenburg, introduced improvements in the cultivation of potatoes and of plants suitable for dyeing, and directed attention to improved methods in shipbuilding, tanning and the manufacture of cutlery. But his most successful undertaking was the importation of sheep from England, Spain and Angora. He died June 2, 1761, leaving several works on practical industrial subjects.

ALT, ALTISSIMO. In music, the notes of the octave beginning with the G above the treble stave are said to be "in alt" and those of the succeeding octave "in altissimo," although by some the F instead of the G is taken as the beginning of the higher octave. The same notes are also indicated by the employment of italic type followed by two and three strokes respectively, e.g., *g'* and *g'''*.

ALTAI (in Mongolian *Altai-nula*, the "Mountains of Gold"), a term used with various significations. The *Altai region*, in west Siberia and Mongolia, is similar in character to the Alps, but covers a much greater area. It extends from the river Irtysh and the Dzungarian depression (46° – 47° N.) northwards to the Siberian railway and to the Sayan mountains. The backbone of the region is the Sailughem mountains (Silyughema or Kolyvan Altai), which stretch north-eastwards from 49° N. and 86° E. towards the west end of the Sayan mountains (51° $60'$ N. and 89° E.). Their mean elevation is 5,000–5,500ft. The snow-line

runs at 6,700ft. on the northern versant and at 7,800ft. on the southern, the rugged peaks standing 3,200ft. above it. Passes are few and difficult, the chief being Ulan-daban at 9,275ft. (9,445ft. according to Kozlov) and Chapchan-daban, at 10,555ft., in the south and north respectively. On the east and south-east this range is flanked by the great plateau of Mongolia, the transition being effected gradually by means of several minor plateaus, such as Ukök (7,800ft.), Chuya (6,000ft.), Kendykty (8,200ft.), Kak (8,270ft.), Suok (8,500ft.) and Juvlu-kul (7,900ft.). This region, which is not accurately known, is studded with large lakes, e.g., Ubsa-nor (2,370ft. above sea-level), Kirghiz-nor, Durga-nor and Kobdo-nor (3,840ft.), and crossed by mountain ranges, the principal being the Tannu-ola, roughly parallel with the Sayan mountains as far east as the Kosso-gol (100° – 101° E.), and the Khan-khu mountains, also stretching west to east.

The *Altai proper* (the Ek-tagh, Mongolian Altai, Great Altai or Southern Altai) likewise extend in two twin parallel chains eastwards as far as 99° , if not farther. The Ek-tagh, which separates the Kobdo basin (north) from the Irtysh basin (south), is a true border-range, in that it rises in a steep and lofty escarpment from the Dzungarian depression (1,550 to 3,000ft.), but descends on the north by a relatively short slope to the plateau (4,000–5,500ft.) of north-western Mongolia. East of 94° the range is continued by a double series of quite distinct chains. The southern chain bears the names of Karadzirga and Burkhan-ola, and terminates in about 99° ; but the northern range, the principal names of which are Artsi-bogdo and Saikhat, extends probably most of the way to the great northward bend of the Hwang-ho round the desert of Ordos. Whereas the western Ek-tagh Altai rises above the snow-line and is destitute of timber, the eastern double ranges barely touch the snow-line and are clothed with thick forests to an altitude of 6,250ft. The slopes of these chains are inhabited principally by nomad Kirghiz.

The north-western and northern slopes of the Sailughem mountains are extremely steep and very difficult of access. On this side lies the culminating summit of the range, the double-headed Byelukha, whose summits reach 14,890 and 14,560ft. respectively, and give rise to several glaciers. Here also are the Kuitun (12,000ft.) and several other lofty peaks. There are numerous spurs, striking in all directions to the lowlands of Tomsk, but their mutual relations are not well known. Such are the Chuya alps (average altitude 9,000ft., with summits from 11,500 to 12,000ft., and at least ten glaciers on their northern slope); the Katun alps (mean elevation about 10,000ft. and mostly snow-clad); the Kholzun range; the Korgon (6,300 to 7,600ft.), Talitsk and Selitsk ranges; the Tigeretsk alps, and so on. Several secondary plateaus of lower altitude are also distinguished. The River Katun begins in a wild gorge on the south-west slope of Byelukha; then pierces the Katun alps, and enters a wider valley, at an altitude of from 2,000 to 3,500ft., which it follows until it joins the River Biya, to form the River Ob. The River Charysh has the Korgon and Tigeretsk alps on one side and the Talitsk and Bashalatsk alps on the other, and its valley, like the others, is very fertile. Farther west the valleys of the Uba, the Ulba and the Bukhtarma open south-westwards towards the Irtysh. The lower part of the first, like the lower valley of the Charysh, is thickly populated; in the valley of the Ulba is the Riddersk mine, at the foot of the Ivanovsk peak (6,770ft.). The valley of the Bukhtarma also has its origin at the foot of the Byelukha and the Kuitun peaks, and it falls some 5,000ft. in less than 200m. to the Bukhtarma fortress (1,130ft.). Its upper parts abound in glaciers, the best known of which is the Berel, which comes down from the Byelukha. On the northern side of the range which separates the upper Bukhtarma from the upper Katun is the Katun glacier, in which the Katun river rises. The middle and lower parts of the Bukhtarma valley have been colonized since the 18th century by runaway Russian peasants who created there a free republic on Chinese territory; and after this part of the valley was annexed to Russia, in 1869, it was rapidly colonized. The high valleys farther north, on the same western face of the Sailughem range, are little known, their only

visitors being Kirghiz shepherds. Those of Bashkaus, Chulyshman, and Chulcha, all three leading to Lake Teletskoye (length, 48m.; max. width, 3m.; altitude, 1,700ft.; area, 87sq.m.; max. depth, 1,020ft.; mean depth, 660ft.), are only inhabited by nomad Telengites or Teletuts. The shores of the lake rise almost sheer to over 6,000ft. and are too wild to accommodate a numerous population. From this lake issues the Biya, which joins the Katun at Biysk. Farther north the Altai highlands are continued in the Kuznetsk district, which has a slightly different geological aspect, but still belongs to the Altai system. But the River Abakan, which rises on the west of the Sayan mountains, belongs to the system of the Yenisei. The Kuznetsk Ala-tau range, on the left bank of the Abakan, runs north-east while a complexus of imperfectly mapped mountains (Chukchut, Salair, Abakan) fills up the country northwards towards the Siberian railway and westwards towards the Ob. The Tom and its numerous tributaries rise on the northern slopes of the Kuznetsk Ala-tau, and their fertile valleys are occupied by a dense Russian population, the centre of which is Kuznetsk, on the Tom.

Geology.—The Altai mountains consist of two distinct elements which differ considerably in geological formation. The Mongolian, or Great Altai, consists essentially of Archaean rocks (gneisses, etc.), in which there is no folding of Hercynian or Alpine age, but the strike of the rocks is independent of the direction, determined by fault fractures, of the chains. The region forms a horst. In the Russian Altai we find various Archaean schists with Palaeozoic rocks, predominantly limestones with Devonian and Carboniferous fossils. They were folded during the Hercynian period, the general trend of the folds being north-north-east. Of the same age as the folding are intrusions of granitic and other igneous bodies with which are associated the famous ore deposits.

Flora.—The flora of the Altai is rich and very beautiful. Up to a level of 1,000ft. on the northern and 2,000ft. on the southern slopes, plant life belongs to the European flora, which extends into Siberia as far as the Yenisei. The steppe flora penetrates into the mountains, ascending some 1,100–1,200ft., and in sheltered valleys even up to 5,500ft., when it comes into contact with the purely alpine flora. Tree vegetation, which reaches up as high as 6,500 and 8,150ft., the latter limit on the north and west consists of magnificent forests of birch, poplar, aspen and Coniferae, such as *P. cembra*, though the fir is not found above 2,500ft., while the meadows are abundantly clothed with brightly-coloured, typical assortments of herbaceous plants. The alpine meadows, which have many species in common with the European Alps, have also a number of their own peculiar Altaian species. For population, administrative divisions, etc., see SIBERIAN AREA.

ALTAIR, the brightest star in the constellation Aquila (*q.v.*), and, on this account, also known as α Aquilae. It is the middle member of the group β , α , γ in the constellation, and is of the first magnitude, being one of the nearest and brightest stars. Its distance from the solar system is about 16 light-years. It is a white star having a size slightly greater than that of our sun and giving out about ten times as much light.

ALTAMURA, Apulia, Italy, province of Bari, 28 mi. S.W. of the city Bari, and 56 mi. by rail via Gioia del Colle. Pop. of the city (1936) 31,099; commune 31,431. It possesses a fine Romanesque cathedral begun in 1232 and restored in 1330 and 1543, the portal being especially remarkable. It is one of the four Palatine churches of Apulia. The mediaeval walls, erected by the emperor Frederick II., rest upon the walls of a pre-Roman city of unknown name. There is some trade in wool.

ALTAR, a base or pedestal used for sacrifice or prayer to a deity.

Mesopotamia.—Altars are found from the earliest times in the remains of Babylonian cities; the oldest are square erections of sun-dried bricks. In Assyrian mounds limestone and alabaster are the chief material. They are of varying form; an altar shown in a relief at Khorsabad has stepped battlements, corresponding to the Hebrew "altar-horns." An altar also from Khorsabad (now in the British Museum) has a circular table and a solid base, triangular in plan, with pilasters ornamented with animals' paws at the

angles. An 8th century B.C. altar from Nimrūd (also in the British Museum) is a rectangular block with cylindrical rolls at the ends. These altars are 2ft. to 3ft. high. According to Herodotus (*i.* 183) the great altars of Babylonia were made of gold.

Egypt.—In Egypt altars took the form of a truncated cone or of a cubical block of polished granite or of basalt, with one or more basin-like depressions (with drainage channels) in the upper surface for receiving libations. The surface was plain, inscribed with dedicatory or other legends, or adorned with symbolical carving.

Palestine.—Recent excavations, especially at Gezer, have shown that the earliest altars, or rather sacrifice hearths, in Palestine, were circular spaces marked out by small stones set on end. At Gezer a pre-Semitic place of worship was found in which three such hearths stood together, and drained into a cave which may reasonably be supposed to have been regarded as the residence of the divinity. These circular hearths persisted into the Canaanite period, but were ultimately superseded by the Semitic developments. To the primitive nomadic Semite the presence of the divinity was indicated by springs, shady trees, remarkable rocks and other landmarks; from this conception grew the theory that a *numen* might be induced to take up an abode in an artificial heap of stones, or a pillar set upright for the purpose. The blood of the



THE CATHEDRAL, ALTAMURA, BUILT IN THE 13TH CENTURY
Altamura, an ancient town of Italy situated in fertile farm country at the foot of the Apennines, is famous locally for its fairs

victim was poured over the stone as an offering to the divinity dwelling within it; and the stone came finally to be used as a table on which the victim was to be burned.

A very remarkable altar, at present unique, was found at Taanach by the Austrian excavators. It is pyramidal in shape, and the surface is ornamented with human-headed animals in relief. This, like the earliest Babylonian altars, is of baked earth. These primitive altars were of the simplest possible description—in accordance with the regulation preserved in Exod. xx. 24–26, that in every place where Yahweh records his name an altar of earth

or of unhewn stone, without steps or other ornamentation, shall be erected.

The priestly regulations affecting altars are of a very elaborate nature, and are framed with a single eye to the essential theory of later Hebrew worship—the centralization of all worship at one shrine. These recognize two altars, which by the authors of this portion of the Pentateuch are placed in the tabernacle in the wilderness.

The first, that for burnt-offering, was in the centre of the court of the tabernacle, of acacia wood, 3 cubits high and 5 square. It was covered with copper, was provided with "horns" at the corners, hollow in the middle, and with rings on the sides into which the staves for its transportation could be run (Exod. xxvii. 1-8). The altar of the Solomonic temple is on similar lines, but much larger. It is now generally recognized that the description of the tabernacle altar is intended to provide a precedent for this vast structure, which would otherwise be inconsistent with the traditional view of the simple Hebrew altars. In the second temple a new altar was built after the fashion of the former (I. Macc. iv. 47) of "whole stones from the mountain." In Herod's temple the altar was again built after the same model. It is described by Josephus (v. 5, 6) as 15 cubits high and 50 cubits square, with angle horns, and with an "insensible acclivity" leading up to it (a device to evade the pre-Deuteronomic regulation about steps). It was made without any use of iron, and no iron tool was ever allowed to touch it. The blood and refuse were discharged through a drain into the brook Kedron; this drain probably still remains, in the *Bir-el-Arwah*, under the "Dome of the Rock" in the mosque which covers the site of the temple.

The second altar was the altar of incense, in the holy place of the tabernacle. It was of similar construction to the altar of burnt-offering, but smaller, being 2 cubits high and 1 cubit square (Exod. xxx. 1-5). It was overlaid with gold. Solomon's altar of incense (I. Ki. vi. 20) would appear to have been of cedar. But the authenticity of the passages describing the altar of incense in the tabernacle, and the historicity of the corresponding altar in Solomon's temple, are matters of keen dispute among critics. The incense altar in the second temple was removed by Antiochus Epiphanes (I. Macc. i. 21) and restored by Judas Maccabaeus (I. Macc. iv. 49). That in the temple of Herod is referred to in Luke i. 11.

On the first of these altars was a fire continually burning, in which the burnt-offerings were consumed. On the second an offering of incense was made twice a day. The use of the altar as an asylum is implied in Exod. xxi. 14. From I. Ki. i. 50, ii. 28, it would appear that the suppliant caught hold of the altar-horns (compare I. Ki. ii. 28).

Greece and Rome.—According to their respective uses, altars fell into two classes. Those of the first class were pedestals, so small and low that the suppliant could kneel upon them; these stood inside the temples, before the sacred image. The second class consisted of larger tables destined for burnt sacrifice; these were placed in the open air, and, if connected with a temple, in front of the entrance. The second class of altars, called *βωμοί* by the Greeks and *altaria* by the Romans, appears to have originated in temporary constructions such as heaps of earth, turf or stone, made for kindling a sacrificial fire as occasion required. But sacrifices to earth divinities were made on the earth itself, and those to the infernal deities in sunk hollows (*Odyss.* x. 25; *Festus* s. v. *Altaria*). The note of Eustathius (*Odyss.* xii. 252) seems to suggest survival of a primitive custom of offering sacrifice without an altar at all. Pausanias (vi. 20. 7) speaks of an altar at Olympia made of unbaked bricks. In some primitive holy shrines the bones and ashes of the victims sacrificed were allowed to accumulate, and upon this new fires were kindled. Altars so raised were considered as endowed with particular sanctity; notable instances are the altars of Hera at Samos, of Pan at Olympia, of Heracles at Thebes and of Zeus at Olympia (Paus. v. 14, 6; v. 15, 5; ix. 11, 7; v. 13, 5). The last-mentioned stood on a platform (*πρόθυρος*) measuring 125 ft. in circumference, and led up to by steps, the altar itself being 22 ft. high. Women were excluded from the platform. Where hecatombs were sacrificed, the *πρόθυρος* necessarily assumed colos-

sal proportions, as in the case of the altar at Parion, where it measured on each side 600 ft. The altar of Apollo at Delos (*κεράτυρος βωμός*) was made of the horns of goats believed to have been slain by Diana; at Miletus was an altar composed of the blood of victims sacrificed (Paus. v. 13, 6). The altar of Phorae in Achaëa was of unhewn stones (Paus. vii. 22, 3); that used at the festival in honour of Daedalus on Mt. Cithaeron was of wood, and was consumed along with the sacrifice (Paus. ix. 3, 4). Others of bronze are mentioned. But these were exceptional. The usual material of an altar was marble, and its form, both among the Greeks and Romans, was either square or round; polygonal altars, of which examples still exist, being exceptions. When sculptured decorations were added they frequently took the form of festoons like those used to ornament altars, or of symbols, such as crania and horns of oxen, referring to the victims sacrificed. Altars apart from temples usually bore the name of the person by whom they were dedicated, and the name, or a representation, of the deity in whose service they were. An altar was usually retained for the service of one particular god, but joint dedications occur, as in the case of the altar at Olympia to Artemis and Alpheus jointly, or that of Poseidon and Erechtheus in the Erechtheum at Athens; at Oropus the altar was divided into five parts, one dedicated to Heracles, Zeus and Paean Apollo, a second to heroes and their wives, a third to Hestia, Hermes, Amphiarus and the children of Amphilocheus, a fourth to Aphrodite Panacea, Jason, Health and Healing Athens, and the fifth to the Nymphs, Pan and the rivers Archelous and Cephissus (Paus. i. 34, 2). Deities of an inferior order, who were conceived as working together—e.g., the wind gods—had an altar in common. In the same way, the "unknown gods" were regarded as a unit, and had in Athens and at Olympia one altar for all (Paus. i. 1, 4; v. 14, 5; cf. Acts xvii. 23). An altar to all the gods is mentioned by Aeschylus (*Supp.* 222). Other exceptional classes of altars are those on which fire could not be kindled (*βωμοί ἀπύρτοι*), and those which were kept free from blood (*βωμοί ἀναιμακτοί*), of which in both respects the altar of Zeus Hypatos at Athens was an example. The *εστία* was a round altar; the *ἐσχάρα*, one employed apparently for sacrifice to inferior deities or heroes (but *ἐσχάρα Φολβου*, Aesch. *Pers.* 205). In Rome an altar erected in front of a statue of a god was always required to be lower than the statue itself (Vitruvius iv. 9). Altars were always places of refuge, and even criminals and slaves were there safe, violence offered to them being insults to the gods whose suppliants the refugees were for the time being.

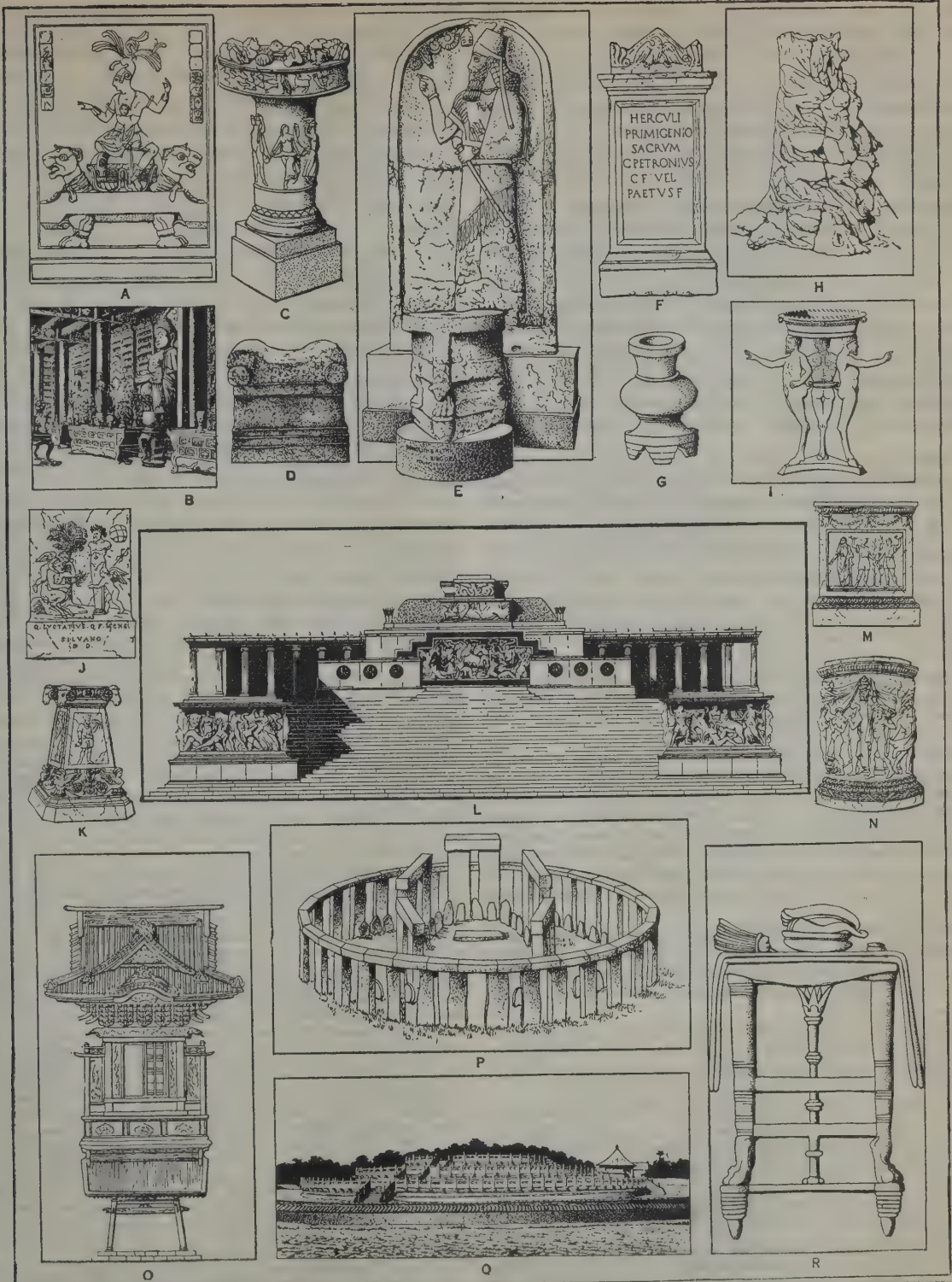
Ancient America.—As a single specimen of an altar, wholly unrelated to any of the foregoing, we may cite the ancient Mexican example described by W. Bullock (*Six Months in Mexico*, London, 1824, p. 335). This was cylindrical, 25 ft. in circumference, with sculpture representing the conquests of the national warriors in 15 different groups round the side.

Portable altars and tables of offerings were used in pre-Christian as well as in Christian ritual. One such was discovered in the Gezer excavations, dating about 200 B.C. It was a slab of polished limestone about 6 in. square with five cups in its upper surface. Another from the same place was a small cubical block of limestone bearing a dedication to Heracles. They have also been found in Assyria. Pocket altars are still used in some forms of worship in India. See the *Journal of the Royal Asiatic Society*, 1852, p. 71.

ALTARS IN THE CHRISTIAN CHURCH

I. The Early Church.—The altar is spoken of by the early Greek and Latin ecclesiastical writers under a variety of names:—*γράβειζα*, the principal name in the Greek fathers and the liturgies; *θυσιαστήριον* (rarer; used in the Septuagint for Hebrew altars); *ἱερόθρονον*; *βωμός* (usually avoided, because of its pagan associations); *mensa Domini*; *ara* (avoided like *βωμός* for the same reason); and, most regularly, *altare*.

In his reply to Celsus (p. 389), who has charged the Christians with being a secret society, "because they forbid to build temples, to raise altars," Origen says, "The altars are the heart of every Christian." We gather from this, and from a passage in Lactantius, *De Origine Erroris*, ii. 2, that down to about A.D. 250, or perhaps



A. BY COURTESY OF THE FIELD MUSEUM OF NATURAL HISTORY; D-E. BY COURTESY OF THE TRUSTEES OF THE BRITISH MUSEUM; I. O. AND P. BY PERMISSION FROM SIR BANISTER FLETCHER'S "HISTORY OF ARCHITECTURE ON THE COMPARATIVE METHOD," EIGHTH EDITION, 1926 (BATSFORD)

A. MAYAN ALTAR. STUCCO ALTAR-PIECE KNOWN AS THE BEAU RELIEF; B. YELLOW TEMPLE, PEKING; C. ROMAN ALTAR; D. STATUE SEAT, BIT-KIDMURI; E. ALTAR AND STELE IN TEMPLE OF ADAR OR NINIB, ASSYRIA; F. ROMAN ALTAR OF HERCULES PRIMIGENIUS; G. ASSYRIAN ALTAR; H. ALTAR OF INCENSE, EXCAVATED AT TAANACH, PALESTINE; I. ROMAN TRIPOD ALTAR; J. ROMAN ALTAR; K. ROMAN ALTAR FROM CAVICIPPI; L. RESTORATION OF THE GREAT HELLENISTIC ALTAR AT PERGAMUM, ASIA MINOR, BY PONTREMOLI; M. ANTIQUE ROMAN ALTAR; N. ANTIQUE ROMAN ALTAR; O. ALTAR SHRINE, TEMPLE OF MIYO-JIN, JAPAN; P. STONEHENGE, AS RESTORED BY WALTIRE; Q. ALTAR OF HEAVEN, PEKING; R. ASSYRIAN SLAB

a little later, the communion was administered on a movable wooden table. In the Catacombs, the *arcosolia* or bench-like tombs are said (though the statement is doubtful) to have been used for this purpose. The earliest church altars were certainly made of wood; and it appears from a passage in William of Malmesbury (*Gesta Pontif.* iii. 14) that in the diocese of Worcester altars were of wood down to the middle of the 11th century.

II. The Mediaeval Church.—It will be convenient now to pass to the fully-developed altar of the Western Church with its accessories.

In the Roman Catholic Church the component parts of a fixed altar are the table (*mensa*), consisting of a stone slab; the support (*stipes*), either a solid mass or four or more columns; the *sepulchrum*, or altar-cavity, a small chamber for the reception of relics. If the support consist of columns, the intervals may be filled with other materials, e.g., brick or cement. The table alone is consecrated, and in sign of this are cut in its upper surface five Greek crosses, one in the centre and one in each corner. These crosses must have been anointed by the bishop with chrism in the ritual of consecration before the altar can be used. Crosses appear on the portable altar buried with St. Cuthbert (A.D. 687), but the history of the origin and development of this practice is not fully worked out.

According to the *Caeremoniale* (i. 12, 13) a canopy (*baldachinum*) should be suspended over the altar; this should be square and large enough to cover the altar and the *predella* on which the celebrant stands. It is sometimes hung from the roof by chains so that it can be lowered or raised; sometimes it is fixed to the wall or reredos; sometimes it is a solid structure of wood covered with metal or of marble supported on four columns. This last form is, however, usual only in large churches, more especially of the basilica type, e.g., St. Peter's at Rome or the Roman Catholic cathedral at Westminster. The origin of the canopy (called liturgically the *ciborium*) is uncertain, but it appears in a mosaic at Thessalonica of a date not later than A.D. 500. The Congregation of Rites (May 27, 1697) ordered it to be placed over all altars, but even at Rome it is usually only found over the high altar and the altar of the Blessed Sacrament.

Multiplication of altars is a mediaeval characteristic, no trace of which appears before the 4th century. In the church of St. Gall, Switzerland, in the 9th century there were 17. In the modern Latin Church almost every large church contains several altars. Archbishop Wulfred in 816 ordered that beside every altar there should be an inscription recording its dedication. This regulation fell into abeyance after the 12th century, and such inscriptions are very rare. One remains mutilated at Deerhurst (*Archaeologia*, vol. 50, p. 69).

The principal altar, in a church having more than one, is called a "high altar." Where there is a second high altar, it is generally at the end of the choir or chancel. In monastic churches (e.g., formerly at St. Albans) it sometimes stands at the end of the nave close to the choir screen.

Beside the altar was a drain (*piscina*) for pouring away the water in which the communion vessels were rinsed. This seems originally to have been under the altar, as it is still in the Eastern Church.

In the time of Optatus (c. A.D. 370), bishop of Milevis, and probably earlier, the altar was covered with a cloth. This had developed by the 14th or 15th century into a cerecloth, or waxed cloth, on the table itself; and three linen coverings one above the other, two of about the size of the table and one rather wider than the altar, and long enough to hang down at each end. In front was often a hanging panel of embroidered cloth (the frontal); but frontals of wood, ornamented with carving or enamel, etc., are also to be found. These embroidered frontals are changeable, so that the principal colour in the pattern can accord with the liturgical colour of the day. A similar panel of needlework (the dossal) is suspended behind the altar.

Portable altars have been used on occasion since the time of Bede. They are small slabs of hard stone, just large enough for the chalice and paten. They are consecrated and marked with the five incised crosses in the same way as the fixed altar, but they

may be placed upon a support of any suitable material, whether wood or stone.

III. Post-Reformation Altars.—At the Reformation the altars in churches were looked upon as symbols of the unreformed doctrine. In England the name "altar" was retained in the English Communion Office printed in 1549, and in the First Prayer Book of Edward VI. But the altars were soon after ordered to be destroyed, and replaced by movable wooden tables; while in the revised Prayer Book of 1552 the term "God's board" or "the table" was substituted for "altar." After a temporary reaction under Mary, the work of reformation was resumed under Elizabeth.

The name "altar" has been retained in the English Coronation Office. In the canons of 1640 it was recognized, but with the reservation that "it was an altar in the sense in which the primitive church called it an altar and in no other"; and the rule for the position of the communion tables, which has been since regularly followed throughout the Church of England, was formulated. In the primitive church the altars seem to have been so placed that, like those of the Hebrews, they could be surrounded on all sides by the worshippers. The chair of the bishop or celebrant was on their east side, and the assistant clergy were ranged on each side of him. But in the middle ages the altars were placed against the east wall of the churches, or against a *reredos* erected at the east side of the altar; the celebrant was thus brought round to the west side and caused to stand between the people and the altar. When tables were substituted for altars in the English churches, these were not merely movable, but at the administration of the Lord's Supper were actually moved into the body of the church, and placed *table-wise*—that is, with the long sides turned to the north and south, and the narrow ends to the east and west—the officiating clergyman standing at the north side. In the time of Archbishop Laud, however, the present practice of the Church of England was introduced. The communion table, though still of wood and movable, is, as a matter of fact, never moved; it is placed *altar-wise*—that is, with its longer axis running north and south, and close against the east wall. Often there is a reredos behind it; it is also fenced in by rails to preserve it from profanation of various kinds.

In 1841 a stone altar, consisting of a flat slab resting on three upright slabs, was set up by the Camden society in the ancient church of the Holy Sepulchre at Cambridge, at the east wall of the chancel. But the Court of Arches in 1845 ordered it to be removed, on the ground that a weighty stone structure was not a communion-table in the sense recognized by the Church of England.

BIBLIOGRAPHY.—For altars in the ancient East see M. Jastrow, *Religion of Assyria and Babylonia*; Perrot and Chipiez, *Art in Chaldea* (i. 143, 255); Sir J. Gardner Wilkinson, *A Second Series of the Manners and Customs of the Ancient Egyptians*, ii. 387; Benzingers and Nowack's works on *Hebräische Archäologie*. For classical altars, much information can be obtained from the notes in J. G. Frazer's *Pausanias*. See also Schömann, *Griechische Alterthümer*, vol. ii.; the volume on "Gottesdienstliche Alterthümer" in Hermann's *Lehrbuch der griechischen Antiquitäten*. On domestic altars and worship see Petersen, *Hausgottesdienst der Griechen* (Cassel, 1851). On plural dedications consult Maurer, *De aribus graecorum pluribus deis in commune positis* (Darmstadt, 1885). For Christian altars, reference is best made to the articles on the subject in the dictionaries of Christian and liturgical antiquities of Cabrol, Migne, Martigny, Smith and Cheetham, and Pugin, where all the available information is collected. See also Ciampinus, *Vetere Monumenta* (Rome, 1747), where numerous illustrations of altars are to be found; Martene, *De antiquis Ecclesiarum ritibus*, iii. vi. (Rouen, 1700); Voigt, *Thysiassteriologia sive de altaribus veterum Christianorum* (Hamburg, 1709); and the liturgical works of Bona. Many articles on various sections of the subject have appeared in the journals of archaeological societies; we may mention Nesbitt on the churches of Rome earlier than 1150 (*Archaeologia*, xl. p. 210), Didron, "L'Autel chrétien" (*Annales archéologiques*, iv. p. 238), and a paper by Texier on enamelled altars in the same volume.

ALTAZIMUTH, an astronomical telescope of a pattern similar to a theodolite but on a much larger scale. It is used principally to observe positions of the moon before first quarter and after last quarter, when the moon passes across the meridian in daylight. In order to secure more favourable nocturnal observations at such times it is necessary to have an instrument which can be turned out of the meridian but in other respects is used similarly to a meridian circle.

ALTDAMM, a town and railway junction on the Oder, opposite Stettin, in the district of Stettin, in the Prussian province of Pomerania. Pop. (1933) 12,311. Its manufactures (starch, cellulose and syrup) are mainly based on potato cultivation.

ALTDORF, capital of the Swiss canton of Uri, 1,516ft. above sea-level, a little above the right bank of the Reuss, not far above the point where this river is joined on the right by the Schächen torrent, 34m. from Lucerne by the St. Gotthard railway and 22m. from Göschenen. Pop. (1930), 4,240, Roman Catholic and German speaking. Its port on the Lake of Lucerne, Flüelen, is 2m. distant. There is a stately parish church, while above the little town is the oldest Capuchin convent in Switzerland (1581). William Tell shot the apple from his son's head, according to tradition, in the market-place, where in 1895, at the foot of an old tower (with rough frescoes commemorating the feat), there was set up a fine bronze statue (by Richard Kissling of Zürich) of Tell and his son. In 1899 a theatre was opened for the performance of Schiller's play of *Wilhelm Tell*. The same year a new carriage-road was opened from Altdorf through the Schächen valley and over the Klausen Pass (6,404ft.) to the village of Linththal (30m.) and so to Glarus. Near Altdorf is the village of Bürglen, where by tradition Tell was born; while he is also said to have lost his life, while saving that of a child, in the Schächen torrent. On the left bank of the Reuss, opposite Altdorf is Attinghausen, where the ruined castle now houses the cantonal museum.

ALTDORFER, ALBRECHT (?1480–1538), German painter and engraver, was born at Regensburg (Ratisbon), where in 1505 he was enrolled a burgher, and described as "twenty-five years old." Soon afterwards he is known to have been prosperous, and as city architect he erected fortifications and a public slaughter-house. Altdorfer has been called the "Giorgione of the North." His paintings are remarkable for minute and careful finish, and for close study of nature. The most important of them are to be found in the Pinakothek at Munich. A representation of the battle of Arbela (1529), included in that collection, is usually considered his chief work. His engravings on wood and copper are very numerous. The most important collection is at the Berlin museum. Albrecht's brother, Erhard Altdorfer, was also a painter and engraver, and a pupil of Lucas Cranach.

ALTEN, SIR CHARLES (KARL) (1764–1840), Hanoverian and British soldier, son of the Hanoverian Baron Alten, took service in the King's German Legion in British pay, and commanded the light infantry in the Hanoverian expedition of 1805, at the siege of Copenhagen in 1807, with Moore in Sweden and Spain, and in the Walcheren expedition. He commanded a brigade at Albuera, and in 1813 the famous "Light Brigade" in Spain. In 1815 he was in command of the 3rd Division, and was wounded at Waterloo. His conduct won for him the rank of Count von Alten. He returned in 1818 to Hanover, where he rose to the rank of field-marshal. Count von Alten, however, remained in the British Army as Major-Gen. Sir Charles Alten.

See *Gentleman's Magazine* (1840); N. L. Beamish, *Hist. of the King's German Legion* (1832–37).

ALTENA, a town in Westphalia, Germany, 30mi. S.S.E. of Dortmund. Pop. (1939) 17,287. It lies in the deep valley of the Lenne, and forms a single street 3mi. in length. The Schlossberg is the ancestral castle of the counts of La Marck. Metal industries and especially wire making are carried on.

ALTENBURG, a town in Thuringia, Germany, formerly capital of the duchy of Saxe-Altenburg, 23mi. south of Leipzig. Pop. (1939) 45,901. From its ancient castle, on a lofty porphyry rock, Kunz von Kaufungen carried off, in 1455, the young princes Albert and Ernest, founders of the royal and ducal families of Saxony. Altenburg has local courts subordinate to those of Jena and a cathedral and various learned societies. There is also a museum, with natural history, archaeological and art collections, and among other buildings St. Bartholomew's church (1089) and the town hall (1562–64). There is considerable traffic in grain, horses and cattle of the surrounding districts. There are lignite mines in the vicinity. The town has foundries and machinery works. Hats, gloves, shoes, metal objects, brushes, musical in-

struments, paper and paper bags, cigars, playing cards and chemicals are made. The card-game of "Skat," universal in Germany since 1835, originated among the peasantry here.

ALTENSTEIN, a castle in Saxe-Meiningen, Germany, on the S.W. slope of the Thüringerwald not far from Eisenach. It has associations with Boniface (c. 724) and with Martin Luther.

ALTERATIVE, an old term in the *materia medica* which comprised a group of substances which were supposed to have a specific influence on the nutritional processes of the body. They were mainly of the metal or metalloid class and included iron, mercury, phosphorus, manganese and arsenic. This rather vague group has fallen into disrepute. The reason for this is that further research has brought to light the biochemical reactions underlying the "alterations," and some of these excellent remedies have been removed to more scientific groups.

ALTERNATING CURRENT, electric current which grows to a maximum value, decreases, changes its direction (with respect to a datum line), reaches a maximum value in the new direction (which is equivalent to a minimum value for the original direction), and returns to its original value, whence it repeats this cycle an indefinite number of times. The interval which elapses between the attainment of a definite value on two successive occasions is called the *period*, and the number of cycles or periods per second, the *frequency* of the alternating current, high frequency currents having several thousand cycles per second. The *amplitude* is the deviation of the maximum (or of the minimum) from the datum line. (See *ELECTRICITY*.)

ALTERNATION, process of "alternating," i.e., of two things following one another regularly by turns, as night and day. In American political representative bodies and in the case of company directors, a substitute is sometimes called an "alternate." An "alternative" is that which is offered as a choice of two things, the acceptance of the one implying the rejection of the other.

ALTGELD, JOHN PETER (1847–1902), American politician, was born in Nieder Selters, Prussia, Germany, on Dec. 30, 1847. In infancy he was brought to the United States by his parents who settled near Mansfield, Ohio. In 1864 he entered the Union army and served for one hundred days as a private. For a time he was a school teacher, subsequently he studied law, and in 1869 he was admitted to the bar. From 1886 to 1891 he was a judge of the superior court in Chicago and from 1893 to 1897 he was governor of Illinois. His pardon, while governor, of the Chicago anarchists, imprisoned for participation in the Haymarket riot caused very extensive comment. He was a convincing public speaker and effectively promoted the cause of prison reform. Espousing the financial doctrine of free silver, he became one of its leading advocates, and, in the presidential campaigns of 1896 and 1900, vigorously supported the candidacy of William Jennings Bryan. He published *Our Penal Machinery and Its Victims* (1890) and *Live Questions* (1890). He died in Joliet, Ill., on March 12, 1902.

See W. R. Browne, *Altgeld of Illinois* (1924); Edgar Lee Masters, "John Peter Altgeld" in *American Mercury*, vol. iv, pp. 161–174 (1925).

ALTHAEA, in Greek and Roman mythology, daughter of Thestius, king of Aetolia, wife of Oeneus, and mother of Meleager (q.v.).

ALTHIBUROS (mod. MEDEINA), an ancient city of Numidia on the road between Carthage and Theveste (Tebessa), which was constructed by Hadrian in 123 A.D., 22 mi. S. of Kef. The town, originally an indigenous settlement, obtained municipal rights from Hadrian, like several other cities of North Africa. It enjoyed considerable prosperity in the 2nd and 3rd centuries after Christ, and was the seat of a bishop from the 5th to the beginning of the 8th century.

There is a well-preserved triumphal arch on the site, and excavations have brought to light the ancient forum and the buildings surrounding it, including two temples, a fallen arch erected in honour of Hadrian, the theatre and some houses with fine mosaic pavements.

See A. Merlin, *Forum et Maisons d'Althiburos* (1913).

ALTHING, the legislative assembly of Iceland (*q.v.*).

ALTICHIERO DA ZEVIO (c. 1320–c. 1385), Italian painter, of the Veronese school, born at Zevio, a village near Verona. His standard work is the fresco decoration of the San Felice chapel in the church of Sant' Antonio at Padua, representing the "Crucifixion" and "Scenes from the Legend of St. James," painted about 1380. The frescoes in the adjacent capella San Giorgio are not on the same high level and were probably mainly executed by his pupil, Jacopo d'Aranzo. The only extant works of Altichiero in Verona are the fresco in the church of Sant' Anastasia representing the "Knights of the Cavalli family kneeling before the Virgin," and another, representing the Crucifixion, in the church of San Zeno. Altichiero was the head of the Veronese School of the Trecento, whose art represented the ideal of a chivalrous aristocracy and embodied the romantic and heroic aspect of the middle ages. In his paintings the pictorial point of view predominates. They are essentially the work of a colourist. Architecture and figures are conceived together; scenes are enacted in roomy interiors. There is, moreover, a certain tendency to depict incidentals, which contrasts with Giotto's concentrated and expressive style, where the figures stand out plastically and everything is subordinated to the main theme. Altichiero's style was not influenced by Giotto.

ALTIMETRY. Altimetry is the process of determining the altitude above mean sea level of a point in the atmosphere, usually by measurement of the air pressure with an aneroid barometer. The relationship between pressure and altitude varies in space and time with varying weather conditions and is determined at known elevations on the surface of the earth with mercurial barometers. However for points above the surface of the earth it must usually be calculated by assuming the hydrostatic equation, which expresses the fact that the rate of decrease of pressure with altitude is such that the difference in pressure on the bottom and top of a unit volume of air is equal to its weight. The weight of the air depends on its pressure, temperature and water vapour content, the values of which are measured in the upper air with radiosondes or aeroplanes. The hydrostatic equation can be expected to be in error by less than 0.1% except in extreme weather conditions such as hurricanes or thunderstorms. Meteorological charts are used to interpolate the pressure-height relationship between observation points and for making forecasts of future conditions. (See METEOROLOGY.)

Altimeters, which are aneroid barometers used for altimetry, are marked in terms of a special pressure parameter, the *pressure altitude*, which is the height in a standard atmosphere at which a given pressure occurs. As an example, the U.S. standard atmosphere is defined as one in which the pressure at sea level is 760 mm. of mercury and in which the temperature is 15° C. at sea level and decreases with altitude at the rate of 6.5° C. per kilometre until it becomes equal to -55° C., above which point the temperature remains constant. The standard atmospheres have been chosen to represent average atmospheric conditions so that the numerical pressure indications are approximately equal to the altitude. The difference between the actual altitude of a point and the pressure altitude at that point is called the *altimeter correction* and thus varies in both space and time. The maximum spacial variations of the altimeter corrections are observed to be about plus or minus 2,000 ft., while the time variations at a given point during periods of a few days are usually considerably less than this amount.

In order to obtain direct indications of altitude most altimeters are constructed so that the pressure measuring apparatus can be adjusted with respect to a separate altitude scale in such a way that the appropriate altimeter correction is mechanically added to the measured pressure altitude. The amount of adjustment is usually indicated by an *altimeter setting* scale. The *altimeter setting* is defined as being the pressure corresponding to that pressure altitude which is equal to the negative of the altimeter correction.

From 1938 *radio altimeters* had been developed which measure the height of an aircraft above the surface of the earth by measuring the time for a radio signal generated in the aircraft to be reflected from the earth's surface back to the aircraft. With such instruments the altitude above mean sea level can be determined directly without a knowledge of the pressure distribution when flying over oceans. How-

ever, when flying over land, rapidly varying altitude of the underlying terrain, the elevation of which many times cannot conveniently be determined from the aircraft, limits the usefulness of these instruments for determining altitudes above mean sea level. (J. C. By.)

ALTINUM (mod. *Altino*), Venetia, 12 mi. S.E. of Tarvisium (Treviso), on the lagoons. From a fishing village it became the junction of the Via Postumia and the Via Popilia (see *AQUILEIA*). Augustus and his successors made it important as a point on the route between Italy and the northeast parts of the empire. After the foundation of the naval station at Ravenna, it became the practice to take ship from there to Altinum and then to continue the journey by land. A new road, the Via Claudia Augusta, was constructed by the emperor Claudius from Altinum to the Danube, a distance of 350 mi.

ALTITUDE, height or eminence and particularly the height above the ground or above sea level. In geometry, the altitude of a triangle is the length of the perpendicular from the vertex to the base. In astronomy, the altitude of a heavenly body is the apparent angular elevation of the body above the plane of the horizon (see *ASTRONOMY: Spherical*). *Apparent altitude* is the value which is directly observed; *true altitude* is deduced by correcting for astronomical refraction and dip of the horizon; *geocentric altitude* by correcting for parallax.

ALTMAN, BENJAMIN (1840–1913), U.S. merchant and art collector, was born in New York city, July 12, 1840, where he was educated and achieved his business career. In 1905 he erected a large store on Fifth avenue which, with the additions on Madison avenue built in 1913–14, made his establishment one of the great department stores of the world. Besides his outstanding success as a merchant, he won wide reputation as an art collector. He formed a large and exceedingly valuable collection of paintings, especially of the old masters, among them 13 Rembrandts and some fine pictures by Botticelli, Filippo Lippi and Holbein. He purchased in 1912 the Velasquez portraits of King Philip IV of Spain and of Olivares, for which he was reported to have paid about \$1,000,000. He also made extensive collections of Chinese porcelains, rugs, crystals and other objects of art. The major part of his art collections was bequeathed to the Metropolitan Museum of Art, New York city, and constitutes one of the most important gifts received by that institution. He died in New York city, Oct. 8, 1913.

ALTMÜHL, a river in Bavaria, Germany, an important left bank tributary of the Danube, rising in the Franconian plateau, and after a tortuous course of 116 mi. alternatively through meadows and in romantic gorges, joining the Danube at Kelheim. It is navigable up to Dietfurt (18 mi.), whence the Ludwigscanal (100 mi. long) leads to Bamberg on the Regnitz, thus establishing communication between Danube and Rhine.

ALTO, a musical term applied to the highest adult male voice or counter-tenor, and to the lower kind of boy's or woman's (contralto) voice. It is typical of the confusing character of musical nomenclature that the term which originally meant "high" should have come to signify the lower of its particular class of voice. It is further applied to the viola as representing the alto voice of the violin family.

ALTON, urban district, Southampton, England, 46½ mi. S.W. of London by the S.R. Population (1938) 7,693. It occupies a pleasant, undulating site near the headwaters of the river Wey. Of the Church of St. Lawrence, part, including the tower, is Norman; the building was the scene of a fierce conflict between the royalist and parliamentary troops in 1643. There is a museum of natural history; the collection is reminiscent of the famous naturalist, Gilbert White, of Selborne in this vicinity. Large markets and fairs are held for corn, hops, cattle and sheep; and there are two breweries, an iron foundry and plow works. Area 6.4 sq. mi.

ALTON, a city of Madison county, Illinois, U.S., on the Mississippi river, about 5 mi. above the mouth of the Missouri and 25 mi. N. of St. Louis. It is on federal highway 67; is served by the Gulf, Mobile and Ohio, the Big Four and the Illinois Terminal railways, and for freight also by the Burlington and the Missouri-Kansas-Texas; and has connections for freight with all railways entering East St. Louis. A railway bridge and a highway bridge cross

the Mississippi at Alton immediately below an \$11,000,000 federal lock and dam. The business streets are on the bottom lands, but the residential part of the city lies on bluffs which rise to a height of 250 ft. The population in 1950 was 32,176 and in 1940 was 31,255.

Transportation facilities, cheap coal, unlimited water, abundant building material and hydroelectric power have favoured industrial development. The value of the products manufactured in 1949 was \$30,500,000, and there are also important establishments near by in the surrounding country, including large oil refineries, to which crude petroleum is brought by pipe lines from Texas and Oklahoma. The leading manufactures are glass bottles, brick, ammunition, flour, petroleum products, lime and stone, pig lead, iron and steel, boxboard and paper. Shurtleff college (Baptist, founded in 1827), at Alton and Monticello seminary for girls, at the village of Godfrey, $\frac{5}{8}$ mi. N. (founded 1835), were among the earliest educational institutions in the Mississippi valley. The first white settler there was Jean Baptiste Cardinal, who built a loose rock shelter in 1783, but was soon taken prisoner by the Indians. Just south of Alton, Lewis and Clark camped through the winter of 1803-04. The town was planned in 1815 by Col. Rufus Easton of St. Louis, who gave it the name of one of his sons. In 1833 it was organized as a town, and in 1837, when the population was about 4,000, it was incorporated as a city. The first state institution in Illinois, a penitentiary, was located there in 1827. Later the prisoners were transferred to Joliet, and during the Civil War the buildings were used as a military hospital and prison. Intense excitement was caused throughout the country in 1837 by the persecution and finally (on Nov. 7) the killing, by a pro-slavery mob, of Elijah P. Lovejoy (b. 1802), the editor of an abolitionist journal. In 1897 on the 60th anniversary of his death a monument, erected by the state and the citizens of Alton, was dedicated to his memory.

ALTONA, former town in Schleswig-Holstein, Germany, on the right bank of the Elbe. Though closely adjoining Hamburg (q.v.), it was administered separately until 1937. Pop. (1880) 91,049; (1900) 161,508; (1933) 242,006. The name may be derived from *allzu-nah* ("all too near"), the Hamburgers' designation for an inn which in the 16th century lay too close to their territory. For a long time this was the only house in the locality. When Altona passed to Denmark (1640), it was a small fishing village, but the Danish kings granted it customs privileges and exemptions to make it a formidable rival to Hamburg. Although burnt by the Swedes in 1713, it rapidly recovered and, despite the Napoleonic wars, increased in prosperity. After 1853, when Denmark withdrew the privileges, its trade waned. Occupied in 1864 in the name of the German confederation, it passed to Prussia after the war of 1866, and in 1888, together with Hamburg, joined the Zollverein, while retaining certain free trade rights over the *Freihafengebiet* which it shared with Hamburg and Wandsbek. Higher than Hamburg proper, Altona enjoys a purer, more healthful atmosphere. The Palmalle, one of the numerous wide streets, ends in a terrace about 100 ft. above the Elbe. An elevated railway connects Altona with Hamburg and provides through communication with the main Prussian railway systems. Altona manufactures tobacco and cigars, machinery, woollens, cottons, chemicals, leather, soap and oil. The port carried on an extensive trade with Great Britain, France and America, but most of its business is transacted on the Hamburg exchange, while the magnificent warehouses at Altona are largely used by Hamburg merchants. After 1888 much was spent at various times, especially in 1918, upon improvement and enlargement of the harbour.

The exports and imports resemble those of Hamburg. Some fishing is carried on and there are ship-repairing yards. In 1890 the populous suburbs of Ottensen to the west, Bahrenfeld, Othmarschen and Üvelgönne were incorporated with the town.

ALTOONA, city of Blair county, Pa., U.S., on the Pennsylvania railroad, 99 mi. E. by N. of Pittsburgh. It lies in the upper end of Logan valley, 1,180 ft. above sea level, on federal highway 220, and commands views of some of the most picturesque mountain scenery in the state. The famous Horseshoe curve is four miles west.

The population of Altoona in 1950 was 76,844 by the federal census, as compared with 80,214 in 1940 and 82,054 in 1930.

Altoona was created by the Pennsylvania Railroad company, which in 1849 bought farm lands there and laid out a town, to be the base of operations while it was constructing the pioneer railway across the Alleghenies. The Pennsylvania Railroad company remained the chief factor in the city's economic life. Its repair shops, foundries and works for the construction of cars and locomotives employ 13,000 men. The output of the city's factories in 1948 was valued at \$125,000,000.

Altoona was incorporated as a borough in 1858 and chartered as a city in 1868. In 1862 the "loyal war governors" of the northern states met there, in the Logan house, to renew their pledge of support to Lincoln.

ALTO-RILIEVO (Ital. for "high relief"), the term applied to sculpture that projects from the plane to which it is attached to the extent of more than one-half the outline of the principal figures, which may be nearly, or in parts, entirely detached from the background, thus distinguishing it from *basso-rilievo* (q.v.). It is not only the actual degree of relief, high or low, which is implied by these two terms, but a resultant difference also of design and treatment necessitated by the differences of light and shadow. (See SCULPTURE TECHNIQUE: *Modelling, Practice*.)

ALTÖTTING, a town of Germany, in Bavaria, on the Mören not far from its junction with the Inn. Pop. (1933) 5,539. The Holy Chapel with its image of the Virgin Mary has long been a place of pilgrimage for Roman Catholics from Central Europe.

ALTRANSTÄDT, a village of Germany, in Prussian Saxony near Merseburg. Altranstädt is famous in history for two treaties concluded here: (1) the peace which Augustus II, king of Poland and elector of Saxony, was forced to ratify (Sept. 24, 1706) with Charles XII of Sweden, whereby the former renounced the throne of Poland in favour of Stanislaus Leszczyński—a treaty which Augustus declared null and void after Charles XII's defeat at Poltava (July 8, 1709); (2) the treaty of Aug. 31, 1707, by which the emperor Joseph I guaranteed to Charles XII religious tolerance and liberty of conscience for the Silesian Protestants.

ALTRINCHAM or **ALTRINGHAM**, municipal borough, in the Altrincham parliamentary division of Cheshire, England, 8 mi. from Manchester, on the L.M.S. Ry. Pop. (est. 1938) 37,350. Area 5.5 sq.mi. The town of Altrincham (Altringham) was originally included in the barony of Dunham Massey. Hamon de Massey granted a charter to his burgesses, establishing the Court Leet, on receiving a concession of a market and an annual fair from Edward I in 1290. Edward II substituted a fair held on the eve, feast and morrow of St. James's day yearly. This fair continued to be held until modern times under the name of "Sanjam" fair. It is believed to have been the practice since the charter was granted for the Court Leet to elect a mayor annually; and this was done by a jury of the Leet of the borough, which consisted of burgesses only. The Court Leet was formerly all-powerful in regulating the affairs of the town; and various officials were appointed (e.g., constables, bailiffs, market lookers, scavengers, swine lookers and bellman) by the court to assist the mayor. All these officers performed their duties until the formation of a local board of health, though they continued to be elected until the town was incorporated in 1937. Latterly their activities had been mainly social. Market gardening is carried on, fruit and flowers being grown for sale in Manchester. Owing to good rail and canal facilities, a large number of works, mostly of an engineering nature, were built on the north side of Altrincham.

The old trades of cotton and worsted are no longer carried on, and although there is still some cabinet-making it is not so important as formerly.

ALTRUISM, a philosophical term used in ethics for that theory of conduct which regards the good of others as the end of moral action. It was invented by Auguste Comte and adopted by the English positivists as a convenient antithesis to egoism. According to Comte, the only practical method of social regeneration is gradually to inculcate the true social feeling which subordinates itself to the welfare of others. The application to sociological

problems of the physical theory of organic evolution further developed the altruistic theory. According to Herbert Spencer, the life of the individual in the perfect society is identical with that of the state; in other words, the first object of him who would live well must be to take his part in promoting the well-being of his fellows individually and collectively. Pure egoism and pure altruism are alike impracticable. For, on the one hand, unless the egoist's happiness is compatible to some extent with that of his fellows, their opposition will almost inevitably vitiate his perfect enjoyment; on the other hand, the altruist whose primary object is the good of others must derive his own highest happiness—i.e., must realize himself most completely—in the fulfilment of this object. In fact, the altruistic idea, in itself and apart from a further definition of the good, is rather a method than an end.

The self-love theory of T. Hobbes, with its subtle perversions of the motives of ordinary humanity, led to a reaction which culminated in the utilitarianism of J. Bentham and James and John Stuart Mill; but their theory, though superior to the extravagant egoism of Hobbes, had this main defect, according to Spencer, that it conceived the world as an aggregate of units, and was so far individualistic. Sir Leslie Stephen in his *Science of Ethics* insisted that the social organism is the unit, and therefore that the aim of moralists is not the "greatest happiness of the greatest number," but rather the "health of the organism." The socialistic tendencies of subsequent thinkers have emphasized the ethical importance of altruistic action, but it must be remembered always that it is ultimately only a form of action, that it may be commended in all types of ethical theory, and that it is a practical guide only when it is applied in accordance with a definite theory of "the good." Finally, he who devotes himself on principle to furthering the good of others as his highest moral obligation is from the highest point of view realizing, not sacrificing, himself.

See works of Comte, Spencer, Stephen, and textbooks of ethics (cf. bibliography at end of article ETHICS).

ALTUS, a city of southwestern Oklahoma, U.S.A., 15 mi. from the Red river; the county seat of Jackson county. It is on federal highways 62 and 283 and is served by the Frisco, the Santa Fe and the Missouri-Kansas-Texas railways. The population in 1950 was 9,543; in 1940, 8,593 by the United States census. Altus is a shipping point for alfalfa, cotton and grain, and has a number of industrial plants and wholesale houses. The city was founded in 1891 and incorporated in 1909.

ALTWASSER, a town in Lower Silesia, Germany, now incorporated in Waldenburg-in-Schlesien.

ALTYN TAGH, the northernmost of the constituent ranges of the Kuen-lun (q.v.), which separates the high plateau of Tibet on the south from the depression of the Tarim basin on the north (see ASIA).

ALUDEL, a pear-shaped pot generally made of fire clay and open at both ends. The aludels are arranged in series, the neck of one fitting into the base of the next, to form a condenser. They were used by the early chemists in sublimation, and, at Almaden in Spain, the aludel or bustamente furnace has long been employed for the extraction of mercury (q.v.) from its ores.

(J. B. Ps.)

ALUM is a hydrated double salt of aluminum sulphate and potassium sulphate, the formula being written either $K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$ or $KAl(SO_4)_2 \cdot 12H_2O$. In chemistry, the name is applied to a whole series of salts of the composition $M^+M^{++}(SO_4)_2 \cdot 12H_2O$, in which M^+ represents a singly charged ion and M^{++} a triply charged ion. Among the singly charged ions that can enter into alum formation are those of lithium, sodium, potassium, rubidium, caesium, silver, thallium, ammonia, hydrazine, hydroxylamine and many organic amines, while the list of trivalent ions includes aluminum, titanium, vanadium, chromium, manganese, iron, cobalt, gallium, indium, rhodium and iridium. Not all of the possible combinations have been realized, however. In general, the ease of alum formation increases (because the solubility decreases) as the size of the univalent ion increases and that of the trivalent ion decreases. Thus, the only lithium alum known is that containing aluminum, but caesium forms alums

with all of the trivalent ions listed.

The list of alums is considerably extended by the substitution of selenate and tellurate ions for part or all of the sulphate ion. Curjel (*Nature*, 123:206 [1929]) has prepared similar compounds in which part of the sulphate has been replaced by fluoberyllate (BeF_4^-) or chlorozincate ($ZnCl_4^-$). These are not alums in the strict sense of the word, but they resemble the alums closely. It has also been reported that part of the water in the alum crystal can be replaced by hydrogen peroxide, but the evidence for this is questionable.

The alums crystallize in the regular system, usually in octahedra; from a basic solution of ordinary alum the cube tends to predominate. An octahedral crystal, immersed in a slightly basic solution at room temperature, will gradually be converted into the cubic form, the composition of the crystal remaining unaltered. Owing to the symmetry of the crystal form, perfect single octahedra of large size may be obtained by slow crystallization at room temperature. A crystal weighing 125 lb. has been grown in this way in a period of about two years.

Studies of alum crystals by X-ray analysis have shown that the trivalent metal ion is in union with six molecules of water, which occupy the corners of an octahedron, with the metal ion at the centre. The other six molecules of water serve to link these octahedra to the ions of the univalent metal and the sulphate ions. The hydrated trivalent metal ions are all approximately the same size, but the ions of the univalent metals vary greatly, so the ions do not pack together in quite the same way in crystals of different alums. This gives rise to three distinct types of alums, which show different crystal habit, and can often be distinguished by outward appearance. The alums containing medium-sized univalent ions (potassium and ammonium) are designated as α ; those of large ions (caesium) as β , and those of small ions (sodium) as γ . Some alums can be induced to crystallize in more than one type, but in general the classes are not isomorphous (q.v.) and do not form mixed crystals. On this account, fractional crystallization of the alums furnishes one of the best means of separating rubidium (α alum) from caesium (β alum). While the size of the univalent ion seems to be the main factor in determining the nature of the alum, the trivalent ion has some influence, as is shown by the fact that rubidium aluminum alum belongs to the α group, while the corresponding chromium alum forms β crystals. The discovery of different types of alums came as a surprise, as it had been generally supposed that the alums are truly isomorphous. It suggests the possibility that other supposedly isomorphous series of double salts, such as the schonites, $M_2SO_4 \cdot M'SO_4 \cdot 6H_2O$, and the rare-earth double sulphates, $M_2SO_4 \cdot Re_2(SO_4)_3 \cdot 8H_2O$, also crystallize in more than one form.

The aluminum alums have an astringent and acid taste. Potassium and ammonium alums are stable in air, but the sodium salt effloresces and disintegrates. The alums melt in their water of hydration between about 37° C. for thallous ferric alum and 117° C. for caesium aluminum alum. By careful heating in a current of air, ordinary alum can be dehydrated at 100° C. If heated rapidly, it swells and forms a light bulky mass of "burnt alum." When ammonium alum is heated at high temperatures it yields pure aluminum oxide.

The solubilities of the alums vary widely: the quantities of some of the aluminum alums dissolved by 100 parts of water (15° C.) are as follows: Caesium alum, 0.35; potassium alum, 9.59; ammonium alum, 12.66; sodium alum, 51 (16° C.). Water dissolves several times its own weight of potassium alum at 90° C. The aqueous solutions act as weak acids. On this account, aluminum alum is used in baking powders and in some types of fire extinguishers. As a source of aluminum hydroxide, it finds employment in a wide range of industries, among which are dyeing, paper making, tanning, water purification, pigment lakes and plaster. Chromium alum is used in dyeing and tanning. Caesium and rubidium are separated from each other by fractional recrystallization of their alums, as are rhodium and iridium; gallium and indium.

Preparation.—The very early history of the manufacture of

alum is unknown. Potash alum, aluminum sulphate, and ferrous and ferric sulphates all occur native as efflorescent salts or earthy impregnations in varying degree of admixture and purity, and the *alumen* of Pliny (*Natural History*, Bk. xxxv., Ch. 15) would appear to have covered a number of salts or their mixtures. In the 15th century the Turkish Mediterranean trade in dyed fabrics and wool, in which alum was employed as a mordant, amounted to a very large annual sum.

About the year 1460, John di Castro learned the art at Constantinople and began to make alum at Tolfa from an important local deposit of alunite (a basic sulphate of aluminum and potassium) which has remained in use to within the 20th century. The introduction of the manufacture into Italy (where it shortly afterwards became a papal monopoly) was announced as a great victory over the Turks. In England Sir Thomas Chaloner began the preparation of alum from the schists on his Yorkshire estate about the year 1600. Despite papal denunciation, the manufacture extended considerably, and the method continued largely unchanged down to about the middle of the 19th century. Deposits of schists occur in many parts of the world and in Europe have been worked for centuries for the preparation of alum.

Both the Italian method of manufacture from alunite and that from the alum schists were carried on, of necessity, in the absence of any extraneous supply of sulphuric acid, the production of which only assumed importance towards the end of the 18th and early part of the 19th centuries. When alunite [$K_2SO_4 \cdot (Al_2O_3 \cdot SO_3)_3 \cdot 6H_2O$, if pure] is calcined at a temperature below that at which SO_3 would be driven off, a part of the alumina together with the major portion of the sulphuric acid and potash is rendered soluble in water, although much of the alumina remains insoluble. The solution obtained was basic and gave rise to a largely cubic alum which, although tending to be tinted by a very small amount of insoluble iron oxide, was otherwise of a very high degree of purity and was known as Roman alum.

In 1845 the manufacture of alum in England was radically altered by the substitution, by Peter Spence, of the alum schists by aluminous shales from the coal-measures. These shales contained more alumina, less iron and some potash and, after regulated calcination, were found to be reasonably soluble in sulphuric acid. The weight of aluminous material required per ton of alum was reduced from about 100 tons to two-thirds of a ton, the time required for the process was shortened very greatly, and the old method of manufacture gradually died out. This process, in which the by-product ammonia from the coal-gas industry largely substituted the potash salts formerly employed, long accounted for the major proportion of the European output.

Potash alum is the principal alum of commerce and is largely obtained from the Italian mineral leucite, a double silicate of alumina and potash or soda. In the lava flows from certain extinct volcanoes in the Apennines, the leucite is almost entirely potassic. The mineral is crushed, graded and subjected to electro-magnetic treatment for the separation of the gangue. The substantially pure leucite meal or grain is then treated with sulphuric acid in which its alumina and potash are soluble and the solution, which already contains these oxides in almost equi-molecular ratio, is crystallized and purified in the ordinary way. In the U.S. it is obtained by treatment of bauxite or clay with sulphuric acid, followed by addition of potassium sulphate to the solution. The alum crystallizes when the solution cools. Iron alum (ferric ammonium sulphate) is prepared technically to a small extent, but the only other alum of commercial importance is the chromium potassium sulphate salt which is obtained as a by-product from the reduction of potassium bichromate in the manufacture of alizarin.

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ALUMINA, the oxide of aluminum, occurs as corundum which is a hard crystalline mineral. The dark variety of corundum contains magnetite and is known as emery (*q.v.*); clear transparent crystals, tinted by other metallic oxides, are gem stones

such as ruby and sapphire. Alumina may be prepared by the ignition of aluminum hydroxide, ammonium alum, etc., and from the various natural hydrated oxides of aluminum which occur in the minerals bauxite and gibbsite. Alumina is used in the manufacture of synthetic gems, as an abrasive, in the metallurgy of aluminum, and in the manufacture of refractory materials. It is polymorphous, existing in a number of crystalline forms, is close to the diamond in hardness and has the chemical formula Al_2O_3 . (See ABRASIVES; ALUMINUM; CORUNDUM; CORUNDUM, ARTIFICIAL; GEM; GEMS, SYNTHETIC.) (J. B. Ps.)

ALUMINUM or **ALUMINIUM** is the most modern of the common metals, having been first isolated in 1825 and introduced to the public in 1855 at the Paris exposition. Its name is derived from the Latin *alumen*—a naturally-occurring aluminous sulphate, probably a crude potash alum. Crude salts of this sort were used as astringents and mordants at least as early as the 5th century B.C. In the 13th century, men began to purify these crude salts into crystalline alum. The first mention of the production of alum from clay occurred in the 17th century, and in the 18th century its earthy base was differentiated from lime, shown to exist in clay, and given a name (*terre argilleuse*). It was suspected that it had a metallic base, but this was unproved until Sir Humphry Davy showed, in 1809, that an aluminum-iron alloy could be produced by the electrolysis of fused alumina in a hydrogen atmosphere, and that, on dissolving this alloy, aluminum oxide could be recovered from the solution. Davy suggested the name aluminum for this metal, a name which has been retained in North America but modified to aluminium in England and in most European countries. Its chemical symbol is Al, atomic weight 26.97 and atomic number 13. World production in recent years is shown in Table I.

TABLE I.—World Production of Aluminum, 1943-48, by Countries, in Metric Tons

	1943	1944	1945	1946	1947	1948
Austria	44,201	40,097	5,250	1,932	4,544	13,319
Brazil	...	...	480	...	...	...
Canada	449,734	479,176	195,691	175,449	271,302	333,007
China:						
Formosa*	14,498	9,201	↑	↑	↑	2,509
Manchuria*	8,557	8,000†	1,500†	↑	↑	64,785
France	46,462	20,154	37,225	47,952	53,225	73,068
Germany	203,068	191,000	20,000‡	...	...	...
Hungary	9,460	13,190§	2,351	1,070	5,203	5,152
India	1,202	1,751	2,254	3,244	3,223	3,107
Italy	40,102	76,795	4,347	17,040	25,064	33,100
Japan	114,057*	88,254*	16,450	3,190	2,700	6,970
Korea	12,520	12,943	1,243	5,000¶	5,000¶	5,000¶
Norway	23,514	20,035	4,608	16,692	21,725	30,065
Spain	797	206	592	1,007	1,000	909
Sweden	...	...	...	...	...	...
(includes alloys)	3,572	3,723	3,236	3,566	2,892	3,500†
Switzerland	13,526	9,786	5,029	13,083	18,458	18,060
U.S.S.R.	62,340	71,000‡	86,310	105,000	120,000	140,000
United Kingdom	56,557	36,038	32,432	32,067	29,384	30,510
United States	834,768	704,376	449,109	371,608	518,680	565,587
Yugoslavia	...	...	...	...	...	...
(estimated)	2,000	1,000	↑	↑	↑	↑
Total‡	1,952,000	1,673,000	869,000	792,000	1,084,000	1,265,000

*Fiscal year ended March 31 of year following that stated. †Data not available; estimate included in total. ‡Estimated. §Bizonal area. ¶January to June, inclusive. ¶April to June, inclusive. ¶Preliminary; subject to revision. Source: U. S. Bureau of Mines.

Occurrence and Ores.—Because of its chemical activity, aluminum never occurs in the metallic form in nature, but its compounds are present to a greater or less extent in almost all rocks, vegetation and animals. In fact, aluminum is the third most abundant element on the earth's surface, being exceeded in amount only by oxygen and silicon. It is estimated that the outer ten miles of the earth's crust contain about 8% by weight of aluminum, or about 15% of aluminum oxide (alumina). The aluminum present in the original igneous rocks on the earth's surface (chiefly as feldspar and mica in the granites, basalts, etc.) is relatively insoluble in the weathering process by which soil has been formed out of these rocks. Therefore, it largely remains in this soil in the form of an aluminum silicate (clay, *q.v.*), or when the weathering was more extensive much of the silica of the aluminum silicate was also dissolved by the percolating water, and the alumina and most of the oxides of iron and titanium present in the rock were deposited in the hydrated form as laterites or bauxites (*q.v.*). These may contain up to 60% or even 70% of aluminum oxide, and are the principal com-

mercial sources of aluminum and its compounds. In a few igneous rocks, deposits of crystalline alumina (corundum or emery) occur, and are mined for the production of natural abrasives. In some places aluminum sulphate, alum or alunite (*q.v.*) have been formed in weathered aluminous rock under the influence of sulphur-bearing gases or solutions. The double fluoride of sodium and aluminum (cryolite) occurs in a great dike in Greenland, and is of commercial importance.

PRODUCTION OF THE METAL

Unlike the other common industrial metals (iron, copper, zinc, lead) pure aluminum is not produced by the direct smelting of its ores. In the first place, its affinity for oxygen is so much greater than that of the principal metallic impurities in the ore (iron, silicon, titanium) that their oxides are more readily reduced to the metallic state than is alumina. Therefore, if smelting conditions were chosen which would reduce the alumina, the other oxides would also be reduced and the resulting alloy would be too impure for use. In the second place, the temperature at which pure aluminum oxide is reduced by smelting with carbon is so near the boiling point of aluminum that the metal produced is carried off as vapour with the gaseous carbon monoxide, unless there is considerable less-volatile metal such as iron or copper present to adsorb it, or enough excess carbon to convert it into aluminum carbide. The production of alloys of aluminum with iron, copper and silicon has, however, been carried out commercially by such electrothermal smelting processes.

The earliest methods of producing metallic aluminum involved chemical reactions between purified aluminum compounds and metallic sodium or potassium. Hans Christian Oersted was the first to produce the metal (in 1825) by causing dilute potassium amalgam to react with an excess of anhydrous aluminum chloride. By distilling the mercury away from the resulting aluminum amalgam, a residue of slightly impure aluminum was obtained. In 1827, Friedrich Wöhler described the production of aluminum as a powder by the direct reaction of potassium upon anhydrous aluminum chloride. In 1845, he was able to make slightly larger amounts of the metal, some of the particles being as large as big pinheads, and determined some of its physical properties, such as specific gravity, ductility, colour, etc. In 1854, H. St. Claire Deville improved Wöhler's method by using the cheaper sodium instead of potassium, forming a fusible double salt ($\text{NaCl} \cdot \text{AlCl}_3$) flux, which allowed the aluminum globules to coalesce. This developed into a successful (but expensive) commercial process which was practised in France and several other countries until the advent of the cheaper electrolytic process.

Aluminum cannot be produced by the electrolysis of aqueous solutions of its salts, hydrogen and aluminum hydroxide being formed at the cathode instead of aluminum. In 1854, Robert Wilhelm von Bunsen showed that the metal could be produced by the electrolysis of molten anhydrous sodium aluminum chloride, but as batteries were the only available source of electricity, the development of this process was impractical.

The modern electrolytic method of producing aluminum was discovered almost simultaneously by Charles Martin Hall, in the United States, and Paul L. T. Héroult, in France, in 1886. The development of the dynamo had then reached the point where currents of several hundred amperes were commercially available, thus making electrolytic methods of production practical.

The essentials of the Hall and Héroult processes were identical and are the basis of the present aluminum industry. Purified alumina (Al_2O_3) is dissolved in molten cryolite and electrolyzed with direct current. The mixture is contained in a carbon-lined steel box which acts as the cathode (negative pole) while carbon rods or blocks dipping into the molten bath form the anode or positive pole. Under the influence of the current, the oxygen of the Al_2O_3 is deposited upon the anode, which is thereby burned, while the molten aluminum is deposited on the carbon lining of the cell (cathode). Since molten aluminum is slightly heavier than molten cryolite at the operating temperature (about 950° C.) the metal accumulates in the bottom of the cell. Additional

alumina is stirred into the electrolyte from time to time and the molten metal removed. Most commercial cells for the production of aluminum use currents of 20,000 to 50,000 amp. Since each cell requires only five to six volts, it is customary to connect a large number (often 100 or more) of such cells in series, and supply the necessary power from a group of rotary converters, mercury arc rectifiers or large direct current generators. In many plants, large Söderberg self-baking electrodes (one or two per cell) are used instead of the numerous smaller prebaked carbon anode blocks or rods which are employed in the older plants.

The steel box for 50,000-amp. cells may be 20 ft. long, 6 ft. wide and about 3 ft. deep, made of steel about an inch thick. Such cells are arranged in a line or several lines in suitable buildings (often 700 ft. or more in length) supplied with adequate ventilation to remove the fumes and minimize the effect of the radiated heat. The gross power consumption may be 9-10 kw.hr. and the gross carbon consumption 0.6-0.8 lb. per pound of metal produced. Aluminum fluoride is added to the molten electrolyte from time to time to neutralize the soda in the alumina (derived from the Bayer process), and some cryolite is added to make up for the absorption by the cell lining, losses caused by spillage, etc. The total of such additions is usually less than 0.1 lb. per pound of metal produced, while the alumina required is somewhat more than 1.9 lb. per pound of metal.

PROPERTIES

Physical.—Aluminum is a silvery ductile metal which is one of the lightest of those used structurally, being only about one-third as heavy as an equal volume of iron, brass or copper. Table II shows many of its physical properties. It crystallizes in the cubic system (face centred cubic lattice) and when it is deformed by working (rolling, forging, drawing, etc.) slip within the crystals occurs predominantly on the octahedral planes. Upon melting, the solid metal expands about 7% in volume, the solidification shrinkage being 6.6% of the liquid volume.

TABLE II.—Physical Properties of Aluminum

Density (g./ml.) at 20° C. (68° F.)	2.6989
Melting point (° C.)	660.2
Melting point (° F.)	1,220.4
Boiling point (° C.)	2,537
Boiling point (° F.)	4,605
Specific heat at 100° C., cal./g.	0.2226
Latent heat of fusion cal./g.	95.3
Heat of combustion ($\text{Al} + \frac{3}{2}\text{O}_2 = \text{Al}_2\text{O}_3$) kg./cal.	399.0
Thermal expansivity 20-100° C., per degree	23.86×10^{-6}
Thermal expansivity 20-200° C., per degree	24.58×10^{-6}
Thermal expansivity 20-300° C., per degree	25.45×10^{-6}
Thermal expansivity 20-400° C., per degree	26.49×10^{-6}
Thermal expansivity 20-500° C., per degree	27.68×10^{-6}
Thermal expansivity 20-600° C., per degree	28.6×10^{-6}
Electrical resistivity (vol.) at 20° C., microhm.-cm.	2.6548
Electrical conductivity (vol.) at 20° C., percent of international annealed copper standard	64.04
Temperature coefficient of resistance at 20° C.	0.00429
Thermal conductivity—cal./sec./sq.cm./cm./° C.	0.52
Thermal emissivity at 100° F., percent	3
Reflectivity for light, tungsten filament, percent	80
Reflectivity for radiation at 2,500 Å.U.	95
Reflectivity for radiation at 10,000 Å.U.	95
Magnetic susceptibility, c.g.s. units	0.58×10^{-6}
Atomic radius, Å.U.	1.48
Ionization potential, volts.	5.96, 18.74, 28.37, 119.37, 153.4
Oxidation-reduction potential (calc.), volts	1.67
Electron structure	$1s^2, 2s^2, 2p^6, 3s^2, 3p^1$
Radioactive isotopes (mass numbers)	26, 28, 29

The strength of aluminum depends upon its purity and the thermal and mechanical treatment to which it has been subjected. Pure aluminum (99.996%) is quite soft and weak in the cast or annealed condition, with a tensile strength of only about 7,000 psi (pounds per square inch). By alloying and proper thermal and mechanical treatment, however, tensile strengths as high as 100,000 psi may be obtained. Silicon and most of the common metals (copper, iron, zinc, tin, manganese, magnesium) readily dissolve in molten aluminum, but sodium and potassium are almost completely insoluble, and the solubility of titanium, vanadium, boron and chromium is low. Hydrogen is about the only gas which is appreciably soluble in molten aluminum: its solubility increases with temperature but becomes nearly zero when the metal freezes.

Chemical.—Ordinarily aluminum is trivalent, although there is evidence that it may be monovalent and possibly bivalent at elevated temperatures under some conditions. Its oxide, Al_2O_3 , is amphoteric; *i.e.*, it may act as a base to form salts with acids, or as a weak acid to form salts with strong alkalis. Its heat of formation is high (399,000 cal. per gram molecule) and aluminum is therefore able to reduce most metallic oxides, in the thermit process (*q.v.*). A freshly cut surface of metallic aluminum is immediately oxidized and covered with a thin, transparent coating of Al_2O_3 , about 0.00000025 in. thick, which protects it from further oxidation and reaction, except with substances which can dissolve the oxide. The surface of molten aluminum is also covered with a similar oxide coating which protects it from burning. However, finely divided metallic aluminum is rather easily inflammable and, when mixed with air and ignited, will produce a violent explosion. Protective coatings of aluminum oxide may be produced by anodic oxidation of aluminum in certain electrolytes such as dilute sulphuric or chromic acids. These coatings are adsorbent and may be impregnated with dyes or mineral pigments to produce pleasing finishes, or with salts of chromic acid to improve their protection against corrosion. Thinner, impervious coatings of Al_2O_3 , produced anodically in boric or phosphoric acid or their salts, are important in aluminum condensers and electrolytic rectifiers.

Aluminum is slowly attacked by most dilute acids, especially the mineral acids. Concentrated hydrochloric acid dissolves it rapidly, $\text{Al} + 6\text{HCl} = 2\text{AlCl}_3 + 3\text{H}_2$. On the other hand, concentrated nitric acid (95–100%) has so little effect on it that aluminum drums and tank cars are used for shipping this chemical. Strictly anhydrous organic acids often attack aluminum vigorously, but the presence of a few tenths of a percent of water will greatly retard this reaction. The rate of attack by dilute acids is largely reduced as the purity of the aluminum is increased, and is slow for metal with a purity more than 99.95%. Alkalies, on the other hand, attack it rather vigorously irrespective of its purity; sodium and potassium hydroxide dissolve it rapidly with the formation of the corresponding aluminates, $2\text{Al} + 2\text{OH}^- + 2\text{H}_2\text{O} = 2\text{AlO}_2^- + 3\text{H}_2$. Sodium carbonate solution attacks and corrodes it more slowly, and this reaction may be largely prevented by the addition of a suitable amount of sodium silicate. Lime also corrodes it. Distilled water at ordinary temperatures has almost no action on aluminum, but water containing dissolved salts (especially common salt) allowed to stand for a long time in contact with commercial aluminum, may gradually attack and corrode it to an extent depending upon both the kind and amount of salts present and upon the kind and amount of alloying elements or metallic impurities present in the aluminum. High purity aluminum and certain aluminum-magnesium alloys are, however, resistant to corrosion, even by sea water, for many years.

Because of its great affinity for oxygen, finely divided aluminum, if ignited, will burn in carbon monoxide or carbon dioxide with the formation of a mixture of aluminum oxide and carbide; it will also burn in nitrogen to form the nitride (AlN). The carbide (Al_4C_3) is substantially insoluble in molten aluminum, so that only a superficial film of it is formed when the molten metal stands in contact with carbon. It is easily formed by the electrothermal reduction of the oxide in the presence of an excess of carbon at temperatures above about 1,800° C. Aluminum combines vigorously with the halogens at slightly elevated temperatures but is inert to sulphur at temperatures up to red heat. Phosphorus does not react with aluminum at ordinary temperatures, and aluminum phosphide is substantially insoluble in molten or solid aluminum.

Most of the metals which are soluble in molten aluminum form compounds with it, which crystallize out when the metal freezes, and can be identified under the microscope on a polished surface, particularly after etching. Silicon alone forms no binary compound with aluminum, and crystallizes out as such upon cooling the binary aluminum-silicon alloy. It does, however, form ternary compounds with aluminum and iron or manganese, when they are present. The study and identification of these compounds

and their behaviour in the aluminum alloys is an important part of the metallography of aluminum. In addition to the amount of alloying metal which combines with the aluminum to form the precipitated compounds, a certain amount remains in "solid solution" in the solid aluminum. The solid solubility of some of these metals (copper, zinc, magnesium) may be considerable at elevated temperatures, but is markedly lower at room temperature.

Physiological.—Metallic aluminum and its oxide and hydroxide are completely nontoxic, and generally inert as far as living organisms are concerned. Thus, in contrast to copper and iron, the metal has no bactericidal effect. Animal experiments have shown that small amounts of aluminum dust inhaled with silica dust into the lungs prevent the development of the typical lesions of silicosis (*q.v.*) by coating the silica particles with a thin layer of aluminum hydroxide, which apparently makes them inert. Inhalation of small amounts of aluminum dust also has been found to have a beneficial effect in allaying some of the symptoms of human silicosis. Colloidal aluminum hydroxide, administered as a nasal drip or by mouth, has been found to exert a marked healing effect in cases of stomach ulcer. Water soluble aluminum salts (such as the chloride and sulphate) are used in medicine and in cosmetics as astringents.

CHEMICAL COMPOUNDS

Oxide and its Hydrates.—Aluminum oxide exists in several different crystallographic forms. The one which occurs in nature (corundum, *q.v.*) is designated as the alpha form, and is characterized by a high specific gravity (4.0), a high melting point (about 2,015° C. or 3,660° F.) and great insolubility. Its high hardness (hard enough to scratch glass) makes it one of the most useful of natural or artificial abrasives (*q.v.*). Commercially pure aluminum oxide is made by calcining the purified hydrate at temperatures about 2,000° F. and is chiefly used as a raw material for the production of the metal. Its principal impurities are soda (0.4–0.6%), iron oxide and silica (usually less than 0.03% each). It is an important raw material for the manufacture of certain articles such as insulators and spark plugs, "Alundum" laboratory ware (tubes, crucibles, etc.) and pure fused alumina for certain types of abrasive wheels. Rubies and sapphires are crystalline, nearly pure varieties of alpha alumina, the colours being the result of small amounts of impurities. Synthetic rubies and sapphires are made on a commercial scale by fusing a mixture of high purity Al_2O_3 with traces of the necessary colouring agents, in an oxyhydrogen blowpipe flame. Most of the material thus produced is cut up into jewels for watches and other precision instruments.

When the alumina hydrates are heated to gradually increasing temperatures up to about 1,000° F., they are decomposed and lose most of their water. The aluminum oxide formed goes through a series of physical changes as the temperature increases, and some of the products are interesting and commercially important. At the lower temperatures, water is driven out without appreciable shrinkage of the granules; so that the result is a porous structure. The area exposed in the pores when the water has been driven out can be measured by physicochemical means, and may be as high as several hundred square metres per gram. This surface is extremely active and has the power of adsorbing water vapour and some other gaseous molecules upon it. The product (commercially known as activated alumina) is important for drying air and other gases, and as a catalyst carrier in certain reactions such as the production of toluol from the vapours of other hydrocarbons at high temperatures. The affinity of the alumina surface for water vapour is such that air may be dried by it as completely as with phosphorus pentoxide.

The hydrous forms of alumina (often called alumina hydrates) may contain either one (monohydrate) or three (trihydrate) molecules of water per molecule of Al_2O_3 . Each is known in two distinct modifications (alpha and beta). In both cases the alpha variety is the more common one. The alpha trihydrate (*gibbsite*, *hydrargillite*) is the principal constituent of the bauxites found in North and South America, and in the East Indies. The alpha monohydrate (*boehmite*) is the principal

constituent of European bauxites. The beta monohydrate occurs in nature as the mineral *diaspore*.

Alpha trihydrate is the variety sold commercially as hydrated alumina. It is the raw material out of which commercial alumina is prepared by calcination, and is produced by the Bayer process. The first step in this process involves dissolving the alumina hydrate out of bauxite or laterite in superheated caustic soda (sodium hydroxide) solution under pressures of 60–200 psi. The solution is then filtered from the residue (red mud) containing the impurities. The filtered solution (sodium aluminate) is cooled to a little above room temperature and becomes supersaturated with respect to alumina hydrate. Upon now agitating this solution with "seed" of the finely divided crystalline trihydrate, the excess (about two-thirds of the total) of the alumina crystallizes out. The solution, after some evaporation, is used to extract more alumina from a new charge of bauxite. The precipitated hydrate is washed and dried or else calcined, if the oxide is to be the finished product. This trihydrate is a fine crystalline powder (specific gravity about 2.4), soluble only to the extent of less than one part per million in water but readily soluble in dilute mineral acids, sodium hydroxide or potassium hydroxide. Aside from the production of the various forms of alumina, its principal use is for the production of pure aluminum sulphate and alums (*q.v.*).

Beta alumina trihydrate may be made by neutralizing sodium aluminate solution with carbon dioxide under certain carefully controlled conditions. It is unstable, rather readily converted to the alpha monohydrate by heating in water.

The alpha monohydrate may be produced from the trihydrate by heating it cautiously in air or under pressure with water containing some sodium hydroxide. It is less easily dissolved in dilute acid and alkalis than the trihydrate; consequently monohydrate bauxites are not as suitable for the manufacture of alum, and require a higher temperature and a higher sodium hydroxide concentration than the trihydrate bauxites in the Bayer process.

Salts.—Various sulphates and double sulphates are the commonest of the aluminum salts. Alums (*q.v.*) are soluble double sulphates of aluminum with potassium, sodium or ammonium. Alunite (*q.v.*) is an insoluble basic alum. The normal aluminum sulphates are quite soluble in water, and are discussed under sulphuric acid (*q.v.*). Aluminum chloride and aluminum nitrate are also soluble, and are discussed under the corresponding acids.

ALLOYS OF ALUMINUM

The purpose of alloying metals is to develop improved properties for special uses. In general, small to moderate amounts of aluminum may be added to certain other metals to improve their properties (*e.g.*, in the case of aluminum bronzes and most magnesium base alloys), or small to moderate amounts of other metals and silicon can be added to aluminum to form the so-called aluminum-base alloys. Because of their improved castability and higher strength, these alloys are better adapted than pure aluminum for most industrial applications.

Strictly speaking, ordinary commercial aluminum (99.0–99.6% pure) should be considered as an alloy of pure aluminum with small amounts of iron and silicon. These definitely change the properties of the pure metal, markedly increasing its strength and decreasing its resistance to corrosion. For practical reasons, iron is generally considered as an impurity to be controlled, while silicon may be either an impurity or a major alloying ingredient. The other major alloying ingredients are copper, magnesium, manganese, zinc and nickel. Moderate amounts of tin, cadmium, lead, bismuth and cobalt may be used in special alloys; small amounts of chromium and titanium (usually less than 0.3%) and still smaller amounts of vanadium, boron, beryllium and sodium are also sometimes used for special purposes, such as grain refinement.

Casting Alloys.—Pure aluminum, like most pure metals, can only be made into commercial castings with considerable difficulty. A pure molten metal freezes quite sharply at a definite temperature, and consequently it is difficult to arrange "risers" and

other devices to feed molten metal into the casting during freezing, and make up for the solidification shrinkage. The alloys used for making castings, on the other hand, freeze through a considerable range of temperature, passing through a mushy stage in which the crystals of more or less pure aluminum are mixed with the still-liquid concentrated alloy. This permits this metal from the gates and risers to flow into the casting until the solidification (and therefore the shrinkage) is nearly complete, and minimizes the formation of shrinkage cavities, which are objectionable in the finished castings. One of the advantages of the presence of a considerable percentage (5–20%) of silicon in aluminum-base casting alloys is that silicon actually expands on freezing or crystallizing out of molten aluminum, and consequently tends to counteract the solidification shrinkage of the aluminum itself.

In the early days of the industry, up to about the outbreak of World War I, the alloys used in the United States were of the aluminum-copper type, while those used in England and in Europe were largely of the aluminum-zinc type, but often contained some copper. Shortly after the war, the aluminum-silicon alloys were introduced and became quite popular. The 12% silicon alloy (containing a small amount of sodium to "modify" the silicon) largely displaced the aluminum-zinc alloy in England and Europe, while a 5% silicon alloy became popular in the United States for architectural and other castings, where good casting properties and high resistance to corrosion were important and high strength was not required. Alloys containing about 10% copper were used quite largely throughout the world after World War I, to make pistons for internal combustion engines, being generally cast for this purpose in iron moulds (so-called permanent moulds). Most of the aluminum alloy castings made in the United States up to the time of World War II continued to be made of alloys containing 7–10% copper, although heat treated alloys containing about 4.5% copper or 10% magnesium were extensively employed where higher strength and ductility were required.

The heat treatment of castings requires a relatively long heating (6–24 hr.) at temperatures of 700–1,000° F.—the exact temperature and time depending on the alloy composition and type of casting (sand or permanent mould). This is followed by "quenching" the casting in hot or cold water or oil, with subsequent aging at either room temperature or a temperature somewhat above the boiling point of water. The purpose of the "solution heat treatment" at 700–1,000° F. is to put into "solid solution" as much as possible of the alloying elements, particularly copper, magnesium and zinc.

The reason for the long time of heat treatment is inherent in the structure of the castings. When a casting is made from an aluminum-base alloy containing copper, for example, the crystals which form first during the freezing process are nearly pure aluminum. Most of the copper remains in the liquid phase, and as the crystals grow the concentration of the copper in the liquid increases, although small amounts of it are deposited in the outer layers of the crystal. Since increasing the proportion of copper in aluminum lowers its freezing point, this process continues as the casting cools, until the temperature is reached at which the eutectic (lowest melting mixture) of aluminum and copper (containing 33% copper) freezes. Meantime, however, the crystals have grown until they almost touch one another, so that when the eutectic freezes it fills the small intergranular spaces and acts as a cement between the crystals. Aluminum can hold approximately 4.3% of copper in solid solution at the heat treating temperature (about 950° F.) but only a small fraction of this is actually in solid solution "as cast"; the rest being in the intergranular eutectic. In order to obtain a nearly saturated solid solution in the aluminum, it is necessary to hold the casting at high temperatures long enough for the copper to diffuse from the grain boundaries and distribute itself throughout the grains or crystals. Naturally, the larger the grains the longer this takes. Consequently, fine-grained castings (such as those cast in permanent moulds) require a shorter heat treating time than coarse-grained castings, and wrought material (where the eutectic has been broken up and mechanically dispersed) a much shorter time.

If the article is now suddenly cooled or quenched to room temperature, we have a supersaturated solid solution, since the solid solubility of copper in aluminum at room temperature is about 0.25%. Unless some accelerating metal, such as magnesium, is present, this solid supersaturated solution only changes and precipitates slowly through a long period of storage at room temperature. However, if the temperature is raised to the boiling point of water or higher, the mobility of the atoms of copper in the alloy is sufficiently increased so they are able to get together in a few hours and apparently precipitate in the form of submicroscopic particles of the compound CuAl_2 . With longer heating and at higher temperatures, these particles may grow large enough to become visible under the microscope upon a polished and properly etched surface of the alloy. They are found to be arranged in quite definite patterns along certain planes in the individual crystals. Apparently the effect of these minute particles of hard constituent is to "key" these slip planes, just as a stack of sheets of paper would be keyed against a sidewise thrust by particles of fine sand between each sheet and the next. The precipitation process thus increases the tensile strength and yield strength of the alloy but decreases its ductility. In the presence of 0.5% magnesium, this precipitation occurs spontaneously in a few days at room temperature. Such precipitation at room temperature is spoken of as "natural aging," while precipitation induced by heating at elevated temperatures is spoken of as "artificial aging."

In the binary aluminum-magnesium alloys the solid solubility of magnesium at the heat treating temperature and at lower temperatures is considerably greater than that of copper, but the phenomena of heat treating, quenching and aging are similar. The solubility of silicon varies little with temperature, so that a solution heat treatment of a binary aluminum-silicon alloy has little effect on its properties. However, if magnesium is present, a magnesium silicide (Mg_2Si) is formed which has an appreciable solid solubility at heat treating temperature, and precipitates by natural aging after quenching. A heat treatable casting alloy of this type may contain about 5% silicon, 0.5% magnesium and 1-1.5% copper. Its tensile properties are lower than those of the heat treated copper or magnesium alloys, but it has much better casting properties.

The physical properties of castings vary greatly, depending not only upon the composition but also on the casting conditions. Thin sections generally show a somewhat higher tensile strength in pounds per square inch than do thick sections. Heat treated alloys generally show higher strength and ductility than those not heat treated. Typical strengths for ordinary sand cast alloys are in the range 19,000-30,000 psi, while heat treated alloys may show 30,000-45,000 psi. As a general rule, an alloy cast in permanent (metal) moulds will show tensile strengths 5,000-10,000 psi higher than when sand cast.

Wrought Alloys.—Contrary to the situation in the casting field, the pure metal is the easiest form of aluminum to use in producing wrought articles. This is because of its softness and high ductility, which permit it to be rolled, forged, drawn, extruded, etc., with a maximum of ease and a minimum of scrap. Alloying elements cause the pure metal to become stronger, harder and less ductile, although these increases are not necessarily directly proportional to the amount of the added alloying ingredients. The higher strength naturally imposes a greater burden upon the fabricating machinery, and the lower ductility increases the tendency of the metal to crack or tear when worked severely.

The first step in the production of wrought articles is the casting of the ingot which is to be worked. Because of the tendency of pure aluminum to crystallize out first and leave the liquid portion enriched in the alloying ingredients (as explained above) the tendency of some of the alloying metals to segregate into certain areas during the freezing of the ingot is increasingly troublesome as the amounts of alloying ingredients increase. Rather elaborate special mechanical arrangements are therefore required to produce satisfactory ingots of such alloys. The basic principle of such ingot production is to chill the metal vigorously and cause it to freeze rapidly, preferably from the bottom up,

so that the primary grains may be as small as possible and the distribution of the eutectic (which solidifies last) may be as uniform as possible throughout the whole ingot.

As indicated, commercial aluminum may be considered to be an alloy of pure aluminum with small amounts of iron plus silicon and traces of other elements, particularly copper and manganese. As the simplest of the aluminum alloys, it stands next to pure aluminum in ease of working. Ordinary commercial "pure aluminum" sheet contains 99.0-99.4% aluminum. Foil is generally made of somewhat higher purity material, ranging up to 99.8% for foil used in electrolytic condensers. Ordinary pure aluminum tubing has about the same composition as sheet aluminum, but the so-called "collapsible tubes," made as containers for tooth paste, shaving cream, etc., are usually made of 99.5-99.8% aluminum to reduce their stiffness. Wire for electrical conductors is usually 99.5-99.7% aluminum. With this purity of metal, the conductivity is 60-62% of the international annealed copper standard.

In the manufacture of wrought aluminum articles, maximum ductility and minimum strength are produced by annealing the cold worked article, usually by heating for some time at a temperature of about 650° F.

The hardening and strengthening effect of even small amounts of alloying ingredients is clearly seen on comparing the typical properties of commercial annealed aluminum sheet with those of similar sheet made of 99.99% aluminum. The typical tensile strength of about 7,000 psi for 99.99% metal increases to 13,000 psi for commercial aluminum sheet, while the yield strength increases from 1,800 psi to 5,000 psi. (The yield strength of aluminum is defined as the load in psi which produces a permanent elongation or "set" of 0.2% in 2 in.). At the same time the elongation in 2 in. is reduced from about 50% to 35%. Cold working (rolling, forging, drawing through dies, etc., at ordinary temperatures) hardens the metal, increasing both tensile and yield strength. This effect increases with the amount of cold work. The magnitude of the changes involved is seen from the fact that a typical tensile strength for hard rolled commercial aluminum sheet would be 24,000 psi with a corresponding yield strength of 21,000 psi and an elongation of only 5% in 2 in. Intermediate amounts of cold working produce intermediate tempers designated as quarter-, half-, and three-quarters hard. In general, annealed or quarter-hard sheet is chosen as the starting point for such operations as the production of cooking utensils by drawing or spinning, and the production of other drawn articles. Aluminum electrical conductors, on the other hand, are practically always delivered in the full-hard condition, because high strength is desired.

Next to commercial aluminum, the simplest wrought aluminum alloy is the one made by adding about 1.25% of manganese to commercially pure aluminum. This alloy has been widely employed under the designation "3S," both in England and the United States, for uses such as the manufacture of cooking utensils, where a somewhat higher strength than that of commercial aluminum is desired. It is slightly more difficult to work (draw, spin, etc.) than commercial aluminum, as would be expected from its higher strength.

Another group of relatively simple aluminum-base alloys includes those in which magnesium (2-9%) is added to commercial aluminum, with or without small amounts of chromium, manganese or zinc. The most common type contains about 2.5-3.5% magnesium and either about 0.5% manganese or 0.2% chromium. It has a considerably higher strength in the annealed and cold worked conditions than alloys of the 3S type, together with excellent resistance to sea water corrosion. An alloy containing 2.5% magnesium and 0.25% chromium would have typical tensile and yield strengths in the annealed condition of 29,000 and 12,000 psi, and in the hard rolled condition of 41,000 and 36,000 psi, with elongations of 25% and 7% respectively. With 5.2% magnesium and 0.1% each of manganese and chromium, these figures become 42,000 and 20,000 psi, respectively, in the annealed condition, and 58,000 and 48,000 psi in the hard worked condition. Somewhat higher physical properties

may be obtained by further increasing the magnesium and manganese contents, at the risk of producing alloys which may be subject to a marked acceleration of their rate of corrosion under the influence of stresses, particularly in the hard worked condition.

The heat treated strong alloys of aluminum form an important and characteristic group. Their importance may be seen from the fact that in 1938-45 substantially all the structural parts of military and larger civilian aeroplanes were made of them. The earliest and most important group of these is popularly known as duralumin (*q.v.*) and contains 4-5% copper, 0.6-1.2% magnesium and 0.6-1.2% manganese. Their heat treatment has been discussed above, under casting alloys.

The important copper-free heat treatable alloys containing magnesium silicide (Mg_2Si) with a slight excess of silicon were first developed and commercially exploited in the United States in the early '20s. Their somewhat inferior strength, compared with the duralumin type alloy, was offset by greater workability, both hot and cold, and consequently lower fabricating cost. The use of these alloys gradually spread to other lands, where they were given distinctive local designations.

Great difficulty was found in the early days in producing satisfactory forgings of the duralumin type alloys, because of their high strength and tendency to crack under the hammer. Along with the magnesium silicide type alloys, therefore, there was developed and commercialized in the United States a special forging alloy which differed from duralumin in omitting the magnesium. This facilitated fabrication, and the resulting forgings, after solution heat treatment and quenching, could be artificially aged to substantially the properties of duralumin. This made it practical to produce commercially aluminum propellers for the multitude of aircraft which were needed in World War II, and most of the metal propellers used before and during this war were forged out of this alloy.

After the obstacles to the fabrication of the standard duralumin had been overcome, intensive research and development work in both Germany and the United States brought forth a stronger variety of this alloy in which the copper and magnesium were both increased appreciably, and yet the composition was so adjusted that it was still possible to fabricate it commercially into sheet and other forms. This variety (first commercialized in the United States and known throughout the English-speaking world as 24S) had, roughly, 10% higher tensile and yield strengths than its predecessor.

A further increase in physical properties was accomplished near the end of World War II, by the practical introduction of aluminum base alloys in which the magnesium-zinc compound $MgZn_2$ was the principal hardening agent. These alloys had been originally developed and patented in Germany in the early '20s, but their practical use had been prevented because of their susceptibility to stress corrosion. After many years of work, the modifying effects of copper and small amounts of chromium, vanadium and other elements on this sensitiveness to stress corrosion were worked out and commercially stable alloys developed. The alloy of this type commercialized in the United States in 1944 contained about 5.75% zinc, 2.5% magnesium, 1.6% copper and a little chromium. Heat treated extrusions of this alloy showed a typical strength of 88,000 psi and a yield strength of 80,000 psi, with an elongation of 10% in 2 in. It was also used in what is known as the "alclad" sheet form, where its tensile properties were somewhat reduced by the presence of a thin layer of a weaker alloy on each surface of the sheet. Even then, in the heat treated state the tensile strength was typically 76,000 psi and yield strength 66,000 psi, with 11% elongation.

The problem of protecting alloys of the duralumin type from corrosion is not serious when only relatively thick pieces are involved, but when the aircraft industry began to require large quantities of very thin sheet (0.01-0.02 in. thick) it became apparent that even slight superficial corrosion might be serious and must be prevented. The advantage of protecting the surfaces of such sheet with a thin integral coating of pure aluminum (which not only mechanically protected the surface

from corrosion, but also electrolytically protected the cut edges, just as zinc does in the case of galvanized iron) was first demonstrated and a practical method for producing such sheet worked out in 1926, in the United States. The production and use of such alclad sheet spread throughout the aluminum-producing countries of the world during the next ten years, and the use of such sheet for wing covering and other purposes on aeroplanes became substantially standard for civilian planes and most military planes by the beginning of World War II. Pure aluminum was satisfactory as a cladding layer for alloys of the duralumin type, but in some countries and for other types, alloys containing small amounts of magnesium silicide or zinc, with or without manganese, were preferred.

Standard specifications for the various types of wrought and cast aluminum alloys have been developed and published by official and semiofficial bodies in the United States, England, Germany and France, and should be referred to in connection with the literature of the producers for specific information as to alloys available in the different countries.

Uses.—High thermal and electrical conductivity, together with light weight and excellent resistance to corrosion, were the basis of most of the early tonnage uses of aluminum, as in the field of cooking utensils and electrical conductors. In cooking utensils, high thermal conductivity of the metal is especially important in conducting the heat laterally and spreading it uniformly over the bottom of the utensil which is in contact with the flame, thus avoiding local hot spots which might cause the food to burn.

Although considerably weaker than hard drawn copper electrical conductors, pure aluminum wire was made to compete economically by stranding it about a strong galvanized steel wire core, to make "aluminum cable steel reinforced." Such cable is particularly valuable for the economical transmission of electric power at high voltages over long distances. More than 1,000,000 mi. of such cable had been erected before 1940, the bulk of it in North America.

With the development of stronger and better cast and wrought alloys in the period between World War I and World War II, aluminum became increasingly important as a structural material, particularly in the transportation industry. The original and most important early use of the wrought alloys of the duralumin type was in the framework of the Zeppelin airships which were used by the Germans in World War I. Aluminum castings were used in aeroplane engines in that war, and the Germans made a beginning in the use of duralumin type alloys in the structural parts of the planes themselves. In the period between World War I and World War II, wood (which had been the principal structural material for planes prior to that time) was almost completely replaced by metal (chiefly strong aluminum alloys of the duralumin type) in the form of sheet, extrusions and tubing. At the same time increased experience and the reduction in cost of producing and fabricating such alloys resulted in their rapid introduction in many other industrial fields where strength was required but light weight was advantageous. Buses and trucks used for long distance hauling were increasingly provided with aluminum bodies, cranks and other parts. Aluminum tank trucks and trailers for hauling gasoline and milk were found to be economically advantageous, and railway tank cars were constructed of aluminum for the shipment of hydrogen peroxide, high strength (95+%) nitric acid, organic solvents and other special materials. Deluxe high speed trains were built of aluminum alloys, and considerable aluminum was used in the construction of passenger automobiles.

The light weight, attractive appearance and resistance to atmospheric influences displayed by aluminum accounted for its introduction and popularity in the architectural industry, beginning about 1926. Aluminum spandrels, windows, doors, ornamental railings and grillwork, roofing, store fronts, and miscellaneous hardware became increasingly popular in the period prior to World War II. Aluminum was extensively used in domestic appliances such as vacuum cleaners, refrigerators and cooking utensils, including large kettles for food manufacturing and industrial chemical purposes.

Because of its resistance to many rather corrosive chemicals, and the colourless and nontoxic character of its corrosion products, aluminum has been extensively used in the chemical and allied industries for tanks, piping, reaction vessels and miscellaneous equipment. Its use is particularly important in the synthetic acetic and nitric acid industries and in the manufacture of formaldehyde, hydrogen peroxide and various organic chemicals. For similar reasons, it has been widely used in the brewing industry for brewing kettles, storage tanks, fermenters and other equipment, and for beer barrels. The use of light aluminum drums was an important and successful application during World War II for the shipment of aviation gasoline by air from India to bases in China.

In this war, the use of aluminum for military and naval purposes other than aviation was limited as strictly as possible because the tremendous demands of the aircraft industry taxed the producing and fabricating capacity. It was, however, extensively used for mess kits, canteens and other articles carried by the men, and for various parts of the superstructure and furniture of naval vessels.

A widespread use of aluminum paint for the protection of both wood and metal structures developed in the United States in the period between World Wars I and II. The aluminum pigment used consisted of fine flakelike particles produced by a stamping or grinding operation and coated with a little stearic acid, which makes them "leaf" or come to the surface when suspended in a suitable vehicle, such as a long oil varnish. The leafing power and complete opacity of the aluminum pigment protect the dried and hardened varnish in the paint layer from the deteriorating effect of sunshine and moisture, so that the paint is long-lived under outdoor exposure, even in the tropics. A finer grade of the same aluminum pigment was extensively used for the manufacture of aluminum ink for use in printing.

Because of its higher strength and lower cost, aluminum foil largely replaced tin foil as a wrapping material for chocolate bars and other candies, cheese and other foodstuffs, etc. Laminated with thermoplastic resins, it was largely used during World War II in the manufacture of small "heat sealed" packages for foodstuffs, medicines, etc. Large tonnages of aluminum foil were also used for electrical condensers in radio and radar equipment, and small strips of foil were scattered from aeroplanes to confuse enemy radar. Aluminum foil and thin aluminum sheet have been used to a large extent in the manufacture of closures for milk bottles and other bottles containing foods and drinks.

Aluminum castings have been used for a great variety of applications, the largest being probably in connection with internal combustion engines (pistons, crankcases, cylinder heads, etc.) and domestic appliances such as washing machines and vacuum cleaners. They are made by techniques similar to those employed with other nonferrous metals.

Extrusions are made by forcing the solid metal (hot or cold) through a suitable die under heavy pressure. Collapsible tubes for toothpaste and the like are made by "impact extrusion" in which a blank of cold metal placed in a suitable die is struck a sudden blow by a plunger in a press. The diameter of the plunger is just a little less than the diameter of the hole in the die, so that the metal is forced back up as a thin tube between the plunger and the die, while a part of the metal remains in the die to form the head of the tube. Most extrusions are, however, made by using hot ingots (700–950° F.) 6–18 in. in diameter and of suitable length, placed in a hydraulic "extrusion press." They are then subjected to high pressures and forced through dies, from which they emerge in the desired form as rods, structural shapes, heavy walled tube "blooms," special mouldings for stiffeners for aircraft construction, etc. These extrusions may be of pure aluminum or of any of the aluminum alloys. Most of the extrusions used in the aircraft industry are made of high strength aluminum alloys and heat treated. Tube "blooms" are reduced to tubing of the desired size by cold drawing.

Forgings are made with air or steam hammers or suitable forging presses, from "forging stock," which is usually a rod or

bar of high strength aluminum alloy. Tremendous numbers of such forgings were used in aircraft in World War II, several hundred being used on each large plane. The manufacturing technique resembles that employed in forging steel articles of similar size.

Joining Aluminum.—In building aluminum structures such as buses, cars, aircraft and the like, and in many simpler articles, it is necessary to join together various pieces of aluminum, with or without pieces of other metal. As in steel structures, riveting may be employed. Untold millions of small, strong aluminum alloy rivets were used in the construction of aircraft in World War II. During that war, however, electric spot welding and seam welding made marked progress and were increasingly used, particularly with alclad sheet. Torch welding, with a suitable welding flux, has been extensively used since before World War I for joining articles of pure aluminum or nonheat treated alloys, and began to be supplemented just before World War II by arc welding, with either metallic or carbon electrodes. Soldering of aluminum is easy, but with most solders the joint weakens in a few weeks and comes apart, unless thoroughly protected from moisture.

While many improvements have been made in solders, the demand for this type of joint has largely been met by the brazing process, in which the metal used for uniting the two aluminum surfaces is an aluminum base alloy (generally containing silicon) melting at a convenient interval below the melting point of the articles to be joined. By the use of a suitable flux, articles may thus be joined by the use of a torch or by passing them through a furnace at a controlled temperature. More intricate assemblies (such as an intercooler for an aeroplane) may be brazed by immersing the article for a few minutes in a bath of molten flux maintained at the proper temperature. Brazing is often facilitated by using sheet metal having a thin layer of brazing alloy on one or both sides, similar to the protective layer in the alclad strong alloy sheet. Brazing became of commercial importance at about the beginning of World War II. Brazed joints are in general as resistant to corrosion as the rest of the article. Inserts of copper, brass or iron may be united with aluminum by the brazing process.

BIBLIOGRAPHY.—For detailed information on alloy compositions, forms, uses, fabrication methods, etc., reference should be made to trade literature and pamphlets issued by all of the important producers and fabricators of this metal. General references: J. W. Mellor, *Comprehensive Treatise on Inorganic and Theoretical Chemistry*, vol. 5 (1924) on the chemistry of aluminum compounds; J. D. Edwards, F. C. Frary and Z. Jeffries, *The Aluminum Industry*, a general survey, 2 vols. (1930); D. B. Hobbs, *Aluminum, Its History, Metallurgy and Uses, with Projects for the School and Home Shop* (1938) is a more popular discussion. Swiss practice is described by A. von Zeerleder, *The Technology of Aluminum and its Light Alloys*, tr. by A. J. Field (1936). For special fields, A. Jenny, *Anodic Oxidation of Aluminum and its Alloys*, tr. by Winifred Lewis (1940); J. D. Edwards, *Aluminum Paint and Powder* (1936); Aluminum Company of America, *Structural Aluminum Handbook* (1945). For a discussion of the economics of the industry, see N. H. Engle, H. E. Gregory and R. Mossé, *Aluminum, an Industrial Marketing Appraisal* (1945).

(F. C. F.)

ALUMINUM BRONZE, the name originally given to an alloy containing 90% copper and 10% aluminum. Later, alloys with smaller percentages of aluminum and also those containing, in addition, 1%–4% of manganese and iron were included under the general term "aluminum bronzes." The maximum percentage of aluminum in industrial bronzes is 11%, as larger proportions entail excessive brittleness.

Aluminum bronzes are distinguished by their golden yellow colour, which has led to their extensive use for art-metal work. Mechanically they approach mild steel, being strong and ductile and lending themselves readily to rolling and forging. In fact the alloy containing 10% aluminum has been compared with 0.35% carbon Swedish Bessemer steel, by no means to the disadvantage of the former. When cast the 10% alloy has the following properties:

Elastic limit	25–30,000 lb. per sq. in.
Tensile strength	70–80,000 lb. per sq. in.
Elongation on 2"	20%
Brinell number	100

As in the case of steel, these properties may be greatly improved by suitable heat treatment.

Casting in sand offers some difficulties and sound castings are not easy to obtain. Casting in chills or by the centrifugal process yields excellent results, and great quantities of such castings are regularly produced. Machining is troublesome and special precautions are called for owing to its high strength and resistance to alternating stresses. The 10% bronze has been used with great success for the worm wheels of motor cars, many thousands of tons of metal having been cast for this purpose.

Aluminum also confers on copper the property of resisting furnace and other sulphurous gases, so that these bronzes have proved themselves well adapted for utensils subjected to direct contact with flames. They have also been used with success to withstand attack by sea-water and the acid waters found in some mines. Aluminum-manganese bronzes possess well defined magnetic properties.

For structure and mechanical properties see 8th and 9th Report of Alloys Research Committee, *Proceedings of the Institute of Mechanical Engineers* (1907, p. 57; 1910, p. 119). (R. S.)

ALUM SHALES, sedimentary rocks, rich in alumina and iron pyrites.

ALUNDUM, a hard material belonging to the class of abrasives (*q.v.*), also used for the manufacture of laboratory apparatus. It is obtained by fusing bauxite (*q.v.*) in an electric furnace.

ALUNITE or **ALUMSTONE**, a mineral first observed in the 15th century at Tolfa, near Rome, where it is mined for the manufacture of alum. Extensive deposits are also worked in Tuscany and Hungary, and at Bulladelah in New South Wales. By repeatedly roasting and lixiviating the mineral, alum is obtained in solution, and this is crystallized out by evaporation. Alunite occurs as seams in trachytic and allied volcanic rocks, having been formed by the action of sulphurous vapours on these rocks. The white, finely granular masses somewhat resemble marble in appearance, and the more compact kinds from Hungary are so hard and tough that they are used for millstones. The hardness is 4 and the specific gravity 2.6. The mineral is a hydrated basic aluminium and potassium sulphate, $KAl_3(SO_4)_2(OH)_6$.

ALUNTUM, an ancient city of Sicily, (Gr. Ἀλόντιον, mod. S. Marco d'Alunzio), 6 m. from the north coast and 25 m. N.E. of Halaesa. It was probably of Sicel origin, though its foundation was ascribed to some of the companions of Aeneas. It suffered considerably at the hands of Verres. The abandoned church of S. Mark, just outside the modern town, is built into the *cella* of an ancient Greek temple, which measures 62 ft. by 18.

ALUR (Lur, Luri, Lurem), a Negro people of the Nile valley, living on the north-west coast of Albert Nyanza. They are akin to the Acholi (*q.v.*), speaking practically the same language.

ALURE, a rare architectural term for a passageway or gutter behind a parapet or a clerestory; sometimes written *valure* or *valoring*.

ALVA or **ALBA**, **FERNANDO ALVAREZ DE TOLEDO**, DUKE OF (1508–83), Spanish soldier, was descended from one of the most illustrious families in Spain. Selected for a military command by Charles V., he took part in the siege of Tunis (1535), and successfully defended Perpignan against the dauphin of France. He was present at the battle of Mühlberg (1547), and the victory gained there over John of Saxony was due mainly to his exertions. He took part in the subsequent siege of Wittenberg, and presided at the court-martial which tried the elector and condemned him to death. In 1552 Alva was entrusted with the command of the army intended to invade France, and was engaged for several months in an unsuccessful siege of Metz. He was then made commander-in-chief of all the emperor's forces in Italy. Success did not, however, attend his first attempts, and after several unfortunate attacks he was obliged to retire into winter quarters. After Charles's abdication he was continued in command by Philip II. Alva had subdued the whole Campagna, and was at the gates of Rome, when he was compelled by Philip's orders to negotiate a peace. One of its terms was that the duke of Alva should in person ask forgiveness of the haughty pontiff whom he had conquered. Proud as the duke was by nature, and

accustomed to treat with persons of the highest dignity, he confessed his voice failed him at the interview, and his presence of mind forsook him. Not long after this (1559) he was sent at the head of a splendid embassy to Paris to espouse, in the name of his master, Elizabeth, daughter of Henry, king of France.

In 1567 Philip sent Alva to the Netherlands to repress Protestantism there. Alva made the long march from Genoa at the head of a perfectly disciplined army of about 10,000 men. When he presented his credentials as captain-general of the Netherlands at Brussels it was clear that there remained to the regent, Margaret, Duchess of Parma, a mere shadow of power. Before the end of the year she resigned, and Alva succeeded her as governor-general and regent.

Alva's first care was to lure into his power Counts Egmont and Horn, two of the leaders of the malcontent nobles. They were seized and imprisoned, and in the next year brought to the block (June 2 1568). The new governor erected a tribunal, known officially as the "Council of Troubles," but popularly called the "Council of Blood." Alva himself presided, and reserved the decisions to himself. Of the seven Netherlands who were members, five resigned after the nature of the operations of the court became clear. From the first the business was in the hands of Alva and two Spaniards, one of whom, Juan de Vargas, received the evidence collected from all over the country against heretics and malcontents. It was at the hands of the Council of Blood that Egmont and Horn received their sentence.

William of Orange, summoned before the Council, refused to acknowledge its competence, and left the country to raise troops to meet force with force. But the army of mercenaries which crossed the frontier under Louis of Nassau was destroyed by Alva without difficulty at Jemmingen (July 21 1568). Another army, led by William himself into Brabant, was felled, and William withdrew and disbanded the force. By the failure of these two attempts Alva's position was made secure, and he was able to devote himself entirely to the crushing of the liberties of the towns and the destruction of heretics. In the terror which followed Alva himself boasted that 18,000 persons were executed, in addition to the numbers killed in battle or massacred after victory.

Alva made a serious blunder when, in desperate straits for money, he attempted in 1569 to levy a property tax and a 10% turnover tax on all sales, for by this measure he united Catholics and Protestants against him. The exiles from the Low Countries encouraged by the general opposition, fitted out a fleet of privateers, which harried the coast towns and seized Spanish ships at sea. On April 1, 1572 the "Sea-beggars" seized Utrecht. They captured Brielle and Flushing, and within a short time four of the northern provinces had declared for the Prince of Orange. Alva's preparations to oppose the gathering storm were made with his usual vigour, and he reduced Mons and Malines while his son Frederick, prior of Toledo, took Zutphen. The towns were sacked and the inhabitants maltreated, Catholic and Protestant alike. With the exception of Zealand and Holland, he regained all the provinces; and at last his son stormed Naarden, and, massacring its inhabitants, proceeded to invest the city of Haarlem, which, after standing an obstinate siege, was taken and pillaged (July 11, 1573).

Their next attack was upon Alkmaar, but the 2,000 burghers repulsed the 16,000 Spanish veterans sent against them with great loss, and Frederick was constrained reluctantly to retire. Alva's feeble state of health and continued disasters induced him to solicit his recall from the government of the Low Countries; a course which was not displeasing to Philip, who was now resolved to make trial of a milder administration. In Dec. 1573 Alva returned to Spain.

On his return he was treated for some time with great distinction by Philip. But he had many enemies, among them Philip's secretary, Antonio Perez. He was banished from court, and confined in the castle of Uzeda. Here he had remained two years, when the success of Don Antonio in assuming the crown of Portugal determined Philip to recall Alva. In 1581 he entered Portugal, defeated Antonio, drove him from the kingdom, and soon reduced the whole, under the subjection of Philip.

Entering Lisbon, he seized an immense treasure, and suffered his soldiers to sack the suburbs and vicinity. It is reported that Alva, being requested to give an account of the money expended on that occasion, sternly replied, "If the king asks me for an account, I will make him a statement of kingdoms preserved or conquered, of signal victories, of successful sieges and of 60 years' service." Alva died in Jan. 1583 at the age of 74.

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ALVA, a small burgh, Clackmannanshire, Scotland, $\frac{3}{4}$ mi. N. of Alloa, terminus of a branch line of the L.N.E.R. Pop. (est. 1938) 3,986. It is situated at the foot of three front peaks of the Ochils-West Hill (1,682 ft.), Middle Hill (1,436 ft.) and Wood Hill (1,723 ft.). There are spinning mills, and also manufactures of tweeds, tartans and other woollen goods. Silver, lead and other metals have been found in the hills, in small quantities.

ALVARADO, PEDRO DE (1485?–1541), one of the Spanish leaders in the discovery and conquest of America, was born at Badajoz about 1485. He held a command in the expedition sent from Cuba against Yucatan in the spring of 1518, and returned in a few months, bearing reports of the wealth and splendour of Montezuma's empire. In Feb. 1519 he accompanied Hernán Cortés in the expedition for the conquest of Mexico. He acted as Cortés' principal officer, and on the first occupation of the City of Mexico was left there in charge. When the Spaniards had temporarily to retire before the Mexican uprising, Alvarado led the rear-guard (July 1, 1520), and the *Salto de Alvarado*—a long leap with the use of his spear, by which he saved his life—became famous. He was engaged (1523–24) in the conquest of Guatemala, of which he was subsequently appointed governor by Charles V, and in the latter year began his conquest of El Salvador. In 1525 he captured the Indian capital Cuscatlán and remained there until 1528, when a Spanish civil government was set up. For many years thereafter El Salvador remained under the captaincy general of Guatemala and was ruled by Alvarado as governor of the latter state. In 1534 he attempted to bring the province of Quito under his power but was unsuccessful. During a visit to Spain three years later, the governorship of Honduras was conferred upon him. He died in Mexico in July 1541.

ALVAREZ, DON JOSÉ (1768–1827), Spanish sculptor, was born at Priego, Cordova, in 1768. His full name was José Alvarez de Pereira y Cubero. In 1799 he obtained from Charles IV a pension of 12,000 reals to enable him to visit Paris and Rome. In Paris he executed in 1804 a statue of Ganymede which is now in the sculpture gallery of the Prado, Madrid. Shortly afterwards he left Paris for Rome, where he remained till 1826. His son, Don José Alvarez y Bougel (1805–29) also distinguished himself as a sculptor and a painter. One of the most successful works of the elder Alvarez was a group representing Antilochus and Memnon, now in the museum of Madrid. He also modelled portrait busts of Ferdinand VII, Rossini, and the duchess of Alba.

ALVAREZ, DON MANUEL (1727–1797), Spanish sculptor; was born at Salamanca. He followed classical models so closely that he was styled by his countrymen *El Griego*, "The Greek."

ALVAREZ DO ORIENTE, FERNÃO (1540–1595), Portuguese poet, was born in Goa and served in the Indies. His incomplete *Lusitania Transformada* (1607) is a pastoral poem.

ALVAREZ, FRANCISCO (c. 1465–1541?), Portuguese missionary and explorer, born at Coimbra, was sent in 1515 as secretary to Duarte Galvão and Rodrigo da Lima on an embassy to the negus of Abyssinia (Lebna Dengel Dawit [David] II.). It was not until 1520 that he reached Abyssinia, where he remained six years, returning to Lisbon in 1526–27. In 1533 he was sent to Rome on an embassy to Pope Clement VII.

His account of his travels, *Verdadera Informaçam das terras do Presto Joam*, was published in 1540 at Lisbon, and translated into English (Sam. Purchas, *Pilgrimes*, part ii., 1625).

ALVAREZ, JUAN (1780–1867), Mexican general, was born at Concepción de Atoyac (now Ciudad Alvarez), territory of Guerrero, Mexico, on Jan. 27, 1780. He joined the revolt of Morelos against the Spanish rule in Nov. 1810, and in various battles in the ensuing struggle for independence won distinction as a cavalry officer. He had a prominent part in the revolt led by Santa Anna in 1822–23 which overthrew the Government of Iturbide and in 1847 served with the Mexican army in the war with the United States. He began the revolt of 1854–55 which ended the despotic rule of Santa Anna. His civil career began in 1849 when he became the first governor of the new State of Guerrero, formed from the territory of his birth. At Cuernavaca, on Oct. 4, 1855, he was made acting president of the republic but was unable to unite the conflicting elements among his followers. On Dec. 8, 1855, therefore, he transferred the office to Comonfort, and retired to his home at Acapulco. Throughout the period of the Second Empire, 1863–67, he was a resolute opponent of Maximilian. Though his liberal principles led him to participate in many revolutions, he was singularly free from selfish ambitions. He died on Aug. 21, 1867.

ALVAREZ QUINTERO, the name of two brothers, SERAFÍN (1871–1938) and JOAQUÍN (1873–1944), Spanish dramatists, born at Utrera. They revived in their graceful plays the traditional humour of Rueda's *pasos*. These plays deal chiefly with scenes of Andalusian life and include such subjects as *Los Galeotes* (1900), *El Patio* (1900), *Las Flores* (1901), *Malvaloca* (1912) and *La Calumniada* (1919). They were characterized by sparkling dialogue rather than by analysis of character or depth of thought.

See *Four Plays by Joaquín and Serafín Quintero*, tr. by Helen and Harley Granville-Barker (1928).

ALVEAR, MARCELO TORCUATO DE (1868–1942), Argentine politician, was born at Buenos Aires, on Oct. 4, 1868, the son of Torcuato de Alvear, several times mayor of Buenos Aires, and grandson of General Carlos de Alvear, first Argentine minister to the United States. After graduating from the University of Buenos Aires, he joined the Radical party, and in 1912, after study and travel in Europe, was elected to the lower house of the Argentine Congress, from the city, and then from the province of Buenos Aires. As a congressman he promoted social service legislation, notably for the improvement of housing and civil service conditions. He served as Argentine minister to France from 1916 until his election as president of Argentina in 1922, when he received a large majority over his opponent, Dr. Lisandro de la Torre. On the whole he continued the policies of his predecessor Hipólito Yrigoyen, though his long residence in Europe gave him a somewhat broader view of foreign affairs. He was succeeded as president by Dr. Yrigoyen, Oct. 1928. In 1931–32 he was a political exile, but in 1937 he was again the Radical candidate for the presidency. He died March 23, 1942.

ALVEARY (Lat. *alvearium*), a beehive; used, like *apiarium*, figuratively for a collection of hard-working people, or a scholarly work (e.g., dictionary) involving bee-like industry. By analogy the term is used for the hollow of the ear, where the wax collects.

ALVENSLEBEN, CONSTANTIN VON (1809–1892), Prussian general, was born on Aug. 26, 1809, at Eichenbarleben in Prussian Saxony, and entered the Prussian guards from the cadet corps in 1827. He served with distinction in the campaign of 1866. In 1870, on the outbreak of war with France, von Alvensleben succeeded Prince Frederick Charles in command of the III. army corps which formed part of the II. German army commanded by the prince. Under their new general, the Brandenburg regiments forming the III. corps proved themselves collectively the best in the whole German army, with the possible exception of the Prussian guards, and, if Prince Frederick Charles may have the chief credit in training the III. corps, Alvensleben had contributed in almost equal degree to the efficiency of the Guard infantry, while his actual leadership of the III. corps in the battles of 1870 and 1871 showed him as a fighting general of the very first rank. The battle of Spicheren, on Aug. 6, was initiated and practically directed throughout by him, and in the confusion which followed this victory, for which the superior commanders were unprepared, Alvensleben showed his energy

and determination by resuming the advance on his own responsibility. This led to the great battles of Aug. 14, 16 and 18 around Metz, and again the III. corps was destined, under its resolute leader, to win the chief credit. Crossing the Moselle the instant that he received permission from his army commander to do so, Alvensleben struck the flank of Bazaine's whole army (Aug. 16) in movement westward from Metz. The III. corps attacked at once, and for many hours bore the whole brunt of the battle at Vionville. By the most resolute leading, and at the cost of very heavy losses, Alvensleben held the whole French army at bay while other corps of the I. and II. German armies gradually closed up. In the battle of Gravelotte, on the 18th, the corps took little part. Its work was done, and it remained with the II. army before Metz until the surrender of Bazaine's army. He became full general of infantry in 1873 and retired immediately afterwards. He died on March 28, 1892, at Berlin.

His brother, GUSTAV VON ALVENSLEBEN (1803-81), Prussian general of infantry, and another brother, ALBRECHT, COUNT VON ALVENSLEBEN (1794-1858), Prussian statesman, also had distinguished careers in the Prussian service.

ALVEOLATE, a word used in biology, to mean pitted like a honeycomb.

ALVERSTONE, RICHARD EVERARD WEBSTER, 1ST VISCOUNT (1842-1915), lord chief justice of England, was born Dec. 22, 1842, the second son of Thomas Webster, Q.C., and died Dec. 15, 1915, at Cranleigh, Surrey. He was educated at King's College and Charterhouse schools, and Trinity College, Cambridge; was called to the bar in 1868, and became Q.C. only ten years afterwards. His practice was chiefly in commercial, railway, and patent cases until (June 1885) he was appointed attorney-general in the Conservative Government, in the exceptional circumstances of never having been solicitor-general, and not at the time occupying a seat in parliament. He sat in the House of Commons first for Launceston and then for the Isle of Wight. Except under the brief Gladstone administration of 1886, and the Gladstone and Rosebery cabinets of 1892-95, Richard Webster was attorney-general from 1885 to 1900. In 1890 he was leading counsel for *The Times* in the Parnell enquiry; in 1893 he represented Great Britain in the Bering Sea arbitration; in 1898 he discharged the same function in the matter of the boundary between British Guiana and Venezuela; and in 1903 he was one of the members of the Alaska Boundary Commission. He was well known as an athlete in his earlier years, having represented his university as a runner, and his interest in cricket and foot-racing was kept up in later life.

In the House of Commons, and outside it, he was throughout his political career prominently associated with church work; and his speeches were distinguished for gravity and earnestness. In 1900 he succeeded Sir Nathaniel Lindley as Master of the Rolls, being raised to the peerage as Baron Alverstone, and in October of the same year he was elevated to the office of lord chief justice upon the death of Lord Russell of Killowen. He retired in Nov. 1913, when he was created a Viscount.

See his *Recollections of Bar and Bench* (1914).

ALVORD, CLARENCE WALWORTH (1868-1928), American educator and historical scholar, was born in Greenfield, Mass., May 21, 1868. He graduated from Williams college in 1891 and pursued further studies at the universities of Berlin, Chicago and Illinois, from the last mentioned of which he received in 1908 the degree of doctor of philosophy. During the period 1891-1901 he devoted six years to teaching in preparatory schools. Entering the faculty of the University of Illinois in 1901 as instructor, he became in 1907 assistant professor, in 1909 associate professor and in 1913 professor of history, and occupied this chair until 1920. From 1920 to 1923 he was professor of history in the University of Minnesota. In 1906 he was appointed editor of publications for the Illinois State Historical Society. In this capacity he edited *Cahokia Records* (1906); with E. B. Greene, *Governors' Letters* (1909); *Kaskaskia Records* (1909); with C. E. Carter, *The British Series* (1915); and *Governor Edward Coles* (1920). His published writings include *Mississippi Valley in British Politics* (1927), which was awarded the Loubat prize of that year; *The*

Illinois Country, 1673-1818 (1920); *Lord Shelburne and the Founding of British-American Goodwill* (1925); and numerous contributions to historical journals. He died at Diano Marino, Italy, Jan. 27, 1928.

ALWAR, an Indian State in the Rajputana agency. Its configuration is irregular, the greatest length from north to south being about 80 mi., and breadth from east to west about 60 mi., with a total area of 3,158 sq.mi. The eastern portion of the state is open and highly cultivated; the western is diversified by hills and peaks, which form a continuation of the Aravalli range, from 12 to 20 mi. in breadth. These hills run in rocky and precipitous parallel ridges, in some places upwards of 2,200 ft. in height. The Sabhi and Ruparel are the only streams of importance. The pop. in 1941 was 823,055. The maharaja Jai Singh, who succeeded in 1892 at the age of ten, represented India at the Imperial Conference in London in 1923. Alwar was the first Indian state to accept a currency struck at the Calcutta mint, of the same weight and assay as the imperial rupee, with the head of the British sovereign on the obverse. Imperial service troops are maintained, consisting of both cavalry and infantry, with transport.

The state was founded by the Rajput chieftain Pratap Singh (1740-91), and increased by his adopted son Bakhtawar Singh. The latter joined the British against the Mahrattas, and in 1803, after the battle of Laswari, signed a treaty of offensive and defensive alliance with the British Government.

The city of Alwar stands in a valley overhung by a fortress 1,000 ft. above. It is surrounded by a rampart and moat, with five gates, and contains fine palaces, temples and tombs. The water-supply is brought from a lake 9 mi. distant. It has a school for the sons of nobles, founded to commemorate the Diamond Jubilee of Queen Victoria. Pop. (1941) 54,143.

ALYATTES, king of Lydia (609-560 B.C.), the real founder of the Lydian empire, was the son of Sadyattes, of the house of the Mermnadae. He carried on the war against Miletus begun by his father, until 604, when it was ended by a treaty of peace and alliance (Hdt. i. 18-23). He next came into conflict with the rising power of Media, but on May 28, 585, a pitched battle was interrupted by an eclipse of the sun (Hdt. i. 74). A peace was concluded, through the mediation of Babylon and Cilicia, which fixed the Halys as the boundary between the two kingdoms (Hdt. i. 102). Alyattes drove the Cimmerii (see SCYTHIA) from Asia, subdued the Carians, and took several Ionian cities (Smyrna, Colophon). He was succeeded by his son Croesus. His tomb still exists on the plateau between Lake Gygaia and the River Hermus to the north of Sardis—a large mound of earth, with a substructure of huge stones. It was excavated by Spiegelthal in 1854, who found that it covered a large vault of finely cut marble blocks approached by a flat-roofed passage of the same stone from the south. The sarcophagus and its contents had been removed by early plunderers of the tomb, all that was left being some broken alabaster vases, pottery and charcoal. On the summit of the mound were large *phalloi* of stone (Hdt. i. 93).

See A. von Ölfers, "Über die lydischen Königsgräber bei Sardes," *Abh. Berl. Ak.*, (1858).

ALYPIUS, a Greek writer on music whose works, with those of six others, were collected and published with a commentary and explanatory notes (*Antiquae Musicae Auctores Septem*, Amstel., 1652), by Mark Meibomius (1630-1711). He is said to have written before Euclid and Ptolemy; and Cassiodorus arranges his *Introduction to Music* between those of Nicomachus and Gaudentius. The work consists solely of a list of symbols of the various scales and modes, and is probably only a fragment.

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ALYPIUS OF ANTIOCH, a geographer of the 4th century, who was sent by the Emperor Julian into Britain as first prefect, and was afterwards commissioned to rebuild the temple of Jerusalem. Among the letters of Julian are two (29 and 30) addressed to Alypius, one inviting him to Rome, the other thanking him for a geographical treatise, which no longer exists.

See also Ammianus Marcellinus xxiii. i. §2.

ALYTES: see MIDWIFE TOAD.

ALZEY, a town in Hesse, Germany, 20 mi. S.S.W. of Mainz. Pop. (1933) 9,712. It is mentioned in the *Nibelungenlied*. In 1277 it became an imperial city, and in 1620 was sacked by the Spaniards and in 1689 burnt by the French. During the Napoleonic wars it was annexed to France and in 1815 passed to the grand-duchy of Hesse-Darmstadt. It has considerable trade in wine.

ALZOG, JOHANN BAPTIST (1808–78), German theologian, was born at Ohlau, in Silesia, June 29, 1808. Together with Johann Döllinger, Alzog was instrumental in convoking the famous Munich assembly of Catholic scholars in 1863. He also took part, with Bishops Hefele and Haseberg, in the preparatory work of the Vatican Council, and voted in favour of the doctrine of papal infallibility but against the opportuneness of its promulgation. Alzog's fame rests mainly on his *Handbuch der Universal-Kirchengeschichte* (Mainz, 1841, often reprinted under various titles; Eng. trans. by Pabisch and Byrne, *A Manual of Church History*, Cincinnati, 1874). Alzog was an active collaborator in the great *Kirchenlexicon* of Wetzer and Welte and was also the author of *Grundriss der Patrologie* (Freiburg, 1866, 4th ed. 1888), a scholarly work, though since superseded.

A full list of Alzog's writings is given in H. Hurter's *Nomenclator litterarum recentioris theologiae catholicae*, vol. iii.

AMADIS DE GAULA. This famous romance of chivalry survives only in a Castilian text, but it is claimed by Portugal as well as by Spain. The date of its composition, the name of its author, and the language in which it was originally written are not yet settled. It is not even certain when the romance was first printed, for though the oldest known edition (a unique copy of which is in the British Museum) appeared at Sargasso in 1508, it is highly probable that *Amadis* was in print before this date; an edition is reported to have been issued at Seville in 1496. As it exists in Spanish, *Amadis de Gaula* consists of four books, the last of which is generally believed to be by the *regidor* of Medina del Campo, Garci Rodriguez de Montalvo. Montalvo alleges that the first three books were arranged and corrected by him from "the ancient originals," and a reference in the prologue to the siege of Granada points to the conclusion that the Spanish recast was made shortly after 1492; it is possible, however, that the prologue alone was written after 1492, and that the text itself is older. The number of these "ancient originals" is not stated, nor is there any mention of the language in which they were composed; Montalvo's silence on the latter point might be taken to imply that they were in Castilian, but any such inference would be hazardous. Three books of *Amadis de Gaula* are mentioned by Pero Ferrús who was living in 1379, and there is evidence that the romance was current in Castile more than a quarter of a century earlier; but again there is no information as to the language in which they were written. Gomes Eannes de Azurara in his *Chronica de Conde D. Pedro de Menezes* (c. 1450) states that *Amadis de Gaula* was written by Vasco de Lobeira in the time of King Ferdinand of Portugal who died in 1383; as Vasco de Lobeira was knighted in 1385, it would follow that he wrote the elaborate romance in his earliest youth. This conclusion is untenable, and the suggestion that the author was Pedro de Lobeira (who flourished in the 15th century) involves a glaring anachronism. A further step was taken by the historian João de Barros, who maintained in an unpublished work dating between 1540 and 1550 that Vasco de Lobeira wrote *Amadis de Gaula* in Portuguese, and that his text was translated into Castilian; this is an unsupported assertion. Toward the end of the 16th century Miguel Leite Ferreira, son of the Portuguese poet, Antonio Ferreira, declared that the original manuscript of *Amadis de Gaula* was then in the Aveiro archives, and an *Amadis de Gaula* in Portuguese, which is alleged to have existed in the conde de Vimeiro's library as late as 1586, had vanished before 1726. These dubious details must be received with extreme reserve. A stronger argument in favour of the Portuguese case is drawn from the existing Spanish text. In book I, chapters 40 and 42, it is recorded that the Infante Alphonso of Portugal suggested a radical change in the narrative of Briolanja's relations with Amadis. This prince has been identified as the Infante Alphonso who died in 1312, or

as Alphonso IV, who ascended the Portuguese throne in 1325. Were either of these identifications established, the date of composition might be referred with certainty to the beginning of the 14th century or the end of the 13th.

Recent critics have inclined to the belief that *Amadis de Gaula* was written by João de Lobeira, a Galician knight who frequented the Portuguese court between 1258 and 1285, and to whom are ascribed two fragments of a poem in the Colocci-Brancuti, *Canzoniere* (Nos. 240 and 240^b), which reappears with some unimportant variants in *Amadis de Gaula* (book ii, chapter 2). The coincidence may be held to account in some measure for the traditional association of a Lobeira with the authorship of *Amadis de Gaula*; but, though curious, it warrants no definite conclusion being drawn from it: Against the Portuguese claim it is argued that the *Villancico* corresponding to João de Lobeira's poem is an interpolation in the Spanish text, that Portuguese prose was in a rudimentary stage of development at the period when—*ex hypothesi*—the romance was composed, and that the book was very popular in Spain almost a century before it is even mentioned in Portugal. Lastly, there is the incontrovertible fact that *Amadis de Gaula* exists in Castilian, while it remains to be proved that it ever existed in Portuguese. As to its substance, it is beyond dispute that much of the text derives from the French romances of the Round Table; but the evidence does not enable us to say (1) whether it was pieced together from various French romances; (2) whether it was more or less literally translated from a lost French original; or (3) whether the first Peninsular adapter or translator was a Castilian or a Portuguese. On these points judgment must be suspended. There can, however, be no hesitation in accepting Cervantes' verdict on *Amadis de Gaula* as the "best of all the books of this kind that have ever been written." It is the prose epic of feudalism, and its romantic spirit, its high ideals, its fantastic gallantry, its ingenious adventures, its mechanism of symbolic wonders, and its flowing style have entranced readers of such various types as Francis I and Charles V, Ariosto and Montaigne.

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AMADOU, a soft tough substance once frequently used as tinder, derived from *Fomes fomentarius* (L.) Gill, a fungus belonging to the group Basidiomycetes and growing upon old trees, especially birch and beech. The fungus is cut into slices and then steeped in a solution of nitre. Amadou is prepared on the continent of Europe, chiefly in Germany, but the fungus is a native of Britain and America. *Fomes igniarius* (L.) Gill and other species are also used, but yield an inferior product.

AMAKUSA, an island of about 200 sq.mi. off the west coast of the larger island of Kyushu in south Japan (32° 25' N., 130° E.). It is of hilly conformation, and its population is engaged in terrace cultivation of rice and other grains, and in fishing. Amakusa island was the scene of a Christian uprising in 1637. (See JAPAN.)

AMAL, the name of the noblest family among the Ostrogoths and that from which nearly all their kings were chosen. The family first appears in history in the 4th century A.D.

AMALARIC (died 531), king of the Visigoths, son of Alaric II, was a child when his father fell in battle against Clovis, king of the Franks (507). He was carried for safety into Spain, which country and Provence were thenceforth ruled by his maternal grandfather, Theodoric the Ostrogoth, acting through his vice-regent, an Ostrogothic nobleman named Theudis. In 522 the young Amalaric was proclaimed king, and four years later, on Theodoric's death, he assumed full royal power in Spain and a part of Languedoc, relinquishing Provence to his cousin Athalaric. He married Clotilda, daughter of Clovis; but his disputes

with her, he being an Arian and she a Catholic, brought on him a Frankish invasion, in which he lost his life in 531.

AMALASUNTHA or **AMALASUENTHA**, queen of the Ostrogoths (d. 535), daughter of Theodoric, king of the Ostrogoths, was married in 515 to Eutharic, an Ostrogoth of the old Amal line, who had previously been living in Spain. Her husband died, apparently in the early years of her marriage, leaving her with two children, Athalaric and Matasuentha. On the death of her father in 526 she succeeded him at Ravenna, acting as regent for her son; but being herself deeply imbued with the old Roman culture, she gave to that son's education a more refined and literary turn than suited the ideas of her Gothic subjects. Conscious of her unpopularity she banished, and afterwards put to death, three Gothic nobles whom she suspected of intriguing against her rule, and at the same time opened negotiations with the emperor Justinian with the view of removing herself and the Gothic treasure to Constantinople. Her son's death in 534 made but little change in the situation. Amalasuntha, now queen, invited her cousin Theodahad to share her throne. Theodahad, notwithstanding a varnish of literary culture, was a coward and a scoundrel. He fostered the disaffection of the Goths and, either by his orders or with his permission, Amalasuntha was imprisoned on an island in the Tuscan lake of Bolsena, where in the spring of 535 she was murdered in her bath.

The letters of Cassiodorus, chief minister and literary adviser of Amalasuntha, and the histories of Procopius and Jordanes give us our chief information as to the character of Amalasuntha.

AMALEKITES, an ancient tribe, or collection of tribes, belonging to the Bedouin type, familiar from their relations to Israel. Though Hebrew ethnology made them a subordinate branch of Edom (Gen. xxxvi, 12), and (if the text of Judges v, 14 and xii, 15 be correct) even connected them closely with the tribe of Ephraim, they are uniformly represented as enemies of Israel. Thus they harried the fugitives as they escaped from Egypt at the Exodus (Deut. xxv, 17-19), were included among the foes through whom a passage must be forced into southern Palestine from Kadesh (Num. xiv, 43-45), attacked Israel at Rephidim, where they were utterly defeated by Joshua (Exod. xvii, 8-16), were doomed to ultimate destruction by Balaam (Num. xxiv, 20), formed part of the coalition which Eglon, king of Moab, used to oppress Israel (Judges iii, 13), were included among the hordes of Bedouin raiders defeated by Gideon (Judges vi, 3, 33), were condemned to annihilation—put to the "herem"—by Saul (I Sam. xv), though the king incurred the anger of Yahweh by sparing Agag and the cattle; and yet enough of them survived to raid Ziklag in David's absence and to be overwhelmed by his vengeance (I Sam. xxx). It is not surprising to find them described as "enemies of Yahweh" (I Sam. xxx, 26), and the objects of a perpetual "Jihād," or sacred war (Deut. xxv, 19, Ex. xvii, 16).

The district over which Amalek ranged lay to the south of Judah, probably between Kadesh and Hormah, though they may at times have been located further east; and the interchange of the ethnic with "Canaanites" and "Amorites" suggests that the Amalekites were merely one of Israel's traditional enemies of the older period. Even in one of the Psalms (lxxxiii, 7) Amalek is mentioned among the foes of Israel, and the same feeling is reflected still later in the book of Esther, where Haman the Agagite is pitted against Mordecai the Benjamite. The name of Amalek is celebrated in Arabian tradition, but the confused and conflicting stories are, for historical purposes, practically worthless.

AMALFI, town and archiepiscopal see, Campania, Italy, in the province of Salerno, 12 mi. W.S.W. from the town of that name, on the north coast of the Gulf of Salerno. Pop. (1936), town, 4,259; commune 7,654. This picturesque old city lies at the mouth of a deep ravine, sheltered at the foot of Monte Cerreto (4,318 ft.), amid splendid coast scenery. The cathedral of San Andrea is in Lombard-Norman style (11th century) with façade in black and white stone, bronze doors executed at Constantinople before 1066, and campanile (1276). The Capuchin monastery on the west with fine cloisters (partly destroyed by landslip, 1899) was remodelled as a hotel. Amalfi, first mentioned in the 6th century, soon became a naval power; in the 9th century it

shared with Venice and Gaeta the Italian trade with the east, and in 848 its fleet went to the assistance of Pope Leo IV against the Saracens. It was then an independent republic with a population of about 70,000, but in 1131 it was reduced by King Roger of Sicily. In 1135 and 1137 it was taken by the Pisans, and rapidly declined in importance, though its maritime code, known as the *Tavole Amalfitane*, was recognized in the Mediterranean until 1570. It now has no harbour.

AMALGAM, the name applied to an alloy containing mercury, and said by Andreas Libavius to be a corruption of *μάλαγμα*; in the alchemists the form *algamala* is also found. Many amalgams are formed by the direct contact of a metal with mercury, sometimes with absorption, sometimes with evolution, of heat. Other methods are to place the metal and mercury together in dilute acid, to add mercury to the solution of a metallic salt, to place a metal in a solution of mercuric nitrate or to electrolyze a metallic salt using mercury as the cathode or negative electrode. Some amalgams are liquids, especially when they contain a large proportion of mercury; others are crystalline. In some cases definite compounds have been isolated from amalgams, which may be regarded as mixtures of one or more of such compounds with mercury in excess. In general these compounds are decomposable by heat, but some of them, such as those of gold, silver, copper and the alkali metals, even when heated above the boiling point of mercury retain mercury and leave residues of definite composition. The use of tin amalgam in "silvering" mirrors and of gold and silver amalgams in gilding and silvering has been almost completely superseded by chemical deposition of silver and by electroplating, respectively. Silver and tin amalgam are employed in dentistry, and an amalgam of zinc and tin for the rubbers of electrical machines. The zinc plates of electric batteries are amalgamated in order to reduce polarization. Native amalgams of gold and silver have been found in various parts of the world, and the amalgamation process has been a standard method for the extraction of these two metals from their ores. Although it is still used to a reduced extent on gold ores, its use for silver ores is now practically obsolete.

Silver is not usually used by dentists for filling cavities in teeth. The so-called "silver fillings" in back teeth are cadmium copper alloys.

Finely divided silver powder would be difficult to amalgamate directly in the dentist's office and would require the use of some chemical. Silver does not oxidize on exposure to the atmosphere but blackens because of the presence of sulphur compounds. Silver powder would soon become inactive because of the formation of such compounds. In the mouth under the conditions prevailing it would probably be attacked by chlorides such as table salt. At mid-20th century bismuth was used in fillings.

AMALGAMATION. The term amalgamation, in its industrial sense, is one of a number of terms used to denote the process whereby previously independent and probably competing business concerns join forces and become a single concern conducted under a unified financial and industrial control. Amalgamation is usually spoken of as taking place between two firms only, and it is usually implied that the two previously independent establishments will continue, after the amalgamation, their outwardly separate existence. The four main methods of carrying out an amalgamation are:

1. One of the two companies purchases the whole or a controlling part of the share capital of the other company;
2. A new company is formed to purchase the whole or a controlling part of the share capitals of both companies;
3. One company purchases outright the other's business; and
4. A new company is formed to purchase outright both businesses.

Amalgamation is a particular form of that movement toward combination and centralization in industry which has been an increasingly prominent feature of industrial development in all the principal industrial countries since the 19th century. (See ASSOCIATIONS, INDUSTRIAL; see also the article TRUSTS.)

(J. H.)

IN METALLURGY

Amalgamation is the process of extracting gold and silver from their ores by means of mercury. It depends on the fact that mercury, or quicksilver as it is usually called by metallurgists, "wets" and adheres to metallic gold and silver and penetrates them, forming pasty amalgams of a silvery colour. Particles of amalgam readily adhere to each other, and the aggregates become large and heavy enough to sink in running water which carries away sand and other earthy materials. Pieces of gold, if not too small, sink perfectly well of themselves and adhere to mercury or amalgam lying at the bottom of the stream, and gold ores have

been widely amalgamated on this principle. Coarse gold can be saved without the aid of mercury but finely divided gold is more likely to escape. Grains of silver naturally settle also, but most silver ores do not contain metallic silver. They contain compounds such as silver sulphide (silver combined with sulphur), and the compounds will not settle in water and must be decomposed to set free the silver before it can be amalgamated.

In amalgamation, ores are crushed to pulp in water and mixed with mercury with violent agitation in order to break up the mercury into minute globules and disperse them throughout the mass, and so enable them to be brought into contact with the gold or silver. Afterwards by dilution with water and gentle stirring, or by a running stream of water, the amalgam and surplus mercury are induced to coalesce and settle to the bottom, where they are caught in a pool of mercury or on the surface of copper plates to which they adhere. When the earthy matter has been washed away, the mixture of metals is put into filter bags and squeezed to remove the surplus mercury. The liquid mercury passes through, containing a minute quantity of gold and silver dissolved in it, and pasty amalgam containing from 25% to 50% of gold remains in the bag. The amalgam is heated in retorts (fig. 5), the mercury driven off as vapour, only to be condensed in a cool chamber for use again, and the gold and silver now nearly pure are melted down and cast into bars. Since all gold ores contain some silver and silver ores some gold, the bars consist of a mixture of gold and silver which are afterwards parted (*see* GOLD). The process is a very old one. The extraction of gold by mercury is mentioned by Pliny in his *Natural History*, and descriptions of amalgamation processes for both gold and silver are to be found in various 16th century treatises. The history of the process is given in detail by Percy.

Mercury may, however, become so excessively subdivided, as the result of too violent agitation or pounding, especially when mixed with grease or certain kinds of ore, that it becomes "floured" or "sickened." Floured mercury is a white powder like flour, although under the microscope it is seen to consist of minute globules of apparently ordinary mercury, heaped together. The globules will not coalesce and are carried away and lost in the tailings or refuse. They are generally separated only by films of air, and may be made to coalesce by the action of acids or in other ways entailing expense or loss. Again, although earthy matter and mercury have no action on each other, nevertheless mercury attacks and amalgamates copper, lead, zinc and some other metals, especially when they are present in the metallic state. The amalgam thus becomes debased and powdery so that part is lost and the remainder is costly to refine. There is also the case of ores which do not yield a reasonable percentage of their values when treated by amalgamation; these are called refractory and those which are amenable to amalgamation are described as free-milling.

Patio or Mexican Process.—Silver ore was ground by mule power in *arrastras* or shallow circular pits paved with stone (fig. 1). Large blocks of stone attached by beams to a central rotating post were dragged round the *arrastra* and reduced the ore to fine mud which was taken out and spread over a courtyard or *patio* in low heaps. It is then sprinkled with mercury and chemicals (common salt and copper sulphate) and mixed by mules which were driven over every part of the heaps. Complicated chemical reactions took place, never fully understood, the effect of which was to free the silver from its intractable compounds and enable it to be taken up by the mercury. The heaps were trodden by the mules every day or two until the amalgamation was complete, which might require a month. Lastly the material was agitated with water in large tubs and the mud run off through the plug holes. The amalgam found at the bottom was collected and treated as already described. The process was especially suitable for the silver ores of the dry barren districts of Mexico, where water and fuel are scarce, and was not finally displaced by the cyanide proc-

ess (*q.v.*) until early in the 20th century. It was used in the production of a large proportion of the world's silver for 350 years.

Pan Amalgamation Process.—The process was used for silver ores, especially in the United States, in the latter half of the 19th century and was superseded by the cyanide process and by smelting. Silver ore was ground to a fine paste with water in iron pans (fig. 2) by rotating iron shoes. The shoes were then raised a little, so as to agitate the pulp without further grinding, and mercury was sprinkled into the pan. The agitation was continued until amalgamation was completed, and the end in view was assisted by heating the pan with steam and by the addition of chemicals, especially common salt and copper sulphate. The amalgam was separated by diluting the pulp and stirring and finally by running off the charge into large settling tanks. The amalgamation pans were about 5ft. in diameter and the charge was 2,000 or 3,000lb.

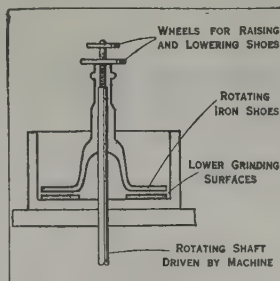


FIG. 2.—AMALGAMATION PAN
Diagram of iron pan used for silver ore in the United States in 19th century. The ore, first ground with water, was then mixed with mercury

Complex silver ores containing minerals not amenable to amalgamation (such as the arsenical and antimonial sulphides, galena and blende) were roasted in furnaces at a red heat, with common salt as a preliminary, when silver chloride was formed, a compound from which the silver can be extracted by mercury.

Amalgamation of Gold Ores.—This is simpler and cheaper than that of silver ores. The machine used more than any other for the reduction of gold ores after mid-19th century was the stamp mill or battery (figs. 3 and 4). The stamp mill is worked on the principle of the pestle and mortar. The mortar is long and narrow, and ore, water and mercury are fed into it continuously. Five heavy steel stampers, each weighing from 800 to 2,000lb., are ranged in a row in one mortar.

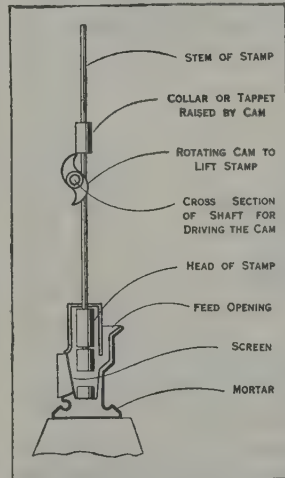


FIG. 3.—STAMP AND MORTAR
California stamp, an improved form of the old German type of 1556, is used for crushing gold ore in all countries. The stamp is raised, slightly rotated and falls by gravity

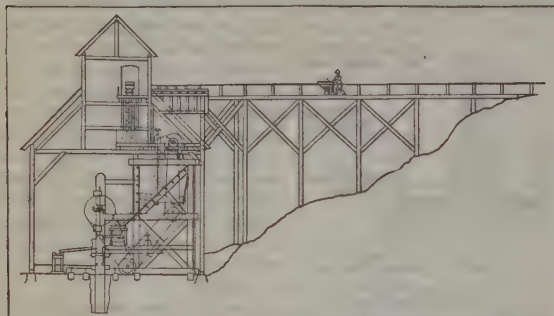
They are raised and let fall in succession, crushing the lumps of ore and driving the pulp through screens set in one side of the mortar. The old-fashioned wire screens were later replaced by perforated steel plates. The pulp coming from the screens is still further reduced by grinding in tube mills (rotating cylinders half filled with large pebbles, or lumps of unbroken ore) and then flows over sloping electro-silvered copper plates or tables, whose surface is amalgamated by rubbing with mercury. In older practice the copper plates were placed just outside the screens (fig. 4). The particles of gold adhere to the surface of the plate. Earlier still, amalgamated plates were fixed inside the mortar. The size and weight of stamps in the 20th century caused excessive loss of mercury by flouing and the addition of mercury and the fixing

of plates in the mortars were given up, the battery reverting to its original use as a mere crushing machine. Stamps forced down by springs or by power applied in various ways are sometimes used instead of gravity stamps and rotating crushers of various kinds (ball mills, tube mills, etc.) replace them in some new plants.

The clean-up takes place at intervals of a fortnight or a month. The stamps are hung up, the sand is washed away, the amalgamated plates are scraped and the amalgam after careful cleaning is squeezed and retorted as usual (fig. 5). The percentage yield of

gold varies with the conditions and the nature of the ore. Coarse gold is easily caught, but finely divided gold escapes in great part. Generally about 60% of the gold in the ore was recovered by amalgamation, and the remainder by cyanide. Ores containing only $\frac{1}{2}$ oz. gold or even less per ton of ore have been treated at a profit.

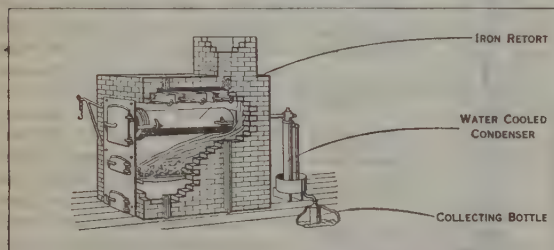
On the Rand, amalgamation on copper plates had been generally discarded by 1925, owing to the difficulty of preventing the theft



BY COURTESY OF FRASER AND CHALMERS ENGINEERING WORKS

FIG. 4.—GENERAL SECTION OF A GOLD STAMP MILL ON A HILL-SIDE, SHOWING SUPPLY OF ORE AND ITS PASSAGE THROUGH THE MACHINES

by Kafirs of the amalgam and the danger from mercury poisoning. Instead of passing the crushed ore from the tube mills over amalgamated plates it is concentrated on a surface of corduroy, which retains the heavy particles including all coarse gold. This is a reversion to the primitive practice of the gold-diggers of California in 1849 who used their blankets in concentrating gold sands. At intervals the corduroy is taken up and washed in boxes and the coarse gold is extracted from the contents of the boxes by further concentration. The fine gold left in the ore is extracted in the cyanide plant. The corduroy also catches osmiridium and other valuable metals of the platinum group which had previously been lost. The changes on the Rand appear to foreshadow the end of the old amalgamation process. Amalgamation on copper



FROM ROSE, "METALLURGY OF GOLD," BY PERMISSION OF C. GRIFFIN & CO., LTD.

FIG. 5.—AMALGAM RETORT FOR SEPARATING GOLD FROM MERCURY. The wall of the furnace is partly removed to show the iron retort. The amalgam of gold and mercury is placed in the retort and heated to redness. The mercury is separated and as vapour passes to the condenser and then to the collecting bottle. The gold remains in the retort

plates lingers only in the Kolar gold-field in India, and in a few mills in Canada and some less important fields. However, amalgamation at mid-20th century was still the method in use at the Homestake mine, Lead City, S.D., where the corduroy tables had not proved to be of value. (T. K. R.)

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AMALRIC I (d. 1174), king of Jerusalem, was the son of Fulk and Melisinda of Jerusalem and succeeded his elder brother, Baldwin III, in 1162. He was twice married: by his first wife, Agnes of Edessa, he had issue a son and a daughter, Baldwin IV and Sibylla; while his second wife, Maria Comnena, bore him a daughter, Isabella, who ultimately carried the crown of Jerusalem to her fourth husband, Amalric of Lusignan (Amalric II). The reign of Amalric I was occupied by the Egyptian problem. It

became a question between Amalric and Nureddin which of the two should control the discordant viziers who vied with one another for control of the decadent caliphs of Egypt. For some five years a contest was waged between Amalric and Shirguh (Shirkuh), the lieutenant of Nureddin, for the possession of Egypt. Thrice (1164, 1167, 1168) Amalric penetrated into Egypt; but the contest ended in the establishment of Saladin, the nephew of Shirguh, as vizier—a position which, on the death of the puppet caliph in 1171, was turned into that of sovereign. The extinction of the Latin kingdom then seemed imminent, and anxious appeals for assistance were made both to Byzantium and the west. But though in 1170 Saladin attacked the kingdom and captured Aila on the Red sea, the danger was not so great as it seemed. Nureddin was jealous of his overmighty subject, and his jealousy bound Saladin's hands. This was the position of affairs when Amalric died, in 1174; but, as Nureddin died in the same year, the position was soon altered and Saladin began the final attack on the kingdom. Amalric I, the second of the native kings of Jerusalem, had the qualities of his brother Baldwin III (*q.v.*). Like him, he fostered the Byzantine alliance. He was something of a scholar, and it was he who set William of Tyre to work. He was more of a lawyer; he knew the *Assises* better than any of his subjects.

William of Tyre is the original authority: see xix, 2-3, for his sketch of Amalric. See also R. Grousset, *Histoire des croisades*, vol. ii (Paris, 1935); and G. Schlumberger, *Campagnes du roi Amaury I en Egypte* (Paris, 1906).

AMALRIC II (d. 1205), king of Jerusalem and Cyprus, was a son of Hugh the Brown of Lusignan and the brother of Guy of Lusignan. His second wife was Isabella, daughter of Amalric I, and he became king of Jerusalem in right of his wife in 1197. In 1198 he was able to procure a five years' truce with the Mohammedans, thanks to the struggle between Saladin's brothers and his sons for the inheritance of his territories. The truce was disturbed by raids on both sides, but in 1204 it was renewed for six years. Amalric died in 1205. The kingdom of Cyprus, which he had inherited from his brother, passed to Hugh, his son by his first wife, Eschiva; while that of Jerusalem fell to Mary, the daughter of Isabella by her previous marriage with Conrad of Montferrat.

AMALRIC OF BENA (Fr. AMAURY) (d. c. 1204-1207), French theologian, who taught philosophy and theology at the University of Paris, and enjoyed a great reputation as a subtle dialectician. His lectures developing the philosophy of Aristotle attracted a large circle of hearers. In 1204 his doctrines were condemned by the university, and, on personal appeal to Pope Innocent III., the sentence was ratified, Amalric being ordered to return to Paris and recant his errors. His death was caused, it is said, by grief at the humiliation to which he had been subjected. In 1209 ten of his followers were burned before the gates of Paris, and Amalric's own body was exhumed and burned. The doctrines of his followers, known as the Amalricians, were formally condemned by the fourth Lateran Council in 1215.

Amalric appears to have derived his philosophical system from Erigena (*q.v.*), whose principles he developed in a one-sided and strongly pantheistic form. Three propositions only can with certainty be attributed to him: (1) that God is all; (2) that every Christian is bound to believe that he is a member of the body of Christ, and that this belief is necessary for salvation; (3) that he who remains in the love of God can commit no sin. These three propositions were further developed by his followers, who maintained that God revealed Himself in a threefold revelation—the first in Abraham, marking the epoch of the Father; the second in Christ, who began the epoch of the Son; and the third in Amalric and his disciples, who inaugurated the era of the Holy Ghost.

Under the pretext that a true believer could commit no sin, the Amalricians indulged in every excess, and the sect does not appear to have long survived the death of its founder.

See W. Preger, *Geschichte der deutschen Mystik im Mittelalter* (Leipzig, 1874, i. 167-173); Hauréau, *Hist. de la phil. scol.* (Paris, 1872); C. Schmidt, *Hist. de l'Eglise d'Occident pendant le moyen âge* (Paris, 1885); Hefele, *Concilien-gesch.* (2nd ed., Freiburg, 1886).

AMALTEO, the name of an Italian family belonging to Oderzo, Treviso, several members of which were distinguished in literature. The best known are three brothers, Geronimo (1507-74), Giambattista (1525-73) and Cornelio (1530-1603), whose Latin poems were published in one collection under the title *Trium Fratrum Amaltheorum Carmina* (Venice, 1627; Amst., 1689). The eldest brother, Geronimo, was a celebrated physician; the second, Giambattista, accompanied a Venetian embassy to England in 1554, and was secretary to Pius IV. at the council of Trent; the third, Cornelio, was a physician and secretary to the republic of Ragusa.

AMALTEO, POMPONIO (1505-1584), Italian painter of the Venetian school, was born at San Vito in Friuli. He was a pupil and son-in-law of Pordenone, whose style he closely imitated. His works consist chiefly of frescoes and altar-pieces and many of them (e.g., in the church of Santa Maria de' Battisti, at San Vito) have suffered greatly from the ravages of time.

AMALTHEIA, in the earlier Greek mythology, the foster-mother of Zeus. She is sometimes represented as the goat which suckled the infant god in a cave in Crete, sometimes as a nymph of uncertain parentage, who brought him up on the milk of a goat. This goat having broken off one of its horns, Amaltheia filled the horn with flowers and fruits and presented it to Zeus, who placed it, together with the goat, amongst the stars. According to another story, Zeus himself broke off the horn and gave it to Amaltheia, promising that it would supply in abundance whatever she desired. Amaltheia gave it to Achelous (her reputed brother), who exchanged it for his own horn which had been broken off in his contest with Heracles for the possession of Deianeira. Speaking generally, it was regarded as the symbol of inexhaustible riches and plenty, and became the attribute of various divinities and of rivers as fertilizers of the land. Cretan coins represent the infant Zeus being suckled by the goat; other Greek coins exhibit him suspended from his teats, others, carried in the arms of a nymph. (Ovid, *Fasti*, v. 115; *Metam.*, ix. 87.)

AMA NDEBELE: see MATABELE.

•**AMANITA**, the name of a genus of mushrooms, important because it contains most of the deadly poisonous species. They are

characterized by having white spores, a ring (annulus) on the stem, and a universal veil (volva). The young plant is completely enveloped by the universal veil and as the plant matures the veil is ruptured. Part remains as a more or less distinct, cup-like sheath enclosing the base of the stem, sometimes completely buried underground; part remains adhering to the upper surface of the cap and becomes torn into patches or scales as the cap expands. The annulus is formed from an inner veil which extends from the margin of the cap to the stem in the young plants, enclosing the gills. As the cap expands the veil tears around the margin and remains attached to the stem.

The genus includes a great number of species, many of which are brilliantly coloured. Some of the species, such as Caesar's mushroom (*Amanita caesarea* Fr.), are edible, others such as the Fly Agaric (*A. muscaria* Fr.) are extremely poisonous, and others such as the Death Angel and related forms (*A. phalloides* Fr., *A. verna* Fr., etc.) are deadly poisonous. The genus is one which should be completely avoided by the amateur who may be gathering mushrooms for the table.

AMANUENSIS, one who writes, from dictation or otherwise, on behalf of another (from Lat. *servus a manu*, slave of the hand). An amanuensis, as a rule, is a copyist only.



FROM COOK, "ILLUSTRATION OF BRITISH FUNGI," BY PERMISSION OF WILLIAMS & NORWAT, LTD.
FLY AMANITA (*A. MUSCARIA*). A POISONOUS FUNGUS FOUND WIDELY IN THE NORTHERN HEMISPHERE. Right, young plant, Centre, mature plant, Left, part of longitudinal section through mature plant

AMANULLAH KHAN (1892-), Amir of Afghanistan, was born June 1, 1892, being the third son of Habibullah Khan by his principal wife, Ulya Hazrat. On Feb. 20, 1919, Habibullah Khan was assassinated, whereupon his brother, Nasrullah Khan, seized the reins of government. Six days later, however, Amanullah Khan declared himself Amir. In Aug. 1919, following fighting between British troops and Afghans, the new Amir successfully negotiated a treaty of peace by the terms of which Afghanistan was left officially free and independent. From this time onward the Amir consistently adopted a policy of westernization: He even went so far as to advocate the emancipation of women by female education, which roused the opposition of the Mullahs and was one of the causes of the rebellion which broke out in Khost in 1924. (See AFGHANISTAN.) He introduced unpopular reforms, causing a revolt late in 1928. Amanullah abdicated on Jan. 14, 1929, and went to Europe in June.

AMAPÁ, one of five federal territories of Brazil provided for in the constitution of 1937 and created by decree law in Sept. 1943. Other territories established by this decree were Rio Branco, Guaporé, Ponta Porã and Iguassú (the last two abolished in 1946). Governed by governors appointed by the federal government, the territories come under the direct administration of the government. Situated along Brazil's sparsely inhabited frontiers, the territories have been ostensibly created for purposes of national defense, selective colonization and economic development. Vast deposits of manganese were discovered in Amapá. In 1950 the first large shipment of commercial manganese from this region was received in the United States. Amapá, formerly a part of northeastern Pará, is bounded northwest by Surinam and French Guiana, northeast by the Atlantic, southeast by the north channel of the Amazon river, and southwest by the Jari river. Area, 54,394 sq.mi.; population (census of 1950) 38,374.

AMAPALA, the Pacific port of Honduras, Central America. Pop. (1945) 2,809. Amapala is on Tigre Island, in the Gulf of Fonseca, and passengers and freight to and from the interior are carried on barges or launches to San Lorenzo, on the mainland, the terminus of the highway to Tegucigalpa.

AMARANTH or **AMARANT**, a name chiefly used in poetry, and applied to certain plants which, from not soon fading, typified immortality (from the Gr. *ἀμάραντος*, unwithering).

The plant genus *Amaranthus* (of the family *Amaranthaceae*) contains several well-known garden plants, mostly of tropical origin, such as love-lies-bleeding (*A. caudatus*), a vigorous hardy annual, with dark purplish flowers crowded in handsome drooping spikes. Another variety, *A. hybridus hypochondriacus*, is prince's feather, with deeply veined lance-shaped leaves, purple on the under face, and deep crimson flowers densely packed on erect spikes. Globe amaranth belongs to an allied genus, *Gomphrena*, and is also a native of India. It is an annual about 18 in. high, with solitary round heads of flowers; the heads are violet, red, pink, white or yellow from the colour of the bracts which surround the small flowers.

In North America upwards of 30 species of amaranth occur, chiefly in the southern and southwestern United States, several of which are introduced weeds, mostly from the tropics. Among the most widely distributed are the green amaranth or rough pigweed (*A. retroflexus*), the red amaranth or pilewort (*A. hybridus*), the spiny amaranth (*A. spinosus*), the prostrate amaranth (*A. blitoides*) and a tumbleweed (*A. graecizans*). In ancient Greece the amaranth (also called *χρυσάνθεμον* and *ἐλίχρυσον*) was sacred to Ephesian Artemis. It was supposed to have special healing properties, and as a symbol of immortality was used to decorate images of the gods and tombs. In legend, Amaranthus (a form of Amaranthus) was a hunter of Artemis and king of Euboea; in a village of Amaranthus, of which he was the eponymous hero, there was a famous temple of Artemis Amaranthia or Amarysia (Strabo x, 448; Pausan. i, 31, p.5).

See Lenz, *Botanik der alt. Griech. und Röm.* (1859); J. Murr, *Die Pflanzenwelt in der griech. Mythol.* (1890).

AMARAPURA, a suburb of Mandalay, Union of Burma; pop. (1931) 8,254. It was founded in 1783 as a new capital about 6 mi. northeast of Ava. In 1810 it was estimated to contain

170,000 inhabitants; but a fire in that year and the removal of the native court to Ava in 1823 caused a decline. In 1827 its population was estimated at only 30,000. An earthquake in 1839 destroyed the greater part of the city. It was finally abandoned in 1860, when King Mindōn occupied Mandalay. Amarapura was laid out on much the same plan as Ava. The ruins of the city wall, now overgrown with jungle, show it to have been a square with a side of about three-quarters of a mile in length. At each corner stood a solid brick pagoda about 100 ft. high. A celebrated temple, adorned with 250 lofty pillars of gilt wood, contained a colossal bronze statue of Buddha. The remains of the former palace of the Burmese monarchs still survive in the centre of the town. Amarapura was defended by a rampart and a large square citadel, with a broad moat, the walls being 7,000 ft. long and 20 ft. high, with a bastion at each corner. The Burmans know it now as Myohaung, "the old city." Myohaung has a station on the Rangoon-Mandalay railway, and is the junction for the line to Maymyo and Lashio and for the Myitkyina railway. Amarapura is known to the Burmans as Taung-myo, "the southern city," as distinguished from Mandalay, the Myauk-myo, or "northern city."

AMARAR (UM 'AR'AR OR BENT 'AMIR), a tribe of African "Arabs" inhabiting the mountainous country on the west side of the Red sea from Suakin northwards towards Kosseir. The tribe is divided into four great families: (1) Weled Gwilei, (2) Weled Aliab, (3) Weled Kurbab Wagadab and (4) the Amarar proper of the Ariab district. They claim to be of Koreish blood.

See *Anglo-Egyptian Sudan*, edited by Count Gleichen (London, 1905); H. A. MacMichael, *History of the Arabs of the Sudan* (1922).

AMARA SINHA (c. A.D. 375), Sanskrit grammarian and poet. He is said to have been "one of the nine gems that adorned the throne of Vikramaditya," and according to the evidence of Hsüan Tsang, this is the Chandragupta Vikramaditya that flourished about A.D. 375. The only work of his which survives is the *Amara-Kosha* (Treasury of Amara), a vocabulary of Sanskrit roots, in three books, and hence sometimes called *Trikanda* or the "Tripartite." It contains 10,000 words, and is arranged, like other works of its class, in metre, to aid the memory.

The first chapter of the *Kosha* was printed at Rome in Tamil character in 1798. An edition of the entire work, with English notes and an index by H. T. Colebrooke, appeared at Serampore in 1808. The Sanskrit text was printed at Calcutta in 1831. A French translation by A. L. A. Loiseleur-Deslongchamps was published at Paris in 1839.

AMARAVATI, a ruined city of India in the Guntur district of the Madras presidency, on the south bank of the Kistna river, 62 mi. from its mouth, a centre of the ancient Buddhist kingdom of Vengi, with a famous *stupa* (sepulchral monument). Its elaborate carvings illustrate the life of Buddha. Some are preserved in the British Museum; others in the museum at Madras. Amaravati has been identified with Hsüan Tsang's To-na-kie-tse-kia and with the Rahmi of Arab geographers. Subsequent to the disappearance of Buddhism from this region the town became a centre of Sivaism.

AMARI, MICHELE (1806-1889), Italian orientalist and patriot, born at Palermo. He joined the Carbonari, and had to leave Italy because he had written a book (1842) containing political allusions reflecting on the Bourbon government of Naples. The revolution of 1848 found him in Sicily once more, but on the restoration of the Bourbons he was once more an exile. He returned to Italy in 1859, and taught Arabic at Pisa and afterwards at Florence. A strong supporter of Cavour, he was minister of education in the Farini and Minghetti cabinets. On the fall of the latter in 1864, he resumed his chair at Florence, where he lived until his death in 1889.

His interest in Arabic studies resulted in a book, *La Storia dei Musulmani in Sicilia*, begun in 1844, the fourth and last volume printed in 1872. He is still the standard authority on the Moslem rule in Sicily. More important are his collections of Arabic sources for the history of Sicily: *Biblioteca Arabo-Sicula; con appendice* (Leipzig, 1857-75), Italian trans. (Rome, 1880); *I diplomi arabi del archivio fiorentino* (Florence, 1863-67).

AMARILLO, a city of Texas, U.S.A., about 267 mi. W. of Oklahoma City, at an altitude of 3,676 ft.; the county seat of Potter county.

Amarillo is on federal highways 60, 66, 87 and 287; and is served by the Rock Island, Burlington and Santa Fe railways, and by air lines, bus and truck. The population of Amarillo which in 1890 was only 482, was 43,132 in 1930, and was 73,737 in 1950 by the federal census. Its rapid growth was due to the development of the entire Texas "Panhandle," of which it is the commercial centre.

The wholesale and jobbing business amounts to approximately \$400,000,000 annually.

The only operating United States government helium plant is at Amarillo.

There are grain elevators, packing houses, creameries, a zinc smelter, an oil refinery and large railway shops. Amarillo was incorporated in 1887 and adopted a commission-manager form of government in 1913.

AMARNA TABLETS: see TEL EL AMARNA.

AMARYLLIDACEAE, the amaryllis family, a numerous group of monocotyledonous plants, closely allied to the lily family (Liliaceae). Familiar representatives are the daffodil, jonquil, snowdrop, tuberose (*qq.v.*) and snowflake. The family comprises about 86 genera and 1,050 species, found chiefly in tropical and subtropical regions. Many are bulbous plants of arid lands, leafing only in spring or after rains. A large number bear handsome lily-like flowers, often popularly called lilies, as Amazon lily (*Eucharis grandiflora*), spider lily (*Hymenocallis* sp., *Pancratium*, sp.) and zephyr lily (*Zephyranthes* sp.). Among the larger genera are *Agave*, *Crinum*, *Hippeastrum*, *Hypoxis* and *Narcissus*. Various species of *Agave* yield valuable fibres, as henequen, pita and sisal hemp; the bulbs of some species are used in medicine, while those of the South African belladonna lily (*Amaryllis Belladonna*) and the buphane (*Buphane disticha*) are highly toxic, the latter furnishing a Kafir arrow-poison. Representatives of more than 40 genera are grown as ornamental plants in greenhouses and gardens. Native plants of the family in the British Isles are the yellow daffodil (*Narcissus Pseudo-Narcissus*), the snowdrop (*Galanthus nivalis*) and the summer snowflake (*Leucojum aestivale*).

In North America there are more than 40 native species; these are found chiefly in the southern and the south-western United States and belong mostly to the genera *Agave*, *Hymenocallis* and *Zephyranthes*. Of those native to the eastern United States, the best known are the atamasco lily (*Zephyranthes Atamasco*), cultivated for its handsome flowers, and the yellow star-grass (*Hypoxis hirsuta*), the only representative extending northward into Canada.

For a treatment of the genera see F. Pax and K. Hoffmann, "Amaryllidaceae"; Engler and Prantl, *Die Natürlichen Pflanzenfamilien*, ed. 2, 15a: 391-430, fig. 163-187, 1930.

(See AGAVE; AMARYLLIS; HEMP; HIPPEASTRUM; LILIACEAE; NARCISSESS; SISAL FIBRE.)

AMARYLLIS (the name of a girl in classical pastoral poetry), a genus of the family Amaryllidaceae, containing only the belladonna lily (*Amaryllis Belladonna*), a native of South Africa, which was introduced into cultivation at the beginning of the 18th century. This is a tender bulbous plant, producing in the spring a number of strap-shaped, dull green leaves, 1-1½ ft. long, arranged in two rows, and later a solid stem, bearing at the top a cluster of 6-12 funnel-shaped rose-coloured, white or purple flowers; fragrant in some cultivated forms.

Amaryllis as a common name is also used for the allied genera *Hippeastrum* (*q.v.*), *Crinum*, *Sprekelia*, *Lycoris* and *Vallota*.

AMASIA or AMASYA, chief town of the Amasia vilayet of Turkey, and a trade centre on the Samsun-Sivas road, beautifully situated on the Yeshil Irmak (*Iris*). Population, according to the 1940 census, 13,635. It was one of the chief towns of the kingdom of Trebizond and of the Seljuks, one of whose sultans, Kaikobad I, enriched it with fine buildings and restored the castle, which was thus enabled to stand a seven months' siege by Timur. It was also much favoured by the early Osmanli sultans, one of whom, Selim I, was born there. Bayezid II built a fine mosque. Amasia is an unusually well-built Turkish

town with a good bazaar and khans and a fine clock-tower. It has extensive fruit gardens. Wheat, flour and silk are exported.

Ancient Amasia has left little trace of itself except on the castle rock, on the left of the river, where the acropolis walls and a number of splendid rock-cut tombs, described by Strabo as those of the kings of Pontus, can be seen. Amasia rose to historical importance after the time of Alexander as the cradle of the power of Pontus; but the last king to reign there was the father of Mithradates Eupator "The Great." The latter, however, made it the base of his operations against the Romans in 89, 72 and 67 B.C. Pompey made it a free city in 65, after Mithradates' fall. It was the birthplace of Strabo.

AMASIS or **AMOSIS** (the Greek forms of the Egyptian name *Akmase*, *Ahmosi*, "the moon is born," often written *Aahmes* or *Ahmes* in modern works), the name of two kings of ancient Egypt.

Amasis I., the founder of the 17th dynasty, is famous for his successful wars against the Hyksos princes who still ruled in the north-east of the Delta (see EGYPT: *History*).

Amasis II. was the last great ruler of Egypt before the Persian conquest, 570-526 B.C. Most of our information about him is derived from Herodotus (ii. 161 *et seq.*) and can only be imperfectly controlled by monumental evidence. According to the Greek historian he was of mean origin. A revolt of the native soldiers gave him his opportunity. These troops, returning home from a disastrous expedition to Cyrene, suspected that they had been betrayed in order that Apries, the reigning king, might rule more absolutely by means of his mercenaries, and their friends in Egypt fully sympathized with them. Amasis, sent to meet them and quell the revolt, was proclaimed king by the rebels, and Apries, who had now to rely entirely on his mercenaries, was defeated and taken prisoner in the ensuing conflict at Momemphis; the usurper treated the captive prince with great lenity, but was eventually persuaded to give him up to the people, by whom he was strangled and buried in his ancestral tomb at Sais. An inscription confirms the fact of the struggle between the native and the foreign soldiery, and proves that Apries was killed and honourably buried in the third year of Amasis. Although Amasis thus appears first as champion of the disparaged native, he had the good sense to cultivate the friendship of the Greek world, and brought Egypt into closer touch with it than ever before. Herodotus relates that under his prudent administration Egypt reached the highest pitch of prosperity; he adorned the temples of Lower Egypt especially with splendid monolithic shrines and other monuments (his activity here is proved by remains still existing). Amasis confirmed the Greeks in possession of the commercial colony of Naucratis on the Canopic branch of the Nile, apparently with a definite charter, and when the temple of Delphi was burned he contributed 1,000 talents to the rebuilding. He also married a Greek princess named Ladice, the daughter of Battus, king of Cyrene, and he made alliances with Polycrates of Samos and Croesus of Lydia. His kingdom consisted probably of Egypt only, as far as the First Cataract, but to this he added Cyprus, and his influence was great in Cyrene. At the beginning of his long reign, before the death of Apries, he appears to have sustained an attack by Nebuchadrezzar (568 B.C.). Cyrus left Egypt unmolested; but the last years of Amasis were disturbed by the threatened invasion of Cambyses and by the rupture of the alliance with Polycrates of Samos. The blow fell upon his son Psammetichus III., whom the Persian deprived of his kingdom after a reign of only six months.

See NAUCRATIS; also W. M. Flinders Petrie, *History*, vol. iii.; Breasted, *History and Historical Documents*, vol. iv. p. 509; Maspero, *Les Empires*.

AMA SWAZI: see SWAZI.

AMA TEMBU: see TEMBU.

AMATEUR, a person who takes part in any art, craft, game or sport for the sake of the pleasure afforded by the occupation itself and not for pecuniary gain (Lat. *amator*, lover). Being thus a person for whom the pursuit in question is a recreation and not a business, and who therefore presumably devotes to it a portion only of his leisure and not his working hours, the average amateur

usually possesses less skill than the average professional, whose livelihood and reputation depend on his proficiency, and who therefore concentrates all his energies on the task of attaining the greatest possible mastery in his chosen career. In the arts, such as music, painting and the drama, the best amateurs are outdistanced as executants not merely by the best professionals but by professionals far below the highest rank; and although the inferiority of the amateur is not perhaps so pronounced or so universal in the case of games and outdoor sports, the records of such pastimes as boxing, billiards, motorcycle racing and golf prove that here also the same contrast is to be found. Hence it has come about that the term "amateur" has acquired a secondary meaning, often employed somewhat contemptuously and sometimes incorrectly, signifying inefficiency, unskilfulness, superficial knowledge or training.

The immense increase in popularity of athletic contests and games of all kinds in modern times, and especially the keen competition for "records" and championships, often of an international character, have made it a matter of importance to arrive at a clear and formal definition of the amateur as distinguished from the professional.

The simple, straightforward definition of the amateur given above has been evaded. Cases are not unknown in the history of county cricket where players preserve their amateur status who, although they are not directly paid wages for cricket, are provided with the money enabling them to take a regular part in the sport by means of a salaried secretaryship or other office, very liberal grants for expenses, etc. Similarly "gentlemen riders" sometimes receive indirect remuneration. The various associations controlling the different branches of sport have therefore devised working regulations to be observed so far as their jurisdiction extends. Thus the Amateur Athletic Association of Great Britain defines an amateur as "one who has never competed for a money prize or staked bet, or with or against a professional for any prize, or who has never taught, pursued or assisted in the practice of athletic exercises as a means of obtaining a livelihood."

The rules of the Amateur Rowing association are stricter, denying amateur status to anyone who has ever steered or rowed in a race with a professional for any prize, or who is or has been by trade or employment for wages a mechanic, artisan or labourer, or engaged in any menial duty, besides insisting upon the usual restrictions in regard to taking money and competing with professionals.

In association football the rules are much more lax, for although amateurs are clearly distinguished from professionals, an amateur may even become a regular member, though unsalaried, of a professional team without losing his amateur status. The Rugby game was, up to 1895, entirely controlled by the Rugby Football union, which, by the strictness of its laws, effectually prevented the growth of professionalism, but there had been much dissatisfaction in the provinces with the union's decision against reimbursing day-working players for "broken time," *i.e.*, for that part of their wages which they lost by playing on working days, and this resulted in the formation (1895) of the Northern union, which permitted remuneration for "broken time" but allowed no person who worked for his living to play football unless regularly employed at his trade. Later the Northern union became purely professional in character and developed into the Rugby league. In 1927 the International Olympic committee was persuaded to announce that payment for "broken time" might in the case of association football be made to the employer(s) of the player(s) affected. This announcement appeared contrary to the spirit of these modern games, as revived by Baron Pierre de Coubertin, and as defined in 1908 in legislation accepted by all the nations then competing. The British Football association therefore withdrew from the Olympic Games (1928).

In the United States the Amateur Athletic union recognizes all amateur sports and claims jurisdiction over certain important branches, excepting, however, baseball, football, golf, rowing and tennis (see ATHLETIC SPORTS, section. *United States*). The A.A.U. rules on the amateur status define an amateur sportsman as "one who engages in sport solely for the pleasure and

physical, mental or social benefits he derives therefrom, and to whom sport is nothing more than an avocation."

The rules, so far as they relate to professionalism, are: No person shall be eligible to compete in any athletic meeting, game or entertainment, given or sanctioned by this union, who has

(1) received or competed for compensation or reward in any form for the display, exercise or example of his skill or knowledge of any athletic exercise, or for rendering personal service of any kind to any athletic organization, or for becoming or continuing a member of any athletic organization; or

(2) has entered any competition under a name other than his own, or from a club of which he was not at that time a member in good standing; or

(3) has knowingly entered any competition open to any professional or professionals, or has knowingly competed with any professional for any prize or token; or

(4) has issued or allowed to be issued in his behalf any challenge to compete against any professional or for money; or

(5) has pawned, bartered or sold any prize won in athletic competition.

It will be seen that by rule 3 the American union enacts a standard for all athletes not much different from that of the British Amateur Rowing association. The rules for the sports not within the union's jurisdiction are practically the same, except that in cricket and golf, and also in baseball, if special permission has been granted, amateurs may compete with professionals, though not for cash prizes. The number of professional football players has grown in recent years and many of the more widely known recruits have come from college football. Not a few of the greatest of the professional baseball players have played the game at college.

It is probably impossible to produce any definition of an amateur which will cover all sports in any single nation. It is hopeless to try to define an amateur for all sports all over the world. The only reasonable method of getting amateurs together in any great international meeting is to lay the responsibility for their selection and appearance upon the governing body of the sport in which they compete in the nation which they represent. These governing bodies at least will have fairly similar rules in all countries, because, in nearly every case, they are affiliated to international associations of the particular sport concerned; and therefore practical justice will be as nearly as possible satisfied. (See also ATHLETIC SPORTS: *United States*, and H. J. Savage, *Games and Sports in British Schools and Universities*, ch. vii, 1927.)

AMA THONGA: see THONGA.

AMATHUS, ancient city, Cyprus, on the south coast, about 24 mi. W. of Larnaka and 6 mi. E. of Limassol, among sandy hills and sand-dunes, which perhaps explains its name (Greek *ἄμμος*, sand). The earliest remains hitherto found on the site are of the early iron age (1000-600 B.C.). Amathus maintained strong Phoenician sympathies, and refused to join the revolt of Cyprus against Persia (500-494 B.C.) (Herod. v, 105). Evagoras of Salamis was similarly opposed by Amathus about 385-380 B.C. in conjunction with Citium and Soli (Diod. Sic. xiv, 98); and even after Alexander the city resisted annexation (Diod. Sic. xix, 62). Its temple of Adonis and Aphrodite (*Venus Amathusia*) remained famous in Roman time but is quite destroyed. Amathus derived its wealth from corn and from copper mines, of which traces can be seen inland; Ovid also mentions its sheep (*Met.* x, 227). But the epithet *Amathusia* in Roman poetry often means little more than "Cypriote." Amathus still flourished and produced a patriarch of Alexandria (Johannes Eleemon), as late as 606-616, but it was almost deserted when Richard Coeur de Lion won Cyprus by a victory there over Isaac Comnenus in 1191. The rich necropolis has yielded valuable works of art; but the city has vanished, except fragments of a Byzantine church, and a great stone bowl on the acropolis. A similar vessel was transported to the Louvre in 1867. (See also CYPRUS.)

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AMATI, the name of a family of Italian violin makers, who flourished at Cremona from about 1550 to 1692. According to Fétis, Andrea and Nicolo Amati, two brothers, were the first Italians who made violins. They were succeeded by Antonio and Geronimo, sons of Andrea. Another Nicolo, son of Geronimo, was born on Sept. 3, 1596, and died on Aug. 12, 1684. He was the most eminent of the family. He improved the model adopted by the rest of the Amati and produced instruments capable of yielding greater power of tone. His pattern was usually small, but he also made the so-called "Grand Amatis." Of his pupils the most famous were Andrea Enameri and Antonio Stradivari.

AMATITLÁN or **SAN JUAN DE AMATITLÁN**, in Guatemala department, Guatemala, on Lake Amatitlán 23 mi. S.W. of Guatemala city by the transcontinental railway from Puerto Barrios to San José. Pop. (1940) municipio 9,705, town 4,759. The town consists almost entirely of small adobe houses inhabited by mulattos and Indians, whose chief industry is the production of cochineal. In 1840 only a small Indian village marked its site, and its subsequent growth was due to the sugar plantations established by a Jesuit settlement.

The wells of the town are strongly impregnated with salt and alum, and in the vicinity there are several hot springs. Lake Amatitlán, 9 mi. long and 3 mi. broad, lies on the northern side of the great Guatemalan Cordillera. Above it rises the four-cratered volcano of Pacaya (8,390 ft.), which was in eruption in 1870.

The outlet of the lake is a swift river 65 mi. long, which cuts a way through the Cordillera, and enters the Pacific at Istapa, after forming at San Pedro a fine waterfall more than 200 ft. high.

AMAUSIS, a term for loss of vision, limited chiefly to those diseases not directly involving the eye, or the optic nerve.

AMAURY: see ALMERIC OF BENA.

AMA XOSA: see XOSA.

AMAZON, the great river of South America and the largest in the world in volume although exceeded in length by the Nile and the Mississippi-Missouri. In the year 1500, Vicente Yañez Pinzon, in command of a Spanish expedition, discovered and ascended the Amazon to a point about 50 mi. from the sea. He called it the *Rio Santa Maria de la Mar Dulce*, which soon became abbreviated to *Mar Dulce*. For some years after 1502 it was known as the *Rio Grande*. The companions of Pinzon, in giving evidence in 1515, mention it as *El Ryo Marañón*.

The first descent of the river from the Andes to the sea was made in 1541 by Orellana who reached the main stream by way of the Napo river. It is rather generally accepted that the name *Amazonas* was given to the river by Orellana after a battle with the Tapuyas savages in which he believed that the women of the tribe fought with the men. The first ascent of the river was made in 1638 by Pedro Texiera, a Portuguese, who reversed the route of Orellana and reached Quito by way of the Napo.

The Amazon river has a drainage area of 2,722,000 sq.mi. if the Tocantins is included. It drains four-tenths of South America and gathers its waters from 5° N. to 20° S. latitude. The main stream rises in a chain of glacier-fed lakes on the eastern border of the main range of the Andes in Central Peru, about 1,000 mi. N.N.E. of Lima, and flows for 3,900 mi. across Peru and Brazil to enter the Atlantic on the equator. While Amazon, or *Amazonas*, is popularly applied to the whole of the main stream it is properly applied only to sections of it in Peruvian and Brazilian nomenclature. In Peru the upper stream from its source to Iquitos is called Marañón and, from there to the sea, Amazonas. In Brazil the name Solimões is used from Iquitos to the mouth of the Negro river and Amazonas only from the Negro river to the sea.

Beginning with the lower river the great tributaries to the main stream will be discussed in order, beginning with the southern or larger affluents.

TRIBUTARIES

The TOCANTINS is not really a branch of the Amazon. It is the central fluvial artery of Brazil, running from south to north for

a distance of about 1,500 miles. It rises in the mountainous district of Pyrenopolis, but its more ambitious western affluent, the Araguay, has its extreme southern headwaters on the slopes of the Sierra Cayapó, and flows 1,080m. before its junction with the parent stream, which it appears almost to equal in volume. Besides its main tributary, the Rio das Mortes, it has 20 smaller branches, offering many miles of canoe navigation. The Pará river, generally called one of the mouths of the Amazon, is only the lower reach of the Tocantins.

The XINGÚ, the next large river west of the Tocantins, was first explored by Karl von den Steinen in 1884-87. The river is formed at about 12° S. lat., by the union of three large headwater streams, the Ronuro, the Tamitotoala, and the Kuluene, all of which, together with their more important tributaries, rise in an area only about 80m. long from west to east and some 200m. N.E. of Cuyabá. From a point about 75m. from the union of these streams the Xingú enters a 400-mile stretch of rapids that are serious obstacles even to canoe navigation.

The TAPAJOS, running through a humid, hot and unhealthy valley, pours into the Amazon 500m. above Pará and is about 1,200m. long. It rises on the lofty Brazilian plateau near Diamantino in 14° 25' S. lat. Near this place a number of streams unite to form the river Arinos. The Arinos, the Alto Tapajos and the Tapajos to the last rapid, the Maranhão Grande, is a continuous series of formidable cataracts and rapids; but from the Maranhão Grande to its mouth, about 188m., the river can be navigated by large vessels.

The MADEIRA has its junction with the Amazon 870m. by river above Pará, and almost rivals it in the volume of its waters. It rises more than 50ft. during the rainy season, and the largest ocean steamers may ascend it to the Fall of San Antonio, 663m. above its mouth; but in the dry months, from June to November, it is only navigable for the same distance for craft drawing from 5 to 6ft. of water. According to the Treaty of San Ildefonso, the Madeira begins at the confluence of the Guaporé with the Mamoré. The Guaporé has its headwaters almost in contact with those of the Paraguay River, but the idea of a connecting canal is based on ignorance of local conditions. San Antonio is the first of a formidable series of cataracts and rapids, 19 in number, which, for a river distance of 263m., obstruct the upper course of the Madeira until the last rapid, called Guajará Mirim (small pebble), is reached, about 120m. below the union of the Guaporé with the Mamoré. The Beni River joins the Madeira at the Madeira Rapids, a stretch of nearly 5 miles of reefs, whirlpools and rapids, about 40m. below the Guajará Mirim Rapids. From the Guaporé, Mamoré and Beni rivers the Madeira receives the drainage from the whole of the eastern and north-eastern slopes of the Andes from the southernmost sources of the Rio Grande (a tributary of the Mamoré) at about 20° S. lat. to the northernmost sources of the Madre de Dios River (a tributary of the Beni) at about 12° S. lat., the whole of the south-western slope of the Brazilian Matto Grosso, and the northern slope of the Sierra de Chiquitos in the Gran Chaco. All of the upper branches of the Madeira flow across open, almost level plains, which, although some 35,000 sq.m. of them are yearly flooded to an average depth of 3ft. for a period of from three to four months, form an agricultural and grazing region that is probably the most healthful and most inviting of the whole Amazon Basin.

The PURÚS, a very sluggish river, enters the Amazon about 230m. west of the Madeira, which it parallels as far as the falls of the latter stream. It is practically only a drainage ditch for the half-submerged, lake-flooded district it traverses. Chandless found its elevation above sea-level to be only 107ft. 590 miles from its mouth. It is due to this extremely gentle gradient that the river, although a young stream, exhibits the meandering character of a mature stream. It is one of the most crooked rivers in the world, its length in a straight line being less than half that by its meanders. One of its marked characteristics is the five parallel *furos*, side channels to the main stream, by which its lower course is connected with the Amazon; the largest and most westerly one connecting with the Purús about 150m. above its mouth. Its width is very uniform for 1,000m. up, and for

800m. its depth is never less than 45 feet. It is navigable by steamers for 1,648m. as far as the little stream, the Curumahá, but only by light-draught craft. Chandless ascended it 1,866 miles. At 1,792m. it forks into two small streams.

The JURUÁ is the next great southern affluent of the Amazon west of the Purús and traverses the same sort of low, half-flooded country as the latter. It has the same character as the Purús as regards gentleness of gradient, meanders and sluggishness. It rises in the highlands east of the Ucayali which carry the Peru-Brazil boundary and is navigable for a distance of 1,133 m. above its junction with the Amazon.

The JAVARY, the boundary line between Brazil and Peru, is another Amazon tributary of importance. It is navigable by canoe for 900m. above its mouth to its sources among the Ucayali highlands, but only 260m. have been found suitable for steam navigation. The Brazilian Boundary Commission ascended it in 1866 to the junction of the Shino with its Jaquirana branch. The country it traverses in its extremely sinuous course is very level, similar in character to that of the Juruá.

The UCAYALI is second only in size to the Madeira among the tributaries of the Amazon. Its headwaters drain a great section of the Peruvian plateau from the source of the Vilcanota River only 70 m. N.W. of Lake Titicaca to the sources of the Mantaro west of Cerro de Pasco. The lower 500 m. of the main channel is bordered by large islands formed by numerous side-channels; the whole being very low and flooded in the rainy season. The Ucayali is navigable for light draft launches as far as the Tâmbor-Urubamba junction but the main Lima-Iquitos route follows the Pichis-Pachitea tributary.

The HUALLAGA which joins the Marañón about midway between the Pongo de Manseriche and the mouth of the Ucayali has its true source in the Yanahuanca River, a stream flowing from a series of glacier-fed lakes which lie north-west of the famous mining centre of Cerro de Pasco on the eastern slope of the main range of the Andes between the sources of the Marañón and Mantaro rivers. The name Huallaga is applied, however, to a more easterly and much less important headwater tributary which rises a short distance east of Cerro de Pasco. The whole stream is deeply entrenched and from the town of Huánuco to the mouth of the river much of its course is impeded by rapids and gorges. Between the Huallaga and the Ucayali lie the famous Pampas de Sacramento, vast plains broken by low outliers of the Andes, forested in part, but said to consist largely of grass-covered areas suited to cattle raising.

The MARAÑÓN River rises in Lake Lauricocha, the northernmost of a chain of glacier-fed lakes about 100 m. N.N.E. of Lima and flows northward in a deeply eroded valley. It is due to this and other deeply entrenched longitudinal valleys that the tributaries of the Amazon have cut in the Peruvian plateau that the erroneous conception of the Peruvian Andes as three separate mountain ranges has arisen. At about 5° 30' S. lat. the river makes a great bend toward the north-east and, after passing through a succession of narrows or *pongos* and no less than 35 formidable rapids, it breaks through from the Peruvian plateau to the Amazon Plain by a great canyon known as the Pongo de Manseriche. This canyon is about 2,000ft. deep and narrows in places to a width of only 100ft. Through this dark canyon the Marañón flows, at times, at a rate of over 12m. an hour. Beyond the *pongo* the river receives several large tributaries from the north and spreads out into a broad stream with numerous channels and islands.

From the north the Amazon receives many tributaries, but their total volume of water is not nearly so great as that contributed to the parent stream by its affluents from the south. The part of Brazil lying between the Amazon and French, Dutch and British Guiana, and bounded on the west by the Rio Negro, is known as Brazilian Guiana. It is the southern slope, very convoluted, of the northern section of the Brazilian Archæan block. Their northern slope, which is occupied by the three Guianas first named, is saturated and river-torn; but their southern one, Brazilian Guiana, is in general thirsty and semi-barren, and the driest region of the Amazon valley. It is an area which has been left almost in the

undisturbed possession of nomadic Indian tribes.

The TROMBETAS is the first river of importance we meet on the northern side as we ascend the Amazon. Its confluence with this is just above the town of Obidos. It has its sources in the Guiana highlands, but its long course is frequently interrupted by violent currents, rocky barriers and rapids. The river is navigable for 135m. above its mouth.

The NEGRO, the great northern tributary of the Amazon, has its sources along the watershed between the Orinoco and the Amazon basins, and also connects with the Orinoco by way of the Casiquiare Canal. The Negro is navigable in dry season for 450 m. above its mouth for vessels of 4 ft. draft, but it has many sandbanks and minor obstructions. In the wet season it overflows its banks, in places to a width of 20 miles. Its lower course is very wide and full of long islands and intricate channels. The main headwater affluent of the Negro is the Uaupes. Its principal affluent from the north is the Branco formed by the union of the Uraricuera and Takatú which, with their tributaries drain a large section of the southerly slopes of the Guiana Highlands which separate Brazil from Venezuela and British Guiana. The Branco flows nearly straight south for 350 miles to the Negro which it enters by numerous channels similar to those of the lower course of the latter.

The Casiquiare Canal which connects the upper Orinoco, about 18 m. below the old mission site of Esmeraldas, with the Rio Negro affluent of the Amazon near the village of San Carlos, is a natural waterway, the only one of its kind known in the world. The existence of the canal was first reported by Father Acuña in 1639 but was not confirmed until 1744, when the Jesuit Father Roman, ascending the Orinoco, met Portuguese slave-traders from settlements on the Rio Negro, accompanied them on their return by way of the Casiquiare Canal and returned to the Orinoco by the same route. According to data obtained by the Rice Expedition which made a survey of the canal in 1919, the length of the canal is 227 m. Its width at its beginning in the Orinoco is 758 ft.; but this rapidly narrows down to 150 ft. and widens again to 2,150 ft. at its mouth in the Negro. The level of the water at the Orinoco end was found to be 283 ft. and, at the Rio Negro end, 212 ft. giving the canal an average slope toward the Negro of 7.2 in. per mile. The banks of the canal are heavily forested. The chief inhabitants of the region are Indians of the Maquiratares tribe although there are some whites engaged in rubber gathering. There are several small settlements at the lower end of the canal of which Solano was founded while the Scientific Expedition of the Boundary Commission of 1756 was at work in the region.

The YAPURÁ. West of the Negro the Amazon receives three imposing streams from the north-west—the Yapurá, the Iça or Putumayo and the Napo. The first was formerly known as the Hyapora, but its Brazilian part is now called the Yapurá, and its Colombian portion the Caquetá. Barão de Marajo gives it 600m. of navigable stretches. Jules Crevaux, who descended it, describes it as full of obstacles to navigation, the current very strong and the stream frequently interrupted by rapids and cataracts. It rises in the Colombian Andes, nearly in touch with the sources of the Magdalena, and augments its volume from many branches as it courses through Colombia.

The IÇA or PUTUMAYO, west of and parallel to the Yapurá, was found much more easily navigated by Crevaux. He ascended it in a steamer drawing 6ft. of water, and running day and night. He reached Cuemby, 800m. above its mouth, without finding a single rapid. Cuemby is only 200m. from the Pacific ocean, in a straight line.

The NAPO rises among the volcanoes of the eastern border of the Andes in northern Ecuador. Its headwater tributaries in the Ecuadorian Oriente flow through one of the least known areas of the eastern border of the Andes. The course of only its southernmost headwater tributary, the Anzu, is definitely known. The Coca which is believed to have its source on the slopes of Cayambe Volcano close to the equator, and the Aguarico, an important river with headwaters between Cayambe and the Colombian frontier, join it from the north. The Curaray, a tributary of secondary

importance, joins it from the south some 200 miles from its mouth. The Napo is navigable for river craft to this point and by canoes to the mouth of the Coca. The Curaray-Coca section of the river is little-known.

The NANAY is the next Amazon tributary of importance west of the Napo. It belongs entirely to the lowlands, and is very crooked, has a slow current and divides much into *caños* and



BY COURTESY OF THE AMAZON EXPEDITION OF THE MUSEUM OF U. OF PA.

WAPISIANA WOMEN OF THE AMAZON BASIN IN SOUTHERN BRITISH GUIANA ENGAGED IN HAMMOCK WEAVING

strings of lagoons which flood the flat, low areas of country on either side.

The TIGRE is the next west of the Nanay, and is navigable for 125m. from its confluence with the Amazon. Like the Nanay, it belongs wholly to the plains. Its mouth is 42m. west of the junction of the Ucayali with the Amazon.

The PASTAZA (the ancient River Sumatara) is the next large river we meet. It rises on the Ecuadorian tableland, where a branch from the valley of Riobamba unites with one from the Latacunga basin.

The MORONA flows parallel to the Pastaza and immediately to the west of it, and is the last stream of any importance on the northern side of the Amazon before reaching the Pongo de Manseriche. Above the Pongo de Manseriche two important tributaries, the Santiago and the Chinchipe join the Marañón from the north.

THE MAIN RIVER

Physical Characteristics.—The AMAZON MAIN RIVER is navigable for ocean steamers as far as Iquitos, 2,300m. from the sea, and 486m. higher up for vessels drawing 14ft. of water, as far as Achual Point. Beyond that, according to Tucker, confirmed by Wertheimann, it is unsafe; but small steamers frequently ascend to the Pongo de Manseriche, just above Achual Point. The average current of the Amazon is about 3m. an hour; but, especially in flood, it dashes through some of its contracted channels at 5m. an hour. The U.S. steamer "Wilmington" ascended it to Iquitos in 1899. Commander Todd reports that the average depth of the river in the height of the rainy season is 120 feet. It commences to rise in November, and increases in volume until June, and then falls until the end of October. The rise of the Negro branch is not synchronous; for the steady rains do not commence in its valley until February or March. By June it is full, and then it begins to fall with the Amazon. The Amazon at times broadens to 4 and 6 miles. Occasionally, for long distances, it divides into two main streams, with inland, lateral channels, all connected by a complicated system of natural canals, cutting the low, flat *igapo* (recent alluvial) lands, which are never more than 15ft. above low river, into almost numberless islands. At the narrows of Obidos, 400m. from the sea, it is compressed into a single bed a mile wide and over 200ft. deep, through which the water flows at the rate of 4 to 5m. an hour. In the rainy season it inundates the country throughout its course to the extent of several hundred thousand square miles, covering

the flood-plain, called *vargem* (land between the levels of moderate and high floods). The flood-levels are in places from 40 to 50 ft. high above low river. Taking four roughly equidistant places, the rise at Iquitos is 20 ft., at Tefé 45, near Obidos 35, and at Pará 12.

The first high land met in ascending the river is on the north bank, opposite the mouth of the Xingú, and extends for about 150m. up, as far as Monte Alegre. It is a series of steep, table-topped hills, cut down to a kind of terrace which lies between them and the river. Monte Alegre reaches an altitude of several hundred feet. On the south side, above the Xingú, a line of low bluffs extends, in a series of gentle curves with hardly any breaks nearly to Santarém, but a considerable distance inland, bordering the flood-plain, which is many miles wide. Then they bend to the south-west, and, abutting upon the lower Tapajós, merge into the bluffs which form the terrace margin of that river valley. The next high land on the north side is Obidos, a bluff, 56ft. above the river, backed by low hills. From Serpa, nearly opposite the river Madeira, to near the mouth of the Rio Negro, the banks are low, until approaching Manáos, they are rolling hills; but from the Negro, for 600m., as far up as the village of Canaria, at the great bend of the Amazon, only very low land is found, resembling that at the mouth of the river.

On the south side, from the Tapajós to the river Madeira, the banks are usually low, although two or three hills break the general monotony. From the latter river, however, to the Ucayali, a distance of nearly 1,500m., the forested banks are just out of water, and are inundated long before the river attains its maximum flood-line. Thence to the Huallaga the elevation of the land is somewhat greater; but not until this river is passed, and the Pongo de Manseriche approached, does the swelling ground of the Andean foot-hills raise the country above flood-level.

The Amazon is not a continuous incline, but probably consists of long, level stretches connected by short inclined planes of extremely little fall, sufficient, however, owing to its great depth, to give the gigantic volume of water a continuous impulse towards the ocean. The lower Amazon presents every evidence of having once been an ocean gulf, the upper waters of which washed the cliffs near Obidos. Only about 10% of the water discharged by the mighty stream enters it below Obidos, very little of which is from the northern slope of the valley. The drainage area of the Amazon basin above Obidos is about 1,945,000sq.m., and, below, only about 423,000sq.m., or say 20%, exclusive of the 354,000 sq.m. of the Tocantins basin.

The width of the mouth of the river is usually measured from Cabo do Norte to Ponta Tijoca, a distance of 207 statute mi.; but this includes the ocean outlet, 40 mi. wide, of the Pará river, which should be deducted, as this stream is only the lower reach of the Tocantins. It also includes the ocean frontage of Marajo, an island about the size of the kingdom of Denmark lying in the mouth of the Amazon. Following the coast, a little to the north of Cabo do Norte, and for 100 mi. along its Guiana margin up the Amazon, is a belt of half-submerged islands and shallow sandbanks. Here the tidal phenomenon called the *bore*, or *Pororoca*, occurs, where the soundings are not over 4 fathoms. It commences with a roar, constantly increasing, and advances at the rate of from 10 to 15 mi. an hour, with a breaking wall of water from 5 to 12 ft. high. Under such conditions of warfare between the ocean and the river, it is not surprising that the ocean is rapidly eating away the coast and that the vast volume of silt carried by the Amazon finds it impossible to build up a delta.

The Amazon averages five miles in width for a long distance but is about 40 miles wide in its lower course. In the wet season a belt of as much as 20 miles width may flood on each side.

Population, Trade, etc.—On Sept. 6, 1850, the emperor, Dom Pedro II., sanctioned a law authorizing steam navigation on the Amazon, and confided to an illustrious Brazilian, Barão Mauá (Irineu Evangelista de Sousa), the task of carrying it into effect. He organized the "Companhia de Navegação e Commercio do Amazonas" at Rio de Janeiro in 1852; and in the following year it commenced operations with three small steamers, the "Monarch," the "Marajo" and "Rio Negro." At first the navigation was principally

confined to the main river; and even in 1857 a modification of the Government contract only obliged the company to a monthly service between Pará and Manáos, with steamers of 200 tons cargo capacity, a second line to make six round voyages a year between Manáos and Tabatinga, and a third, two trips a month between Pará and Cametá. The Government paid the company a subvention of £3,935 monthly. Thus the first impulse of modern progress was given to the dormant valley. The success of the venture called attention to the unoccupied field; a second company soon opened commerce on the Madeira, Purús and Negro; a third established a line between Pará and Manáos; and a fourth navigated some of the smaller streams; while the Amazonas Company had largely increased its fine fleet.

The economic vicissitudes through which the Amazon basin has passed in late years are traceable largely to changes in the rubber industry. Although crude rubber was sent from the Amazon as early as 1827, several decades passed before the annual exportation attained commercial importance. With the remarkable increase in the demand for rubber, prices rose, and gatherers in the forests were sent further afield.

About 1910-11 prices reached their highest point, yearly exportations amounted to thousands of tons and numerous river craft plied on the Amazon and its tributaries. The inhabitants of the valley were almost exclusively engaged in rubber exploitation. The growing of foods was largely abandoned, even necessary commodities being imported. About this period, however, plantation rubber trees of the East Indies were coming into bearing and the result was a collapse by 1915 of the one great industry of the region. During the five years ending in 1927 there was a gradual increase of rubber exportation from the Amazon region, the total shipments for 1927 being in excess of 28,700 long tons.

A land concession of 3,700,000ac. granted by Brazil in 1927 to the Ford Motor Company, Detroit, Mich., and the formation of a Brazilian subsidiary with Brazilian stockholders provide large capital for the development of plantation rubber. The land lies along the eastern side of the Tapajós river 125 to 150m. south of Santarém on the Amazon. The two rivers afford sufficient water depth for ocean-going vessels to traffic directly with the plantations, work upon which is progressing.

Trading Spheres.—Exporters and importers recognize three trading spheres: the regions, respectively, of Pará (or Belém), Manáos and Iquitos. Numerous European and American steamships call at Pará; some proceed to Manáos, while others go up the river to Iquitos. Motor-cars are numerous in Pará and Manáos, and are being introduced into regions such as Cobja in Bolivia and other primitive settlements. Electric-light plants are in operation in larger cities and in Obidos, Porto Velho, Riberalta, Cobja, Amenquer, etc. River steamers are also thus equipped. The Mamoré-Madeira railroad, 220m. around Madeira Falls, opened in 1912, provides access to additional virgin territory. Land telegraph and radio services operate between the several cities of the region and many smaller places, thereby lessening their isolation.

Estimates place the population of the Amazon basin at about 3,000,000 to 4,000,000, most being credited to Brazil. The city of Belém had 166,662 in 1940; Manáos, 67,866; Santarém, 47,927 (*município*); Obidos, 13,960 (*município*); Iquitos, 34,231. Quantities of rubber, timber, Brazil nuts and carnauba wax are exported; other products are yerba maté, medicinal plants, vegetable oils and fish. The area offers an excellent field for development, and could support a considerably larger population.

Expeditions.—During the period 1910-27 there were numerous expeditions, exploratory and scientific, into regions watered by the Amazon and its tributaries. Roosevelt and Rondon in 1913-14 in a notable trip down the so-called River of Doubt in two months covered 470 miles of this river, hitherto unknown except to rubber-gatherers and found it to be a branch of the Madeira, joining it at 5° 21' S. lat. The Fleming expedition (1919) studied the industrial possibilities of the region and Rice in a series of expeditions (1910 to 1924) made accurate surveys of the Negro, Uaupes and Branco. A Carnegie Museum expedition made a study of fishes; the Ellsworth, Farabee, Fawcett and other parties obtained geographic, geological and ethnographical

data. In 1923-24 the American Rubber Mission financed by the U.S. Government conducted a survey along a total of 37 waterways including the Tocantins, Xingú, Tapajós, Madeira, Mamoré, Beni, Madre de Dios, Acre, Purús, Ucayali, Huallaga, Negro and Branco. Special parties penetrated inland and examined soils and agricultural possibilities particularly with a view to the cultivation of rubber and sugar cane. Its leader, Dr. W. L. Schurz, was assisted by specialists from the U.S. Departments of Commerce and Agriculture (among them Dr. C. F. Marbut of the Bureau of Soils) and from the business world, and by experts from Brazil, Bolivia and Peru. In 1927 and 1928 the American Geographical Society, in connection with its work of collecting source material for the new map of Hispanic America on the millionth scale which the Society is producing from original sources, sponsored two expeditions to the Amazon Basin. Joseph H. Sinclair, the leader of one of these parties continued his surveys of the sources of the Napo River begun in 1921 and located a new volcano. The other, conducted by O. M. Miller, of the Society's School of Surveying, made reconnaissance surveys in Central Peru, including a topographic survey of the sources of the Marañón.

Early in 1925 Col. P. W. Fawcett, British explorer, with a small party left Cuyabá to explore the Xingú-Tapajós region of Brazil. After some months news ceased to come from the party and it was feared that they were lost. In 1928 Commander G. M. Dyott, of England, sailed from New York with a relief party, retraced Fawcett's route for some distance and reported that he had found evidence that the party had been killed by Indians. (X.)

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Flora.—In diversity of forms and profusion of individuals the plant life of the Amazon river basin is probably the richest on the globe. Within the area drained by this river system, species of practically every oecological type find homes. Here most of the idiosyncrasies of the plant kingdom are in evidence, for this enormous territory presents a myriad-faced environment, and each face has its own peculiar complement of plant inhabitants. There are few parts of the earth's surface where the struggle for existence appears so intense, for plants literally swarm here.

Nearly all types of plant associations occur and many of these have native names, such as *monte*, *montaña* (forest), *varzea* (overflow forest), *curiche* (swampy meadow), *campo*, *pampa* (prairie or park-like country), *avanga* (araceous swamps, mostly of the arborescent relative of the calla-lily, *Montrichardia arborescens*), *terra firma* (in Brazil, land rarely, if ever, overflowed), *ceja* (bush, copse or chaparral), *pajonales* (small grass lands), *paramos* and *paramillos* (large and small alpine meadows).

The dominant feature of this area is the great forest—an expanse of green-topped columns that stretch from a zoom. front on the Atlantic in an ever-widening angle, almost across the continent to the snow-capped Andes. It ranges from the swampy tidewater mangrove thickets at sea-level to the bush country that marks the tree limit on the Andes at from 10,000 to 12,000 ft. altitude, where the last arborescent remnants hug the stream borders.

The most striking characteristics of these vast woods are the comparative absence of pure stands of any tree species; the paucity of forest giants in large groups; the division of the vertical height of the forest into storeys or floors on account of the mass effects of the various growths as regards size; the multitudes of very different types, both as to form and habit, jumbled together, often in the most tangled confusion; the general absence of seasonal leaf-fall and flowering time; the small percentage of soft woods; the number of tree forms with prop-roots or buttressed trunks; the long distance between the forest floor and the first branches; the absence of great masses of floral colour and, comparatively speaking, the light colour of the bark.

In the temperate zones, solid forests of one or a few species are characteristic, so that they are designated under the name of their dominant species, such as oak or pine forests. On an acre of

Amazon forest, in most regions, scores of species occur, but only a few individuals of each, although there are considerable areas that might be called laurel forests.

Palms, myrtles, laurels, acacias, bignonias, cedrelas, cecropias, rosewoods, bombacaceas, Brazil-nuts, rubber trees, figs, purple-hearts and dozens of others often grow on one small area. Within a half-mile square, Agassiz counted 117 different woods. In some regions, particularly rain forest on certain mountain slopes, tree-ferns add to the variety. Conifers are practically absent.

In general, forest giants stand alone and are conspicuous against the sky-line because they number so few. They rarely exceed 200 ft. and probably the average tree height of the larger growing species is not over 100 feet. Examples of species that attain the greatest height are the Brazilian cow-tree or *massaranduba* (*Mimosa lupulina*), the silk-cotton (*kapok*) or *samaúba* (*Ceiba* sp.), *pau d'arco* (*Tecoma* sp.), *bacori* (*Symphonia* sp.), Brazil-nut or *castanheira* (*Bertholletia* sp.), and the cream-nut or *sapucaia* (*Lecythis ollaria*). Species of fig and garlic trees (*Gallea*) also reach huge proportions. As one stands in the midst of a typical section of the Amazonian wilderness, nothing is perhaps more impressive or full of greater contrast than the changing scenes presented as one glances from the forest floor to its blue-apertured, sky-faced ceiling.

Often the floor level is covered by a mosaic of carpet forms (selaginellas, acantheas, thalias, ferns and bromeliads), beautiful both in design and colour. Beneath the willow-like *Tessaria* thickets on the sandy river flats meibomias form extensive mats. Gorgeous-hued amaryllids flower in clumps here and there. Our greenhouse lantana is a colourful fragrant weed. Sprays of various orchids cling to sticks, logs and small twigs. Several diminutive species remind one of tiny yellow, brown-spotted pansy sprays made up with equally delicately dimensioned iris leaves. Begonias, various in foliage and flower colour, are common. Profusions of fallen flowers in brilliant vivid shades of red, orange, yellow and pink frequently cover many square yards. Flowering trunks of the wild chocolate, huge buttresses of various forest giants, prop roots of certain palms and many vines and shrubs carry the eye upward to where they branch and leaf.

The second level is where the bushes, tall herbs and slender walking-stick palms flower, leaf and reach their maximum height. Red and yellow heliconias with their enormous banana-like leaves produce luxuriant tropical effects. Slender palms, with orange yellow panicles of male flowers, scent the glades. If fortune favours the visitor, the more open areas may be floriferous with the fugitive plum-like bloom of hirtellas and eugenias, or with the clambering types of pink and yellow orchids, sometimes with sprays 5 ft. long. Along the river fronts in the higher altitudes (2,000 to 3,000 ft.), calliandras with their profusion of brilliant henna-red cockades leave an unforgettable impression. Other typical plants of this level in some regions are the panama-hat plant (*toquilla*), the ivory-nut-palm (*tagua*), various passion-flowers and bignoniad vines, papayas and cassavas.

Still farther the eye ascends to meet the crowns of the various shade-loving trees that form the third storey of the Amazonian forest. These include numerous species of palms (*Mauritia*, *Euterpe*, *Attalea*, *Gulielma*, *Iriarteia*), the chocolate-tree, the ant-protected tree member of the buckwheat family, *Triplaris*, or *palo de santo*, besides hordes of perching orchids, pipers, ferns, cacti, tradescantias, bromeliads and aroids. Finally there is the canopy that fronts the sky, where the sun-loving vines, perchers and larger trees flower and fruit.

Although the valley lies wholly within the tropics, on account of the range in altitude, temperate as well as tropical plants occur, and every marked change in elevation results in a consequent change in the characteristic species. The greatest differentiation in plant life between the various areas is found, generally speaking, on the outer edge or rim of the basin, where the streams start and the mountain spurs are barriers to the mixing of flora. Hence each mountain valley may have a distinctive flora, and the greater the distance from the delta, in general, the more varied the vegetation over large areas. In some of the peripheral Andean regions, the ascent is so rapid that within a few miles tropical, subtropical



BY COURTESY OF UFA

PLANT AND ANIMAL LIFE IN THE BASIN OF THE AMAZON RIVER

1. Typical jungle scenery on the upper Amazon, showing trunks of the palm trees in the foreground covered with a creeping parasitic plant that is very destructive to them
2. Native beaters in the upper region of the Amazon risking their lives in an attempt to round up crocodiles by driving them out of the swamp and up the river
3. Round-up of thousands of crocodiles as a result of efforts of the beaters for several days (see fig. 2). Over 2,000 reptiles were killed
4. Native hut which German explorers used as a station when stopping on expedition into the upper Amazon in 1924 and 1925

and temperate climates are experienced. Bananas, coffee and oranges are grown on the valley floor, while toward the top of the mountain, the climate makes potatoes and barley successful crops. Tropical and temperate types under such conditions are present in strange companionships, such as the trail-side alder (*Alnus*) loaded with bright-flowered, perching bromeliads, cousins of the pineapple.

The region of the Amazon basin richest in flowers and colour is the ceja or bush country that fringes the tree limit on the eastern flanks of the Andes. Many of the plants recall the temperate zones, although the species are generally different. Lupines, gentians, barberries, fuchsias, viburnums, lycopodiums, buddleias, raspberries and clematis are typical types.

The high altitudes are treeless and often bleak, barren, stony and full of moors. Grasses (*Stipa*, *Festuca*, *Calamagrostis*) and rushes bulk large, while here and there peculiar relatives of the pineapple (*Puya*, *Pourretia*) form small colonies, sentinel-like in habit. *Yareta* (*Azorella*), a moss-like cushion plant of the carrot family, furnishes the dwellers in the higher altitudes with part of their fuel. Potatoes, barley, broad beans and native root crops thrive. A lichen (*Lecanora subfusca*), growing at 18,000ft., is said to be the highest altitude reached by plants in these regions.

Between the forest and the low water-line, particularly on the upper Amazon and many of its southern tributaries, but not on the Rio Negro and other "black water" rivers, large areas, often a mile or more in width, are dominated by the tall plumed canegrass, *caña brava*, a giant relative of the well-known pampasgrass. Forest and river usually meet on the "black water" rivers, and small streams of this character are often completely arched by the jungle flora of tree and vine. The grass lands largely lie between the forested valleys of the tributaries or at their head. For the most part, they are park-like in character, sprinkled here and there either with single trees, or with islands of forests from rac. to roac. or more in extent. Marshy, sluggish, plant-choked streams drain them. Cannas, water-lettuce, water-hyacinth and azolla cover enormous underwater areas, while much of the upland recalls a temperate prairie.

Some of the most valuable economic plants are indigenous to the Amazon valley. In addition to those already cited, mention should be made of quinine, cacao, cassava (*Manihot utilitissima*)

Fauna.—Although the fauna of the Amazon valley is noteworthy for the variety and number of its genera and species, it is very deficient not only in species of the larger mammals but also in the individuals of these comparatively few species. In contrast to other regions of the world, a large percentage of the mammals are tree-dwellers. None of them will attack man unprovoked, under ordinary circumstances. The monkeys are all arboreal and are common below 3,000ft. altitude. The best known are the red howlers, or *guaribas*, which make the great forest resound with their morning and evening chorus. Other common species are the spider, night, saki, marmoset, titi and squirrel-monkeys. A scarlet-faced, almost tailless species occurs near Ega. All forms are hunted and eaten by the aborigines. There are six species of the cat family, among which are the jaguar, puma or cougar and the ocelot. A small fox or fox-like dog lives on the prairies. A species of *Procyon* is described as a crab-eating racoon, and the two species of coati (*Nasua*) also belong with the racoons. The *janauhy* (*Icticyon*) or *cachorro de matto* combines the characteristics of a dog, badger, martin and beaver. Other Amazonian carnivores are the *papa-mel* (*Galictis*), kinkajou, otter, *grison* or ferret (*Grisonia*) and weasel (*Putorius*), the latter rather rare.

This region is particularly rich in rodents, the largest rodent species in the world, the capybara, being indigenous and common along the stream banks. It is said to attain a length of over 3ft. and a weight of over 50 kilograms. Other common rodents are the paca (*Coelogenys*), *cutia* or agouti (*Dasyprocta*), *sauia* or spiny rat, *toro* (*Loncheres*), several species of squirrels, rats and mice, and two species of porcupines. Paca meat is highly esteemed, but the capybara and a number of other forms are frequently used as food.

The largest animal is the *anta* or tapir, which makes its home in the giant cane-brakes along the streams. There are two species of peccary (*Dicotyles*). One of these, the *queixada* or *porco de matto*, lives in bands of 100 or more and twice invaded the small city of Obidos.

Five species of armadillos or *tatú* occur, both the giant and the pygmy species being represented. The former reaches a length of 3 feet. Of the three species of ant-eaters, two of them are tree-dwelling, while the giant ant-eater or *tamandua bandeira* is generally a prairie animal. The two sloths are both forest forms, and one species lives largely on cecropia leaves, while the other has a more varied plant diet of foliage and fruit. The flesh of the latter recalls mutton.

Four species of deer are found on the prairies and neighbouring woods, and thousands of hides are exported. The three species of opossums range in size from the *mucura*, as large as a cat, to the mouse-dimensioned *mucura chichica* with large eyes.

Bats by the million fan the Amazon night air, and represent numerous species and genera. Among them are the blood-sucking vampires (*Dysoptes*, *Phyllostoma*), although these are by no means as dangerous as we are led to infer from travellers' tales.

The sea-cow or manatee is common in the lakes and hunted for its meat, which resembles pork. It is one of the most peculiar mammals of the region, with its cow-like face, its small eyes and its two large, well-developed pectoral mammae. Fresh-water dolphins of several species disport themselves in small schools.

The Avifauna is exceedingly rich. The great valley teems with species, genera and individuals. Vultures are the universal scavengers and always alert for work. Morning and evening the parrots and macaws, two by two, in brilliant aerial processions, fly to and from their feeding grounds, their gorgeous plumage flashing in the sun, and their raucous voices calling out their presence. Toucans cry at sundown a discordant plaint from some tall, trail-side tree. Through the day the hangnests or caciques quarrel in trees where their nests swing by dozens. Doves of various species dolorously coo through the hot afternoons. Hawks and eagles scream from dead tree stumps. The forest aisles ring with the clear, silvery, metallic notes of the *uirá purú* (*Pachysylvia*). At sundown *perdis* or tinamous call out as do our quail. At night the air vibrates with the "correos" of the goat-suckers and whip-poor-wills. Early morning is full of the clatter-



BY COURTESY OF AMAZON EXPEDITION OF THE MUSEUM OF U. OF PA.

THE INTERIOR OF A NATIVE HUT IN THE AMAZON BASIN SHOWING THE SLEEPING ARRANGEMENTS OF THE WAIWAI INDIANS OF NORTHERN BRAZIL

from which tapioca is derived, sarsaparilla, *ipecacuanha* (the source of ipecac), copaiba, tonka-beans for flavouring tobacco, arnotto (*Bixa orellana*) for colouring butter and cheese, Pará rubber (*Hevea*), balata, rosewood, snakewood, guava, calabash, coca from which cocaine is derived, chirimoya (one of the world's premier fruits), beans, pineapple and probably the tomato and potato. The giant water-lily (*Victoria regia*) is not uncommon throughout the basin below 1,000ft. altitude, while here the Brazil-nut, bignonia and the potato families attain their greatest development.

ing music of the pheasant-like pavas. Hoactzins screech in noisy flocks from stream-side brush. Then there is always the twittering of legions of small birds, the sound of busy woodpeckers and the guttural noises of various water-birds. Parakeets fly about in great flocks, more common than our sparrows.

Humming-birds are not so numerous at low altitudes in the main valley, but in the Andean headwaters region, especially in the bush country, they are a striking feature of the scene. One of the common birds is the Clay-John or oven-bird, with its peculiar oven-shaped nest on a forked prairie-tree limb. Egrets roost beside the campos lakes. Muscovy and teal ducks swim about in quiet lagoons. In the marshes, the *jabirú* or great South American marabou stork is not an infrequent sight. There are two species of geese. Herons, gulls, anhingas, cormorants, roseate spoonbills, scarlet ibises and jacanas are among the common water-birds. Gorgeous trogons, cock-of-the-rocks, cotingas and tanagers are natives, while on the prairies between the Mamoré and the Beni rivers the rhea or South American ostrich is found.

One of the principal food supplies of the valley is the tartaruga turtle (*Podocnemis*). The swamps, sluggish streams and lakes usually contain one or more species of cayman. Lizards of various sizes and colours dart back and forth across the trails. The snakes, relatively speaking, are not numerous, but representatives of both poisonous groups occur (*Lachesis*, *Crotalus*, *Cophais*, *Elaps*). The constrictors (*Eunectes*, *Epicrates*) reach huge proportions, 18 to 20 ft. not being rare. Snakes, however, are not a prominent feature of Amazon life; perhaps the poisonous individuals observed are not more than one in 20 or 30. One of the deadly *Lachesis* species (rattlesnake) is considered a royal dish by the Indians. The frogs and toads abound in vivid contrasts both in shape and colouring; they are very noisy at night, and are not as edible as temperate-zone frogs.

The fish species of the Amazon have been estimated to be anywhere from 521 to 1,800 or 2,000, but only a few of them are of economic importance. Of these, the *pirarucu* is the most sought after. The scales of one species are utilized for making artificial flowers. In the half-covered forest pools, the electric eel is at home. Most of the streams are well stocked with the blood-thirsty piranha (*Serrasalmo*). Giant catfish are common and sting rays are present.

As to insects, their name in Amazonia is legion. Countless multitudes of ants work night and day. Their work varies with the species. Some are farmers like the saubas or leaf-cutters, others are always on marauding expeditions, while still others live in certain types of trees, and sting as well as bite. Termites, the so-called "white ants," abound and cause great destruction to nearly anything of wood. Fireflies with yellow, red and green lights make toy fairylands of little brooks, while a host of other insects by various devices, depending on the region, turn a paradise into purgatory. The bees are stingless, but hornets and wasps are plentiful. *Titanus giganteus*, the largest beetle known (5-6 in. long), is native. The larvae of some of the palm-beetles are relished when fried. Cockroaches are ever-present. Part of the afternoon and evening music is furnished by several species of cicadas, one of which sounds like a shrill steam whistle. Centipedes, scorpions, ticks, red bugs and giant spiders are often met with. Finally there are the moths and butterflies, hundreds of kinds and thousands of individuals, in marvellous assortments of brilliant colours and patterns. Within an hour's walk of Pará, 700 species have been collected, as compared with 321 species for all Europe. Around Ega, Bates collected 7,000 species of insects, of which 550 were species of butterflies.

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AMAZONAS, the extreme northwestern and largest state of Brazil, bounded north by Colombia, Venezuela and the territory of Rio Branco (*q.v.*), east by the state of Pará, south by the state of Mato Grosso, Bolivia and the territory of Acre, and west by Peru and Colombia. Areal losses sustained through the creation of the territory of Rio Branco in Sept. 1943 reduced the size of the state to 608,430 sq.mi.; pop. (1950) 530,920. Approximately two-thirds of the inhabitants are Indians who are subject only in small part to government control. In the humid tropics, the state occupies an immense plain, densely wooded and traversed by innumerable rivers, whose flood plains are subject to extensive annual inundations.

The principal commercial products are rubber, cacao and nuts; cattle are raised on the elevated grassy plains of the north, west and southwest, while curing fish and collecting turtle eggs for their oil give occupation to many people on the rivers. Maize, manioc, rice and various fruits are produced for domestic needs. The capital, Manaus, is the only city and port of general commercial importance in the state; it is situated on the Rio Negro, 10 mi. above its junction with the Amazon, about 1,000 mi. from the sea. Manaus became a centre of population during the rubber boom which ended in 1910, and maintained its population in spite of the collapse of the industry. In 1950 the population was 110,678 (*município* 142,372). There is but one railway in the state, the Madeira-Mamoré line built around the 200 mi. of rapids (*cachoeiras*) on the Madeira river. Transportation depends upon the Amazon river and its tributaries, the Madeira, the Purús, the Jutáí, the Juruá, the Rio Negro and others, a total of some 7,500 mi. of navigable waterways. Up to 1755 all the Portuguese territory on the Amazon formed part of the *capitania* of Pará. The upper districts were then organized into a separate *capitania*, called S. José do Rio Negro, to facilitate administration. When Brazil became independent in 1822, Rio Negro was overlooked in the reorganization into provinces, and reverted, notwithstanding the protests and an attempted revolution (1832) of the people, to a state of dependence upon Pará. In 1850 autonomy was voted by the general assembly at Rio de Janeiro, and on Jan. 1, 1852, the province of Amazonas was formally installed. In 1889 it became a federal state in the Brazilian republic. A governor is chosen by direct election for five years and is ineligible for immediate re-election. A single-chambered legislature of 24 members elected for three years exists. For purposes of internal administration the state is divided into 25 municipalities.

The increased demand for rubber during World War II revived the wild rubber industry of the Amazon basin, and thousands of rubber workers entered the region by way of Belém and Manaus.

AMAZONAS, a department of northern Peru, on the eastern slopes of the Cordillera between the departments of Loreto and Cajamarca, with Ecuador on the north (area, 13,947 sq.mi., pop. 1950, 103,559). The northern section, almost entirely low-lying equatorial virgin forest, is inhabited by wild Indian tribes. The south, where most of the settlements are, is higher and more rugged. The capital, Chachapoyas (pop. 6,673) dates from 1540. Though 7,600 ft. in altitude, it has a warm, malarial climate. Its chief industry is the plaiting of fine quality "Panama" hats.

In the valleys and on the lower slopes, sugar, cotton, coffee, tobacco, cacao, coca and cereals are grown. Rainfall is abundant throughout, and the rivers, tributaries of the Marañón, which crosses the department, are navigable for canoes and rafts; trails are usually impassable. The great Marañón, parent of the Amazon, crosses the eastern Cordillera at the Pongo de Manseriche (4° 30' S.), a narrow gorge only a few hundred feet wide. The mountains are rich in minerals, but remoteness from markets as well as lack of transportation facilities make these resources of little value. There is a highway to Chachapoyas and one through Bellavista and down the Marañón. (L. W. BE.)

AMAZONAS, a territory belonging to Venezuela, and occupying the extreme southern part of that republic, adjoining the Brazilian state of Amazonas. Area 67,857 sq.mi., pop. (exclusive of about 43,400 unassimilated Indians) 3,728 in 1941. It lies partly within the drainage basin of the Orinoco and partly

within that of the Rio Negro, an affluent of the Amazon. The territory is covered with dense forests and is filled with intricate watercourses, one of which, the Casiquiare, forms an open communication between the Orinoco and the Rio Negro and is navigable for large canoes. The capital of the territory is Atures (Puerto Ayacucho) on the Orinoco river.

AMAZONS, a legendary nation of female warriors, said to have lived in Pontus near the shore of the Euxine sea, where they formed an independent kingdom under the government of a queen, the capital being Themiscyra on the banks of the River Thermodon (Herodotus iv. 110–117). From this centre they made numerous warlike excursions—to Scythia, Thrace, the coasts of Asia Minor and the islands of the Aegean, even penetrating to Arabia, Syria and Egypt. According to one account, they originally came to the Thermodon from the Palus Maeotis (Sea of Azov). No men were permitted to reside in their country; but once a year, in order to prevent their race from dying out, they visited the Gargareans, a neighbouring tribe. The male children who were the result of these visits were either put to death or sent back to their fathers; the females were kept and brought up by their mothers, and trained in agricultural pursuits, hunting and the art of war (Strabo xi. p. 503).

The Amazons appear in connection with several Greek legends. They invaded Lycia, but were defeated by Bellerophon (*Iliad*, vi. 186). They attacked the Phrygians, who were assisted by Priam, then a young man, though later they took his side against the Greeks under their queen, Penthesileia, who was slain by Achilles (Virgil, *Aen.* i. 490). One of the tasks imposed upon Heracles by Eurystheus was to obtain possession of the girdle of the Amazonian queen, Hippolyte. He was accompanied by his friend Theseus, who carried off the princess Antiope, sister of Hippolyte, an incident which led to a retaliatory invasion of Attica, in which Antiope perished fighting by the side of Theseus. They are heard of in the time of Alexander the Great, and Pompey is said to have found them in the army of Mithridates.

The origin of the story of the Amazons has been the subject of much discussion. While some regard them as a purely mythical people, others assume an historical foundation for them. The deities worshipped by them were Ares (who is consistently assigned to them as a god of war, and as a god of Thracian and generally northern origin) and Artemis, not the usual Greek goddess of that name, but an Asiatic deity in some respects her equivalent. Another theory is that, as the knowledge of geography extended, travellers brought back reports of tribes ruled entirely by women, who, carried out the duties which elsewhere were regarded as peculiar to men. Hence arose the belief in the Amazons as a nation of female warriors, organized and governed entirely by women. It has been suggested that the fact of the conquest of the Amazons being assigned to the two famous heroes of Greek mythology, Heracles and Theseus, shows that they were mythical illustrations of the dangers which beset the Greeks on the coasts of Asia Minor; rather, perhaps, it may be intended to represent the conflict between the Greek culture of the colonies on the Euxine and the barbarism of the natives.

In works of art, combats between Amazons and Greeks are placed on the same level as, and often associated with, combats of Greeks and centaurs. Their arms were the bow, spear, axe, a half shield, nearly in the shape of a crescent, called *pelta*, and in early art a helmet, the model before the Greek mind having apparently been the goddess Athena. In later art they approach the model of Artemis, wearing a thin dress, girt high for speed; while on the later painted vases their dress is often peculiarly Persian—that is, close-fitting trousers and a high cap called the

kidaris. The battle between Theseus and the Amazons is a favourite subject on the friezes of temples (e.g., the reliefs from the frieze of the temple of Apollo at Bassae, now in the British Museum), vases and sarcophagus reliefs; at Athens it was represented on the shield of the statue of Athena Parthenos, on wall-paintings in the Theseum and in the Poikile Stoa.

In the 16th century the Spanish explorer Orellana asserted that he had come into conflict with fighting women in South America on the river Marañón, which was named after them the Amazon (*q.v.*) or river of the Amazons, although others derive its name from the Indian *amassona* (boat-destroyer), applied to the tidal phenomenon known as the “bore.” The existence of “Amazons” (in the sense of fighting women) in the army of Dahomey (*q.v.*) in modern times is certain, but they are said to have died out during the French protectorate.

See H. L. Krause, *Die Amazonensage* (1893); P. Lacour, *Les Amazones* (1901); articles in Pauly-Wissowa's *Realencyklopädie* and Roscher's *Lexikon der Mythologie*; Grote, *Hist. of Greece*, pt. i. ch. xi.; L. Whibley, *Companion to Greek Studies* (1916).

AMAZON-STONE or Amazonite (named from the Amazon river, its supposed locality), a bright green variety of microcline felspar (which see) obtained from Miask in the Ilmen mountains, Russia, and at Pikes Peak, Colorado, and in Madagascar.

AMBACA: see **ANGOLA**.

AMBALAVASI: see **CASTE**.

AMBARVALIA, an annual festival of the ancient Romans, occurring in May, usually on the 29th, the object of which was to secure the growing crops against harm. The priests were the Arval Brothers (*q.v.*), who conducted the victims—ox, sheep and pig (*suovetaurilia*)—in procession with prayer to Ceres round the boundaries of the *ager Romanus*. As the extent of Roman land increased, this could no longer be done, and in the Acta of the Fratres, which date from Augustus, this procession is not mentioned; but in Virgil, *Georg.* i. 338 et seq., and in Cato's *de Re Rustica*. (141) we have full details and the text of the prayers used by the Latin farmer in thus “lustrating” his own land. The Christian festival which seems to have taken the place of these ceremonies is the Rogation or Gang week of the Roman Catholic Church. The perambulation or beating of bounds is probably a survival of the same type of rite.

See W. W. Fowler, *Roman Festivals* (1899).

AMBASSADOR, a public minister of the first rank, accredited and sent by the head of a sovereign State as his personal representative to negotiate with a foreign Government, and to watch over the interests of his own nation abroad. The power thus conferred is defined in the credentials or letters of credence of which the ambassador is the bearer, and in the instructions under the sign-manual delivered to him. The credentials consist of a sealed letter addressed by the sovereign whom the ambassador represents to the sovereign to whom he is accredited, and they embody a general assurance that the sovereign by whom the ambassador is sent will confirm whatever is done by the ambassador in his name. In Great Britain letters of credence are under the royal sign-manual, and are not countersigned by a minister.

It was agreed by the Congress of Vienna, 1815, that three classes of diplomatic agents should be recognized; and a fourth class was added by the Congress of Aix-la-Chapelle. There are, therefore, now four classes of diplomatic agents:

(1) Ambassadors, including papal legates and nuncios, who enjoy the highest rank and are deemed to represent the person and dignity of the sovereign or head of their State, and who are entitled to personal access to the sovereign or head of the State to which they are accredited;

(2) ministers plenipotentiary and envoys extraordinary, including papal internuncios, who are accredited to the head of the State, and may also be resident, but who do not represent the person and dignity of the head of their own State;

(3) ministers resident, who are accredited to the head of the State, but rank below the last class in their official position and dignity; and

(4) *Chargés d'affaires* who are accredited by the Minister of



THE MATTEI AMAZON
WITH HER BATTLE EQUIP-
MENT. IN THE VATICAN
MUSEUM, ROME

Foreign Affairs to the Minister of Foreign Affairs and who may be appointed *ad hoc* or *ad interim*. It was also agreed that diplomatic agents of the same class should take precedence according to the date of the presentation of their credentials, but in Catholic countries (except in France since the abrogation of the concordat) precedence is usually given to the papal legate. The senior minister is the *doyen* or dean of the "diplomatic corps," and it is his function to see that the diplomatic privileges and immunities are duly observed.

Ambassadors were formerly accredited only to States enjoying royal honour. Later they were accredited also to republics regarded as of equal rank. By an act of Congress in 1893 the President of the United States was empowered to accredit ambassadors to the Great Powers. Great Britain sends diplomatic agents of the first class only to 11 States, Argentina being the last so promoted.

An ambassador, however, unless specially armed with plenary authority, cannot decide any questions beyond his instructions without reference to his government. Thus Lord Londonderry (Lord Stewart), who represented Great Britain at the conferences of Troppau in 1820 and Laibach in 1821, had not the same standing as the plenipotentiaries of the other Powers present, and efforts were even made to exclude him from some of the more important discussions in consequence, not on the ground of inferior rank, but of defective powers. For the special immunities and privileges of ambassadors see EXTE RRITORIALITY and DIPLOMACY. See also the latter for the history of the subject.

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AMBASSADORS, CONFERENCE OF. The term has been used in times past to denote the sessions or reunions of ambassadors at a certain centre, generally for the period of the execution of a treaty. The best example of this is the Ambassadors' Conference which sat at Paris and Vienna during 1815–26. After the World War a similar conference meeting at Paris became one of the organs concerned with the execution of the Versailles Treaty. It consisted of the representatives of Great Britain, France, Italy and Japan, with the American Ambassador attending in the capacity of a spectator after 1921. Many of the technical decisions under the treaties were actually taken by the ambassadors, and in a large number of cases important interpretations were given.

It is difficult to give details of their activities when so much mystery obtained concerning them. Except in the case of Memel and the plebiscite areas, the complicated frontiers of Poland, left unsettled by the Peace Conference, were decided by the ambassadors. They also reorganized the frontiers established between Poland and Russia by the agreement of Riga. The most important function performed by the Ambassadors' Conference was undoubtedly in Oct. 1921, when the ex-Emperor Karl for the second time returned to Hungary with the intention of regaining his crown. The "Little Entente" (Czechoslovakia, Yugoslavia and Rumania) threatened very strong measures against Hungary. But, largely as a result of the ambassadors' intervention, Karl was arrested (Oct. 24), and a law was passed by the Hungarian Parliament which abrogated his sovereign rights (Nov. 3).

Its action in 1923, in connection with the Corfu incident, brought the conference into some discredit, and shortly after he became prime minister, Ramsay MacDonald announced that its powers would be limited to the execution of the Versailles Treaty, and this policy seems in effect to have been continued.

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AMBATO or **ASIENTO DE AMBATO**, an inland town of Ecuador, capital of the province of Tungurahua, 80 mi. S. of Quito by the highway, and near the northern foot of Chimborazo. Pop. (1942 estimate) 26,796. The town stands in a bowl-like depression, 8,435 ft. above sea-level, surrounded by steep, sandy, barren mountains, and has an equable climate. The immediate en-

vironments are fertile and produce a variety of fruits, but the surrounding country is arid and sterile, producing scanty crops of barley, Indian corn and pease. The town is known throughout Ecuador for its manufacture of boots and shoes, and for a cordage made from *cabuya*, the fibre of the agave plant. Ambato was destroyed by an eruption of Cotopaxi in 1698, and has been badly damaged two or three times by earthquakes.

AMBATO is also the name of a range of mountains in northern Argentina, being a spur of the Sierra de Anconquija crossing the province of Catamarca from north to south.

AMBER, a ruined city of India, the ancient capital of Jaipur in Rajputana. The name is first mentioned by Ptolemy. It was founded by the Minas and was still flourishing in A.D. 967. In 1037 it was taken by the Rajputs, who held it till it was deserted. In 1728 it was supplanted by the modern city of Jaipur, from which it is 5 mi. distant.

Amber stands at the mouth of a rocky mountain gorge, in which lies a lovely lake, and is known for the beauty of its architecture. The old palace begun by Man Sing in 1600 ranks second only to Gwalior. The chief building is the Diwan-i-Am, built by Mirza Raja, the pillars of which are still plastered over with the stucco with which Mirza had them covered to avert the anger of Jahangir; for the emperor had been told that the sculptures on them eclipsed the marvels of the imperial city.

AMBER, a fossil resin much used for the manufacture of ornamental objects. The name comes from the Arabian *anbar*, probably through the Spanish, but this word originally referred to ambergris, which is an animal substance quite distinct from yellow amber. The property which amber possesses of acquiring electrical charge by friction is first recorded by Thales of Miletus, and suggested the word "electricity" from the Greek, *ἤλεκτρον*, a name applied, however, not only to amber but also to an alloy of gold and silver.

Amber is not homogeneous in composition, but consists of several resinous bodies more or less soluble in alcohol, ether and chloroform, associated with an insoluble bituminous substance. The average composition of amber leads to the general formula $C_{10}H_{16}O$. In concentrated sulphuric acid finely powdered amber is perfectly soluble even in the cold, and it is completely decomposed by boiling nitric acid. Heated rather below 300°C. amber suffers decomposition, yielding an "oil of amber" and leaving a black residue which is known as "amber colophony," or "amber pitch"; this forms, when dissolved in oil of turpentine or in linseed oil, "amber varnish" or "amber lac." True amber yields on dry distillation succinic acid, the proportion varying from about 3 to 8% and being greatest in the pale opaque or "bony" varieties. The aromatic and irritating fumes emitted by burning amber are mainly due to this acid. True Baltic amber is distinguished by its yield of succinic acid, for many of the other fossil resins which are often termed amber contain either none of it, or only a very small proportion; hence the name "succinite" proposed by Prof. J. D. Dana, and now commonly used in scientific writings as a specific term for the real Prussian amber.

The physical characters of amber are in every respect those of a resin. It is perfectly amorphous, as is shown by the recent X-ray investigations of Prof. F. Rinne. It occurs in irregular rounded nodules having the form of rods, drops, plates, etc., and never in masses bounded by plane surfaces. The specific gravity of amber ranges from 1.05 to 1.10; the substance is thus only slightly heavier than water. Its hardness, $H = 2\frac{1}{2}$, is a little greater than that of gypsum, and it is therefore just not possible to scratch it with the finger-nail. It is harder than most other resins but is not very brittle and can therefore be carved, worked on the lathe or bored with little difficulty. When rubbed on cloth amber becomes strongly charged with negative electricity, and attracts small light particles. It is also a very good insulator for use in electrical apparatus and is superior to sulphur because of its mechanical properties. The colouring of amber is very uniform in character, no colour but yellow occurring in the great majority of specimens; though all shades of this colour, from the palest yellow to brown, are known.

The turbidity of certain kinds of amber is due to the inclusion

of great numbers of minute air bubbles. Various other enclosures are found in amber, some of which are of special significance. Drops of water sometimes occur, but enclosures of solid matter, either organic or inorganic, are more frequent. The enclosures of organic material, partly of vegetable and partly of animal origin are of great importance, as they have thrown much light on the flora and fauna existing at the time of the exudation of the amber.

Amber is extensively used for beads and other small ornaments, and for cigarette-holders and the mouth-pieces of pipes. Small fragments, formerly thrown away or used only for varnish are now utilized on a large scale in the formation of "ambroid" or "pressed amber." The pieces are carefully heated with exclusion of air and then compressed into a uniform mass by intense hydraulic pressure. Rods of amber are then obtained by forcing the mass of softened amber through holes in a metal plate. The product possesses practically the same physical properties as natural amber.

The greatest amber-producing region is the promontory of Samland in East Prussia, where the amber occurs in a marine glauconitic sand, known as "blue earth," occurring in the Lower Oligocene strata. It appears, however, to have been partly derived from yet earlier Tertiary deposits (Eocene) and it occurs also as a derivative mineral in later formations, such as the drift. Rolled pieces of amber may be picked up at various places along the east coast of England and also on the coasts of Holland, Denmark, Sweden, in Bornholm and other islands and in South Finland. Varieties of amber differing slightly from succinite are found in Rumania, Sicily and Burma.

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AMBERG, a town in Bavaria, formerly capital of the Upper Palatinate, on both sides of the Vils, 42m. E. of Nürnberg by rail. Pop. (1939) 31,699. It has eleven churches; St. Martin's (15th century) has good paintings and a tower 300ft. high. A former Jesuit monastery is now a grammar school and seminary. There is also a pilgrimage church on a hill (1,621ft.). The principal manufactures are enamels, ironmongery and machinery, gold objects and furniture. In the neighbourhood are iron and coal mines. The Austrians defeated the French near Amberg in 1796.

AMBERGRIS, a solid, fatty, inflammable substance of a dull grey or blackish colour, the shades being variegated like marble, possessing a peculiar sweet, earthy odour. It occurs as a biliary concretion in the intestines of the spermaceti whale (*Physeter catodon*), and is found floating upon the sea, on the sea-coast or in the sand near the sea-coast. It is met with in the Atlantic ocean; on the coasts of Brazil and Madagascar; also on the coast of Africa, of the East Indies, China, Japan and the Molucca islands; but most of the ambergris which is brought to England comes from the Bahama islands, Providence, etc. It is sometimes found also in the abdomen of whales, always in lumps of various shapes and sizes, weighing from one-half oz. to 100 or more pounds, having a disagreeable smell, and hardening on exposure to air. Its specific gravity ranges from 0.780 to 0.926. It melts at about 62°C. to a fatty, yellow, resinous-like liquid; and at 100°C. it is volatilized into a white vapour. It is soluble in ether, and in volatile and fixed oils; it is only feebly acted on by acids. By digesting in hot alcohol, a substance termed *ambrein*, closely resembling cholesterolin, is obtained, which separates in brilliant white crystals as the solution cools.

The use of ambergris in Europe is now entirely confined to perfumery. In minute quantities its alcoholic solution is much used for giving a "floral" fragrance to bouquets, washes and other preparations of the perfumer. It occupies a very important place in the perfumery of the East, and there it is also used in pharmacy and as a flavouring material in cookery. The high price it commands makes it peculiarly liable to adulteration, but its

genuineness is easily tested by its solubility in hot alcohol and its uniform fatty consistence on being penetrated by a hot wire.

AMBIDEXTERITY, the ability to use both the right and the left hand with equal ease (Lat. *ambi* both, *dexter* right-handed). Educationalists and physiologists frequently advocate the cultivation of ambidexterity in children on the ground that the brain-centres controlling the motor functions thereby become more highly developed. Since, however, the left hemisphere of the brain controls both the function of speech and the motor functions of the right side, over-development of left-handedness has been known to cause speech impediment and must be avoided.

See F. W. Mott, *The Brain and the Voice in Speech and Song* (1910); H. Macnaughton Jones, *Ambidexterity and Mental Culture* (1914).

AMBIENT (Lat. *ambi*, on both sides, *ire*, to go), surrounding; a word implying a moving rather than a stationary encircling. It is used mostly in the phrase the "ambient air." In astrology it means the sky.

AMBIGU, a French game of cards in which a whisk pack with the court cards omitted is used. It is composed of the characteristic elements of poker, bouillotte and piquet.

AMBIGUITY, in law, is of two kinds, *patent* and *latent*. (1) Patent ambiguity is that which is apparent on the face of an instrument to anyone perusing it. In the case of a patent ambiguity parol evidence is admissible to explain only what has been written, not what it was intended to write (*Garrard v. Lewis* [1882] 10 Q.B.D. 30). Where it appears from the general context what the parties really meant, the instrument will be construed as if there were no ambiguity (*Saye and Sele's case* 10 Mod. 46; *De Rosaz, in the Goods of* [1877] 2 P.D. 66). (2) Latent ambiguity is where the wording of an instrument (on the face of it clear and intelligible) may at the same time apply equally to two different things or subject matters. Latent ambiguity may be explained by parol evidence, as the ambiguity has been brought about by circumstances extraneous to the instrument (*Doe D. Thomas v. Beynon* [1840] 12 Ad. and E. 431). But a contract that is void for uncertainty will not be rendered certain by part performance (*Waring and Gillow v. Thompson* [1913] 29 T.L.R. 154 C.A.). (See also CONTRACT; EVIDENCE; PRINCIPAL AND AGENT.)

AMBIORIX, prince of the Eburones, a tribe of Belgian Gaul. Although Caesar (q.v.) had freed him from paying tribute to the Aduatuci, he joined Catuvolcus (winter, 54 B.C.) in a rising against the Roman forces under Q. Titurius Sabinus and L. Aurunculeius Cotta, and almost annihilated them. An attack on Quintus Cicero (brother of the orator), then quartered with a legion in the territory of the Nervii, failed owing to the timely appearance of Caesar. Ambiorix is said to have found safety across the Rhine.

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AMBLESIDE, parish and town of Westmorland, England, a mile from the head of Lake Windermere. Population (1931) 2,343. It is beautifully situated among the bare hills surrounding the richly wooded valley of the Rothay. The hills are Wansfell on the east, Loughrigg Fell on the west, and Rydal Fell and the ridge below Snarker Pike (2,096ft.) to the north. At the head of Windermere is Waterhead, the landing-stage of Ambleside, which is served by the lake steamers of the L.M.S.R. The chief roads centring in Ambleside are from Windermere, Ullswater, Keswick, the Brathay valley and the Langdales. State quarries are in the neighbourhood. From 1895 to 1935 the town was an urban district.

Close by the lakeside the outlines of a Roman fort, the name of which is not known, are still visible. It appears to have guarded a route over the hills by Hardknott and Wrynose pass to Raven-glass on the coast of Cumberland.

AMBLYGONITE, a mineral usually found as cleavable, compact masses; it is translucent and has a vitreous lustre, and the colour varies from white to pale shades of violet, grey, green or yellow. There are good cleavages in two directions. The mineral is thus not unlike feldspar in general appearance, but it is readily distinguished from this by its specific gravity (3.0) and

chemical characters, being an aluminium and lithium fluophosphate, Li (AlF)PO_4 , with part of the lithium replaced by sodium and part of the fluorine by hydroxyl. Amblygonite occurs with lepidolite, tourmaline and other lithia-bearing minerals in pegmatite-veins. It was first discovered in Saxony in 1817, and later at Montebas, dep. Creuse, France, and at Hebron in Maine. More recently it has been discovered in considerable quantity at Pala in San Diego county, California, and at Cáceres in Spain.

AMBLYOPIA is a somewhat indefinite term meaning dimness of vision, or loss in the acuity of sight. It is usually restricted to those cases of dim vision which are not due to refractive errors such as can be corrected by glasses and to cases in which there are no visible changes in the exterior or interior of the eye. Loss of vision may be partial or total, temporary or permanent. Total blindness is usually called amaurosis. The symptom may come on suddenly, with immediate total loss of sight, or gradually, with a sense of a blue veil or mist before the eyes, or it may not be noticed until the patient suddenly finds he cannot read. Colour blindness, night blindness, and day blindness are varieties of amblyopia. The causes may be injury to the brain, disease of the nervous and retinal structures involved in vision, drugs, and the poisons of certain diseases, such as chronic nephritis, acute nephritis, toxemias of pregnancy, diabetes and malaria. Other common causes are intoxicating liquor, tobacco, lead, quinine and wood alcohol. It has long been recognized as a manifestation of hysteria and many cases were encountered during the war in soldiers suffering from "shell shock."

AMBLYPODA, a common name for two extinct orders of hoofed mammals, the Pantodonta and the Dinocerata. It was formerly believed that these two groups were closely related, or even that one was composed solely of the later survivors of the other, but later discoveries in America and in Asia had by 1940 shown that, in spite of various resemblances, the two are quite distinct and evolved separately over approximately the same periods of time. Both orders are typical of the earlier stages of the age of mammals, both evolved rapidly and precociously to become beasts of great size and peculiar specialization, and both then became wholly extinct, the Pantodonta in the Oligocene and the Dinocerata in the Eocene. Like hoofed mammals generally, both orders probably arose from the most primitive condylarths (see PHENACODUS), but the exact ancestry is unknown.

The Pantodonta first appear in the genus *Pantolambda*, middle Palaeocene of North America, and the best-known forms are *Coryphodon* in the early Eocene of North America and Europe,

many ways the most remarkable of Eocene mammals. They first appeared as hornless herbivores, no larger than a pig, in the late Palaeocene of North America and Mongolia. By late Eocene, when the last survivors lived, still confined to North America and Mongolia as far as known, they had become as large as a big African rhinoceros and had two or three pairs of bony, hornlike knobs on the top of the skull. The upper canines were daggerlike, almost as in the sabre-toothed tigers, although uintatheres were certainly herbivorous. In keeping with the great bulk of the body, the legs became heavy, elephantlike, straight pillars with short, rounded feet, with five small hoofs and heavy, elastic supporting pads. The brain did not evolve as rapidly as the other parts and remained relatively tiny and primitive in the midst of the huge, specialized skull. The grinding teeth also remained relatively small and simple in pattern, seeming barely adequate to feed so large an animal. This lack of harmony in their evolution was probably one factor in the early extinction of the group. (G. G. Sr.)

AMBO, the reading-desk of the early Christian church, originally movable, but by the 6th century established as an important and stationary piece of great decorative value. From the 12th century on, and earlier than that outside Italy, the ambo was more and more superseded by the pulpit and lectern, and even in Italy it has gone out of liturgical use, except in the Ambrosian rite in Milan. The normal single ambo consisted of a raised platform in three levels, reached by steps and protected by railings. Each level was consecrated to a special part of the service: the highest, reserved for the deacon who read the gospel; the middle, for the deacon reading the epistle; the lowest, for the subordinate clergy. Later, two separate ambos were used, one on each side of the church; the one to the south was used for reading the gospel, the other for the epistle.

These ambos were usually composed as part of the choir screen, and, like it, were, in all the finer churches, made of marble, frequently decorated with mosaics and carving. A normal type is represented by those in San Clemente at Rome which are at least as old as the beginning of the 12th century; others of great interest, of later date, and rich with that fine-scaled geometric mosaic known as Cosmati work, are those of Sta. Maria-in-Ara-Coeli, Sta. Maria-in-Cosmedin and San Lorenzo outside the walls, all of the 12th or 13th centuries.

Outside of Rome, although Ravenna has early examples, it is in south Italy that the finest are found; notably that of Ravello (1130), and that of Salerno.

In south Italy it is the rule to have the ambos supported on spiral columns; in Rome the base is usually solid.

In the Eastern Church, the ambo is slightly different. In Russian orthodox usage the term usually designates the steps leading to the platform in front of the iconostasis (*q.v.*). In the Greek Church the ambo retains its earlier form, and is placed at one side of the church. In the Greek Catholic Church, the ambo is a table before the doors of the iconostasis.

See the liturgical and ecclesiastical dictionaries of Martigny, Migne, and Smith and Cheetham, *sub voce*.

AMBOINA is a district of the residency of the Moluccas, Netherlands Indies, area 11,455 sq.mi., and is the name of the capital and the island on which it is situated. Amboina includes the island of that name, Saparua (with Haruku and Nusa Laut—the Uliassers); Buru (cap., Kajeli); Ceram (cap., Kairatu); and the Banda Isles.

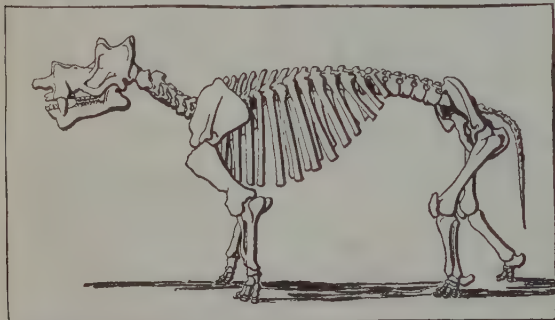
Pop. (1930) 239,906, comprising 3,208 Europeans (including Eurasians), 231,258 natives, and 5,440 foreign Asiatics, including Chinese.

The major export crops of the district are nutmegs, cloves and forest products (gums, resins).

The island of Amboina lies S.W. of Ceram, N. of the Banda sea.

Two oblong peninsulas, Hitoe much larger than Leitomor, rise parallel from the sea, and are united by a narrow alluvial isthmus not more than a mile long.

Total length of the island is 32 mi., and its area is 386 sq.mi. It is subject to damage from earthquakes as are the neigh-



BY COURTESY OF THE AMERICAN MUSEUM OF NATURAL HISTORY
SKELETON OF A UINTATHERIUM THAT ROAMED WYOMING MILLIONS OF YEARS AGO IN THE MIDDLE EOCENE PERIOD

and *Barylambda* in the late Palaeocene of North America. *Coryphodon* reached the size of a cow or large bear, but had a squatter, heavier build than either. It had a large head, flattened on top, and flaring tusks somewhat like those of a hippopotamus. The low-crowned grinding teeth, with a unique pattern of crescentic and curving crests, would have served for eating succulent water plants or leaves. *Barylambda* probably had a similar diet, but is characterized by a disproportionately small head and a remarkably heavy, slothlike tail.

The Dinocerata, or Uintatheres, were the largest and in

bouring isles to the east, the Uliassers (pop., 20,000, largely Christian).

Amboina is of Tertiary (Miocene) formation, and is traversed by mountain ranges (highest peaks Salhatu, 3,405 ft., and Wawani) of fine-grained granite, with serpentine, magnesite, etc.

The chalk cliffs round Amboina Bay have stalactite caves; the rivers are small and unnavigable, there are hot springs and solfataras, but no active volcanoes.

The climate of Amboina is comparatively healthful and not unpleasant, the mean maximum temperature being 84.6° and the mean minimum 73.4°, while a minimum of 66.6° has been registered.

The hottest time is in February, the wettest in June–July (during the east monsoon with very strong winds) and the average yearly rainfall is 135.63 in.

The mammalian fauna of Amboina is very poor, but birds include a fine racquet-tailed kingfisher, *Tanysiptera nais*, described by A. R. Wallace as "the largest and handsomest" of this family. It has also a crimson lory, *Eos rubra*, and a brush-tongued parrot, of vivid crimson colour, and it is rich in insects, particularly Lepidoptera, and in shells. There are 700 varieties of fish in the Bay of Amboina, under which, at the eastern end, are very fine marine gardens. The profuse vegetation varies on different sides of the island. Spice trees are grown, principally clove and nutmeg, fruit trees, and coconut palms, maize, sugar-cane, rice, also coffee and cocoa. Cloves and copra are the chief exports. The natives live largely on fruit and vegetables and sago—the sago being imported from Ceram. Amboina wood, very hard and knotty, and of great value for ornamental wood-work, is obtained from Ceram, and exported. Goats and sheep are kept, and pigs in the Christian villages, fishing provides a living for a numerous class, and shells and turtle-shells are collected. Pop. 114,297 (Europeans and Eurasians 2,290), almost entirely Christian in the south and Mohammedan in the north. The Amboinese are a strong and thick-set race, with dark skin, curly or wavy hair, flat nose and thick lips. The women are slender in build, but not good-looking. The men wear a cotton jacket and trousers; the women a *sarong* and *kabayah*.

Amboina, the town, and residence of the assistant-resident and commander of the forces in the Moluccas, is a clean and well-built place with wide streets, often tree-lined, and many houses and business premises of stone; Ft. Victoria, built in the early 17th century and restored later; a church dating from the earliest settlement, a hospital, barracks (within the fort), and many Government buildings, a commodious club, and two good parks. In Amboina G. E. Rumph (Rumphius) the well-known naturalist, lived and died, and a monument commemorates the fact. The town is at the head of the bay, which, at its entrance, is 5½ m. in width and continues so for 10 m., when it contracts and forms a narrow passage leading into an inner harbour 3 m. long by 1½ broad. The town and port is on the eastern side of the bay, a mile short of the entrance to the inner harbour and about 8 m. from the outer entrance. The depths in the outer bay are very great and anchorages are few, but safe. The port is well equipped with wharves and warehouses, has a regular connection with Java, Sumatra, Borneo and Celebes, as well as with the rest of the archipelago, and is the chief centre for the shipment of Moluccan produce and for the distribution of imports from Europe and America. Pop. 17,334—1,878 Europeans (and Eurasians), 13,587 natives, and 1,869 foreign Asiatics, including Chinese, engaged in agriculture, fisheries and trade. There are roads sufficient for local needs, a government wireless station and a telephone system.

The clove trade of Amboina led the Portuguese to the island, Antonio d'Abreu arriving there and departing with a cargo of cloves in the same year (1510) as that in which Albuquerque captured Malacca. The Portuguese gave the place its name and founded a settlement (1521), but their policy of ruthless repression made it easy for the Dutch to arrange with the Sultan of Ternate, recognizing him as suzerain over Amboina and other Moluccan islands, and, in 1600, with the chiefs of Amboina. This enabled them first to dispossess the Portuguese and then to bring the Amboinese within their power. In 1615 a British

settlement was formed on the other side of the island at Cambello (the Dutch were on the Amboina town site) and it remained there until 1623, when the Dutch claimed to have discovered British participation in a native revolt in Ceram and in the Bandanese island of Run, and massacred the settlers. The massacre was unnoticed by James I, but in 1654 Cromwell compelled the Dutch government to give the sum of £300,000, and the island of Run, as compensation to the descendants of those who had suffered. Dryden (1673) wrote a tragedy, *Amboyna, or the Cruelties of the Dutch to the English Merchants*. In 1683 the Dutch declared all contracts with the sultan of Ternate void, and took over his suzerainty of Moluccan islands, Amboina included. In 1796 the British, under Admiral Rainier captured the island, but it was restored in 1802, re-taken in 1810, during the Napoleonic War, and once again restored to the Dutch in 1814. Japan occupied the whole district in 1942. (E. E. L.; X.)

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AMBOISE, GEORGES D' (1460–1510), French cardinal and minister of state, was the son of Pierre d'Amboise, seigneur de Chaumont, chamberlain to Charles VII and Louis XI. Georges d'Amboise was bishop of Montauban, then archbishop of Narbonne and then (1493) of Rouen. On the accession of Louis XII, to whose party he had belonged beforehand, he became a cardinal and first minister of the crown, which office he retained until his death, setting aside all rivals. His domestic policy was wise and prudent. He worked to reform the university and the monastic orders, assured a more regular justice by his *ordonnances* and tried to economize and to reduce the weight of taxation. In foreign affairs he sought to increase the French power in Italy and to seat himself on the papal throne by diplomacy, not by force. But he supported the campaign begun in 1499 for the conquest of Milan. In 1500 he was named lieutenant-general in Italy and charged with the organization of the conquest. He administered the Milanese especially wisely. On the death of Alexander VI he aspired to the papacy. He had French troops at the gates of Rome and could easily have frightened the conclave into electing him; but he was persuaded to trust to his influence. The troops were dismissed, and an Italian was appointed as Pius III; and again, on the death of Pius within the month, another Italian, Julius II, was chosen (1503). D'Amboise received in compensation the title of legate for life in France and in the Comtat Venaissin. He was one of the negotiators of the disastrous treaties of Blois (1504) and of the League of Cambrai against Venice (1508). In 1509 he again accompanied Louis XII into Italy, but on his way home he died at Lyons on May 25, 1510. His body was moved to Rouen, and a magnificent tomb, on which he is represented kneeling in prayer, was erected in the cathedral.

See J. Godefroy (ed.), *Lettres du roi Louis XII et du cardinal d'Amboise*, 4 vol. (Brussels, 1712); L. Legendre, *Vie du cardinal d'Amboise* (Rouen, 1724); and histories of the reign of Louis XII.

AMBOISE, a town of France, department of Indre-et-Loire, on the left bank of the Loire, 12 mi. E. of Tours by the Orléans railway. Pop. (1946) 5,807. Its famous château overlooks the Loire from the rocky plateau above the town. In the 11th century Amboise was a lordship under the counts of Anjou, who rebuilt the ancient castle. Its territory was united to the domain of the crown of France by Charles VII. about the middle of the 15th century, and thenceforth the château became a favourite residence of the French kings. The discovery in 1560 of the "conspiracy of Amboise," a plot of the Huguenots to remove Francis II. from the influence of the house of Guise, was avenged by the death of 1,200 members of that party. In 1563 Amboise gave its name to a royal edict allowing freedom of worship to the Huguenot nobility and gentry. The château was frequently used as a state prison. In 1872 it was restored by the National Assembly to the house of Orléans. The Logis du Roi, the most important portion, was the work of Charles VIII.; the other wing was built under Louis XII. and Francis I. The ramparts are strengthened by two massive towers containing an

inclined plane on which horses and carriages may ascend. The chapel of St. Hubert, said to contain the remains of Leonardo da Vinci, who was summoned to Amboise by Francis I., king of France, and died there in 1519, is late Gothic; a delicately carved relief over the doorway represents the conversion of St. Hubert. The town has a 15th-century gateway surmounted by a belfry. Iron-founding, wool-weaving and the manufacture of boots and



AMBOISE, FRANCE. SCENE OF MANY STIRRING HISTORIC EVENTS, WITH THE CHATEAU, FAMOUS AS A RESIDENCE OF THE FRENCH KINGS, IN THE LEFT BACKGROUND

shoes, sabots, and farm and fishing implements are among the industries.

AMBRACIA (more correctly Ampracia), an ancient Corinthian colony in Epirus about 7m. from the Ambracian gulf, on the navigable river Aracthus, in a fertile wooded plain. It was founded between 650 and 625 B.C. by Gorgus, son of the Corinthian tyrant Cypselus. After expulsion of Gorgus's son Periander its Government developed into a strong democracy. Early features were loyalty to Corinth, consequent aversion to Corcyra, and frontier disputes with Amphilocheians and Acarnanians. Hence it took a prominent part in the Peloponnesian War until the defeat at Idomene (426). In 338 it surrendered to Philip of Macedon. After forty-three years of autonomy under Macedonian suzerainty it became the capital of Pyrrhus, king of Epirus, who adorned it with a palace, temples and theatres. In the wars of Philip V. of Macedon and the Epirotes against the Aetolian league (220–205), Ambracia ultimately joined the Aetolians, and during their struggle against Rome it stood a stubborn siege. After its capture in 189, it fell into insignificance. The foundation by Augustus of Nicopolis (*q.v.*), into which the remaining inhabitants were drafted, left the site desolate. In Byzantine times a new settlement took its place under the name of Arta (*q.v.*).

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AMBRIDGE, a borough of Beaver county, Pa., U.S., on the Ohio river, 16 mi. N.W. of Pittsburgh. It is served by the Pennsylvania railroad.

Ambridge lies on a wide plain, 755 ft. above sea level, and 70 ft. above the river. The population in 1950 was 16,415, and 18,968 in 1940 by federal census. The American Bridge company has a large fabricating plant there. Ambridge's manufactures include structural steel for bridges, buildings and barges; bare and insulated wire and cable; flexible steel conduit, carburettor tubing, asbestos-protected metal, electric conduit and fittings, pig-casting machines, cold finished steel, mining and coal-handling machinery, skylights and ventilators, oil well tubing, steel plates and wrought iron.

Within the boundaries of Ambridge is the former village of Economy, founded in 1824 by the Harmony society, under its leader, George Rapp, the German communist.

Under Rapp and his successor, R. L. Baker, the community

built up substantial agricultural and manufacturing industries; but after 40 or 50 years the rule of celibacy and the lack of fresh converts resulted in dwindling numbers, and in 1906 the society was disbanded.

Many of the original buildings are still standing, including the Great House, which is now owned by the state of Pennsylvania and maintained as an historical museum.

Ambridge was incorporated as a borough from part of Harmony township in 1905. It has a council-manager form of government.

AMBROS, AUGUST WILHELM (1816–1876), distinguished musical historian, was born at Vysoké Myto, Bohemia. From 1850 onwards he became well known as a critic and essay-writer, and in 1860 he began working on his *magnum opus*, his *History of Music*, which was published at intervals from 1864 in five volumes, and reissued in a revised and enlarged edition in 1909. Ambros became professor of the history of music at Prague in 1869, and later occupied a similar position at Vienna, where he died.

AMBROSE, SAINT (340?–397), bishop of Milan, one of the greatest Fathers of the Church, was born a Roman citizen about 337–340 in Trèves, where his father was prefect of Gallia Narbonensis. His mother was a woman of intellect and piety. Ambrose was intended to follow his father's career and accordingly educated in Rome. He became consular prefect of Liguria and Emilia, with headquarters at Milan, where he made an excellent administrator. In 374 Auxentius, bishop of Milan, died, and the orthodox and Arian parties contended for the succession. An address delivered to them at this crisis by Ambrose led to his nomination to the see; though only a catechumen, he was baptized and duly installed as bishop of Milan. Having apportioned his money among the poor, he settled his lands upon the Church, but leaving his sister Marcellina tenant for life and committing the care of his family to his brother, he entered upon a course of study under Simplician, a presbyter of Rome, and devoted himself to the labours of the episcopate. An invasion of Goths compelled Ambrose and other churchmen to retire to Illyricum for a time. His eloquence soon found ample scope against the Arians. Gratian, the son of the elder Valentinian, took the same side; but the younger Valentinian, now a colleague in the empire, adhered to the Arians, and Ambrose failed to win him to orthodoxy. The Arian leaders Palladius and Secundianus, confident of numbers, persuaded Gratian to call a general council from all parts of the empire; but Ambrose in the end prevailed upon the emperor to remit the matter to a council of the Western bishops alone. A synod, composed of 32 bishops, was held at Aquileia in the year 381. Ambrose was elected president; and Palladius, being called upon to defend his opinions, declined, insisting that the meeting was a partial one, and that, since not all the bishops of the empire were there, the sense of the whole Christian Church could not be manifest. A vote was then taken, and resulted in Palladius and Secundianus being deposed.

Ambrose was zealous in combating the pagan reaction. Quintus Aurelius Symmachus, consul in 391, besought Valentinian II. to set up again the altar of Victory in the hall of the senate, to provide for the support of seven vestal virgins and to revive the pagan ceremonies. Ambrose, in a letter to Valentinian, countered this petition: both documents are extant.

Although the court rejected the religious tenets of Ambrose, it respected his statesmanship. When Maximus usurped supreme power in Gaul and meditated a descent upon Italy, Valentinian sent Ambrose to dissuade him: Ambrose was successful. On a second attempt of the same kind Ambrose was unsuccessful; the enemy entered Italy; Milan was taken. Justina and her son fled; Ambrose remained, and for the relief of the suffering populace he did not hesitate to cause the consecrated vessels used in the most sacred rites of the Church to be melted down: a memorable precedent often to be cited in Church history. Theodosius, the emperor of the East, espoused the cause of Justina, and regained the kingdom.

In 392, after the assassination of Valentinian and the usurpation of Eugenius, Ambrose fled; but when Theodosius proved victorious, the saint became a suppliant to the emperor for the pardon

of those who had followed Eugenius. Theodosius died at Milan in 395, and two years later (April 4, 397) Ambrose also passed away.

A man of pure character, vigorous mind, unwearying zeal and uncommon generosity, Ambrose ranks among the Fathers of the ancient Church, with Augustine, Jerome, and Gregory the Great; as one of the Latin "doctors," he is fitly compared with Hilary, whom he surpasses in statesmanship, if he falls below him in theology. Even in theology, however, his achievements are of no mean order, especially when we remember his juridical training and his comparatively late handling of Biblical and doctrinal subjects. In matters of exegesis he is, like Hilary, an Alexandrian; his chief productions are homiletic commentaries on the early Old Testament narratives, e.g., of the Hexaëmeron and of Abraham, some of the Psalms, and the Gospel according to Luke. In dogmatic he follows Basil of Caesarea and other Greek authors, but nevertheless gives a distinctly Western cast to the speculations of which he treats. This is particularly manifest in the emphasis which he lays upon human sin and divine grace, and in the place which he assigns to faith in the individual Christian life. His chief works in this field are *De fide ad Gratianum Augustum*, *De Spiritu Sancto*, *De incarnationis Dominicæ sacramento*, *De mysteriis*. His great spiritual successor, Augustine, whose conversion was helped by Ambrose's sermons, owes more to him than to any writer except Paul. Ambrose's intense realization of the dignity of the episcopal office furthered the growing doctrine of the church and the *sacerdotium*, while the prevalent asceticism of the day, continuing the Stoic and Ciceronian training of his youth, enabled him to promulgate a lofty standard of Christian ethics. Thus we have the *De officiis ministrorum*, *De viduis*, *De virginitate* and *De penitentia*.

Ambrose has also left several funeral orations and 91 letters. Catching the impulse from Hilary and confirmed in it by the success of Arian psalmody, Ambrose composed several hymns, marked by dignified simplicity, which served as a fruitful model for later times. We cannot certainly assign to him more than four or five (*Deus Creator Omnium*, *Aeternæ rerum conditor*, *Jam surgit hora tertia*, and the Christmas hymn *Veni redemptor gentium*) of those that have come down to us. Each of these hymns has eight four-line stanzas and is written in strict iambic tetrameter. The attribution of the *Te Deum* to him, either as sole author or in collaboration with St. Augustine, has long since been discredited by all competent scholars.

On the Ambrosian ritual see LITURGY; on the Ambrosian library see LIBRARIES; on the church founded by him at Milan in 387 see MILAN. EDITIONS: The Benedictine (4 vols., Venice, 1748 ff.). Migne, *Patrol. Lat.* xiv-xvii.; P. A. Ballerini (6 vols., Milan, 1875 ff.). LITERATURE: Th. Förster, *Ambrose, B. of Mailand* (Halle, 1884) and art. in Herzog-Hauck, *Realencycl.*, where the literature is cited in full; A. Ebert, *Gesch. der christlichen Lit.* (2nd ed., 1889). O. Bardenhever, *Patrologie* (2nd ed., 1891); A. Harnack, *Hist. of Dogma*, esp. vol. v.; W. Bright, *Age of the Fathers*.

AMBROSE (c. 1190), Norman poet, chronicler of the third crusade and author of a work called *L'Estoire de la guerre sainte*, which describes in rhyming French verse the adventures of Richard Coeur de Lion as a crusader. The poem is known to us only through one Vatican ms., and the credit for detecting its value belongs to Gaston Paris, although his edition (1897) was partially anticipated by the editors of the *Monumenta Germaniae Historica*, who published some selections in the 27th volume of their *Scriptores* (1885).

Ambrose followed Richard I. as a non-combatant, and not improbably as a court minstrel. He is surprisingly accurate in his chronology; though he did not complete his work before 1195, it is evidently founded upon notes which he had taken in the course of his pilgrimage. He is rather to be treated as a biographer than as a historian of the crusade in its broader aspects. None the less he is the chief authority for the events of the years 1190-92, so far as these are connected with the Holy Land. The *Itinerarium Regis Ricardi* (formerly attributed to Geoffrey Vinsauf, but in reality the work of Richard, a canon of Holy Trinity, London) is little more than a free paraphrase of Ambrose. Stubbs's edition of the *Itinerarium* (Rolls series,

1864) in which it is treated as an independent work, appeared before Gaston Paris published his discovery.

See the edition of *L'Estoire de la guerre sainte* by Gaston Paris in the *Collection des documents inédits sur l'histoire de France* (1897); the editor discusses in his introduction the biography of Ambrose, the value of the poem as a historical source, and its relation to the *Itinerarium*. R. Pauli's remarks (in *Monumenta Germaniae Historica. Scriptores*, xxvii.) also deserve attention. (H. W. C. D.)

AMBROSE (ANDREY SERTIS-KAMENSKIY) (1708-1771), archbishop of Moscow from 1761 to 1771, was famous for his interest in schemes for the alleviation of poverty in Moscow and as the founder of new churches and monasteries. A terrible outbreak of plague occurred in Moscow in 1771, and the populace began to throng round an image of the Virgin to which they attributed supernatural healing power. Ambrose, seeing that the crowding together spread the contagion, had the image secretly removed. The mob, suspecting that he was responsible for its removal, attacked a monastery to which he had retired, dragged him away from the sanctuary, and, having given him time to receive the sacrament, strangled him. Ambrose's works include a liturgy and translations from the Fathers.

AMBROSE (AMBROISE), AUTPERT (d. 778), French Benedictine monk. He became abbé of St. Vincent on the Volturno "in the time of Desiderius, king of the Lombards." He wrote commentaries on the Apocalypse (see *Bibl. Patrum*, xiii. 403), on the Psalms, on the Song of Solomon; *Lives of SS. Paldo, Tuto and Vaso* (according to Mabillon); *Assumption of the Virgin*; *Combat between the Virtues and the Vices*.

BIBLIOGRAPHY.—Mabillon, *Acta sanct.* Bolland. III. ii. 259, 266; Georg Lommel, *Der ostfränkische Reformator Ambrosius* (Giessen, 1847); Bollandist *Bibl. hag. lat.* (1898), 61.

AMBROSE, ISAAC (1604-1663-4), English Puritan divine, vicar of Preston. Ambrose left his great church of Preston in 1654 and became minister of Garstang, whence he was ejected in 1662 with the two thousand ministers who refused to conform. As a religious writer Ambrose has a vividness and freshness of imagination possessed by scarcely any of the Puritan Nonconformists. His *Looking to Jesus* long held its own in popular appreciation with the writings of John Bunyan.

AMBROSE THE CAMALDULIAN, the name by which Ambrogio Traversari (1386-1439), Italian humanist and ecclesiastic, is commonly known. Ambrogio was born at Portico, near Florence, and studied Greek under Emmanuel Chrysoloras. He entered the Camaldulian Order at 14, and became general of the order in 1431. His great work was the introduction of the Greek theologians' works to the church of the Renaissance by a series of translations to which he devoted his life. Those writings of the fathers which were available were often rendered into obscure and barbarous Latin, and many had not been translated at all. He produced a new version of the homilies of St. Chrysostom and of others of his works, and translations of Dionysius the Areopagite and other authors. Many of his mss. are preserved in the library of St. Mark's, Venice. He was a friend of Cosmo de Medici, at whose desire he reluctantly turned aside from the Greek fathers for a moment to make a Latin version of Diogenes Laertius. He died on Oct. 20 1439.

See G. Voigt, *Die Wiederbelebung des klass. Altertums*, 3rd ed. (1893); his *Epistolæ* were published by Cannato (Florence, 1759) with a life by Mehus; Bollandist *Bibl. hag. lat.* (1898), 63; A. Masius, *Über die Stellung des Kamaldulensers Ambrogio Traversari zum Papst Eugen IV. und zum Basler Konzil* (Döbeln, 1888); Savigny, *Geschichte röm. Rechts im Mittel.* (1850), vi. 422-424.

AMBROSIA, in ancient mythology, sometimes the food, sometimes the drink, of the immortals. The word has generally been derived from Gr. *ἀ-* not, and *μ(β)porós*, mortal. A. W. Verrall, however, denies that there is any clear example in which the Greek word *ambrosios* necessarily means "immortal," and explains it as "fragrant," a sense which is always suitable. If so, the word may be derived from the Semitic *ambar* (ambergis), to which Eastern nations attributed miraculous properties. W. H. Roscher thinks that both nectar and ambrosia were kinds of honey. The name *Ambrosia* was also later applied by Dioscorides and Pliny to certain herbs, and has been retained in modern botany for a genus of plants from which it has been extended to the group

of dicotyledons called *Ambrosiaceae*, including *Ambrosia*, *Xanthium*, and *Iva*, all annual herbaceous plants represented in America. *Ambrosia maritima* and some other species occur also in the Mediterranean regions.

There is also an American beetle, the Ambrosia beetle, belonging to the family of Scolytidae, which derives its name from its cultivation of a succulent fungus, called ambrosia. Ambrosia beetles bore galleries into timber, and the wood-dust provides a bed for the fungus on which the insects and larvae feed.

AMBROSIAN CHANT, a general term applying to the particular type of liturgical music associated with the name of St. Ambrose, bishop of Milan, and introduced by him into the churches of his diocese. As to what it amounted to precisely considerable doubt exists, but it is generally agreed that St. Ambrose transplanted the singing of the Hallelujah and antiphonal singing from Greece into Italy, while he is also looked upon as the originator of the Responses. Otherwise the Ambrosian Chant seems to have had much in common with the Gregorian, which is regarded by some as having been merely a comprehensive revision of the then existing (7th century) ritual song, based on Ambrosian practice, although doubtless including much which had been added after St. Ambrose's death (397). St. Ambrose was also responsible for the introduction of hymn-singing, as distinguished from the chanting of the Psalms and the canticles, as an essential feature of the music of public worship in the Western Church, and wrote many hymns himself, though the number of genuine examples to be ascribed to him is less than has sometimes been stated. (See also AMBROSE, SAINT; GREGORY [Pope]; and PLAINSONG.)

AMBROSIANS, the name given to several religious brotherhoods which at various times since the 14th century have sprung up in and around Milan; they have about as much connection with St. Ambrose as the "Jeromites" who were found chiefly in upper Italy and Spain have with their patron saint. Only the oldest of them, the *Frates S. Ambrosii ad Nemos*, had anything more than a very local significance. This order is known from a bull of Gregory XI. addressed to the monks of the church of St. Ambrose outside Milan. These monks, it would appear, though under the authority of a prior, had no rule. Their discipline became so slack that an appeal was made to Cardinal Borromeo asking him to reform their houses. By Sixtus V. the order was amalgamated with the congregation of St. Barnabas, but Innocent X. dissolved it in 1650.

The name Ambrosians is also given to a 16th century Anabaptist sect, which laid claim to immediate communication with God through the Holy Ghost. Basing their theology upon the words of the Gospel of St. John i. 9 ("There was the true light which lighteth every man coming into the world"), they denied the necessity of any priests or ministers to interpret the Bible. The doctrine of the Ambrosians may be compared with the "inner light" doctrine of the Quakers.

See Herzog-Hauck's *Realencyklopädie*, i. 439.

AMBROSIASTER. A commentary on St. Paul's epistles, "brief in words but weighty in matter," and valuable for the criticism of the Latin text of the New Testament, was long attributed to St. Ambrose. Erasmus in 1527 threw doubt on the accuracy of this ascription, and the author is usually spoken of as Ambrosiaster or pseudo-Ambrose. Owing to the fact that Augustine cites some parts of the commentary on Romans as by "Sanctus Hilarius" it has been ascribed by various critics at different times to almost every known Hilary.

See Souter, *Study of Ambrosiaster* (1905), with references given there.

AMBROSIUS AURELIANUS, leader of the Britons against the Saxons in the 5th century, was, according to the legends preserved in Gildas and the *Historia Brittonum*, of Roman extraction. There are signs of the existence of two parties in the national opposition to the invaders, but as Pascent, son of Vortigern, is said by Nennius to have held his dominions in the west by leave of Ambrosius, the Roman element seems to have triumphed. It has been suggested that Amesbury in Wiltshire is connected with Emrys, the Celtic form of his name.

See Bede, *Eccl. Hist.* (Plummer) i. 16; Nennius, *Hist. Britt.* § 31; Gildas, *De excidio Britanniarum*, § 25; J. Rhys, *Celtic Britain* (1884), pp. 104, 105, 107.

AMBRY. An ambry in mediaeval churches was a wall-niche or recess near the altar in which the sacred vessels were kept. Large churches and cathedrals had numerous ambries fitted with shelves and richly carved doors, where consecrated oils, vestments, holy relics, books or linen were stored. Occasionally an ambry was a chest or cupboard hung near the altar. Variant forms of the word are almetry, aumbry and armalorium.

AMBULANCE, a term applied in England and America to the wagon or other vehicle in which the wounded in battle, or those who have sustained injuries in civil life, are conveyed to hospital. More strictly it signifies a hospital establishment moving with an army in the field, to provide for the collection, treatment and care of the wounded on the battlefield, and of the sick, until they can be removed to hospitals of a more stationary character. In 1905-06 the term "field ambulance" was adopted in the British service to denote this organization. The ambulance organization which, variously modified in details, now prevails in all civilized armies, only dates from the last decade of the 18th century. Hitherto surgical assistance did not reach the battlefield till the day after the engagement, or even later. In 1792 Baron Dominique Jean Larrey (1766-1842) of the French army introduced his system of *ambulances volantes*, or flying field hospitals, like the "flying artillery" of that time. They were adapted both for giving the necessary primary surgical treatment and for removing the wounded quickly from the sphere of fighting. A corps of *brancardiers*, or stretcher-bearers, was organized about the same time.

Geneva Convention.—An important step toward the amelioration of the condition of the wounded of armies in the field was the European convention signed at Geneva in 1864, by the terms of which, subject to certain regulations, the wounded and the official staff of ambulances and their equipment were declared neutral. The American Civil War marked the beginning of the modern ambulance system. The main feature of the hospital organization throughout that war was the railway hospital service. Hospital trains and ships equipped with medical staff, nurses, stores and appliances, for the transport of cases from the front to the base, were rapidly introduced into other armies.

When a soldier is wounded the regimental surgeon and stretcher-bearers apply the "first field dressing"—a packet of antiseptic material which every officer and man on active service carries stitched to his tunic. From the field he walks or is carried on a stretcher by bearers to the collecting station, where he is placed in an ambulance truck and taken to the dressing station. Here his wound is examined if necessary, but as on the field the first medical officer who examined him has already attached a "specification tally" to the patient, giving particulars of the wound, it will probably not be disturbed. Any urgent operation, however, will be here performed, nourishment, stimulants and opiates administered if required, and the patient moved to the field hospital in an ambulance truck. From the field hospital he is transferred as soon as possible by ambulance truck, train or plane to the general hospital at the advanced base of operations.

AMBULATORY, the covered passage round a cloister, or the aisle or procession way around the east end of a church choir behind the altar.

AMBUSCADE, an alternative form of ambush (*q.v.*).

AMBUSH (older form, "embush," O.Fr. *embusche*, from the Ital. *imboscata*, in and *bosco*, a wood), the hiding of troops, primarily in a wood, and so any concealment for the purpose of a sudden surprise attack.

AMEBIASIS or **AMOEBIASIS**: see PARASITIC DISEASES.

AMEDEO FERDINANDO MARIA DI SAVOIA, DUKE OF AOSTA (1845-90), third son of Victor Emmanuel II, king of Italy, and of Adelaide, archduchess of Austria, was born at Turin May 30, 1845. In 1868 he was created vice-admiral of the Italian navy, but two years later left Italy to ascend the Spanish throne, his reluctance to accept the invitation of the Cortes having been overridden by the Italian cabinet. On Nov. 16, 1870, he was proclaimed king of Spain by the Cortes; but before he could arrive at Madrid, Marshal Prim, chief promoter of his candidature, was assassinated.

Though warned of a plot against his life (Aug. 18, 1872) he

refused to take precautions, and while returning from Buen Retiro to Madrid in company with the queen was repeatedly shot at in the Via Arenal, but escaped unhurt. A period of calm followed the outrage. On Feb. 11, 1873, however, Amedeo, abandoned by his partisans and attacked more fiercely than ever by his opponents, signed his abdication. Upon returning to Italy he was cordially welcomed and reinstated in his former position. His wife, born Princess Maria Carlotta del Pozzo della Cisterna, died Nov. 3, 1876. On Sept. 11, 1888, Amedeo contracted a second marriage with his niece Princess Letitia Bonaparte. Less than two years later (Jan. 18, 1890) he died at Turin, leaving four children—the duke of Aosta, the count of Turin, the duke of the Abruzzi (issue of his first marriage), and the count of Salemi.

AMELIE-LES-BAINS, watering place, southwest France, in the department of Pyrénées-Orientales, at the junction of the Mondony with the Tech, 28½ mi. south-southwest of Perpignan by rail. Pop. (1936) 1,806. It has numerous warm sulphurous springs and both a winter and summer season. There are two bathing establishments, one of which preserves remains of Roman baths. The town was known successively as Arles-les-Bains, Bains-sur-Tech and Fort-les-Bains, and received its present name in 1840 in honour of the wife of Louis-Philippe.

AMELOT DE LA HOUSSEY, ABRAHAM NICOLAS (1634–1706), French historian and publicist, was born at Orleans in Feb. 1634 and died in Paris on Dec. 8, 1706. His most important work is *Histoire du gouvernement de Venise* (1676), which called forth a violent protest from the Venetian ambassador in Paris. The author spent six weeks in the Bastille, but the popularity of the book was increased by the publicity given to the affair. It went through 22 editions in three years, and was translated into English and other languages.

AMEN. This old Hebrew expression has become “perhaps the most widely known word in human speech,” being used today in worship not only by Jews but by Christians and, in a minor degree, by Mohammedans. (a) As a religious term expressing affirmation and desire it signifies (as in the Greek translation of the O.T.) “so be it”; (b) but essentially it was an interjection of *assent*—“so it is,” or “so it will be,” even of secular application (1 Ki. i, 36; Jer. xi, 4, xxviii, 6) in the sense of “yes.” The Hebrew verb means to *be firm*, or *sure*; also to *be trusted*. (1) The term is employed by the user to adopt as his own, words spoken by another; so in Tobit viii, 8; cf. Judith xiii, 20. As a response of the people at the close of a doxology or prayer uttered by the priest, it is found in Neh. viii, 6; 1 Chron. xvi, 36; cf. Ps. cvi, 48. This use, which became especially common in the Jewish synagogue, was developed by the Christian church. In 1 Cor. xiv, 16, St. Paul refers to “the Amen.” Justin c. 150 A.D. writes: “The president likewise offers up prayers and thanksgivings, and the people answer the Amen” (*Apol.* I. 67; cf. 65). (2) Developed out of this use Amen is employed also by the *offerer* of thanksgivings and prayers, public and private, in order to sum up and thus to confirm what he himself has said. Signs of this use even in the O.T. are to be seen in the detached doxology placed as vv. 18 and 19 of Ps. lxxii., and in the short doxologies with which the 3rd and 4th books of Maccabees end. It is found in Rom. i, 25; Gal. vi, 18, etc., and it has become exceedingly common with Christians. Like (1), as an aid in focusing the concentration of the worshipper, its value is obvious. With the growing popularity of hymns the use of Amen has been extended. (3) Unique, but in harmony with the meaning “so it will be,” was the usage of Jesus Christ to *introduce* a statement of his own by “Amen” (translated “Verily”), “I say unto you” (or “thee”). In the Fourth Gospel uniformly, and only in that gospel, is the *double* and more emphatic “Verily, verily” (e.g., iii, 3); cf. the double Amen in Ps. xli, 13, etc. In Rev. iii, 14, the word Amen is applied, probably under the influence of Isa. lxi, 16, to Christ Himself; i.e., He in whom things become true—“the faithful and true witness”; cf. 2 Cor. i, 20. The nearest parallel to the Amen introducing a sentence is in Rev. i, 7, where the writer *closes* an affirmation thus: “Behold he cometh . . . Even so, Amen.”

See Hogg, *Jew. Qrly. Rev.*, Oct., 1896; Nestle, *Exp. Times*, 1897 pp., 190f.; Dalman, *Worte Jesu* pp. 185–187 (Eng. trans. pp. 226–229).

(R. S. C.)

AMENDMENT, originally a change or alteration for the better, applying either to moral character or to an existing oral or written statement or written document. The word has come to have a broader meaning, particularly in its legal use. It requires in all cases something that is to be altered, and, irrespective of improvement, is a change of some document or written or oral statement, by substitution, omission or addition, or by a combination of these methods of change. The change or proposed change may usually intend an improvement or correction on the part of the one proposing the amendment, but improvement or correction are not essential elements.

The word “amendment” is used with respect to many transactions, such as the amendment of federal and state constitutions and statutes, and of municipal ordinances; the amendment of bills in the course of their passage by congress or state legislatures; the amendment of indictments in criminal cases; of pleadings and records in civil and criminal proceedings, and in briefs filed in such cases; the amendment of trusts, of the charters of private corporations, and of numerous other papers representing private transactions; the amendment of oral motions that may be made in meetings of public bodies and private organizations.

Some types of proposed amendments, such as those to correct errors in court pleadings, records, and in briefs submitted to courts, are intended to correct and improve existing documents. Amendments to constitutions, statutes and municipal ordinances, and in many private transactions are proposed or adopted not to correct errors in the original instrument but to change the purpose or policy because of changed conditions or desires. They may also be regarded as changes or alterations for the better.

Instead of proposing amendments to strengthen a bill, it is not uncommon in legislation that proposed amendments often seek to alter both the language and the purpose of a bill. The proposal of adverse amendments is one of the most effective means of defeating rather than improving proposed legislation. The same statement is true as to motions made in legislative bodies and in meetings of private organizations. In connection with a statement that the term amendment is used to denote any alteration which may be proposed, Cushing's *Law and Practice of Legislative Assemblies* (section 1302) says: “A proposition may be amended, in parliamentary phraseology, not only by an alteration which carries out and effects the purpose of the mover, but also by one which entirely destroys that purpose, or which even makes the proposition express a sense the very reverse of that intended by the mover; and, in like manner, a motion, which proposes one kind of proceeding, may be turned into a motion for another of a wholly different kind, by means of an amendment; so, that, in point of fact, an amendment is equally effectual, and is often used to defeat a proposition, as well as to promote the object which the mover of that proposition has in view.”

In connection with constitutions and statutes, amendments that are proposed and adopted may be intended to bring a change for the better; and statutes, particularly in new fields, are experiments which require successive amendments in order to meet the new problems of 20th century civilization. Much of the most important legislation by congress and by state legislatures is thus in the form of amendments to prior legislation. Amendments are thus to a large extent changes for the better, although all amendments are by no means for the better. (W. F. D.)

AMENDOLA, GIOVANNI (1882–1926), Italian politician and journalist, was born at Naples, April 15, 1882. He entered journalism at the age of 18, and eventually became Rome correspondent of the Milan *Corriere della Sera*, which he left in 1921 to found a paper of his own, *Il Mondo*. In 1919 he was elected deputy for Sarno in the province of Salerno and re-elected in 1921 and 1924. After World War I he devoted himself entirely to politics as a Democratic Liberal and a supporter of Nitti. On Nitti's fall, June 9, 1920, he joined the opposition to Giolitti, and became minister for the colonies, first under Bonomi, then under Facta. He opposed fascism from the first, and after Mussolini's advent to power he became, with Albertini, Sforza, Sturzo and Turati, one of the leaders of the various opposition groups. After Matteotti's murder he was the leader of the members of the cham-

ber of deputies who withdrew to the Aventine (*see* ITALY). In spite of fascist menaces to his life during the election campaign of 1924 he declared the electoral law enacted by the fascist government to be unconstitutional and therefore void and null. Two publications of his, *Una battaglia liberale* and *La democrazia dopo il 16 aprile 1924*, both of 1924, and a third publication made in collaboration with Sforza, Ruini, etc., *Per una nuova democrazia* (1926), made known his political faith. Attacked by a gang of fascists while on a cure at an Italian spa, Montecatini, he died—as a result of the blows at Cannes, April 6, 1926.

AMENEMHET I., the ruler of Egypt who began the 12th Dynasty (c. 2212 B.C.). His personal name was *Sehetepibre*, which shows that he was especially devoted to Amon (q.v.), the god of Epet. (*See Cambridge Ancient History*, vol. i. 2nd ed., 1924.)

AMEN HOTEPI, I.-IV.: *see* EGYPT: *The New Empire*.

AMENORRHOEA, normally the absence of the menstrual flow is a part of the sexual cycle which culminates in ovulation or the discharge of the egg from the ovary. It is of two types: the physiologic or normal and the pathologic or abnormal. The former occurs before puberty, during pregnancy and lactation and after the menopause or change of life. The latter may occur as the result of some abnormal development or of some disease, local or general, acute or chronic; or it may result from disturbances of the endocrines or the organs of internal secretion, or from emotional disturbances such as shock or fear. While not necessarily serious, it should be investigated and the cause determined. Detection of the underlying condition is important because if neglected it may develop into something serious. One may expect a cessation of the menstrual flow or amenorrhoea after certain operations where the uterus or womb and the ovaries are removed.

AMENTACEAE or **AMENTIFERAE**. This name was formerly used to include the families of plants which bear their flowers in catkins (*amenta*). It comprised the families *Salicaceae*, willows and poplars, *Juglandaceae*, walnut and hickory, *Betulaceae*, birch and alder, *Fagaceae*, oak, beech and chestnut. It is not used in the most modern systems of botanical classification.

AMERCEMENT or **AMERCIAMENT**, in English law, an arbitrary pecuniary penalty, inflicted in old days on an offender by the peers or equals of the party amerced. The word has in modern times become practically a poetical synonym for fine or deprivation. But an amercement differed from a fixed fine, prescribed by statute, by reason of its arbitrary nature; it represented a commutation of a sentence of forfeiture of goods, while a fine was originally a composition agreed upon between the judge and the prisoner to avoid imprisonment. The assessment of an amercement was termed an *affeerment*. In the lower courts the amercement was offered by a jury of the offender's neighbours (*affeerors*); in the superior courts by the coroner, except in the case of officers of the court, when the amount was affeered by the judges themselves. All judgments were entered on the court roll as "in mercy" (*sit in misericordia*). Articles 20 to 22 of Magna Carta regulated the assessment of amercements.

See Stephen, *Hist. Crim. Law*; Pollock and Maitland, *Hist. Eng. Law*; McKechnie, *Magna Carta*.

AMERIA (mod. *AMELIA*), Umbria, about 65 mi. N. of Rome on the Via Amerina (which diverged from the Via Cassia, passing through Castellum Amerinum, probably mod. Orte, where it crossed the Tiber). It has a fine position, 1,332 ft. above sea-level, and still retains considerable remains of the city wall. Pop. (1936) 2,583 (town), 11,055 (commune). Roman remains include a large ten-chambered water reservoir. The lofty campanile of the cathedral was erected in 1050. Ameria is alluded to as a flourishing place, with a fertile territory extending to the Tiber, by Cicero in his speech in defence of Sextus Roscius Amerinus.

AMERICA, the general name by which the huge continent called the western hemisphere is now known. It is commonly agreed that the name is derived from that of the navigator, Amerigo Vespucci (q.v.). America is divided geographically and ethnologically into three parts: North America (Canada and the United States of America); Central America and South America. These three divisions will be found treated separately under their own names.

Physical Geography.—The accidental use of a single name, America, for the pair of continents that together have a greater north-south extension than any other continuous land area of the earth, gives some support to the theory of its tetrahedral deformation; for America, broadening in the north toward its neighbours on the east and west, and tapering far to the south toward the Antarctic continent, roughly presents the triangular outline that is to be expected from tetrahedral warping. There is, however, not a unity but a duality, in its plan; North and South America resemble each other roughly in geological evolution as well as in outline, their chief correspondences being: (1) the area of ancient fundamental rocks in the north-east (Laurentian highlands, Guiana), without great deformation since early geological times; (2) the area of south-eastern highlands (Appalachians, Brazil), with a crystalline belt near the ocean and more or less deformed Palaeozoic strata farther inland, both owing their present altitude to broad and modern geological uplifts; (3) the complex of younger mountains along the western coasts (Cordilleran highlands of both continents) of comparatively modern deformation and upheaval, associated with much volcanic activity; (4) confluent lower lands between the several highlands, with rivers flowing to the north (Mackenzie, Orinoco), east (St. Lawrence, Amazon), and south (Mississippi, La Plata). Differences are numerous, but they do not suffice to conceal the resemblance in general plan. Indeed, the chief differences between the two continents arise from their unlike position with respect to the equator. North America is bathed in frigid waters around its broad northern shores, its mountains in the north-west bear huge glaciers, the outlying north-eastern area of Greenland is shrouded with ice, and in geologically recent times a vast ice-sheet spread over its north-eastern third; while a warm and moist climate in its southern part gives it a torrid flora and fauna, and warm waters bring coral reefs to parts of its southern shores. South America has a torrid flora and fauna over its northern half and coral reefs on parts of its northern shores, while cold waters and glaciers characterize its narrowing southern end, where geologically recent glaciation has taken place.

The similarity of outline between the western margin of the Old World and the eastern margin of the Americas, long ago noticed, has in recent years been taken to support a daring theory of continental fragmentation, according to which the Atlantic is thought to occupy the space left vacant when America floated away westward from its original moorings.

The relation of the Americas to the rest of the world as the home of plants and animals is greatly affected by the breadth of the adjacent oceans. Between the parallels of 60° and 70° N., the east-and-west widening of North America forms more than a third of the almost continuous land ring around a zone of sub-Arctic climate; as a result there is a remarkable resemblance of plant and animal life in the high latitudes of North America and Eurasia. In strong contrast with this is the exceptional isolation of far southern South America, which but slightly interrupts a sub-Antarctic ocean ring; as a result, the land flora and fauna of South America to-day are strongly unlike those of the other south-ending continents.

For further treatment of the physical geography of the American continents, *see* NORTH AMERICA and SOUTH AMERICA. (W. M. D.)

GENERAL HISTORICAL SKETCH

The name America was derived from that of Amerigo Vespucci. In Waldseemüller's map of 1507 the name is given to a body of land roughly corresponding to the continent of South America. As discovery revealed the existence of another vast domain to the north, the name spread to the whole of the pair of continents, in spite of the protests of the Spaniards, by whom it was not officially used of North America till the 18th century.

Barring any trips which the Norse sea-rovers made, or may have made, to the Western continent, the discovery of America is justly dated, Oct. 12 (N.S. 21), 1492, when Christopher Columbus (q.v.), the Genoese, made his landfall on the island of Guanahani, now identified with Watling Island in the Bahamas. After many disappointments Columbus persuaded the Catholic sovereigns, Ferdi-

nand and Isabella of Spain, to furnish him with a squadron of three small vessels. With it he sailed from Palos in Andalusia on Aug. 3, 1492, reached Guanahani on Oct. 12, touched on the coast of Cuba and on Hispaniola, established a small post, and returned to Lisbon on March 4, 1493, and thence to Spain.

It was the belief of Columbus and his contemporaries that he had reached the islands described by Marco Polo as forming the

Nūc ꝑo & hę partes sunt latius iustratę & alia
quarta pars per Americū Vesputiū (vt in sequend
bus audietur) inuenta est / quā non vīdeo cur quis
iure veter ab Americo inuēto re sagacis ingennū vī
Americo Amerigen quali Americi terrā / siue Americam
dicendā: cū & Europa & Alia a mulienibus sua for
tūa sint nomina. Eius sūū & genis mores ex his bi
nis Americi navigationibus quę sequunt liquide
intelligi datur.

FROM WALDSEEMÜLLER, "COSMOGRAPHIÆ INTRODUCTIO," ST. DIE, MAY 1507

THE EARLIEST MENTION OF AMERICA

In his essay, "Cosmographiæ Introductio," published in 1507, a geographer, Martin Waldseemüller, termed the western lands "America" after Amerigo Vesputolo who had referred to them for the first time as the New World in 1499

eastern extremity of Asia. Hence he spoke of the "Indies," and "las Indias" continued to be the official name given to their American possessions by the Spaniards for many generations. His feat produced a diplomatic controversy with Portugal which was destined to have important political consequences. In 1454 Pope Nicholas V. had given the Portuguese the exclusive right of exploration and conquest on the road to the Indies. His bull contemplated only the use of the route by the coast of Africa to the south and east. After the return of Columbus and his supposed demonstration that the Indies could be reached by sailing west, disputes might obviously arise. The Catholic sovereigns applied to Pope Alexander VI., a Spaniard, for a confirmation of their rights. The pope drew a line from north to south 100 leagues west of the Azores and Cape Verde islands, and gave the Spaniards the claim to all to the west (May 4, 1493). The Portuguese thought the division unfair to them, and protested. A conference was held between the two powers at Tordesillas in 1494, and by common consent the line was shifted to 370 leagues west of the Cape Verde islands. The boundary line is generally considered as the 50th degree of longitude west of Greenwich, which strikes the mainland of South America about the mouth of the Amazon. Thenceforward the Spaniards claimed the right to exclude all other peoples from trade or settlement "beyond the line."

Between Sept. 1493 and the time of his last voyage (May 1502 to Nov. 1504), Columbus explored the West Indies, reached the mainland of South America at the mouth of the Orinoco and sailed along the coast of Central America from Cape Honduras to Nombre de Dios (near Colon). Henry VII. of England allowed the Bristol merchants to fit out a western voyage under the command of another Genoese, John Cabot (*q.v.*), in 1497. The history of the venture is very obscure, but Cabot is thought to have reached Newfoundland and the mainland. Between 1500 and 1503 a Portuguese family of the name of Cortereal carried out voyages of exploration on the eastern coast of North America. In 1500 the Portuguese, Pedro Alvarez Cabral, while on his way to the East Indies, sighted the coast of Brazil at Monte Pascoal in the Aimores, and took formal possession. The belief that the eastern extremity of Asia had been reached died slowly, and the great object of exploration in America continued to be the discovery of a passage through to the Spice islands, in order to compete with the Portuguese, who had reached them by the Cape route. The first Spanish settlement in Hispaniola spread to the mainland by the adventure of Alonso de Ojeda and Diego de Nicuesa in Darien in 1509. Cuba was occupied by Diego de Velasquez in 1511. In 1512 (or 1513) Juan Ponce de Leon made the first recorded exploration of the coast of Florida and the Bahama channel. In 1513 Vasco Nuñez de Balboa crossed the isthmus

of Darien and saw the South Sea (Pacific). The hope that a passage through to the Spice Islands would be found near existing Spanish settlements was now given up. One was sought farther south, and in Nov. 1520 Ferdinand Magellan (*q.v.*) passed through the strait which bears his name and sailed across the Pacific. At last the existence of a continent divided by a vast stretch of ocean from Asia, and mostly lying within the sphere of influence assigned to Spain by the pope, was revealed to the world.

The first aim of the Spaniards had been trade with the Indies. The *Casa de Contratacion*, a committee for the regulation of trade, was established at Seville in 1503. European plants and animals were introduced into Hispaniola and Cuba, and sugar plantations were set up. But the main object of the Spaniards was always gold, to be won by slave labour. As the surface gold of the islands was exhausted, and the feeble island races perished before the invaders, the Spaniards were driven farther afield. In 1519 Pedrarias Davila transferred the Darien settlement to Panama. In that and the following year the coasts of Yucatan and of the Gulf of Mexico were explored successively by Francisco Hernandez Córdova and Juan de Grijalva, who both sailed from Cuba. From Cuba it was that Hernan Cortes (*q.v.*) sailed on Feb. 10 or 18, 1519, for the conquest of Mexico. Hitherto the Spaniards had met only the weak islanders, or the more robust cannibal Caribs, both alike pure savages. In Mexico they found "pueblo" or town Indians who possessed an organized government and had made progress in civilization. The hegemony of the Aztecs, who dominated the other tribes from the central valley of Mexico, was oppressive. Cortes, the most accomplished and statesmanlike of the Spanish conquerors, raised the subject peoples against them. His conquest was effected by 1521. His example stimulated the settlers at Panama, who had heard of a great people owning vast quantities of gold to the south. Between 1524 and 1535 Francisco Pizarro (*q.v.*) and Diego de Almagro had completed the conquest of Peru, which was followed, however, by a long period of strife among the Spaniards, and of rebellions. From Peru the Spaniards advanced southwards to Chile, which was first unsuccessfully invaded (1535-37) by Diego de Almagro. Their advance to the south was checked by the indomitable opposition of the Araucanians, but from the southern Andes the Spaniards overflowed on to the great plains which now form the interior of the Argentine republic. The first permanent settlement at the mouth of the river Plate at Buenos Aires dates from 1580. In its main lines the Spanish conquest was complete by 1550. What the Spaniards had then overrun from Mexico to Chile is still Spanish America. Brazil, after a period of exploration which began in 1510, was gradually settled by the Portuguese. The vast territories acquired by Spain in this brief period were held to be, by virtue of the pope's bull, the peculiar property of the sovereign. In 1509 the Council of the Indies was established, but it did not take its final form till 1524. It consisted of a president, with a board of advisers, who possessed legislative and administrative powers, and who varied in number at different times. The *Casa de Contratacion*, another board, regulated the trade. In America the Crown was represented by governors. After the preliminary period of conquest the whole of the Spanish possessions were divided into the two "kingdoms" of New Spain—consisting of Venezuela and the Spanish possessions north of the isthmus—and of New Castile, a title soon changed to Peru, which included the Central American isthmus and all of South America except Venezuela and Brazil. Each was ruled by a viceroy. As the Spanish dominions became more settled, the viceroyalty of Peru was found to be unwieldy. New Granada (which included the present republics of Venezuela, Colombia and Ecuador) was created a viceroyalty in 1718 (soon abolished, but re-created in 1740). A fourth viceroyalty for the river Plate was formed in 1778. Other governments known as captain-generalships were cut out of the viceroyalties at different periods.

The government of Spain administered its dominions from the beginning in the strictest spirit of the "colonial system." The Indies were expected to supply precious metals and raw mate-

rials, and to take all manufactures from the mother country. In order to facilitate the regulation of the trade by the *Casa de Contratacion*, it was concentrated first in Seville, and when the Guadalquivir was found to be becoming too shallow for the growing tonnage of ships, at Cadiz. Merchant vessels were required for their protection to sail in convoy. The convoys or *flotas* sailed in October first to Cartagena in South America, and thence to Nombre de Dios or, in later times, Porto Bello. The yearly fairs at these places received the imports from Europe and the colonial trade of the Pacific coast, first collected at Panama and then carried over the isthmus. From Nombre de Dios or Porto Bello the convoys went to La Vera Cruz for the trade of New Spain, and returned home in July by the Florida straits. One-fifth of the produce of the mines belonged to the Crown. The collection of this bullion was at all times a main object with the Spanish government, and more especially so after the discovery of the great silver deposits of Potosi in Bolivia. Forced labour was required to work them and the natives were driven to the toil.

The Portuguese settlement in Brazil was more purely colonial than the Spanish possessions. Until 1534 little was done to regulate the activity of private adventures. In that year the coast was divided into captaincies, which were united under a single governor-general in 1549. Between 1572 and 1576 there were in Brazil the two governments of Rio de Janeiro and Bahia; but its history is of little importance till the occupation of Portugal by Philip II. drew the country into the wars of the Spanish monarchy.

The claim of the peninsula powers to divide the American continent between them, based as it was on an award given in entire ignorance of the facts, would in no case have been respected. As England was in general alliance with the sovereigns of Spain during the early 16th century, Englishmen turned their attention at first towards the discovery of a route to the Spice islands round the north of Asia. But the rivalry of Francis I. and Charles V. gave France a strong motive for assailing the Spaniards in the New World. King Francis encouraged the ill-recorded and disputed voyages of the Florentine Giovanni da Verrazano in 1524, and the undoubted explorations of Jacques Cartier. Between 1534 and 1542 this seaman, a native of St. Malo, explored the Strait of Belle Isle and the Gulf of St. Law-

the dissensions of the colonists. Meanwhile, French corsairs from St. Malo and Dieppe had been active in infesting the West Indies and the trade route followed by the Spanish convoys. After the accession of Queen Elizabeth, and the beginning of the breach between England and Spain, they were joined by English sea-rovers. The English claimed the right to trade with all Spanish possessions in or out of Europe by virtue of their



BY COURTESY OF THE PILGRIM SOCIETY, PLYMOUTH, MASS.

THE "MAYFLOWER"

In 1620, 35 years after the Raleigh expeditions, and 128 years after Columbus landed at San Salvador, a party of pilgrims sailed from Southampton on the "Mayflower" for the New World. A voyage of 65 days brought them to the shores of North America, and they settled at Plymouth treaty of trade and amity made in the reign of Charles V. The Spaniards maintained that there was "no peace beyond the line," i.e., Pope Alexander's line as finally fixed by the conference at Tordesillas. The English retaliated by armed smuggling voyages. It was, however, not till late that they attempted to found permanent settlements. In 1578 Sir Humphrey Gilbert obtained a patent for discovery and settlement. In 1583 he perished in an effort to establish a colony in Newfoundland. His work was taken up by his half-brother, Sir Walter Raleigh, in 1584. Between 1586 and 1603 Sir Walter made successive efforts to settle a colony in the extensive territory called Virginia, in honour of Queen Elizabeth. His colony at Roanoke, in what is now North Carolina, was unsuccessful, and after his fall his patent reverted to the Crown, but the new Virginia company carried on his schemes. In 1607 the first lasting settlement was made in Virginia, and after a struggle began to flourish by the cultivation of tobacco.

In 1620 another settlement was made. A small body of religious dissentients, 101 men, women, and children, secured leave from the Virginia company to plant themselves within its bounds. They sailed in a single ship, the "Mayflower," and landed near Cape Cod, where they founded the colony of Plymouth, afterwards (1621) obtaining a patent from the council for New England. From these two centres, and from later settlements, arose the "plantations" of the English, which gradually increased to the number of 13 and were destined to become the United States of America.

The English colonies, though divided by interest or character, were all alike jealous to defend, and eager to extend, their freedom of self-government, based on charters granted by the Crown. The settlers by degrees threw off the control of the proprietors who had received grants from the Crown and had promoted the first settlements. It was a marked characteristic of the English colonists, and a strong element in their prosperity, that they were hospitable in welcoming men of other races—Germans from the Palatinate, and French Huguenots driven out by persecution who brought with them some capital, more intelligence, and enduring hatred of Roman Catholic France. Though the British Government gave, more or less unwillingly, a large measure of self-government to the plantations, it was no less intent than the Spanish Crown on retaining the whole colonial trade in British hands, and on excluding foreigners. Two foreign settlements within the English sphere—the Dutch colony



FROM A MURAL PAINTING BY CHARLES Y. TURNER IN THE HOTEL RALEIGH, WASHINGTON, D.C.
THE DEPARTURE OF RALEIGH'S COLONISTS FROM ENGLAND IN 1585
In 1585 Sir Walter Raleigh sent a group of colonists to Virginia in the hope of establishing a permanent settlement. But the new land offered so many hardships that the colonists sailed home with Sir Francis Drake the following year, just before a relief ship arrived at Roanoke Island in search of them

rence, and visited the Indian village of Hochelaga, now Montreal. The claims of France to the possession of a great part of the northern half of America were based on the voyages of Verrazano and Cartier. The death of King Francis, and the beginning of the wars of religion, suspended colonial enterprise under royal direction. But the Huguenots, under the inspiration of Coligny, made three attempts to found colonies to the south—at Rio de Janeiro (1555-67), near the present Beaufort, South Carolina (1562), and in Florida (1565). These ventures were ruined partly by the hostility of the Spaniards and Portuguese, partly by

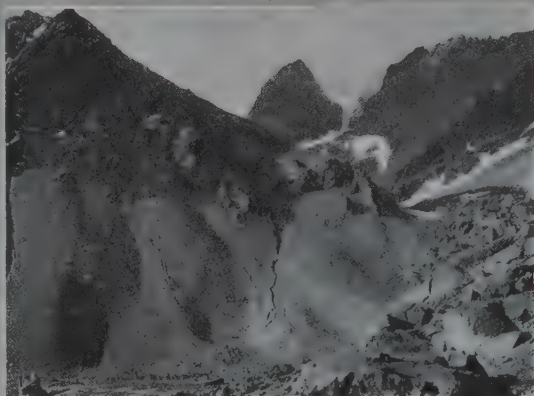


PHOTOGRAPHS, (1) DE COU FROM EWING GALLOWAY, (2, 4, 5) PUBLISHERS PHOTO SERVICE, (3) VISUAL EDUCATION SERVICE, CHICAGO

LAKE, BEACH AND RIVER SCENES IN NORTH AMERICA

1. Rocky Mountain scene in Canada showing Lake Louise, Mirror Lake, and Lake Agnes from left to right taken from a point near the trail from Château Lake Louise. Big Bee Hive is the tree-covered peak near the centre of the picture
2. View of Auk Lake, near Juneau, Alaska

3. A large sand dune on the shore of Lake Michigan
4. Scene along the Indian River boulevard in Florida, U.S.A.
5. Looking down the Crescent river, Florida, U.S.A.
6. Mother Ann Profile in the rocks at Gloucester lighthouse, Gloucester, Mass.



BY COURTESY OF (6) GOVERNOR-GENERAL N. M. TOWNER; PHOTOGRAPHS, (1) PUBLISHERS PHOTO SERVICE, (3) T. F. LEE, (4) E.N.A., (2, 5) COPR. E. M. NEWMAN, FROM PUBLISHERS PHOTO SERVICE

SCENES IN CENTRAL AND SOUTH AMERICA

1. The highest Trans-Andean station on the Argentine side of the mountains
2. A canyon near Oroya on the Mantaro river in Peru
3. Quarters for workmen on a plantation in Honduras
4. A mangrove swamp and forest on a backwater of the Amazon in Brazil
5. A corner of a banana plantation in Colombia, South America
6. Cane and coffee plants bordering a road in Porto Rico

of New Netherland, now New York, and the Swedish settlement on the Delaware—were absorbed by the growing English element.

While the English plantations were striking root along the coast, by somewhat prosaic but fruitful industry, and were growing in population with rapid strides, two other movements were in progress. To the south, the English, French, and Dutch, though often in rivalry with one another, combined to break in on the monopoly of the Spaniards. They turned the maxim that "there is no peace beyond the line" against its inventors. They invaded the West Indies, seized one island after another, and formed the freebooting communities known as the brethren of the coast and the buccaneers. After the renewal of the war between Spain and Holland in 1621, the Dutch invaded the Portuguese colony of Brazil and seized Bahia. A long period of struggle followed, but, after the declaration of Portuguese independence in 1640, local opposition, and the support given to the Portuguese by the French, led to the retreat of the Dutch.

To the north, to the west, and to the south of the English settlements on the mainland, a most characteristic French colonial policy was being carried out. No sooner were the wars of religion over than the French again set about making good their claim to Canada, and to whatever they could represent as arising naturally out of Canada. In 1599, under the encouragement of Henry IV., speculators began to frequent the St. Lawrence in pursuit of the fur trade. Their settlements were mainly trading posts. Their colonists were not farmers but trappers, wood-rangers, *coueurs du bois*, who married Indian women, and formed a mixed race known as the *bois brûlés*. Not a few of the leaders, notably Samuel de Champlain (q.v.), who founded Quebec in 1608, were brave, ingenious men, but the population provided no basis for a lasting colony. It was adventurous, small, scattered, and unstable. The religious impulse which was so strong both in the Spanish and the English colonies was prominent in the French, but in the most fatal form. Pious people were eager to bring about the conversion of the Indians, and were zealously served by missionaries. The Jesuits, whose first appearance in New France dates from 1611, were active and devoted. Their aim was to reduce the fierce Red men to a state of childlike docility to priests. It was true that the most active French colonial element, the trappers, were barbarized by the natives, and that the pursuit of the fur trade and other causes had brought the French into sharp collision with the most formidable of the native races, the confederation known as the Five (later Six) Nations. During the reign of Louis XIV., after 1660, the French government paid great attention to Canada, but not in a way capable of leading to the formation of a colony. The king was as intent as the rulers of Spain had been to keep the American possessions free from all taint of heresy. Therefore he carried on the policy of excluding the Huguenots—the only colonizing element among his subjects—and drove them into the English plantations. A small handful of obedient peasants formed the basis of the colony. On this narrow foundation was raised a vast superstructure, ecclesiastical, administrative, and military. His priests, and his officials civil and military, gave the French king many daring explorers. While the English colonies were slowly digging their way, taking firm hold of the soil, and growing in numbers, from the sea to the Alleghanies, French missionaries and explorers had ranged far and wide. In 1682 Robert Cavalier, Sieur de la Salle, who had already explored the Ohio, sailed down the Mississippi and took possession of the region at the mouth by the name of Louisiana.

The problem which was to be settled by a century of strife was now posed. On the one hand were the English plantations, populated, cultivated, profitable, stretching along the east coast of North America; on the other were the Canadian settlements, poverty-stricken, empty, over-officialled, a cause of constant expense to the home government, and, at a vast distance, those of Louisiana, struggling and bankrupt. The French remedy for an unsuccessful colony had always been to annex more territory, and forestall a possible rival. Therefore the French government strove to unite the beggarly settlements in Canada and Louisiana by setting up posts all along the Ohio and the Mississippi, in

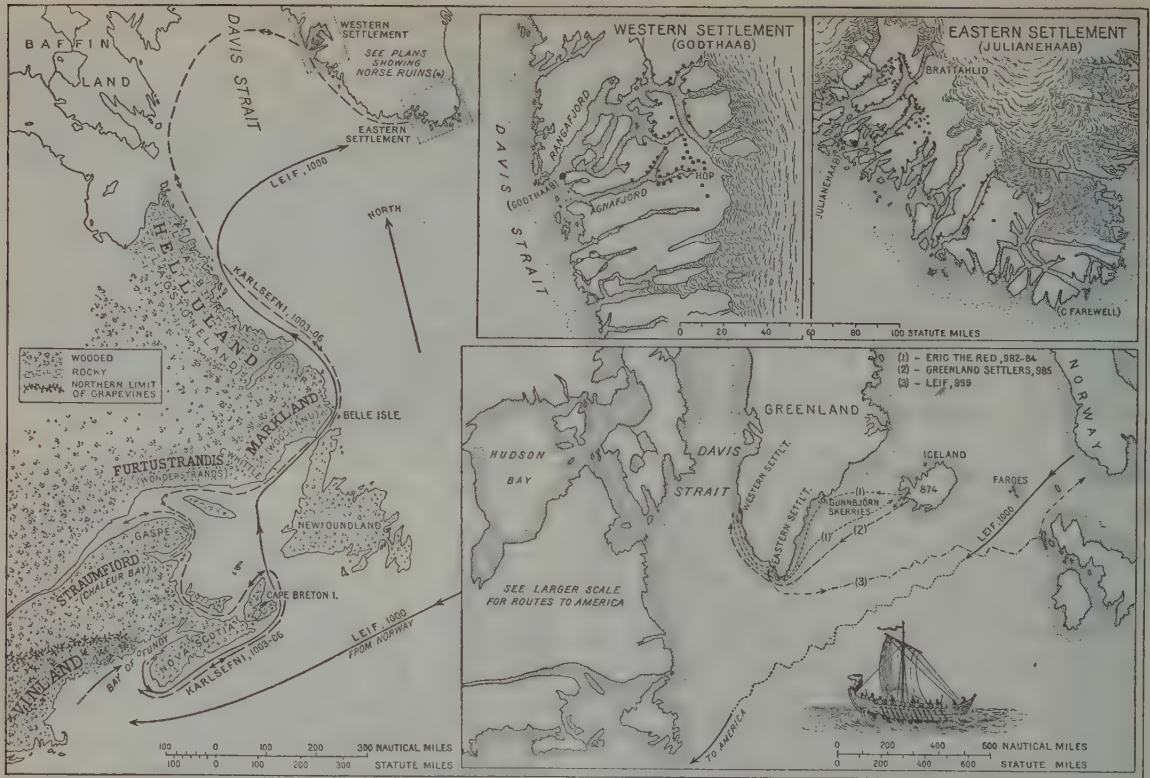
order to confine the English between the Alleghanies and the sea.

The political history of North America till 1763 is mainly the story of the pressure of the English colonies on this paper barrier. As regards Spanish America, England was content to profit by the *Asiento* treaty, which gave her the monopoly of slave-hunting for the Spanish colonies and an opening for contraband trade. In the River Plate region, where the dissensions of Spaniards and Portuguese afforded another opening, English traders smuggled. The Spaniards, with monstrous fatuity, refused to make use of the superb waterways provided by the Paraná and Paraguay, and endeavoured to stifle all trade. England's main struggle was with France. It was prolonged by her entanglement in European disputes and by political causes, by the want of co-operation among the English colonies, and their jealousy of control by the home government. The organization of the French colonies, though industrially ruinous, gave them the command of more available military forces than were at the disposal of the English. Thus the fight dragged on. At last, when under the leadership of the elder Pitt (see CHATHAM, EARL OF) England set to work resolutely to force a final settlement, the end came. The British navy cut off the French from all help from home, and after a gallant struggle, their dominion in Canada was conquered. They surrendered Louisiana to Spain, which had suffered much in an attempt to help them, and their possessions in America were reduced to their islands in the West Indies and French Guiana.

The fall of the French dominion on the continent of North America was practically the beginning of the existence of independent nations of European origin in the New World. The causes which led to the revolt of the colonies, the political and military history of the war of independence, are dealt with under the heading of UNITED STATES (*History*) and AMERICAN REVOLUTION. The significance of these epoch-making events in the general history of America is that from 1783 onwards there was, in the New World, an autonomous community in entire separation from European control. Such a polity, surrounded as it was by territory dependent on European sovereigns, could not be without a profound influence on its neighbours. No deliberate direct action by the United States was needed, for its example worked. Its independence tempted, its prosperity stimulated. From the freedom of the United States came the revolt of Spanish America, and the grant by Great Britain to Canada of the amplest rights of self-government.

The effect which the establishment of the great northern republic was bound to have on their own colonies was not unknown to the wiser among the rulers of Spain. They took, however, few and weak steps to counteract the visible peril. (The wars of the French Revolution and of Napoleon, in which Spain was entangled, interrupted her communications with her colonies, and weakened her hold on them. The defeat, in 1806 and 1807, of two British expeditions to Buenos Aires and Montevideo, resulting in the capitulation of the English force, gave a great impulse to the self-reliance of the colonists, to whom the credit of the victory entirely belonged. When the intervention of Napoleon in Spain plunged the mother country into anarchy, the colonists began to act for themselves. They were still loyal, but they were no longer passive. The brutality of some Spanish governors on the spot provoked anger. The cortes assembled in Cadiz, being under the influence of the merchants and mob, could make no concessions, and all Spanish America flamed into revolt. For the details of the struggle the reader must refer to the articles ARGENTINA, BOLIVIA, CHILE, COLOMBIA, ECUADOR, PANAMÁ, PERU, PARAGUAY, URUGUAY, VENEZUELA. Brazil followed the same course in a milder way and a little later. The struggle of Spanish America for independence lasted from 1810 to 1826.

Meanwhile the United States had taken decisive action. President Monroe, in his message to Congress on Dec. 2, 1823, laid down the rule that no part of America was any longer *res nullius*, or open to colonial settlement. From President Monroe's declaration has grown up what is now known as the Monroe Doctrine (q.v.) which, in substance, insists that America forms a separate



THE CONJECTURAL ROUTES OF THE NORSEMEN TO AMERICA DURING THE VIKING PERIOD, A.D. 800-1000

From the 7th to the 11th century the spirit of expansion that characterized the Norsemen for several hundred years appeared at its height. They settled in France, England, Scotland and Ireland and journeyed as far east as Russia. In the western hemisphere they colonized Iceland and, late in the 10th century, Greenland. It was from this latter place that expeditions were made by Eric the Red and others to the north-east shores of America.

system apart from Europe, wherein still existing European possessions may be tolerated, but on the understanding that no extension of them, and no establishment of European control over a nominally independent American state, will be allowed.

The Monroe Doctrine is indeed the recognition, rather than the cause, of undeniable fact. Europe is still possessed of some measure of sovereign power in the New World, in Canada, in Guiana, and in the West Indian islands. But Canada is bound only by a voluntary allegiance, Guiana is unimportant, and in the West Indian islands, where the independence of Haiti and the loss of Cuba and Puerto Rico by Spain have diminished the European sphere, European dominion is only a survival of the colonial epoch. America, North and South, does form a separate system. That system is divided into what are sometimes called an Anglo-America and a Hispanic, or Latin, America. On the one hand are the United States and Canada. On the other are all the states formed out of the colonial empires of Spain and Portugal. The states of the American union, as also Canada, are nontropical, adapted to the development of European races, not mixed with Indian blood, and possessed by long inheritance of the machinery needed for the successful conduct of self-government. They grew during the 19th century in population and wealth at a rate that placed them far ahead of the Spanish and Portuguese states, which in the beginning were the richer and the more populous. The Spanish and Portuguese states of America are largely tropical, and therefore less adapted to the health of a white race. Their population is divided between a white, an Indian and a coloured portion, the latter two sometimes docile and industrious, sometimes almost savage. They inherited no machinery of self-government. Townships governed by close corporations, and all embedded in the despotic power of the Crown, presented few of the elements out of which a stable commonwealth could be

formed. It was inevitable that in the early stages of their history, the so-called Latin communities should fall under the control of "the single person," and no less inevitable that he should be a soldier. The sword and military discipline long supplied the only effective instruments of government. It would have been a miracle if the first generation of Mexican and South American history had not been anarchical. It was not until the last quarter of the 19th century that the greater portion of Spanish and Portuguese America settled down and established permanent and peaceful governments. (X.)

In the early decades of the 20th century, this tendency toward relative political stability continued, with a number of substantial exceptions, of which the turbulent Mexican revolutionary period beginning in 1910 was the most serious. The "A.B.C. powers," Argentina, Brazil and Chile, made considerable political, economic and cultural advances, and came to exercise a certain leadership among the Latin-American countries. Meantime, the rôle of the United States in the western hemisphere steadily increased, most obviously in the development of its domination of the Caribbean, a domination both conferred and required by the acquisition of the Panama Canal Zone and the construction and control of an interoceanic canal. The degrees and kinds of influence exercised by the United States were varied. Acquisition of literal sovereignty was limited to Puerto Rico, ceded by Spain in 1898, and the Virgin Islands, purchased from Denmark in 1917. The treaty of 1903 with the new republic of Panamá gave the United States the rights of control as "if it were the sovereign" of the Canal Zone. There were military and financial interventions in Cuba, Haiti, the Dominican Republic, Honduras and Nicaragua in the earlier decades of the century. Over-shadowing all previous measures for the security of the Caribbean, however, was the executive agreement with Great Britain in

1940, by which the United States leased several sites for air and naval bases.

The growth in the influence of the United States was viewed with mixed feelings in Latin America. One school of thought hoped that the concept of Pan-Hispanism might counteract the movement toward a Pan-Americanism under the aegis of the great power of the north. There was particular resentment against the so-called "Roosevelt Corollary to the Monroe Doctrine," stated in messages to congress by President Theodore Roosevelt in 1904 and 1905, and announcing the necessity of intervention by the United States in certain unstable Latin-American countries.

The date 1930, when this idea was officially and publicly renounced by the U.S. state department, may be used to mark the beginning of a better era of inter-American relations. The new policy of the United States, sloganized by President Franklin D. Roosevelt in his first inaugural address as the policy of "the Good Neighbor," had already made progress toward greater inter-American unity when this progress was accelerated by the coming of World War II and the rise of the idea that hemisphere solidarity was vital to hemisphere defense.

BIBLIOGRAPHY.—Separate bibliographies will be found under the headings of the separate states. In the field of general histories the eight volumes of Justin Winsor's *Narrative and Critical History of America* (1886-89) have not been superseded, or even equalled, in scope. A fairly successful attempt at a popularized treatment of the whole subject in one volume is L. D. Baldwin, *The Story of the Americas* (1943). Among the works on large phases of the subject, these may be mentioned: H. E. Bolton and T. M. Marshall, *The Colonization of North America* (1920); C. E. Chapman, *Hispanic America, Colonial and Republican* (1938); J. F. Rippey, *The Historical Evolution of Hispanic America* (1932); A. C. Wilgus, *The Development of Hispanic America* (1941); and Dexter Perkins, *Hands Off: a History of the Monroe Doctrine* (1941). (W. E. Bn.)

PRE-COLUMBIAN DISCOVERIES

Alleged discoveries of the continent or islands of America by Europeans before Columbus lack foundation, with the exception of those made by the Norsemen. Because of the geographical conditions it was natural that they should be the first to discover territory in the western hemisphere. They advanced step by step towards west and northwest. First they accidentally discovered the Faroes, then Iceland, and finally, early in the 10th century, Gunnbjörn Ulfsson probably sighted the snow-clad mountains of Greenland, when he landed on some desert islands which afterwards were called Gunnbjörn Skerries, and which presumably were identical with some of the islands off Angmagssalik on the east coast. This discovery was not followed up until Eric the Red, who had first been exiled from Norway and thereafter from Iceland, decided to seek those islands in 982 and to ascertain if they were habitable. Thus he discovered the mainland of Greenland, the southwestern part of which he explored during the next three years; he thereafter returned to Iceland and succeeded in persuading a number of people to go with him to Greenland, and to establish there a colony on the model of the Icelandic commonwealth.

From this colony further discoveries were made not only along the west coast of Greenland but also on the American continent. These were in the beginning accidental, and a fairly full account of them has been preserved in Icelandic tradition, which has two somewhat different versions of them. The older of the two, the *Saga of Eric the Red*, ascribes the discovery of the continent to Leif Ericsson (*q.v.*); the younger, called the "Tale of the Greenlanders" (found in the *Flatey Book*) makes Bjarni Herjólfsson the first discoverer. The *Saga* is doubtless much more reliable although the "Tale" probably preserved a few things which the *Saga* left out. The accidental discovery of Leif in the year 1000 was followed up the next year by his brother, Thorstein Ericsson, who, however, failed to reach the new lands. Two years later the Icelander, Thorfinn Karlsefni (*q.v.*), went with three ships from Greenland in search of Vinland with the intention of settling there. His expedition lasted three years (1003-06), at the end of which time he returned to Greenland, realizing that a colony could not be maintained there because of the hostile aborigines.

Probably in 1007, Karlsefni returned to Iceland, where the story of his exploits was finally written down. The various place names

mentioned in this are impossible of definite identification with localities on the American continent, since no genuine Scandinavian remains of those times have been found there. There seems, however, little doubt that Helluland (Flagstoneland) is Labrador; while Markland (Woodland), the next land south of this, has often been looked upon as identical with Nova Scotia or Newfoundland, but it might as well be sought on the south coast of Labrador, where almost certainly Furdustrandir (Wonderstrands) are to be found. As Prof. Steensby has pointed out, no place on the east coast of America tallies so well with the description of those desolate strands as the low coast west of Cape Whittle. In such case Straumfiord, where Karlsefni wintered twice, has probably to be looked for within the Gulf of St. Lawrence, and Chaleur bay is possibly identical with it. Vinland (*q.v.*) must, however, be sought somewhere on the coast of New England.

After Karlsefni's expedition Icelandic sources mention only two sailings towards those lands from Greenland; the first of these was in 1121, when Bishop Eric of Greenland left for Vinland, probably as a missionary, but he was never heard of again. In 1347 there arrived in Iceland a ship of Greenland which had been to Markland for timber, but had been driven out of its course. This may indicate that such trips were made now and then from Greenland, although only this one is on record. The Greenland colony probably existed until the 15th century, but at that time its connections with those lands discovered in the west as well as with the mother country had ceased. Although Columbus may have visited Iceland some years before his discovery of America, there is no reason to believe that he heard of these early Norse discoveries, or that they in any way influenced him.

An attempt has been made by Dr. Sophus Larsen to show that a combined Danish-Portuguese expedition under Didrik Pining and Pothorst reached the coast of Labrador or Newfoundland shortly after 1472, thus substantiating the alleged discoveries in those regions by the elder Corte Real. The evidence presented in support of this is partly indirect and hence dubious, and partly drawn from late sources which are not authoritative.

For the bibliography of this subject see H. Hermannsson, *Northmen in America 982-c. 1500* (Ithaca, N.Y., 1909). In addition to the titles given under LEIF ERICSSON the following may be mentioned: F. Nansen, *In Northern Mists* (1911); W. H. Babcock, *Early Norse Visits to America* (1913); W. Hovgaard, *The Voyages of the Norsemen to America* (1914); H. P. Steensby, *The Norsemen's Route from Greenland to Vinland* (Copenhagen, 1918); G. M. Gathorne-Hardy, *The Norse Discovery of America* (1921); S. Larsen, *The Discovery of North America Twenty Years before Columbus* (Copenhagen, 1924); H. Hermannsson, *The Problem of Vinland* (1936).

(H. He.)

AMERICAN ACADEMY IN ROME, THE, situated on the Janiculum, in Rome, Italy, comprises a school of fine arts and a school of classical studies. It was founded in 1894 under the leadership of Charles F. McKim. It is administered by a director and staff in Rome, and a president and board of trustees in New York city. The school of fine arts includes departments of architecture, painting, sculpture, landscape architecture and musical composition. Mature students of advanced attainment are chosen, through annual competitions, as Fellows, for a term of one or more years. Residence and studio are provided in the academy without charge, and stipends are granted to cover the cost of living and travel. There is no formal instruction, but work of certain kinds and travel in classic lands are prescribed. Results of research and reproductions of the work of the artists are published in the *Memoirs or Papers and Monographs of the Academy*. By giving its selected artists and scholars opportunities for intimate association through study and travel in an atmosphere of art and amid the inspiration of masterpieces, the academy aims to contribute toward the elevation of American art and letters.

(J. K. S.)

AMERICAN AGRICULTURAL CHEMICAL COMPANY, THE. The present company was incorporated under the laws of the state of Delaware on Dec. 8, 1913, and in 1930 was reorganized taking over at that time a predecessor company (the Connecticut company) which had been incorporated back in 1899 and which, over a period of years, had acquired a good many smaller companies. It is one of the largest producers and distribu-

tors of fertilizer in the United States and operates as well in Canada and Cuba, producing and distributing its products under "AA Quality" and "Agrico" registered brand names.

In addition, it manufactures and distributes insecticides and a line of chemicals. Its Florida phosphate rock properties are sufficient to supply its needs for this basic material for decades to come.

The company has no funded debt, its capital consisting of common stock only.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, founded in 1848 and incorporated in 1874, is an organization which "aims to advance science in the New World in every feasible way." Its membership is approximately 21,000 in 1940, the majority of the members residing in the United States and Canada. It has two divisions, which are autonomous: the Pacific division and South-western division. In addition to individual membership there are connected with the association 174 wholly autonomous and independent associated scientific societies including 33 State academies. The association has 15 sections, representing the main current subdivisions of science, each designated by a letter, as follows: A (Mathematics), B (Physics), C (Chemistry), D (Astronomy), E (Geology and Geography), F (Zoological Sciences), G (Botanical Sciences), H (Anthropology), I (Psychology), K (Social and Economic Sciences), L (Historical and Philological Sciences), M (Engineering), N (Medical Sciences), O (Agriculture), Q (Education). Funds are received and administered for the advancement of science and education. The permanent endowment in 1939 amounted to over \$252,000, the income being devoted mainly to grants for scientific research. A volume of summarized proceedings is published at intervals of about four years, including a directory of members. Current expenses are cared for by membership dues. Each member in good standing receives *Science*, the official journal, or the *Scientific Monthly* may be taken instead. The annual meeting occurs during the Christmas holidays, at which time a number of the associated and affiliated societies meet with it for the reading of papers. Its headquarters are in the Smithsonian Institution building, Washington, D.C.

AMERICAN ASSOCIATION OF ADVERTISING AGENCIES, an organization comprised of approximately 125 of the leading advertising agencies in the U.S. It was organized in 1917, with a small group of agents, but now its members place about 75% of national advertising. The purposes of the association centre around the improvement of advertising and advertising procedure. It has promulgated a standard of ethics for the advertising business which is widely quoted and followed. Correction of such unethical practices as rebating, making false claims in advertising and unfair methods of soliciting business in its field has been one of its important activities. The association maintains a research committee which makes qualitative surveys of media circulation. It also maintains an export department which operates a rate and data file covering advertising media of the entire world. This is primarily in the interests of the manufacturer or advertising agency which advertises in foreign countries. While this service is maintained primarily in the interests of members, much of the data it has on file is available to those who have a legitimate need for it. It also contributes to the organized effort to improve consumer-advertiser relations, especially to make the economics of advertising better understood by those who buy advertised goods, and to foster such informative advertising copy that consumers as well as advertisers will benefit from it. (H. E. A.)

AMERICAN BANK NOTE COMPANY, THE, an organization in the field of "security" engraving and printing, specializing in quality of workmanship and effective safeguarding during manufacture. In addition to an extensive business in the United States, more than 40 other countries are its customers for bank-notes, postage stamps, revenue stamps, bonds and similar work requiring the protection against counterfeiting given by fine engraving. The business of engraving and printing securities in the United States was founded during the American Revolution by Paul Revere of Boston. His first work of importance was the making of some paper money for the colony of Massachusetts

bay, now the State of Massachusetts. The business was subsequently carried on by various partnerships until 1858 when it was incorporated as the American Bank Note company. In 1879 the National Bank Note company and the Continental Bank Note company were consolidated with it. At various times since the American Bank Note company has acquired the capital stock and property of other concerns. Among these were the Franklin- Lee Bank Note company, Western Bank Note and Engraving company and International Bank Note company. In 1906 the United Bank Note corporation was organized to acquire the stock of the Consolidated American Bank Note company. In 1911 the United Bank Note corporation merged with it and assumed the name American Bank Note company.

As of March 31, 1940 the Company had outstanding 89,913 shares of \$50. par value preferred stock and 652,773 shares of \$10. par value common stock. Total assets amounted to \$17,025,234 and the earned surplus was \$4,068,566. The Company's principal office and engraving and printing plant are in New York City. An important manufacturing branch is located in Chicago and sales offices are maintained in several of the principal cities of the United States and subsidiaries in Canada and England.

(A. L. Sc.)

AMERICAN BAR ASSOCIATION, a voluntary association of lawyers and jurists organized at Saratoga, N.Y., in 1878. Its object, as defined by its constitution, is "to advance the science of jurisprudence, promote the administration of justice and uniformity of legislation and of judicial decision throughout the nation, uphold the honour of the profession of the law, encourage cordial intercourse among the members of the American Bar, and to correlate the activities of the Bar organizations of the respective States on a representative basis in the interest of the legal profession and of the public throughout the United States." The association in 1940 had about 32,000 members, residing throughout all of the United States proper and in Hawaii, Puerto Rico, Philippine islands and in foreign countries. The work of the association is supervised by its House of Delegates, acting through a board of governors. There were in 1940, 12 standing and 18 special committees appointed by the president. In addition to the committees, there were 14 self-perpetuating sections which elected their own officers, while remaining intimately affiliated with the work of the association. Thus, the association, through its committees and the affiliated sections, covers the whole field of the law, including among its activities the adoption of canons of the professional and judicial ethics and advancing the standards of legal education; the introduction and support of measures in Congress for the improvement of the administration of justice; defence of the guarantees of the Bill of Rights; defence of the power and jurisdiction of the Federal courts; the recommendation of proposed uniform State laws; and the defence of the rights of the poor. The American Bar Association publishes a *Year Book* and an official organ monthly called the *American Bar Association Journal*.

(S. H. S.)

AMERICAN CAN COMPANY, THE, was incorporated in 1901. It was a consolidation of 65 manufacturers of metal containers for foods, chemicals, tobacco, paints and many other products, and is the leading producer in its field. Its manufacturing plants are situated in 50 cities of the United States (21 States), Canada and Hawaii. The company's products include, besides both tin and fibre cans and fibre milk containers, packages and metal receptacles; metal-ware, sheet-metal and other metal manufactures; machinery and tools for all its activities.

From 1903 to 1939, the plant and real estate account increased from \$77,000,000 to \$110,000,000 after eliminating in 1937 the amount of \$44,594,000 representing the intangible assets included in the plant account. The corporate surplus increased \$47,593,697, reaching a total of \$50,255,972 in 1939. In 1939 the company's total current assets were \$76,995,395; total assets, \$190,983,759; net working capital aggregated \$56,257,686, in which effect is given to the receipt of \$10,000,000 on Feb. 1, 1939 from the First National Bank of New York in exchange for an issue of the company's ten year 2½% debentures due Feb. 1, 1949. In addition to this small amount of debt, the capital stock consists of \$41,-

233,300, 7% non-callable cumulative Preferred (par \$100), and \$61,849,950, Common (par \$25). (H. W. PH.)

AMERICAN CAR AND FOUNDRY COMPANY, a leading manufacturer in the United States of railway equipment and various allied products. Its incorporation in 1899 effected the union of 13 important manufacturing concerns, situated in eight different States from New York to Missouri, with the avowed purpose of engaging in the manufacture of railway cars and supplies, cast iron pipe and other foundry products. During the period following 1899 eight other similar companies, with various subsidiaries, were acquired. When the company was organized, the standard equipment on American railways comprised only wooden passenger coaches, of slight protection to passengers in case of collision, and wooden freight cars limited to a capacity of only 60,000lb. and, owing to the type of construction, to a very short period of service. To the great revolution that has since taken place in the character of railway carriers and equipment, the company has made substantial contributions. Old plants have been modernized and new plants have been built. In 1940 the physical property of the American Car and Foundry Company included 3 passenger car plants, 8 freight car plants, 5 wheel foundries, 6 gray iron factories, 1 rolling mill and forge, and a plant for building car floats, small commercial boats and motor yachts.

Moreover, it controlled subsidiaries equipped for making motor-buses, motor rail cars, electric railway cars, internal combustion engines, carburetors and forge-welded and fusion-welded steel tanks.

The large working capital has been provided from earnings.

AMERICAN CIVIL WAR, a conflict lasting four years in the United States of America between eleven States of the South, which asserted their right to leave the Union, and the States and Territories of the North, which were determined to maintain the Union. The Southern States contained slightly over half the population of the Northern States which remained in the Union. At the opening of the conflict, an independent government, the Confederate States of America (*q.v.*) was set up. The Civil War began when the guns of the South fired on the Federal Fort Sumter on April 12, 1861, and ended with the surrender of General Lee at Appomattox on April 9, and of General Johnston at Greensboro on April 26, 1865. Approximately 4,000,000 troops took part in the war, which resulted in the preservation of the Union, the abolition of slavery, and many important social and economic changes.

For the sake of clearness, the names of Confederate statesmen, soldiers and ships are in italics.

Charleston Harbour, 1860-61.—During the last months of Buchanan's presidency a succession of events occurred, which brought the United States to the verge of armed conflict between the rival sections. South Carolina seceded from the Union (Dec. 20, 1860), and Governor *Pickens* sent commissioners to Washington to claim possession of the forts in Charleston harbour and all other U.S. property in his State. Anderson, commanding the Federal garrison, secretly transferred his two weak companies from Ft. Moultrie, which was untenable against a land attack, to Ft. Sumter in the mouth of the harbour (Dec. 26). *Pickens* seized the arsenal and other forts and began throwing up batteries against Sumter, whilst his commissioners at Washington demanded the recall of the Federal troops from Charleston. This demand Buchanan refused. He had already (Dec. 3) in his message to Congress denied the right of secession, though he qualified this denial by expressing the opinion that the Constitution gave him no right to attempt coercion. An unarmed steamer with supplies and reinforcements was sent to the relief of Sumter, but it turned back when fired on as it was entering the harbour (Jan. 9). *Pickens* sent a fresh envoy to demand the surrender of Sumter. Between Jan. 9 and Feb. 1 six other States followed South Carolina's example. Their governors without attempting negotiation seized all the forts and arsenals in their respective States except Ft. Pickens in Pensacola harbour. Delegates from the seceding States met at Montgomery, Ala., organized the Confederate States of America, and set up a pro-

visional Government with *Jefferson Davis* as President. His inauguration took place on Feb. 18. The Confederate Government now assumed control of the negotiations about Sumter. Neither Buchanan nor *Davis* was anxious to precipitate a crisis. The former's fervent desire was to leave the solution of the whole problem to his successor; *Davis* was chiefly concerned to get his administration in working order, whilst Buchanan with a "no



THE FIRST "WHITE HOUSE" OF THE CONFEDERATE STATES, MONTGOMERY In Dec. 1860, South Carolina seceded from the Union. By Feb. 1861 six other States had followed her example. Their delegates assembled at Montgomery and organized the Confederate States of America, with *Jefferson Davis* as president. The building now stands near the State Capitol

coercion" policy was in office, and present the latter's successor with a *fait accompli*. In spite of the remonstrances of *Pickens*, who urged the importance of securing Sumter before Buchanan quitted office, the question was temporarily shelved, though *Beauregard*, an engineer officer of distinction, was sent to Charleston to complete the preparations for attacking Sumter. The day after *Beauregard* reached Charleston, Lincoln was inaugurated at Washington (March 4, 1861).

It was a difficult problem which confronted him. Seven slave States had seceded, but eight still remained in the Union. Any attempt at coercion would throw all these States, except Delaware (which practically counted as a northern State), into the arms of the Confederacy. With these siding with the seceders or even maintaining neutrality as between the two combatants, it seemed impossible to restore the Union by force of arms. At this stage neither side wanted war; certainly not the North, where a strong feeling was growing in favour of letting "the wayward sisters depart in peace"; the South was less reluctant to face the risk, because its leaders were confident that the other slave States would rally to their help, but they were no less confident that, if peace could be maintained, these States would soon seek admission to the Confederacy. Lincoln's inaugural speech was really addressed to the slave States still in the Union; to the Confederate States it sounded like a declaration of war. But they sought to avoid the responsibility of striking the first blow. Theirs was a defensive rôle, that of a newborn nation only asking to be left alone. They hoped to force Lincoln's hand over Sumter. Anderson's position there was daily growing more difficult. The late administration had imposed a policy of inaction. He would himself have gladly evacuated the fort to avert a civil war. But his duty as a soldier compelled him to sit there with folded hands, whilst the enemy were completing their preparations. His provisions would be exhausted by mid-April. The Confederate batteries had made such progress that he doubted whether it was still possible to relieve the fort, unless possession of the whole harbour were secured, and for that purpose he estimated that 20,000 men would be required. The whole U.S. army only numbered 17,000 men, most of whom were scattered in small posts on the Indian frontier, whence they could not be hastily withdrawn. Only on March 5 did Lincoln learn that Anderson might be starved into surrender. Gen. Scott, his chief military adviser, urged evacuation on military grounds. But Lin-

coln had pledged himself "to hold, occupy and possess the property and places belonging to the Government." It would be fatal to the prestige of his administration to start by going back on his word. Evacuation might seem a virtual recognition of the Confederacy. He determined to send food supplies only to Sumter. If the Federal flag was fired on, that would constitute a *casus belli*. The responsibility of beginning the war would be thrust upon the Confederates. To prevent them from pleading a misunderstanding, he gave *Pickens* precise information of his intention. Lincoln must have foreseen the actual event. But only by war could the Union be restored, and the sooner war came, the better; the longer the Confederate Government was allowed to function unchallenged, the more difficult it would become to unite the North in resistance to its "declaration of independence." Lincoln's despatch was delivered to *Pickens* (April 8), who promptly informed his President. From Montgomery orders were sent to *Beauregard* to reduce Sumter. On Anderson's refusal to evacuate, the batteries opened fire at 4:30 A.M. on the 12th. The bombardment continued without intermission till the afternoon of the next day, when Anderson agreed to surrender. At noon of the 14th Anderson evacuated the fort and the Federal flag was lowered. The ready acceptance of Lincoln's challenge by the South was probably due to the desire of its leaders, who now realized his steadfast purpose, to provoke a collision for fear lest the ardour of their people, a considerable minority of whom were originally opposed to secession, might abate. At that date Fts. Sumter and Pickens were the only places where they could strike a blow, and they selected the more vulnerable.

The Call to Arms.—The fall of Sumter "set the heather on fire" in the North. Democrats were at one with Republicans in denouncing this crowning insult to the national flag. Lincoln called for 75,000 militia for three months' service (April 15). Not that he underrated his task, but he intended to start by treating secession as an act of insurrection. To suppress insurrection was a constitutional function of the militia, but this force could only be held for three months' service outside its own State. The free States enthusiastically responded to the call, but the governors of the seven slave States still in the Union, except Hicks of Maryland, refused to raise their contingents. The Virginia convention passed an ordinance of secession (April 17). Governor *Letcher* immediately seized the Harper's Ferry arsenal and Norfolk navy yard, and without waiting for popular confirmation of the convention's action entered into a military alliance with the Confederacy. North Carolina, Arkansas and Tennessee took the same course. If they had to choose between fighting for and against the Confederacy, they unhesitatingly threw in their lot with their sister States of the South. But Western Virginia beyond the Alleghanies, which had its own personal grievances against the eastern section of the State and belonged geographically to the Ohio valley, repudiated the ordinance of secession and prepared to join the North. In Maryland there was a considerable secessionist minority, chiefly concentrated in Baltimore, where a riot occurred (April 19), as a Massachusetts regiment was passing through to Washington. For three weeks Baltimore was in the hands of the secessionists and the movement threatened to spread through the State. Washington was cut off from direct railway communication with the North. But troops were brought round by water to Annapolis, whence they were railed to the capital. No help came to Baltimore from Virginia, and Governor Hicks outmanoeuvred the local leaders of insurrection by pretending to yield to their demands, until Butler with a small force made a sudden dash at the city and occupied it unopposed (May 13).

In Kentucky parties were fairly equally divided. There was general sympathy for the South, of which the State regarded itself as a part, but also a genuine devotion to the Union. If the governor favoured secession, a small majority in the legislature was opposed to it. His refusal to supply Lincoln with troops met with no protest from the Unionists, who at first concentrated upon keeping the State neutral. But neutrality could not be a permanent attitude. It gave too great an advantage to the Confederates, who drew food supplies from Kentucky and were

sheltered from invasion along their western front from the Alleghanies to the Mississippi. Sooner or later the Federal armies must occupy Kentucky as a base for an offensive campaign. But a premature movement would drive Kentucky into secession and to lose Kentucky would be "nearly the same as to lose the whole game," in Lincoln's judgment. Understanding the feelings of his fellow Kentuckians better than any of his counsellors at Washington, he handled the critical situation with consummate tact. It was worth suffering some temporary disadvantage to win Kentucky in the end. The legislature steadily refused to summon a convention, which might declare for secession. The governor was too good a Kentuckian to overstep the constitutional limits of his office. In August a new legislature was elected with an overwhelming Unionist majority. The inevitable decision was hastened by the tactless policy of the Confederacy. Kentucky declared for the North (Sept. 20).

In Missouri, Governor *Jackson* was a violent secessionist, eager to go all lengths to take his State out of the Union, and the legislature seemed ready to support him. But the convention, which was summoned, was overwhelmingly Unionist. An extreme section of Unionists, led by F. P. Blair, whose brother was in Lincoln's cabinet, and largely recruited from the Germans in St. Louis, was ready to meet violence with violence. The St. Louis arsenal, the best equipped in all the slave States, was too rich a prize to be allowed to fall into *Jackson's* hands. But in February Scott had placed in it a sufficient Federal force to secure it against sudden surprise, and in March the convention had adjourned without even discussing secession. A large majority of the people favoured neutrality, and a policy of conciliation would probably have preserved peace within the State, as in Kentucky. But Lincoln allowed himself to be guided by the Blairs. Their agent was the fanatical Capt. Lyon, who broke up (May 10) a militia camp close to St. Louis on the ground that *Jackson* was planning an attack on the arsenal, and his return to the city with his prisoners caused a riot with considerable loss of life. This premature appeal to force and the use of Federal troops caused a revulsion of feeling. Civil war became inevitable, when Lyon was appointed temporary commander of the department. He promptly ascended the Missouri with a small force, occupied the State capital, Jefferson City (June 15) and routed a body of secessionist militia at Booneville (June 17). After this defeat *Jackson* fled to the Arkansas border.

Lincoln by undertaking definitely a policy of coercion had lost four more of the slave States, but secured three, and West Virginia was soon to make a fourth.

The Military Outlook.—Twenty-two States (including Kentucky and Missouri) were now arrayed against eleven, and the white population of the former was four times that of the latter. But the $3\frac{1}{2}$ million slaves in the South, so far from being a danger, proved of great assistance, supplying the labour required for the production of food and construction of fortifications. Over two-thirds of the officers and all the men of the U.S. army were on the side of the North; so too was the navy. In material resources and business capacity the North was overwhelmingly superior. All the manufacturing centres were within its borders, all the shipping in its hands. The South was dependent upon it for practically everything except food. But in spite of these advantages the North was likely to find its strength taxed to the uttermost. To restore the Union the South would have to be conquered piecemeal and resistance crushed throughout the whole region, which was "30,000sq.m. larger than the combined areas of Austro-Hungary, Germany, France and Italy, with Belgium, Holland and Denmark thrown in." Neither a few victories in the field nor the capture of the Confederate capital would end the struggle, but only the permanent occupation of great stretches of Southern territory. The country in which the invading armies must operate was sparsely inhabited, with few cities, poor railways and worse roads. Except in a few favoured districts an army could not find subsistence but would have to carry its supplies with it. Consequently it would be tied to its lines of communication; viz., single track railways and rivers. East of the Alleghanies the rivers ran down to the Atlantic across the line of the invader's

advance and constituted formidable obstacles, but to the west the Mississippi, the Tennessee and Cumberland rivers opened a way into the heart of the Confederacy. Their superiority in mechanical resources enabled the Federals to gain command of these rivers with squadrons of gunboats, to which the Confederates could only oppose a few untrustworthy craft. The possession of the navy similarly secured to the North command of the sea. In a war of attrition the blockade would prove a potent weapon. The rôle of the North seeking to reconquer the South was necessarily offensive; that of the South fighting to win its independence mainly defensive. Against such heavy odds the Confederates could not hope to conquer the North, but they expected to make the task of reconquest so costly in life and money that public opinion in the North would demand its abandonment, and in this they nearly succeeded. But at the outset they made a miscalculation. They cherished the delusion that "cotton was king" and that a stoppage of their cotton supply would compel the intervention of Great Britain and France. But in 1861 there happened to be in England, at least, abundant supplies on hand owing to the previous year's record crop, and a glut of manufactured cotton goods. The manufacturers disposing of their accumulated stocks at rising prices had no wish to see the blockade raised. In 1862 and 1863 cotton was exported from Liverpool to New York. The pressure of the "cotton-screw" was not felt till the time for intervention had passed. Yet it was this groundless belief in foreign intervention which dictated *Davis's* military policy in the first stage of the war. He believed that within 12 months at longest, Britain and France would come to his aid, unless he intensified the prejudice felt against the Confederacy as a slave power by wantonly invading the North.

Both sides had to create their armies before they could fight. Here the South had a distinct advantage. The officers who resigned their commissions contained a disproportionately large number of the ablest men in the old army; the two *Johnstons* and *Lee* had been pre-eminent in their profession. *Davis* was a graduate of West Point, had served seven years in the regular army, later as a volunteer won distinction in the Mexican War, had been secretary of war and was chairman of the military committee in the Senate till just before the outbreak of the Civil War. He could be trusted to appoint the best officers to command his armies and to see that the first steps in military organization were wisely taken. Lincoln was void of military experience, had no knowledge of the professional merits of his officers and personal acquaintance with but a few, including McClellan, and no business training. His appointments were too often made for political reasons. Banks, Butler and Frémont were flagrant instances. Again, the Southerners could be more quickly trained as soldiers. There was an aristocracy accustomed to rule, and another class of whites who recognized its claim to their obedience. Under the patriarchal conditions of Southern civilization its men were more robust, accustomed to an open-air life, of pugnacious disposition, trained to the use of gun and horse. The democratic North except in the west, did not provide such good fighting material. The Federal armies were uniformly more successful in the West, where the troops on both sides were much of the same class and the North's superior resources turned the scale, whereas in the East townsmen and European immigrants were fighting against country-bred men. But, given time, the quality of the Northern armies would improve and throughout the advantage of superior numbers would be theirs. But this advantage would be least felt in the first months of the war. The initial problem of both governments was not how to raise men, but how to equip them. There were more volunteers than could be armed. The stocks in the arsenals were quickly exhausted. The South had at least its fair share of them, and *Davis* was purchasing arms in England. But the meagreness of his order (10,000 rifles) indicates that he did not anticipate a lengthy war.

The Opening Moves, April-Aug. 1861.—In the first days Washington, shut in between Virginia and Maryland, had been in danger, but by the end of April was secure against a raid, and a fortnight later railway communication with the North through Baltimore was re-established. *Lee*, commanding the Virginia State

forces, was loath to become the aggressor and refrained from attacking Washington or helping Baltimore. Lincoln had proclaimed a blockade of the Confederate ports (April 19), and called for 42,000 three-year volunteers and 40,000 more men for the regular army and navy (May 3). He was awaiting the result of the referendum to be taken in Virginia on May 23 and scrupulously avoided any violation of Virginian territory. Federal troops crossed the Potomac (May 24) and without opposition occupied the south bank for the protection of the capital.

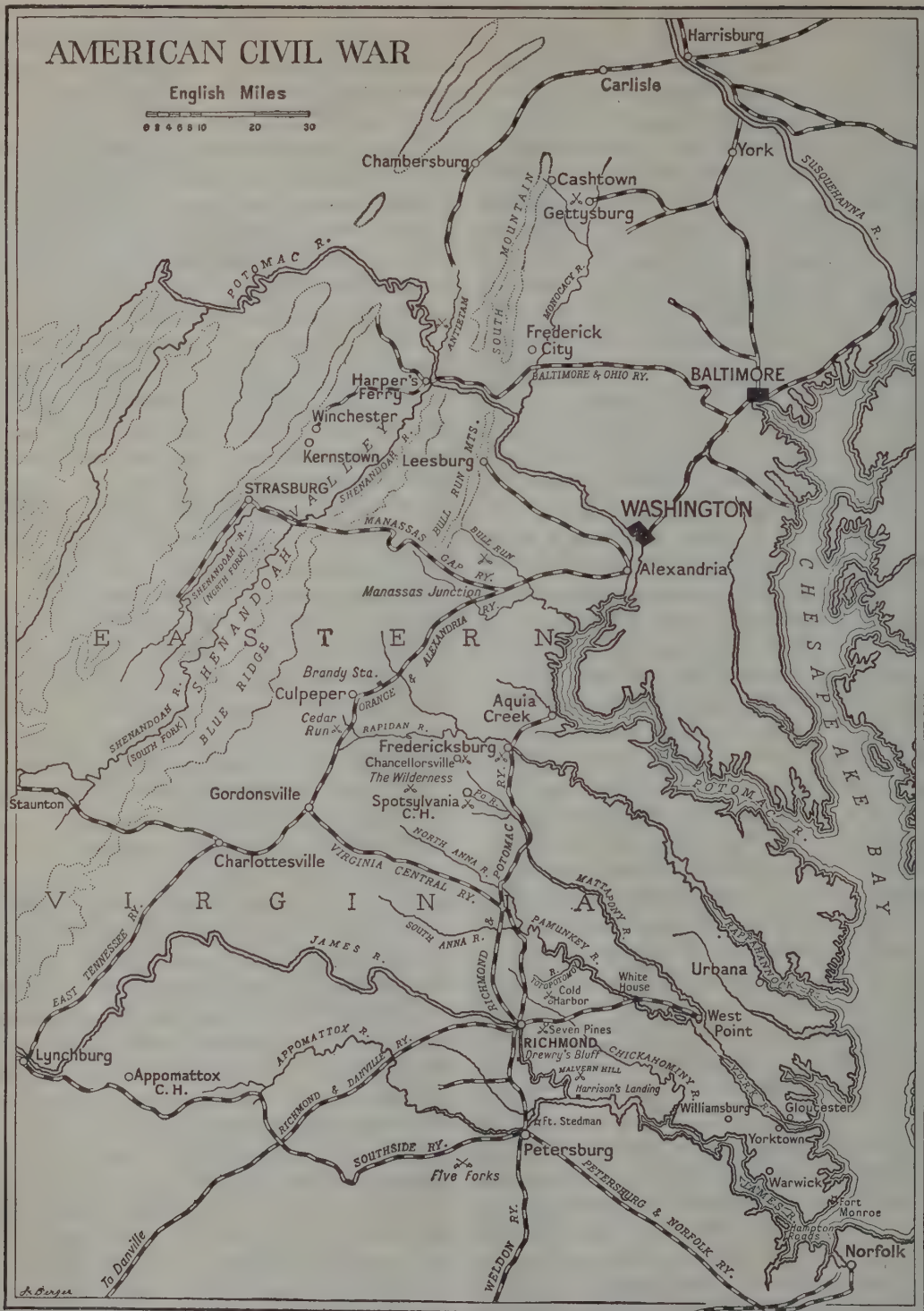
Scott had little faith in the militia. He proposed to use them to defend Washington and recover Harper's Ferry, whilst he trained the volunteers for an autumn campaign. Washington was served by two railways, the Orange and Alexandria (O. and A.) running southward to Lynchburg and the Baltimore and Ohio (B. and O.) passing through Harper's Ferry. The former was joined at Manassas Junction, 30m. from Washington, by the Manassas Gap railway from Strasbourg in the Shenandoah valley. The Valley (as it was commonly called) between the Blue Ridge and the Alleghenies was of great strategic importance, providing the Confederates with a covered line of advance into Maryland and giving them control of a considerable section of the B. and O. railway. To the Federals it was of less offensive value, as its direction led away from Richmond, but its possession would enable them to strike at Richmond's direct line of railway communication with the West.

Lee, now acting as *Davis's* military adviser, was gathering two armies, one under *Beauregard* at Manassas Junction, the other at Harper's Ferry under *J. E. Johnston*. The latter evacuated his post (June 15) when Patterson with a larger force threatened attack, and fell back covering the Manassas Gap railway.

The Richmond authorities had vainly attempted to retain their hold on the western section of the State. Having failed to raise recruits from the district itself for its defense, they sent a small force to hold the crests of the Alleghenies. But McClellan crossed the Ohio and overwhelmed it (July 11-13) at Rich Mountain and Carrick's Ford. Meanwhile a convention at Wheeling had repudiated secession and set up "a Restored Government of Virginia." West Virginia's defection was a serious blow to the Confederates, losing them the Ohio, which they intended to make their line of defense, and the western portion of the B. and O. railway.

At Washington there was a demand that *Beauregard* should be attacked before the term of the militia's service expired. "On to Richmond," the new capital of the Confederacy, was the popular cry. On political grounds a plausible case could be made out for overruling Scott's advice. McDowell, whom Scott, too old and infirm for service in the field, had appointed commander of the forces south of the Potomac, submitted a plan of operations (June 24). With 30,000 men he proposed to drive *Beauregard's* 20,000 back behind the Rappahannock, provided that Patterson prevented the Confederates the advantage of "interior lines." McDowell advanced from Alexandria (July 16). The two armies met (July 21) at Bull Run (*q.v.*), where after several hours' fighting the Federals left the field. Their retreat became a panic-stricken flight, which carried them back to the Potomac. The Confederates were too disorganized to conduct an immediate pursuit. Presently they advanced to Centreville, where they established their main position and waited for the Federals to make the next move. Washington quickly recovered from its alarm. McClellan was summoned from West Virginia and started to organize a fresh army. The first pitched battle of the war was barren of decisive results.

In the west a neutral Kentucky interposed a barrier between the combatants, but there was some fierce fighting in south-west Missouri. Lyon pursued *Jackson* as far as Springfield, where he halted to await reinforcements. Ex-Governor *Price*, commanding the State militia, raised a fresh force and being joined by *McCulloch's* troops from Arkansas advanced against Lyon, who being left unsupported was defeated and killed at Wilson's Creek (Aug. 10). This battle too lacked decisive results. *McCulloch*, having entered Missouri without orders from the Government, retired after his victory into Arkansas, leaving *Price* to continue the struggle with his own resources.



EASTERN VIRGINIA ON THE OUTBREAK OF THE CIVIL WAR BECAME THE MAIN SCENE OF CONFLICT AND THROUGHOUT THE FOUR YEARS, 1861-65, CONTINUED TO BE THE MOST STUBBORNLY CONTESTED GROUND. HERE WAS THE BACKBONE OF THE CONFEDERACY WITH THE CONFEDERATE CAPITAL, RICHMOND. THE MAJOR CAMPAIGNS CONDUCTED IN VIRGINIA BY THE ARMIES OF THE UNION, BEGINNING WITH BULL RUN, LED TO MANY SANGUINARY CONFLICTS, THE MOST IMPORTANT OF WHICH ARE SHOWN ABOVE, AND CULMINATED IN THE SURRENDER AT APPOMATTOX

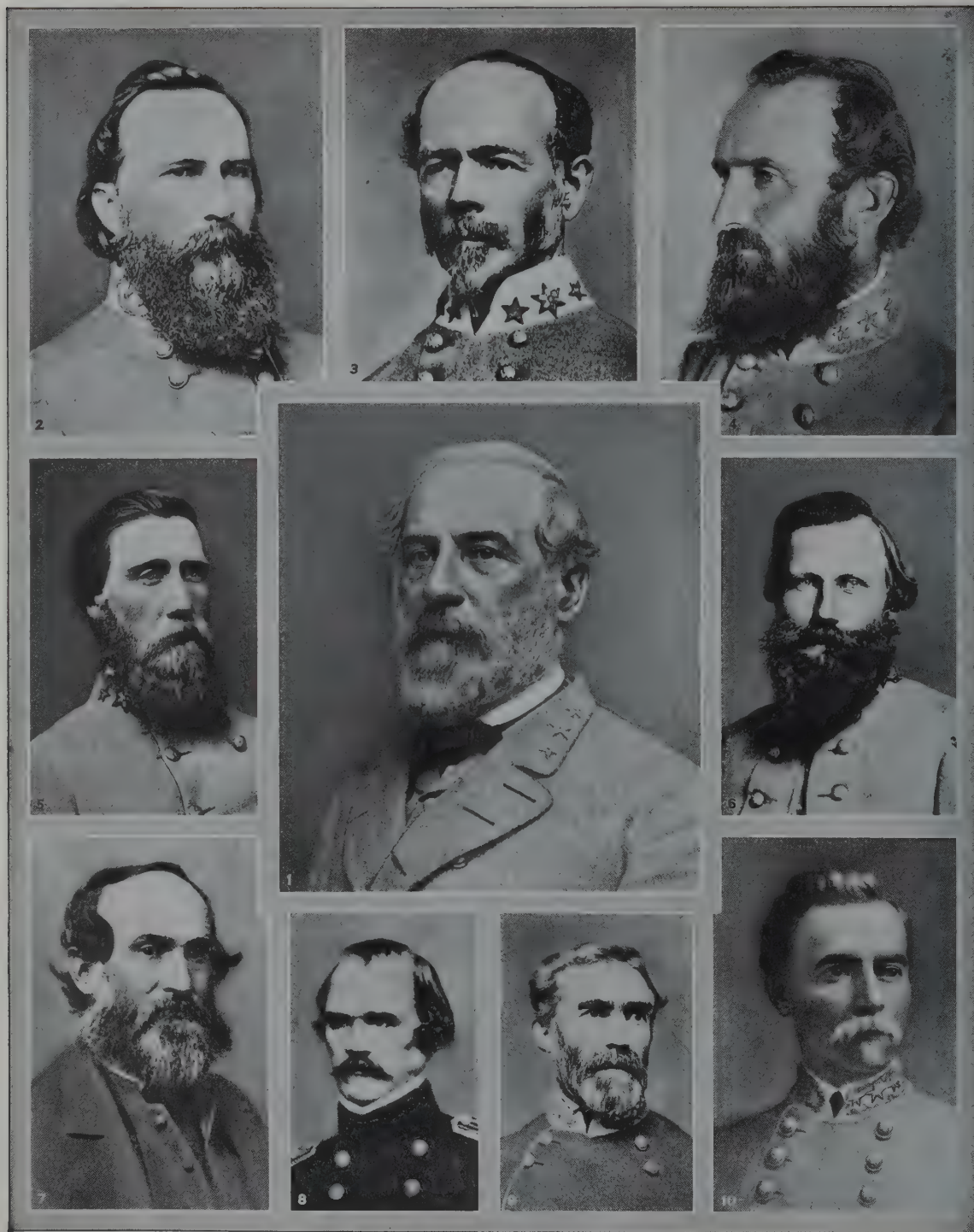


BY COURTESY OF (1, 2, 4-7, 9, 10) H. P. COOK, (3, 8) THE U.S. WAR DEPARTMENT

GENERALS OF THE UNION ARMY

1. Ulysses S. Grant (1822-85), created general-in-chief in March, 1864.
 2. W. S. Hancock (1824-86), commanded a brigade in the Army of the Potomac.
 3. W. T. Sherman (1820-91), who made the march through Georgia to the sea.
 4. G. B. McClellan (1826-85), organizer of the Army of the Potomac.
 5. H. W. Halleck (1815-72), general-in-chief of Union Armies, July 1862-64.
 6. "Fighting Joe" Hooker (1814-79), won the

"battle above the clouds."
 7. G. G. Meade (1815-72), defeated Lee's Army at battle of Gettysburg.
 8. P. H. Sheridan (1831-88), in command of the Army of the Shenandoah.
 9. A. E. Burnside (1824-81), in command of the Department of the Ohio, 1863.
 10. G. H. Thomas (1816-70), known as the "rock of Chickamauga"



BY COURTESY OF (1, 2, 3, 4, 5, 6, 8, 9, 10) H. P. COOK

GENERALS OF THE CONFEDERATE ARMY

1. R. E. Lee (1807-70), commander-in-chief of Confederate armies, February, 1865. 2. James Longstreet (1821-1904), "General Lee's war horse." 3. J. E. Johnston (1807-91), as commander of army of the Tennessee, conducted the campaign against Sherman in Georgia until July, 1864. 4. T. J. Jackson (1824-63) "Stonewall Jackson," Lee's chief subordinate. 5. J. B. Hood (1831-79), given command of army of the Tennessee, July, 1864. 6. J. E. B. Stuart (1833-64), held a command in army

of Northern Virginia. 7. J. A. Early (1816-94), in command in the Shenandoah valley, 1864-65. 8. A. S. Johnston (1803-62). (Photograph taken during his service in the United States army previous to the outbreak of the Civil War). 9. B. Bragg (1817-76), the commander of the Western Department, 1862-63. 10. P. G. Beauregard (1818-93), opened the war by bombardment of Fort Sumter

McClellan in Supreme Command.—The defeat at Bull Run was followed by "the second uprising of the North." Congress authorized the enlistment of 500,000 three-year volunteers, and again recruits poured in. McClellan excelled as an organizer and within three months added 100,000 men to the Army of the Potomac, whose discipline and training rapidly improved under his command. But in October public confidence in him began to abate. Confederate batteries on the lower Potomac, which closed its navigation, were left undisturbed, and the discreditable affair of Ball's Bluff occurred (Oct. 21) where four Federal regiments were ferried over the Potomac to make a reconnaissance towards Leesburg, but were driven back into the river with the loss of over half their numbers. Nevertheless on Scott's resignation he was appointed general-in-chief (Nov. 1). He was expected to open an offensive campaign while the "mud" roads in Virginia were still hard and dry. But though his forces were twice as strong as *Johnston's* at Centreville, he accepted the report of his secret service, which doubled *Johnston's* actual numbers. Moreover, in his new post he was engaged, as will be seen, in organizing the military resources in all theatres of war and despatching expeditions against the Confederate coast. Appreciating the value of sea power he was already contemplating the transfer of his army by water next spring to some point where he would be nearer to Richmond than *Johnston*. But he treated Lincoln with great want of consideration in keeping his plans a secret from him. In December he contracted typhoid fever and was absent from duty for some weeks.

The Confederate generals at Centreville had been vainly pressing *Davis* for reinforcements that they might enter Maryland. They realized the danger of prolonged inaction, while McClellan's army was daily growing stronger. If *Davis* could reinforce them with 20,000 trained men, they proposed to cross the Potomac and by threatening the communications of Washington force McClellan to risk a pitched battle, before he had time to train his raw levies. *Davis* in conference with his generals (Oct. 1) said that he had no reinforcements to spare; he could not withdraw troops from the coast, which was itself threatened with attack. Though the Confederate coastline extended 3,000 m. the Federals could make the blockade practically effective by sealing up the few important harbours and getting possession of the North Carolina "sounds." The forts guarding Hatteras Inlet had been captured (Aug. 29); those protecting the entrance to Port Royal, S.C., fell to another and larger force (Nov. 7); and a third expedition on a still larger scale under Burnside was being equipped against Roanoke island, whose capture would complete the conquest of North Carolina's "inland waters."

What, however, chiefly decided *Davis* to refuse his generals' request was his determination to stand strictly on the defensive in the belief that the war had been won at Bull Run, and that before the spring campaign could open, European intervention would end hostilities. Even in West Virginia, where Rosecrans, McClellan's successor, was pushing forward into the Kanawha valley, no real counter-offensive was attempted. *Lee* after Bull Run was sent to co-ordinate the operations of four separate detachments acting independently of each other. But he failed to produce an effective combination, and after his return to Richmond in October the loss of West Virginia was regarded as inevitable.

In the west, Confederate encroachments upon Kentucky's territory forced it into the war. Frémont, commanding in Missouri, was threatening an expedition down the Mississippi, which would involve the occupation of the Kentuckian shore. Therefore *Polk*, general and bishop, early in September seized Hickman and Columbus, which afforded strong defensive positions on the river, whilst Grant, one of Frémont's brigadiers, promptly replied by occupying Paducah and Smithland at the mouths of the Tennessee and Cumberland. *Polk's* refusal to withdraw his troops, unless Grant set the example, ended Kentucky's neutrality. A new theatre of war was opened up, the great extent of which offered immense possibilities to either side. McClellan on becoming general-in-chief set up in the west two military departments, that of the Missouri embracing all Kentucky west of the Cumberland under Halleck, and that of the Ohio including the rest of Kentucky

under Buell. *Davis* appointed A. S. *Johnston*, one of his ablest generals, to supreme command in the west. *Johnston* advanced into Kentucky and took up a defensive position with his left at Columbus and his right at the important railway junction of Bowling Green, whilst Forts Henry and Donelson in the centre guarded the approaches up the Tennessee and Cumberland. At the outset the Federals were ill prepared to take the offensive. In Missouri, Frémont had left everything in confusion. Kentucky appeared unable or unwilling to defend itself. The troops from the free States north of the Ohio had been largely diverted to West Virginia or Missouri. Lincoln and McClellan were at one in pressing Buell to advance into East Tennessee, Lincoln wishing to send relief to the distressed Unionists there and make of it a second West Virginia, whilst McClellan considered that the success of his campaign in Virginia depended upon the capture of the East Tennessee railway, Richmond's direct line of communication with the west. But the proposed movement presented great difficulties, especially so late in the year, when the roads were almost impassable. There was no railway or navigable river to serve as a line of communication for an invading force, whilst the enemy could bring up troops from east or west over their railway. Buell proposed a different plan. An offensive against *Johnston* should precede any movement into East Tennessee. Halleck with two "flotilla columns" should ascend the Tennessee and Cumberland and break through the Confederate line at its most vulnerable point. Buell would himself advance overland on Nashville, Tennessee's capital. This was the plan of campaign, which when carried out two months later met with brilliant success, but it found no favour with Lincoln, McClellan or Halleck. A small Confederate force advancing through Cumberland Gap into Kentucky was defeated by Thomas at Mill Springs (Jan. 19, 1862). This victory cleared the way for an advance into East Tennessee, but before Buell could follow it up, his attention was called to another quarter by an unexpected move on Halleck's part.

Beyond the Mississippi *Price* had marched north towards the Missouri, gathering up recruits as he went. All over the State, except in St. Louis, Southern sympathizers took up arms to avenge the violation of their "State rights." *Price*, not strong enough to attack St. Louis, aimed at crossing the Missouri to join the secessionists in the north of the State. He captured Lexington (Sept. 20). But Frémont's advance with 40,000 men forced him to retreat to the southwest border. Frémont followed in pursuit to Springfield, where he was relieved of his command (Nov. 2). He had won fame as an explorer in the Rockies, and in California during the Mexican War, and had been a candidate for the Presidency in 1856, but he now proved incompetent both as an administrator and in the field and was held responsible for Lyon's defeat. When *Polk* from Columbus established a post at Belmont on the Missouri bank, Grant descended the river and attacked Belmont (Nov. 7). He was eventually driven back to his boats and forced to re-embark. During the winter Halleck restored order out of chaos and made all preparations for driving *Price* finally out of the State.

On his return to duty in mid-January 1862 McClellan found two changes, both destined to affect his fortunes adversely. Congress had appointed a joint committee of the two houses on the conduct of the war, and Stanton had become secretary of war. McClellan now revealed his new plan of campaign to Lincoln, who first rejected it, but three days later reopened the discussion. McClellan offered a choice of three overseas routes, stating his own preference for a movement to be made with great secrecy to Urbana on the lower Rappahannock, where he would be within 50 m. of Richmond. He expected by a rapid advance from that base to cut off a Confederate force in the Yorktown peninsula and capture Richmond, before *Johnston* could intervene. Lincoln did not see how the preparations could be kept secret, and was sure that McClellan would still find *Johnston* between himself and Richmond. He objected to any movement which uncovered Washington and withdrew McClellan from interposing between the capital and *Johnston*. He gave, however (Feb. 27), a grudging assent to an overseas movement without specifying the actual point of disembarkation. Finally he forbade the Urbana plan and left

McClellan his choice between landing at Fortress Monroe at the end of the Yorktown peninsula, the route which McClellan considered the worst of the three, and making an overland campaign. McClellan chose the first alternative. Probably the withdrawal (March 9) of *Johnston* behind the Rappahannock reconciled him to the sacrifice of his Urbana plan. Throughout these discussions Lincoln demanded adequate protection for Washington, and McClellan undertook to leave ample forces for the purpose.

The Federal Offensive in the West, Feb.-May 1862.—The weak point in A. S. *Johnston's* line was at the centre, where the

nently on the defensive and that the concentration of his own forces would be effected without interruption. But *Johnston* and *Beauregard*, well served with information by local sympathizers, seized their opportunity. By calling up *Bragg* from Pensacola with 10,000 men they concentrated an army of nearly 40,000 at Corinth before the end of March. *Van Dorn* was bringing 15,000 men from Arkansas, but they could not wait for his arrival. The battle of Shiloh (*q.v.*) (April 6-7) was one of the most fiercely contested in the war. *Johnston* was killed the first day and *Beauregard* retreated to Corinth. Halleck joined his armies (April 11) and having been reinforced by Pope (April 21), who had captured with the help of the gunboats the garrison (7,000) of Island No. 10 with all its guns and stores, commenced a slow and cautious advance on Corinth. *Beauregard* held on to Corinth till May 30th, when he retreated to Tupelo. The evacuation of Corinth was followed by that of Ft. Pillow below Island No. 10 and Memphis (June 3). The Federal squadron fought and destroyed a Confederate flotilla at Memphis (June 6). With the capture of Corinth and Memphis the Federal offensive virtually ended. They had cleared Kentucky and West Tennessee of the enemy, established themselves on the M. and C. railway, and opened the Mississippi to Vicksburg. But the Confederate army of the west had escaped and would presently take the offensive.

West of the Mississippi Halleck had scored another success. *Price* had been driven out of south-west Missouri by Curtis, who followed him into Arkansas. *Van Dorn*, commanding in the newly formed Trans-Mississippi department, reinforced *Price*, and their combined forces attacked Curtis at Pea ridge (or Elk Horn) but suffered a severe defeat (March 7-8). Still farther west the Confederates had suffered another reverse. A small expedition under *Sibley* had been sent up the Rio Grande to secure Arizona and New Mexico with a view to bringing California into the Confederacy. *Sibley* occupied Santa Fe in March, but was forced by Canby in April to make a disastrous retreat to Texas, and the whole of the territory, which he had overrun, was secured permanently by the Federals. But of all the disasters suffered in the west by the Confederates in the spring of 1862 the greatest, because irreparable, was the loss of New Orleans. Farragut with the Gulf squadron ran past the forts guarding the lower Mississippi and appeared next day before the city (April 24-25), which, abandoned by its garrison, surrendered to the fleet, and was formally occupied by Gen. Butler's troops (May 1).

McClellan's Peninsular Campaign, March-July 1862.—The sensational appearance of the iron-clad "Merrimac" in Hampton Roads, at the mouth of the James river (March 8), had threatened the collapse of McClellan's oversea campaign, but next day the "Monitor" proved more than her match, and the naval authorities gave a doubtful assurance that they could cover the landing. The embarkation began (March 17); McClellan himself reached Fortress Monroe (April 2). On taking command in the field of the Army of the Potomac he had been relieved of his duties as general-in-chief. For the next four months Lincoln and Stanton were responsible for the "higher strategy." McClellan commenced his advance (April 4), expecting to move rapidly up the peninsula to the neighbourhood of Richmond, where he would fight and win the decisive battle, and capture the Confederate capital. He knew that Yorktown and Gloucester on opposite banks of the York river were fortified, but he counted on the co-operation of the navy to capture Yorktown and intended to land McDowell's corps, which had not yet arrived, on the left bank for the reduction of Gloucester. But the navy could give no help as long as the "Merrimac" was afloat; Lincoln detained McDowell for the protection of Washington on the ground that McClellan had not kept his promise of leaving it absolutely secure. McClellan was held up before Yorktown for a month (April 5-May 3).

J. E. *Johnston*, who had brought his army to the peninsula and assumed command at Yorktown (Apr. 17), slipped away just as McClellan was about to open fire with his siege batteries. A sharp rearguard action took place at Williamsburg (May 5), and an attempt to intercept *Johnston's* retreat by sending a force up the York failed. McClellan established his headquarters at White House on the Pamunkey (May 16). He had succeeded in bring-

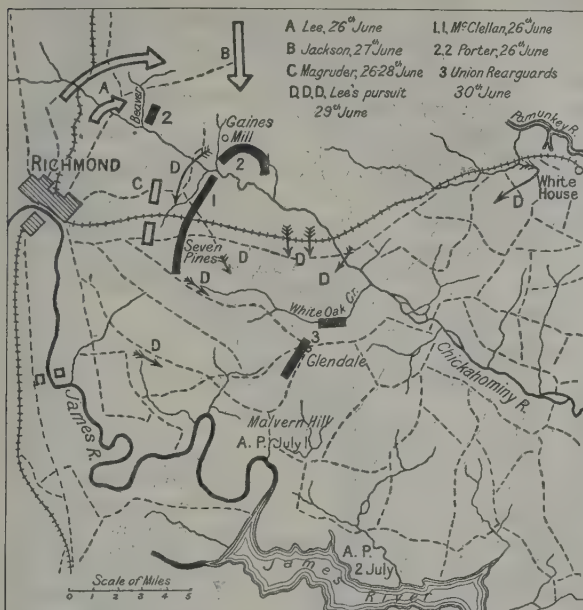


THEATRE OF THE FEDERAL OPERATIONS IN THE WEST. FEB.-MAY 1862

Memphis and Ohio railway, which formed the link between his two wings, crossed the Cumberland and Tennessee so close to Fts. Donelson and Henry that the capture of these forts would sever his line of communication with the Mississippi. The Tennessee was navigable as far as Tusculum in North Alabama, and the Cumberland up to Nashville. The Confederates had no gunboats on these rivers, and if these forts fell there was nothing to oppose the Federal advance to the Memphis and Charleston (M. and C.) railway, the direct line of communication between east and west. Halleck without orders from McClellan or arrangement for co-operation with Buell ordered Grant (Feb. 1) with 15,000 men and Foote's gunboats to ascend the Tennessee, capture Ft. Henry and destroy the railway bridge. Ft. Henry surrendered to the gunboats (Feb. 6), the garrison escaping to Ft. Donelson. *Johnston* evacuated Bowling Green, sending half his army to Ft. Donelson and retiring with the other half to Nashville. This division of forces proved fatal. The concentration of 18,000 men at Ft. Donelson did not prevent its surrender with the bulk of its garrison to Grant (Feb. 16). *Johnston* abandoned Nashville, which was occupied by Buell (Feb. 24), and took up his position at Murfreesboro, and *Beauregard*, sent from the east to command on the Mississippi under *Johnston*, evacuated Columbus (Mar. 2) after removing its armament to New Madrid and Island No. 10, where he intended to make the next stand against a Federal descent of the river. *Johnston* was thus thrown back to his second line of defence along the M. and C. railway with his wings at Memphis and Chattanooga and his centre at Corinth. Halleck's unauthorized movement had proved a brilliant success, but he was in no hurry to follow it up. Buell proposed that they should unite their forces as far up the Tennessee as possible on the east bank, cross the river and seize the M. and C. railway. The occupation of Corinth would secure control of the Mississippi down to Vicksburg. Halleck preferred to act independently, sending a strong force up the Tennessee to raid the Confederate communications on the west bank. Lincoln gave Halleck the supreme command in the west (Mar. 11) placing Buell under his orders.

Halleck now sent Pope with 20,000 men down the Missouri bank to capture New Madrid and Island No. 10, and summoned Buell from Nashville to Savannah on the Tennessee to join Grant encamped on the opposite bank at Pittsburgh landing. He assumed that the recent campaign had thrown the Confederates perma-

ing over 100,000 men (organized into five corps) within striking distance of Richmond, and only 60m. away on the Rappahannock opposite Fredericksburg lay McDowell's corps, now under orders to advance on Richmond on May 26. McClellan would have transferred his base from the York to the James, now open to the Federal war vessels as far as Drewry's Bluff, as the Confederates after the evacuation of Yorktown had abandoned Norfolk and



DISPOSITION OF OPPOSING FORCES JUST PRIOR TO THE RETREAT OF THE FEDERAL ARMIES FROM BEFORE RICHMOND, 1862

destroyed the *Merrimac*, which was unable to ascend the river. But, informed by Stanton that he was to be reinforced, he advanced to the Chickahominy (May 20) and sent two corps across in preparation for the advance on Richmond, keeping three on the left bank to join hands with McDowell. He retained this position with his wings divided by the Chickahominy, although he learnt (May 24) that McDowell's advance was suspended owing to "Stonewall" Jackson's operations in the Valley, hoping that McDowell's movement would shortly be resumed. Johnston concentrated against the two corps on the right bank and brought on the battle of Seven Pines (May 31-June 1). He was beaten off, and himself severely wounded the first day. Lee on assuming command withdrew the troops. McClellan moved two more corps to the right bank, leaving one to cover his communications with White House and still hoping for McDowell's coming. Lee's plan was to continue using Jackson in the Valley to prevent McDowell moving south, and at the right moment to bring him to Richmond to take part in the decisive battle. Jackson's successes (June 8-9) served to hold McDowell fast, and Lee learning (June 15) that McClellan's right was "in the air," next day ordered Jackson from the Valley. McClellan had been waiting for the ground to dry, that he might move his siege batteries to the front. On the 25th his outposts were only 4 m. from Richmond, and he telegraphed to Washington that the final advance was about to begin. He was too late. Next day Lee struck and the Seven Days' Battle began (*q.v.*) (June 26-July 2.)

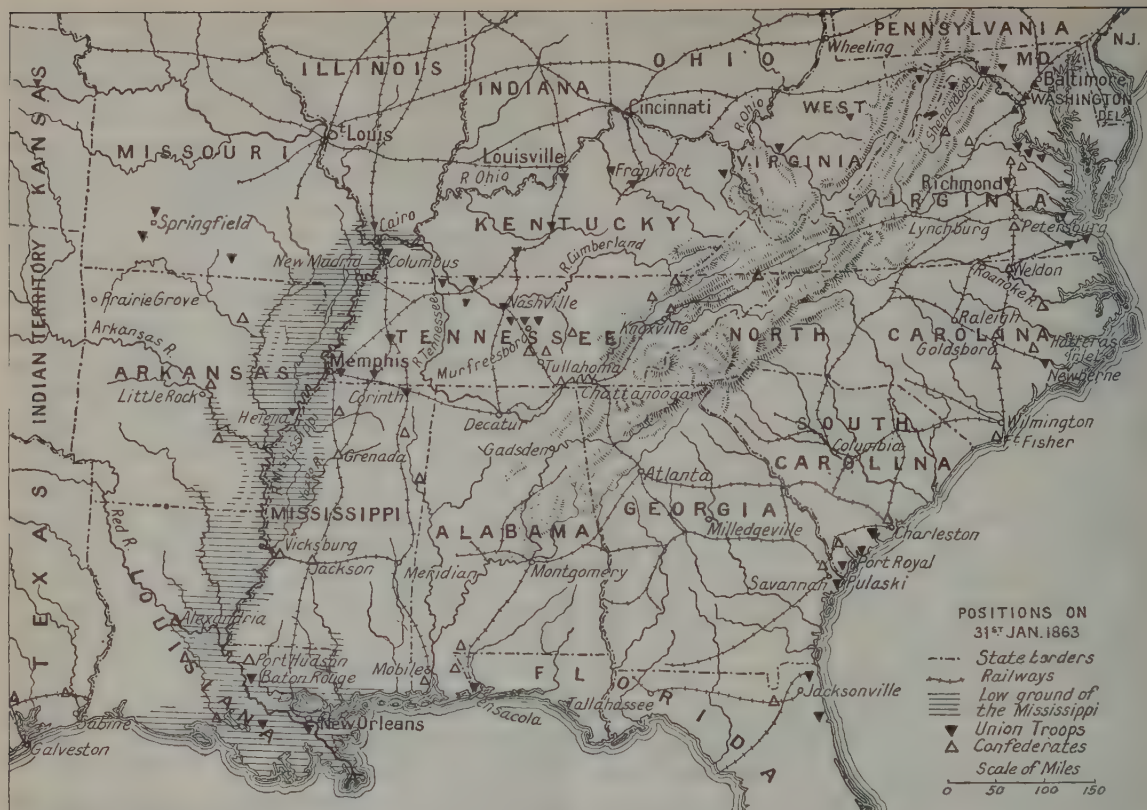
After the defeat of his one corps on the left bank of the Chickahominy (June 27), McClellan decided to "change his base" by a flank march through the White Oak swamp to the James. To cover the passage of his trains he was forced to stand and give battle to Lee, who sought to destroy the Federal army by a combined attack upon its rear and right flank. But, as at Seven Pines, the Confederate commander and his staff failed to co-ordinate the movements of their troops. June 30 was the critical day of the retreat, when the Confederates almost broke through the

Federal centre, but failed through lack of support to reach the road on which McClellan's trains were moving. After repulsing a final assault at Malvern hill (July 1), McClellan reached the James and entrenched a position at Harrison's Landing. Lee finding that his opponent designed no immediate movement withdrew nearer Richmond (July 8).

McClellan's "change of base" placed him in a position to renew the offensive with good chance of success. He was farther away from Richmond, but his communications were absolutely secure. He could advance on either side of the river. Petersburg lay practically defenceless within his reach and its occupation would enable him to cut Richmond's communications with the south, as Grant did in 1864-65. His army was still numerically stronger than Lee's which had suffered the heavier losses in the week's fighting. It was at first assumed at Washington that he would resume the advance on Richmond, when he received reinforcements. But McClellan demanded 100,000 fresh troops, and Lincoln could not find more than 20,000. Political pressure was being put upon him to replace McClellan. To solve the problem, Halleck was appointed general-in-chief (July 11). A retired engineer officer, who had taken up legal practice, he was an acknowledged authority on the art of war. His recent success seemed to mark him out as McClellan's natural successor, but he proved but little help to Lincoln as a military adviser. He visited McClellan's army (July 25) and committed his first blunder by ordering the withdrawal of the Army of the Potomac to Aquia creek, where it could unite with Pope's Army of Virginia on the Rappahannock for an overland advance on Richmond (Aug. 3).

Jackson's "Valley campaign" is described elsewhere. Here it may be noted that on three separate occasions Jackson caused McDowell's corps to be withdrawn from McClellan. For his attack at Kernstown (March 23) alarmed Lincoln and was partly the cause of his detaining McDowell in the first instance at Washington. Throughout the campaign Lee worked upon Lincoln's anxiety for the safety of Washington to break up the threatened combination against Richmond.

The Confederate Offensive in the East, Aug.-Sept. 1862.—Pope was summoned (June 26) from the west to command an army composed of the forces on the Rappahannock and in the Valley. Jackson's campaign had taught Lincoln that one general is better than three. Pope's immediate task was to lighten the pressure upon McClellan by threatening the Virginia Central railway. Lee despatched (July 13) Jackson in time to save Gordonsville from Pope's cavalry. Jackson advancing towards Culpeper to prevent the concentration of Pope's scattered forces defeated Banks at Cedar Run (Aug. 9), but fell back when Banks was reinforced. Lee joining Jackson with *Longstreet's* command (Aug. 15) sought to crush Pope, before he could be reinforced from McClellan's army now definitely leaving the peninsula. Pope narrowly escaped being cut off on the Rapidan and retreated behind the Rappahannock. Lee, learning that portions of McClellan's army had disembarked at Aquia creek and were marching to Pope, detached Jackson to make a wide detour through the Bull Run mountains and strike Pope's line of communications at Manassas Junction (Aug. 25-27). Pope, mystified by this movement, made a succession of mistakes and Lee, reuniting his army on the battlefield, drove Pope across Bull Run (*q.v.*) (Aug. 29-30). Pope retired within the fortifications of Washington (Sept. 3). Lee would not allow the second Bull Run to be as barren of results as the first. Having received reinforcements from Richmond, which more than made good his losses, he crossed the Potomac at Leesburg and occupied Frederick (Sept. 7). He entered Maryland partly to "shift the burden of military occupation from Confederate to Federal soil." But his objective was mainly political, to influence the approaching elections in the North, impress Europe with a sense of Southern power and detach Maryland from the Union. Finding his line of communications up the Valley threatened by a strong garrison at Harper's Ferry, he divided his forces (Sept. 10), sending Jackson with the larger half to capture that post, whilst he withdrew the rest behind South Mountain. After the fall of Harper's Ferry he proposed to reunite his army and invade Pennsylvania.



BARTHOLOMEW, EDIN.

McClellan, placed by Lincoln in command of all the forces in Washington, again took the field (Sept. 7). Not knowing what *Lee's* next move might be, he advanced slowly, until a copy of *Lee's* order for the division of his army fell into his hands at Frederick (Sept. 13). He forced the South mountain passes (Sept. 14). *Lee* fell back behind the Antietam, covering a ford over the Potomac.

Jackson with three divisions had crossed the Potomac at Williamsport and appeared before Harper's Ferry from the west (Sept. 13). Other divisions occupied the heights north and east of Harper's Ferry on the opposite banks of the Potomac and the Shenandoah. The garrison (12,500), being completely surrounded, capitulated early on the 15th. Leaving A. P. Hill's division to complete the arrangements for the surrender, *Jackson* started for Sharpsburg and after a night-march rejoined *Lee* on the morning of the 16th with two divisions, and a third arrived later in the day. McClellan reached the Antietam on the 15th, devoted the next day to reconnaissance and fought the battle of Sharpsburg or the Antietam (*q.v.*) (Sept. 17). At the close of the day *Lee* still held his ground, but on the night of the 18th he recrossed the Potomac. His stay in Maryland was too short to produce any effect upon the political attitude of the State and the inhabitants had shown scant signs of sympathy.

The Confederate Offensive in the West, Aug.-Oct. 1862.—Halleck after the fall of Corinth could either follow up *Beauregard's* retreat or strike at Vicksburg or Chattanooga. Pursuit should have ended in the annihilation of the sole Confederate army in the west; the capture of Vicksburg would open the Mississippi to its mouth and cut the Confederacy in two; the occupation of Chattanooga would further Lincoln's policy of sending relief to the Unionists in East Tennessee. Halleck limited his offensive to sending Buell's army alone towards Chattanooga, and wasted three weeks by forcing him to use as his line of supply the M. and C. railway, which was exposed to cavalry raids. At the

end of June Buell gained permission to transfer his base to Nashville. As no movement was made towards Tupelo, *Bragg*, who had succeeded *Beauregard* (June 27), left *Van Dorn* and *Price* to check Grant, who on Halleck's appointment as general-in-chief at Washington was left in command of the department of the Tennessee, Buell resuming command of his original department, and moved the bulk of his army to Chattanooga. He sought the co-operation of *Kirby Smith*, commanding in East Tennessee, in an advance on Nashville, but yielded to the other's confidence in the political results of an invasion of Kentucky and agreed to march to the Ohio. Buell, whose advance from Nashville on Chattanooga was twice suspended in consequence of cavalry raids upon his communications, took up a defensive position at Murfreesboro covering Nashville.

Kirby Smith "turned" Cumberland Gap, swept aside an extemporized force, which faced him at Richmond, Ky. (Aug. 30), and occupied Lexington (Sept. 2), threatening Louisville and Cincinnati. *Bragg*, concentrating behind the Cumberland mountains, appeared on Buell's front (Sept. 5). Then ensued a race to Louisville, in which Buell got the worse of the start, as he dared not uncover Nashville, and reached Bowling Green (Sept. 14) to find *Bragg* planted squarely across the railway between him and Louisville. Buell could not risk an offensive battle with so much at stake; *Bragg* would only fight on the defensive. He moved out of Buell's path owing to lack of supplies (Sept. 21) to make connection with *Kirby Smith*, who had collected a large depot of stores at Lexington. Buell entered Louisville (Sept. 25) and having reorganized his army marched out (Oct. 1) to find and fight the invaders. Their generals were more occupied with the inauguration of a provisional governor at Frankfort (Oct. 4) than with the need for concentrating their forces. An accidental encounter with indecisive results occurred at Perryville (Oct. 8) between Buell's and *Bragg's* left wings. *Bragg* and *Kirby Smith* now united their armies, but only to retreat through Cumberland

Gap into East Tennessee. The Confederate invasion of Kentucky was barren of political results. The provisional governor was chased out of his capital immediately after his inauguration.

The Federals Resume the Offensive, Nov.-Dec. 1862.—Lincoln celebrated *Lee's* retreat with the Emancipation Proclamation. This alienated the Democrats, and if the Administration was to win the autumn elections it must raise its credit by some signal success. McClellan was urged to cross the Potomac and force another battle. He demanded time to reorganize his army. Five weeks passed before he began his advance along the east side of the Blue Ridge. But *Lee*, bringing *Longstreet* to Culpeper, again interposed. McClellan was relieved of his command (Nov. 7) and his successor, Burnside, adopted a new plan of campaign, to transfer his base to Aquia creek, cross the Rappahannock at or below Fredericksburg, and march straight on Richmond. But delay in forwarding a pontoon-train from Washington prevented him crossing till *Lee* had taken up a position on the Fredericksburg heights. Though the element of surprise was lost, Burnside persisted in crossing the river and, attacking *Lee*, was repulsed with terrible slaughter (Dec. 13).

In the west, Buell was replaced (Oct. 30) by Rosecrans, who as Pope's successor under Grant had gained the credit of defeating *Price* at Iuka (Sept. 19) and *Van Dorn* at Corinth (Oct. 3-4). Before renewing the advance upon Chattanooga he determined to make himself temporarily independent of the railway by accumulating a reserve of 2,000,000 rations at Nashville. For this purpose he had first to repair the Louisville railway, as the Cumberland, like the Tennessee, only became navigable in the latter part of the winter. The Government chafed at the delay. Rosecrans refused to be hurried. He commenced his advance against *Bragg* (Dec. 26), who since returning from Kentucky had established himself at Murfreesboro, where he expected to pass the winter. The battle of Stone river or Murfreesboro (Dec. 31-Jan. 2) ended with *Bragg* abandoning the battlefield, evacuating Murfreesboro and falling back to Tullahoma. Rosecrans occupied Murfreesboro, and settled down for the winter.

After *Van Dorn's* defeat Grant moved against Vicksburg. Sherman starting down the river from Memphis was to land his troops at the mouth of the Yazoo, seize the bluffs north of Vicksburg, and attack the city from the rear, whilst Grant, who was already advancing along the Mississippi Central railway towards Jackson (Mississippi) would hold *Pemberton*, *Van Dorn's* successor, fast and prevent him sending help to Vicksburg. But Grant had to retire when his supply depot was destroyed by a cavalry raid (Dec. 20), and Sherman was forestalled by *Pemberton*, who was kept informed by spies of the Federal movement, and defeated at Chickasaw Bluffs (6 m. north of Vicksburg) (Dec. 29). In north-west Arkansas *Hindman* was organizing a fresh invasion of Missouri but was anticipated by Blunt and Herron, who crossed the frontier and defeated him at Prairie Grove (Dec. 7).

Operations in the East, 1863: Chancellorsville and Gettysburg.—After "the horror of Fredericksburg" the two armies passed the winter facing each other across the Rappahannock. Hooker replaced Burnside (Jan. 26) and quickly restored the shaken morale of his army. *Lee* found great difficulty in feeding his troops, and by direction of the war department *Longstreet* with two divisions was sent to the south bank of the James to collect provisions in the vicinity of Suffolk, which was in Federal occupation. *Longstreet* invested Suffolk and at the moment, when his divisions were urgently needed on the Rappahannock, was engaged in a futile siege 120 m. away.

Both *Lee* and Hooker were eager to take the offensive. *Lee* had been considering with *Jackson* an invasion of Pennsylvania, but in the absence of *Longstreet's* divisions had to resign the initiative to Hooker. The latter aimed at forcing *Lee* out of his entrenchments by a wide turning movement over the upper fords of the Rappahannock above its junction with the Rapidan, and sent his newly organized cavalry corps to destroy the railways in *Lee's* rear and intercept his retreat. He thus deprived himself of "the eyes of his army," and to the absence of his cavalry (except one brigade) was largely due the failure of the Chancellorsville campaign.

Hooker, who outnumbered *Lee* by fully two to one, concentrated the larger half of his army about Chancellorsville (April 30), whilst Sedgwick crossed the Rappahannock below Fredericksburg. *Lee*, leaving 10,000 men to check Sedgwick, threw Hooker on the defensive (May 1), outflanked and rolled up his right wing with *Jackson's* corps (May 2), drove him out of his entrenchments to a fresh defensive position (May 3), turned on Sedgwick, who had captured the Fredericksburg heights, and forced him back over the river (May 4), and then counter-marched to Chancellorsville to strike another blow at Hooker. But the latter retreated across the Rappahannock on the night of May 5. *Lee's* victory was dearly bought at the price of *Jackson's* life (May 10). He now reorganized his army into three corps under *Longstreet*, *Ewell* and *A. P. Hill* and prepared to carry out his plan of invading Pennsylvania.

Longstreet had proposed another plan, viz., to utilize the advantage of the "interior lines" for the relief of Vicksburg now in dire straits. *Lee* should leave the army, which had fought at Chancellorsville, to "contain" Hooker on the Rappahannock, and with *Longstreet's* two divisions join *Bragg* in Tennessee. *Johnston's* troops should be brought from Mississippi and *Buckner's* from East Tennessee to the same point. The united forces under *Lee's* command could then take the offensive against Rosecrans with a good prospect of overwhelming him. If victorious, *Lee* should then invade Kentucky and threaten Louisville and Cincinnati as the most likely means of forcing Grant to raise the siege of Vicksburg. But *Lee* was unwilling to leave Virginia or divide his army.

Lee's objects were much the same as had prompted his invasion of Maryland in 1862, and in particular he hoped to levy much-needed supplies of food and clothing from a free State and at least prevent reinforcements being sent to Grant before Vicksburg. He commenced his movement on June 3. His plan of campaign was to transfer his army to the Valley, cross the Potomac and march to the Susquehanna. He could count upon Lincoln's anxiety for Washington's safety keeping Hooker from attacking any of his widely separated corps before they were concentrated in Pennsylvania. He left *Hill* at Fredericksburg till Hooker should withdraw northwards, and *Longstreet* at Culpeper formed the link between *Hill* and *Ewell* pushing down the Valley. A cavalry battle at Brandy Station (June 9) warned Hooker that *Lee* was on the move. Being refused permission to march on Richmond, he began to fall back towards Manassas (June 13). *Hill* marched to the Valley covered by *Longstreet*, who advanced east of the Blue Ridge. *Ewell* captured Winchester (June 15) and crossed into Maryland, pushing his cavalry forward into Pennsylvania. *Longstreet* passed into the Valley in *Hill's* rear and their two corps were crossing the river on June 23-24. Hooker began crossing on June 25 and concentrated at Frederick, threatening *Lee's* line of retreat. *Hill* and *Longstreet* were at Chambersburg, *Ewell* on his way to Harrisburg with two divisions at Carlisle and one at York (June 27). But the absence of *Stuart's* cavalry, which was on a raid round the Federal army, and did not rejoin till July 2, left *Lee* in ignorance of Hooker's movements. He did not learn till the night of the 28th that Hooker had crossed into Maryland and was threatening his communications. He at once ordered a concentration of all his forces at Cashtown to keep the Federals east of South Mountain by threatening Baltimore. Meade, who had replaced Hooker (June 28), was moving his army northwards to prevent *Lee* crossing the Susquehanna. A chance encounter on June 30 at Gettysburg (*q.v.*) brought on the famous battle.

Hill advancing from the west and *Ewell* coming down from the north had defeated two Federal corps and occupied Gettysburg (July 1). Neither *Lee* nor Meade expected a battle so soon, but *Lee* could complete his concentration first, and the chance of defeating his opponent in detail urged him to assume the offensive. But he could not get his corps commanders to work together as a team. No attack was delivered (July 2) till 4 p.m., and though the Confederates gained some ground on both flanks and for a moment broke through the Federal centre, at nightfall Meade still held Cemetery Ridge and had his whole army concentrated. *Lee* made his final assault (July 3) with two divisions against the enemy centre, but again concert of action was lacking, and

Pickett's charge, being unsupported, was a costly failure. *Lee* commenced his retreat (July 4) through the South Mountain passes. He was held up at Williamsport for a week waiting for the river to run down, but on the night of the 13th withdrew his army and trains into the Valley before Meade, who had only appeared on his front the day before, could make up his mind to attack.

Lee gradually fell back behind the Rapidan and Meade followed him across the Rappahannock as far as Culpeper. Both armies were weakened in September by sending heavy detachments to Tennessee. In October and November the two generals engaged in a campaign of manoeuvre, which had no decisive result and left them in their original positions on the Rapidan and Rappahannock respectively.

Operations in the West, 1863: Vicksburg and Chattanooga.—In 1863, as in 1862, it was in the west that decisive results were obtained. By the capture of Vicksburg and Port Hudson the Federals gained complete control of the Mississippi, and in East Tennessee they captured Chattanooga and Knoxville. Grant's Vicksburg campaign (*q.v.*) was one of the most brilliant operations of the war, though he owed much to his opponent's mistakes.

The problem was to transport his army from the right bank of the Mississippi to the high ground in the rear of Vicksburg. After four unsuccessful attempts (Feb.—March) to open up a water-route, by which the enemy's flanks might be turned, Grant in April, when the winter-floods had begun to subside, moved two corps by land to a point below Grand Gulf, the extreme left of the Confederate defences. Part of the Federal fleet had run past the Vicksburg batteries by night (April 16), bringing with them two transports, and five more transports got past six nights later. Grant began crossing the river (April 30). *Pemberton*, who as commander of the Department of Mississippi and East Louisiana was responsible for both Vicksburg and Port Hudson, had been so mystified by Grant's demonstrations on the north side of Vicksburg that he had only four brigades available to meet his advance south of the Big Black river. Grant defeated these (May 1) and established a temporary base at Grand Gulf. Having been joined by Sherman with further supplies, he advanced (May 7) against the Vicksburg—Jackson railway, on which *Pemberton* depended for supplies and reinforcements. But suspecting after the engagement at Raymond (May 12) that a considerable force was collecting at Jackson, Grant cut loose from his base and marched with his whole army on Jackson, living off the country till he could work round to the north of Vicksburg and establish a new base on the Yazoo. *J. E. Johnston*, commander-in-chief in the west, had been ordered (May 9) to go and assume personal command of the troops in Mississippi. He reached Jackson from Tullahoma (May 13) but found only two brigades there. Next day, after fighting a delaying action at Jackson, he retreated up the Mississippi Central railway to Canton. Grant then fell upon *Pemberton's* field-force at Champion Hill (May 16) and drove it into the fortifications of Vicksburg, occupying Haynes's Bluff two days later. The fate of Vicksburg was now sealed. For *Johnston* was unable to collect a force strong enough to create a diversion, and *Pemberton* capitulated (July 4).

Butler's successor at New Orleans was equally successful in reducing Port Hudson, 200 m. below Vicksburg (July 9). Farragut with two warships had run past the Port Hudson batteries (Mar. 14), and by closing the mouth of the Red River deprived the garrison of its main source of supplies. Banks commenced siege operations (May 24), and the Confederates were on the verge of starvation when they surrendered.

For several months Rosecrans and *Bragg* remained watching each other in Middle Tennessee, confining themselves to cavalry raids against each other's lines of communication. Rosecrans was urged by the Government to take the offensive against *Bragg* to prevent him sending reinforcements to Mississippi. But Rosecrans maintained that, while he remained on *Bragg's* front, the latter would not risk the loss of Middle Tennessee by detaching troops elsewhere. *Bragg* did in fact send some reinforcements to *Johnston*. Rosecrans was really afraid that Grant might be

defeated and was unwilling to commit himself to a fresh movement while the issue at Vicksburg remained unsettled. At last he advanced (June 23) and in nine days of incessant rain manoeuvred *Bragg* out of two strong positions in succession and forced him to retreat behind the Tennessee. He resumed his advance (Aug. 16) in co-operation with Burnside, who advancing from Kentucky occupied Knoxville (Sept. 2). Rosecrans feinting at *Bragg's* right, as if he intended to cross the Tennessee above Chattanooga and join Burnside, moved the bulk of his army across well below Chattanooga (Sept. 4) and advanced over the mountain ranges south of the river against *Bragg's* line of retreat. This manoeuvre forced *Bragg* to evacuate Chattanooga (Sept. 8), but he retreated only 25 m. to Lafayette, where he covered the railway, waiting for a chance of defeating Rosecrans's army in detail. Rosecrans, imagining *Bragg* to be in full retreat, fell into the trap and pressed forward with three columns so widely separated that no two were within supporting distance of each other. But *Bragg* failed to close the trap. Two chances of overwhelming isolated portions of the Federal army were lost by his lieutenants. Rosecrans reconcentrated his army (Sept. 18), and *Bragg*, having received considerable reinforcements, including five brigades under *Longstreet*, from Virginia, attacked and defeated him (Sept. 19–20) in Chickamauga valley (*q.v.*) and drove him back into Chattanooga, where the Federal army was practically besieged and in danger of starvation. Grant was now appointed to the supreme command in the west and reached Chattanooga (Oct. 23), where Hooker with reinforcements from the Army of the Potomac had already arrived. Grant substituted Thomas for Rosecrans in command of the Army of the Cumberland and averted all fear of starvation by opening a short line of communication with Bridgeport by way of two ferries over the Tennessee. *Bragg* now weakened himself by sending *Longstreet* with a large detachment against Burnside (Nov. 3). Grant on the arrival of four divisions of the Army of the Tennessee under Sherman took the offensive and stormed *Bragg's* position on Missionary ridge, which overlooked Chattanooga (*q.v.*) (Nov. 25).

In his anxiety for Burnside's safety Grant ceased his pursuit of *Bragg's* retreating army (Nov. 28) and despatched Sherman to Knoxville, where *Longstreet* was besieging Burnside. After failing in an assault upon the Federal works (Nov. 29), *Longstreet* raised the siege (Dec. 4) on Sherman's approach and retreated up the Holston valley. The greater part of East Tennessee was now in Federal hands.

Grant in the East, 1864.—Halleck having failed during 18 months to co-ordinate from Washington the movements of the Federal armies, Grant was commissioned (March 9) lieutenant-general, a grade revived by Congress, and appointed general-in-chief to command in the field. Deeming his presence more urgently needed in the east, he attached himself to the Army of the Potomac, retaining Meade in actual command. Sherman succeeded him in the west. The presidential election was due in November. The North was war-weary, and Lincoln's chance of re-election would be small unless speedy victory were in sight. Grant's was a policy of attrition, aiming at the exhaustion of the only two enemy armies of considerable size still in the field, viz., *Lee's* in Virginia and *Johnston's* in Georgia, by concentrating against them all the force available. For Meade's army not Richmond, but *Lee's* army was the objective. Grant designed to flank *Lee* out of his entrenchments behind the Rapidan and wear him down by "continuous hammering." He could afford to lose two men to *Lee's* one, because Southern man-power was nearly exhausted. But he also sought to create a diversion by threatening Richmond and its railway communications on both flanks. Columns were ordered to march on Staunton and Lynchburg, and then unite for a movement against Richmond; the Army of the James was to advance up the south bank of the James River. But in allowing Butler to command this army, Grant made a grievous mistake. B. F. Butler, a criminal lawyer and influential politician, had shown no military capacity in his various commands, but he was a dangerous man to alienate in a presidential year.

Grant crossed the Rapidan (May 4). After two days' battle in the Wilderness (*q.v.*) he moved by the left flank to Spotsyl-

vania and continued this "side stepping" manoeuvre till close to Richmond. But in these forty days he never got *Lee* into the open. On the Po, North Anna, Totopotomoy and at Cold Harbor he found *Lee* entrenched across his path. No diversion came from Butler, who missed the opportunity of capturing Petersburg in the first week and was "bottled up" by *Beauregard* (May 16). The other subsidiary movement was nearly as unsuccessful.

After Grant's defeat at Cold Harbor (June 3) *Lee* detached *Early's* corps to save Lynchburg from Hunter, who had already captured Staunton. Hunter retreated into West Virginia, leaving the Valley open to *Early*, who marched down it, crossed the Potomac, defeated a scratch force on the Monocacy (July 9) and appeared before Washington (July 11). Grant sent back one corps for the protection of the capital. But *Early* withdrew (July 12) and retired into the Valley, having given Washington and Baltimore a sudden fright, but without seriously deranging Grant's plans. Grant's casualties had reached 55,000, and though probably he inflicted as heavy losses on *Lee* in proportion, he had to part with 36 time-expired regiments, and the reinforcements, which kept up his numbers, could not replace the veterans of the old army.

Grant's finest achievement was the transfer of his army across the Chickahominy and the James unopposed under *Lee's* nose (June 12-15), but he lost the chance of capturing Petersburg (June 15-18), which *Lee* was slow to reinforce (see *PETERSBURG CAMPAIGN*). The ensuing siege of Petersburg was "trench warfare" and a siege only in name, as *Lee's* army was never invested. Grant's aim was to extend his lines to his left so as to get possession of the railways from the south and south-west to Petersburg and Richmond, whilst making demonstrations on the north bank of the James and "feeling" the Richmond defenses. The fiasco of the "Burnside mine" (July 30)—when a mine was successfully exploded under a salient in the Confederate lines, but the assaulting troops owing to the mismanagement of Burnside, the corps-commander on whose front the attempt was made, were repulsed with heavy loss—warned him against frontal attacks on *Lee's* lines round Petersburg. He secured a considerable section of the Weldon railway, but at the end of the year *Lee* still held the Southside and Danville lines. The only Federal successes in the east this year were won by Sheridan in the Shenandoah valley (see *SHENANDOAH VALLEY CAMPAIGNS*). Sent by Grant to drive out *Early*, he won three victories in a month (Sept. 19-Oct. 19) and completely devastated the valley, which had become the granary of Richmond. These victories, coupled with Sherman's capture of Atlanta (Sept. 2), secured Lincoln his overwhelming triumph over the Democratic candidate, General McClellan.

Sherman in the West, 1864.—Sherman with three armies under Thomas, McPherson and Schofield confronted *Johnston*, who had taken command of *Bragg's* beaten army.

The Richmond Government had wished *Johnston* to effect a junction with *Longstreet* and invade Middle Tennessee, but *Johnston* finding his army in no condition to take the offensive remained at Dalton, where he occupied a strong defensive position. Grant's instructions to Sherman were "to move against *Johnston's* army, to break it up and to get into the interior of the enemy's country as far as you can." To Grant the destruction of the enemy army was the primary objective, but Sherman thought more of occupying strategic points in Confederate territory. Atlanta, *Johnston's* base, was at the junction of four important railways and "full of foundries, arsenals and machine-shops. Its capture would be the death-knell of the Confederacy" (Sherman). Eventually Sherman captured Atlanta but let the Confederate army escape. He had about the same superiority of numbers as Grant had, roughly 100,000 against 60,000, and was as far from Atlanta as Grant was from Richmond. But as compared with Grant he had one great disadvantage. He was practically tied to the railway and could not be continually shifting his base. Grant had intended that Banks should effect a diversion in Sherman's favour by a movement on Mobile in co-operation with Farragut's fleet. But Banks was not available, having been previously sent by Halleck up the Red River to establish at Shreveport a base for the military occupation of

northern Texas, the Government fearing that the French in Mexico were planning to establish an independent republic in Texas.

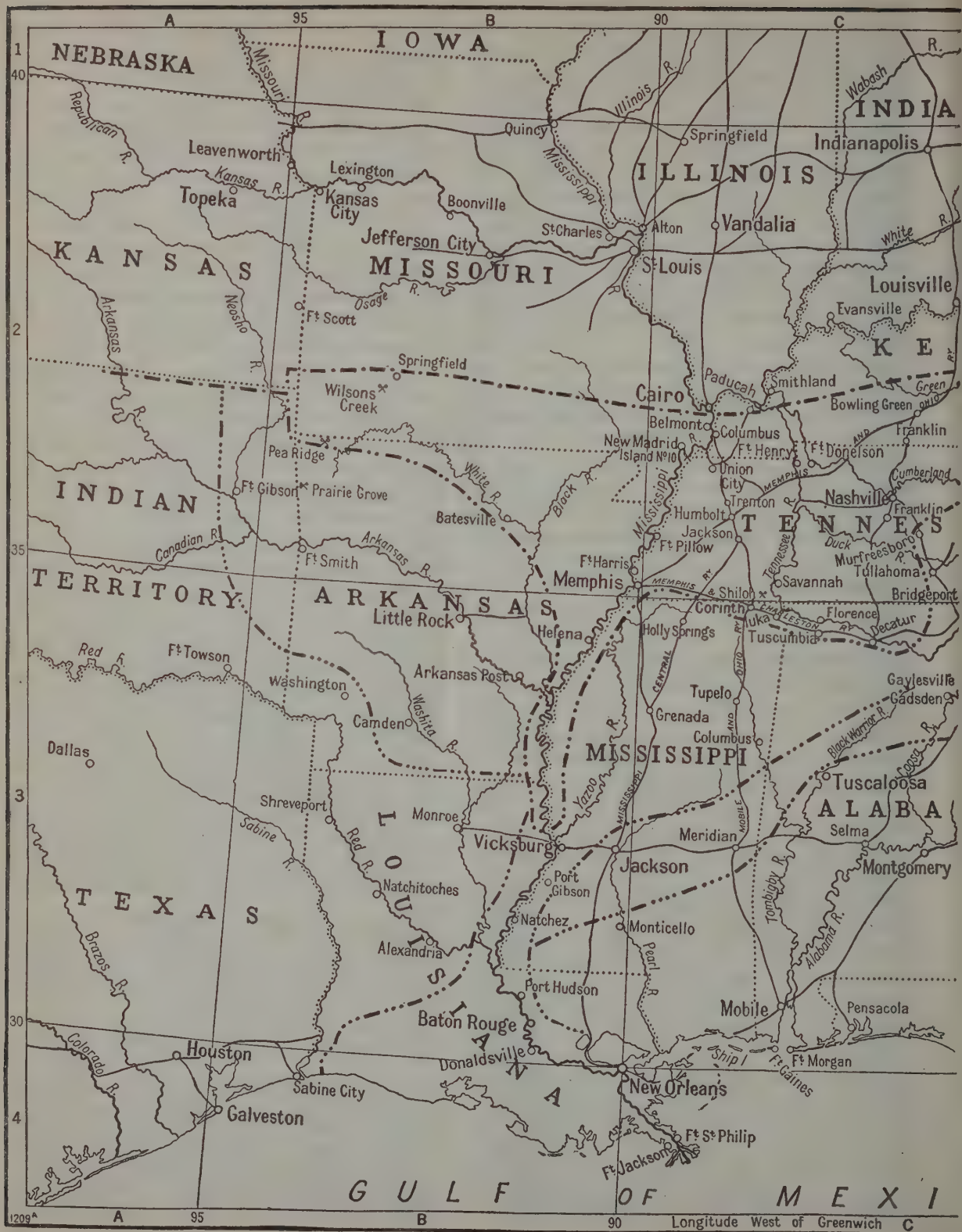
The campaign opened (May 4). Between Dalton and Atlanta the railway crossed three rivers, the Oostanaula at Resaca, the Etowah and the Chattahoochee.

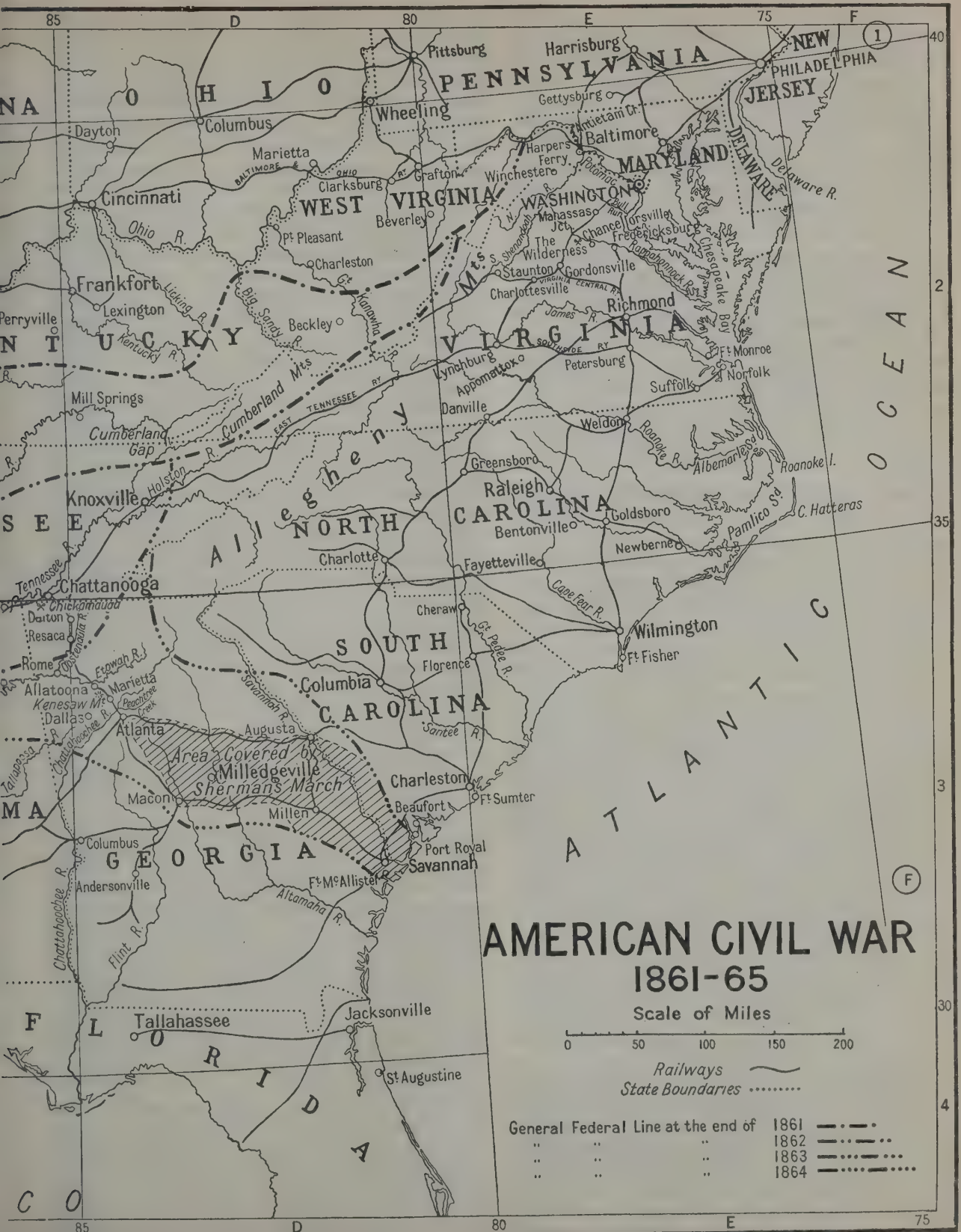
Johnston's policy was to delay Sherman's advance as much as possible, withdrawing from his successive positions before he could be drawn into a pitched battle except upon his own terms. He was prepared to fall back as far as Atlanta, which he regarded as impregnable, "too strong to be taken by assault and too extensive to be invested." Sherman's general plan of campaign was to keep Thomas's army in the centre to "contain" *Johnston's* army, for which it was in itself a match, and use the other two to turn his flanks. With McPherson's army he outflanked *Johnston's* left and forced him to evacuate Dalton (May 13) and Resaca (May 15). In the comparatively open and rolling country between the Oostanaula and the Etowah *Johnston* expected to be able to make a stand and give battle, but his corps commanders dissuaded him, and retreating across the Etowah (May 20) he took up a strong position in the mountain pass at Allatoona.

By temporarily cutting loose from the railway and marching on Dallas Sherman turned the Allatoona pass and by shifting McPherson over to the left flank gradually forced *Johnston* to contract his lines round Marietta (*q.v.*). Wishing to save his troops the fatigue of yet another flank movement over roads rendered almost impassable by continuous rain, Sherman attacked *Johnston's* lines on Kennesaw mountain (June 27), but was repulsed with heavy loss. Resuming the outflanking movement round *Johnston's* left he manoeuvred him out of the Marietta position (July 2), and a week later *Johnston* withdrew his whole army behind the Chattahoochee, after Schofield had crossed above his right flank. Though in this protracted duel only the engagement at Kennesaw mountain ranks as a battle, skirmishing never ceased, often developing into hard fighting, especially during the operations round Dallas. During May and June Sherman's casualties amounted to about 17,000, and *Johnston's* were relatively, if not actually, greater. *Johnston* was preparing to fall upon Sherman's columns, as they crossed the Peach Tree creek, the only natural obstacle between the Chattahoochee and Atlanta's northern defences, when he was superseded by *Hood* (July 17). *Davis* was tired of *Johnston's* Fabian tactics and believing that he would abandon Atlanta without a battle, put a fighting general in his place. *Hood* promptly fought three battles before the end of July, but was defeated in them all, and evacuated Atlanta (*q.v.*) (Sept. 2). Sherman waited for *Hood's* next move. *Hood* crossed the Chattahoochee (Sept. 29) and striking first at Sherman's communications marched to Gadsden (Alabama) drawing Sherman in pursuit more than 100 miles from Atlanta as far as Gaylesville (Oct. 20). When *Hood* moved still farther west to cross the Tennessee, Sherman started back to Atlanta to execute his long-cherished plan of marching through Georgia to the coast. He left Thomas to deal with *Hood*. But the force assigned to Thomas was barely sufficient for the purpose.

In actual numbers superior to *Hood's* army, it was made up of widely separated commands; one corps was still in Missouri, and until its arrival at Nashville (Nov. 30) Thomas can hardly be said to have had an army at all. Sherman could easily have spared another 12,000 men, and this addition to his strength would have made Thomas's position absolutely safe.

Hood's plan was to destroy Thomas's forces before they could concentrate, capture Nashville, invade Kentucky, threaten Cincinnati and then march through East Tennessee to join *Lee*. But a three weeks' delay at Florence to collect supplies proved fatal. Schofield with 23,000 men had time to take position at Pulaski and delay his advance, whilst Thomas was concentrating his other forces at Nashville. Having failed to envelop Schofield on the Duck river, *Hood* attacked him furiously but unsuccessfully at Franklin (Nov. 30) and appeared before Nashville (Dec. 2). In spite of the severity of his losses and the fact that he was confronted by an army superior to his own, *Hood* was still bent on retaining the offensive and detached his cavalry





against the Federal lines of communication. He remained before Nashville in the vain hope of receiving reinforcements promised from Texas, until Thomas marched out and defeated him in the most decisive battle of the war (Dec. 15-16). (See NASHVILLE.) Hood escaped over the Tennessee, but his army as a fighting force practically ceased to exist.

Sherman started from Atlanta (Nov. 15) on his 300m. march with 60,000 men and without encountering any organized resistance reached the outskirts of Savannah (Dec. 10), feeding his army off the country. His purpose was to demonstrate "the hollowness" of the Confederacy and by ruining the railway system of Georgia, now the granary of the South, prevent food reaching Richmond. Georgia was left undefended except by Wheeler's cavalry and the State militia, Hood's invasion of Tennessee being counted upon to bring Sherman back in pursuit. Sherman, having destroyed 160m. of the Georgia Central railway, by storming Ft. McAllister established communication with the fleet in Ossabaw sound. Savannah was evacuated (Dec. 20). Sherman was now free to join Grant by sea or land.

Though the Confederates still held Mobile, its value as a port was gone. Farragut had forced an entrance into the bay (Aug. 5) and captured the forts guarding the harbour mouth. Only in the Trans-Mississippi had the Confederates gained any success. Banks's Red River expedition proved a complete failure and he retreated to New Orleans. But the Federals retained their hold upon northern Arkansas, including Little Rock, the State capital. Price made a last raid into Missouri in September and October.

Collapse of the Confederacy, Jan.-May 1865.—Richmond's fall was near at hand. Grant's next advance would plant him on the Southside railway. Lee had not sufficient troops to hold a further extension of his lines. Desertion was thinning his ranks; conscription had broken down. Wilmington, the last Confederate port, was closed by the capture of Ft. Fisher (Jan. 15). A peace conference held in Hampton Roads failed (Feb. 3) because Davis still insisted on the recognition of Southern independence. Congress forced Davis to appoint Lee (Feb. 9) commander-in-chief of all the Confederate forces. But this step came too late; Lee could only appoint Johnston to command such troops as could be mustered to meet Sherman. For Grant, having decided that to the Army of the Potomac should fall the honour of capturing Richmond, ordered Sherman to march up through the Carolinas, and to provide him with a base on the coast, brought Schofield round from Nashville to North Carolina to capture Wilmington. Sheridan with 10,000 cavalry moved from the Valley to White House (March 19) in time for Grant's next advance. Lee had determined to withdraw his army to Danville and effect a junction with Johnston against Sherman. But his artillery horses and transport animals were in no condition for hard work, until the roads improved. To prevent Grant extending to the left, Lee attempted a diversion by attacking Ft. Stedman (March 25) on the right of the Federal lines. After the repulse of this sortie Grant ordered a general advance by the left flank. Sheridan's victory at Five Forks (April 1), beyond the extreme right of Lee's lines, where with his cavalry and Warren's corps he defeated Pickett's division and Fitzhugh Lee's cavalry, gave the Federals possession of the Southside railway. Next morning Grant broke through Lee's lines on a broad front, driving him back into the suburbs of Petersburg. That night Lee commenced his retreat. Richmond surrendered (April 3). Lee having been forced by Sheridan from the Danville road to the north bank of the Appomattox surrendered (April 9).

Sherman advanced (Feb. 1) and occupied Columbia (Feb. 17), which was accidentally burnt. Charleston was evacuated (Feb. 18). Although the march over swollen rivers and swamps was most arduous, Fayetteville, N.C., was occupied (March 11), where communication was established with Wilmington, which had been captured (Feb. 22). Sherman now aimed at Goldsboro to effect a junction with Schofield, who had left Wilmington for New Berne. To prevent this junction Johnston attacked Sherman's left wing at Bentonville (March 19), but withdrew his forces and retreated to cover Raleigh (March 21). Sherman

joined Schofield at Goldsboro (March 23). From Goldsboro Sherman moved out against Johnston (April 10) and occupied Raleigh (April 13). Next day Johnston asked for an armistice. The assassination of Lincoln (April 14) caused a delay, but Johnston finally surrendered at Greensboro (April 26). In the lower South, Wilson conducted a brilliant cavalry campaign in Alabama, defeating Forrest and capturing Selma (April 2), the last Confederate arsenal, and Canby, Banks's successor, captured Mobile (April 12). Taylor surrendered the Confederate forces in Alabama and Mississippi to him (May 4), and Kirby Smith surrendered the Trans-Mississippi forces (May 26). Davis was captured by some of Wilson's cavalry (May 10).

The Navies and the Blockade.—The United States navy was quite unprepared for war. Half of the 34 steamships available for service were on foreign stations and the home squadron comprised only seven steamers and five sailing ships. The navy department was slow to recognize the value of armour plate for warships and let the Confederates get the start with the "*Merrimac*." Mallory, secretary of the navy, aimed at providing three types of warships: armoured rams for coast defence, sea-going ironclads to destroy the blockading squadrons and commerce-destroyers. The last two classes he hoped to build or purchase in Europe. The "*Merrimac*" and the "*Monitor*" represented the types of ironclad constructed by the two combatants respectively. The former, a U.S. frigate, which had been fired and scuttled at Norfolk, was raised and cut down to a ram with a wooden casemate, protected by armour and carrying ten heavy guns, erected upon her hull. At her first appearance in Hampton Roads she sank two wooden sailing vessels, the "*Cumberland*" and "*Congress*," but next day, after a drawn battle with the "*Monitor*," retired to Norfolk. Altogether 12 of these ironclads were constructed, but the weakness of their engines rendered them less formidable than was expected. The Confederates, unable to build engines in their workshops, had to use for their ironclads either the old ones or those which they took out of other steamers. The main features of the "*Monitor*," designed by Ericsson to counter the "*Merrimac*," were the revolving turret, the low freeboard and the projecting overhang. She drew less water and was more easily handled. The Federals built a large number of monitors, which, though more than a match for the rams, were comparatively ineffective against forts, as was proved by the failure of the naval attack on the Charleston forts (April 7, 1863). The river "ironclads," which fought in the waters of the west, were gunboats constructed by Eads with a partially armoured casemate. To the original nine, five more were added in 1863, more heavily armoured and powerfully armed. Three single-turret ironclads of light draught were specially constructed for the Red River expedition.

Two powerful ironclads were built in England for the Confederates, but the British Government prevented them sailing. One ironclad built in France passed into Southern hands, but reached Havana too late to take part in the war. Three commerce-destroyers built or purchased in England drove the Federal mercantile marine from the seas. Having auxiliary sail power they could economize coal. The "*Alabama*" during her 22 months' cruise never put into a Confederate port. She captured 68 prizes in the Atlantic, Indian ocean and China sea, sank the Hatteras gunboat off Galveston but was herself sunk off Cherbourg by the sloop-of-war "*Kearsarge*" (June 11, 1864). The "*Shenandoah's*" objective was the whaling fleet in the North Pacific, which she destroyed (June 1865), having no official news that the war was over. The Geneva Arbitration (1872) found Great Britain responsible for the losses inflicted by these three cruisers to the amount of \$15,500,000.

The Federal navy concentrated upon blockading the seven principal southern ports. Lincoln had proclaimed a blockade of the Southern coast (April 19, 1861). But for many months it was little more than nominal for lack of ships which could enforce it. An attempt to close Charleston harbour by sinking stone-laden hulks in the entrance proved a failure. Not till the middle of 1862 could the blockade be regarded as even moderately effective. Then with the export of cotton at last unrestricted

and an increasing demand in the English market, vessels specially adapted for blockade-running were built in the English shipyards, and in spite of the Federal navy blockade-running only ceased to be a profitable speculation when the ports were actually in Federal occupation. Savannah had been practically closed since the capture of Ft. Pulaski (April 1862). The loss of Charleston and Wilmington left the Confederacy without an Atlantic port, and reduced the armies of *Lee* and *Johnston* to a state of destitution.

Conclusion.—The collapse of the Confederacy was so sudden and complete that it took Europe by surprise. Sherman's "march to the sea" first opened foreign eyes to the probability of Southern defeat. But by the end of 1863, when *Lee* had suffered defeat at Gettysburg and *Bragg* had finally lost Chattanooga, and the Federals had recovered the Mississippi between Vicksburg and Port Hudson, thus completely isolating the Trans-Mississippi department, ultimate defeat stared the Confederacy in the face. The sole remaining hope was that the North through sheer weariness might throw away the victory already won. When Grant seemed fought to a standstill by *Lee* round Richmond in the summer of 1864, and between Sherman and Atlanta *Johnston's* army interposed still unbeaten, the North very nearly reached the limit of its endurance. The Democrats put forward a programme, the first article of which pronounced the war a failure. Lincoln despaired of re-election. But the fall of Atlanta and Sheridan's triple victory over *Early* in the Valley came in time to turn the scale in favour of the Government. Gradually too the significance of Grant's position in front of Petersburg began to be realized. *Lee* had lost the power to manoeuvre, when he was shut up in Richmond and Petersburg, and could not force Grant to relax his hold. Yet once more the North was filled with alarm when *Hood* crossed the Tennessee and, with Sherman far away in Georgia, threatened an invasion of Kentucky. Grant himself was on his way to take command at Nashville, when he heard the news of Thomas's crowning victory. Sherman could now present Lincoln with Savannah as a Christmas gift, and the one organized army of the Confederacy in the west was definitely broken up.

The South made a great mistake during the first winter of the war, when the North was organizing its military strength and the Confederates took no counter-measures. Their Government, counting on European recognition to be followed by peace, left *A. S. Johnston* in the west with an entirely inadequate force to hold Kentucky and Tennessee. At the first onset the Federals broke through his line of defence; his counterstroke failed; Kentucky and a great part of Tennessee were permanently lost, New Orleans fell, and the Federals gained control of great stretches of the Mississippi. Then the Confederate Government awoke from its dream. The first Conscription Act (April 1862) retained in service the 148 regiments of one-year volunteers and by encouraging voluntary enlistment enabled *Lee* to save Richmond, but the ground lost in the west was never recovered.

The Confederacy had one inherent weakness. It was composed of "sovereign" States, which would temporarily sacrifice their "State rights" for the success of their revolution, but demanded that the Central Government should provide for their protection, and if it failed in that duty, would take their own measures for self-defence. The State governors were always a thorn in *Davis's* side. From the first they required delicate handling and, when things began to go wrong, became refractory. This State patriotism combined with geographical conditions to isolate the different sections of the country and prevented the Confederates from taking proper advantage of the "interior lines." Only once did troops from the Trans-Mississippi come to the help of their countrymen on the other side of the river. *Van Dorn* moved from Arkansas to *Beauregard's* aid at Corinth, but his men were very reluctant to cross the river, and it is significant that no attempt was made to bring reinforcements to Vicksburg in 1863 from that department. Only once were considerable reinforcements sent from the east to the west, when *Longstreet* with two divisions was sent to *Bragg's* aid, and the victory of Chickamauga (*q.v.*) was the result.

The west was the really decisive theatre of war. In the east *Lee's* victories did not alter the strategic position. The end of each campaign found the Army of the Potomac on the Rappahannock, still menacing Richmond. But the fall of Vicksburg cut the Confederacy in two; the loss of the food supplies, especially cattle, from the Trans-Mississippi was sorely felt, and the capture of Chattanooga and Knoxville not only cut off another section of territory, but opened the way to Georgia, the granary of the South. That *Lee's* and *Johnston's* armies were reduced to starvation was due to the loss of Georgia's supplies. Grant indeed captured Richmond and *Lee's* army, but had he chosen he might have brought Sherman's army by sea from Savannah to the James, and it could have been there two months before he began his final move.

In final analysis the North's naval superiority must be reckoned a decisive factor. It made possible the conquest of the Mississippi and Sherman's march through Georgia. The capture of New Berne by the Burnside expedition (Mar. 1862) provided the Federal land forces with a base, from which they could threaten an advance on Richmond, and caused the permanent retention in North Carolina of a considerable Confederate force, which might have been profitably employed elsewhere, notably at the time of *Lee's* invasion of Pennsylvania. The blockade threw the South upon its own resources, which proved inadequate, especially in the matter of munitions of war and medical stores. It was not lack of food, but the difficulty of transport, which reduced the Confederate armies to the verge of starvation. The Southern railways were not equal to the strain of a four years' war. The rolling stock could not be replaced when worn out or the permanent way kept in working order owing to the lack of iron rails.

(W. B. Wo.)

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AMERICAN COLLEGE OF PHYSICIANS, an association of physicians engaged in the study and practice of internal medicine in its various branches. It was legally chartered on May 11, 1915, under the laws of the State of Delaware as a corporation "not for profit." The objects of the college as stated in the constitution are: "to establish an organization composed of qualified internists of high standing, who shall meet from time to time for the purpose of considering and discussing medical and scientific topics, and who, through their organization, shall attempt to accomplish the further purposes of: (a) maintaining and advancing the highest possible standards in medical education, medical practice, and clinical research; (b) perpetuating the history and best traditions of medicine and medical ethics; (c) maintaining both the dignity and the efficiency of internal medicine in its relationship to public welfare." Its membership is made up of outstanding internists (including pediatricians, psychiatrists, neurologists, bacteriologists, pathologists, dermatologists, röntgenologists, medical teachers and investigators, tuberculosis and public health specialists) of the countries constituting the North American continent and their possessions.

Fellowship, with the degree or designation of "F.A.C.P." (Fellow of the American College of Physicians), is conferred on nominees who present evidence of suitable and adequate professional qualifications and character, as specifically set forth in the constitution and by-laws of the organization. (E. R. Ld.)

AMERICAN COLLEGE OF SURGEONS, an American college or guild (not a teaching institution), whose fellowship embraced in 1939 approximately 12,500 qualified surgeons and surgical specialists, principally in North and South America. The college was organized in 1913 by some 500 surgeons of North America, leaders in every branch of surgery and representatives of all sections of the United States and Canada. The object of the col-

lege is "to establish and maintain an association of surgeons, not for pecuniary profit but for the benefit of humanity by advancing the science of surgery and the ethical and competent practice of its art; by establishing standards of hospital construction, administration, and equipment, and all else that pertains to them; by engaging in scientific research to determine the cause, nature, and cure of disease; by aiding in better instruction of doctors; by formulating standards of medicine; and methods for the improvement of all adverse conditions surrounding the ill and injured wherever found." At the annual clinical congresses and sectional meetings of the college, conferences are held on all matters pertaining to general surgery and the surgical specialties, and to hospital standardization of interest to the profession, hospital personnel, and the public. The "Minimum Standard for Hospitals" of the college sets forth definite requirements essential for every hospital which aims to give the highest degree of efficiency in the professional care of its patients. Regular and special bulletins are published by the college containing information dealing with clinical research in cancer, bone sarcoma, and fractures and other traumas; graduate training for surgery; cancer clinics; hospital standardization, and other phases of the work of the college. A hospital information and service bureau is maintained. *Surgery, Gynecology and Obstetrics* is the official journal of the college. The library and department of literary research of the college were organized to co-ordinate literature on surgery and closely allied subjects and to encourage the wider reading and study of scientific material. A department of clinical research includes the committee on cancer, the committee on fractures and other traumas, and the registry of bone sarcoma. There is also a committee on the Hall of the Art and Science of Surgery of the college. An extensive plan for approving medical motion picture films is fostered by the college. Annually, in October, the college publishes an approval number of its bulletin in which are included approval lists as follows: hospitals; opportunities for graduate training in general surgery and the surgical specialties; standardized surgical dressings; cancer clinics; medical services in industry; and medical motion picture films. Annually, in January, there is published a *Blue Book* of fellows of the college. The headquarters of the college are at 40 East Erie street, Chicago, Illinois.

AMERICAN FARM BUREAU FEDERATION was an outgrowth of the county farm bureau movement. Shortly before World War I the idea of county agents, or agricultural experts, to provide farmers with the results of scientific study, and by contact and demonstration to induce them to use such information, had taken root. In many localities these agents were supported by local groups of farmers who constituted county committees or bureaus. Before the end of the war the county farm bureaus in several states had formed state organizations. In Nov. 1919 representatives of the state farm bureaus met in Chicago and completed plans for the organization of the American Farm Bureau federation. Prior to this meeting, education for better production had been emphasized, but postwar conditions were already bringing to the fore the need of a business organization to secure economic justice for farmers. In consequence, the purposes of the federation, as stated in its constitution, are "to promote, protect and represent the business, economic, social and educational interests of the farmers of the nation, and to develop agriculture."

From the first, the federation recognized that the farmers needed adequate prices. To effect this end, it proposed the control of production and marketing of agricultural products. In 1921 it organized the basis for the farm bloc in congress which secured the enactment of considerable emergency legislation designed to assist agriculture. Later the federation supported the McNary-Haugen bill to control surpluses, which was passed by congress in 1926 and 1928, but vetoed each time by President Coolidge. After 1929, with agricultural conditions becoming worse, the president of the federation called conferences of the leading national farm organizations, which provided fairly united support for the agricultural adjustment legislation of the early

1930s.

Under its organization plan, the federation is designed to be farmer-controlled. The governing body is the board of delegates, which meets annually and formulates policies. Each state farm bureau has one or more delegates, depending on the size of its membership. The board of directors, which is the governing body between annual meetings, consists of representatives from the main agricultural regions of the country. The state farm bureaus have a similar setup, and at the base are the county farm bureaus, which, in turn, frequently have local community units.

In 1943 the federation comprised 687,000 farm families. Its official publication is the *Nation's Agriculture*. The national office is in Chicago and the legislative office in Washington, D.C.

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AMERICAN FEDERATION OF LABOR. The American Federation of Labor was organized in Pittsburgh, Pennsylvania, November 15, 1881 by a group of trade unionists representing 50,000 members. Today it represents 104 national and international unions which comprise 33,744 local unions, 4 Departments, 1,563 directly affiliated local unions, and 806 city central bodies, with a paid up membership as of Aug. 16, 1939, of 3,915,143. The Federation is financed solely by per capita tax paid by affiliated organizations. It is based upon the principle of voluntarism, that is, the organization has no power to compel any union or person but must secure consent. Membership in the Federation and compliance with regulations are the result of voluntary decisions. The Federation can, of course, suspend or expel.

National and international unions are composed of workers in the same trade or calling with control over a definite jurisdiction to which the affiliated members of the Federation have agreed. International unions have members in Canada as well as in the United States. Several of the international unions cover an entire industry, and all members connected with that industry are eligible to membership therein. Others have jurisdiction over their craft or occupation in all industries, as the machinists, while the carpenters began with a craft and later gained jurisdictions over the materials with which they worked. The Federation chartered the first industrial union, the United Mine Workers. With changes in industrial organization and the introduction of new inventions and processes it has been found practical to enlarge the jurisdiction of some international unions and in some instances to merge existing organizations.

The unions of a single city or industrial centre have found it advantageous to band together for mutual protection and assistance in local undertakings. These organizations are chartered by the American Federation of Labor as city central bodies. In turn the State federations of labour have been formed to further State-wide interests of labour and to promote State legislation. These bodies are likewise chartered by the American Federation of Labor. In some industries or related trades a method of co-ordinating the work of these several national and international unions involved has been worked out through Departments of the American Federation of Labor. These represent the Building Trades, Metal Trades, and Railway Shop Crafts. The fourth Department—the Union Label Trades Department—was formed to promote the sale and demand for union label products. The metal trades and construction departments promote the formation of corresponding local bodies through which their related local unions function. The railway shop unions organize system federations with jurisdictions paralleling railway systems. In similar manner local union label leagues are formed in industrial centres sponsored by the Union Label Trades Department.

To take care of workers over whose organization no national or international union has responsibility, the Federation charters them in directly affiliated local unions. Where there are not enough workers to meet the charter requirements of standard trade unions, the Federation issues a charter to the whole group as a federal labour union. It is from the directly affiliated local unions that new national and international unions grow.

Administration.—Executive work of the Federation is in

charge of a President and a Secretary-Treasurer. These officers, with 15 Vice-Presidents, constitute the Executive Council which meets four times a year and decides policies of the American Federation of Labor in the interim between conventions. The final authority of the American Federation of Labor in all matters is the convention which is held annually and to which all affiliated organizations may send delegates.

The field work of the Federation is done by a staff of commissioned organizers. Administrative, legislative, and educational work is carried on through the headquarters office which is located in Washington, D.C.

One of the major activities of the American Federation of Labor is in the legislative field. A legislative staff is maintained at headquarters whose function it is to keep members of Congress informed as to Labour's interests in pending legislation. The Federation is active politically, following a non-partisan policy. Labour's political slogan is "Elect your friends—Defeat your enemies," regardless of their political affiliations.

Largely through the efforts of the Federation, much favourable legislation has been enacted, including immigration restriction, the National Labor Relations Act with supplementary State laws, child labour laws, laws limiting the hours of work of women and children, compulsory education laws in every State, the establishment of a Federal Department of Labor the head of which is a member of the President's Cabinet, mechanics lien laws, laws governing method of payment of wages, employees compensation and other social security acts, laws governing working and sanitary conditions in places of employment, safety laws, laws controlling convict labour, the establishment of Labor Day as a national holiday, legislation granting seamen the right to leave their vessels when in safe harbour, legislation regulating the use of injunctions in labour disputes, the outlawing of the yellow-dog contract in employer-employee negotiations through which workers were forced to sign away their rights to belong to a labour union.

Objectives.—One of the main objectives of the American Federation of Labor is to shorten the hours of work. When the Federation was organized in 1881 the average workday ranged from ten to eighteen hours. The average workday is now 8 hours. The Federation has always opposed the fixing of other than minimum standards of hours of labour and wages by legislation except for Federal, State, county, and municipal employees. The Federation insists upon the equity of workers in their jobs and their right to bargain collectively with employers through representatives of their own choosing.

Industrial history shows that collective bargaining is the method by which substantial progress is made in industrial relations, and balance maintained in our economic structure. Collective bargaining is a procedure based upon the principle that those concerned by decisions should have a voice in their making. The American Federation of Labor is constantly on guard against denial of the right of workers to engage in collective bargaining with their employers. When the National Recovery Act was drafted, it included a section guaranteeing workers the right to collective bargaining. This was known as Section 7 (a), and it was the first time such a provision was included in Federal legislation. This was followed by Joint Resolution 44 establishing a Board to deal with violations of Section 7 (a) and later by the National Labor Relations Act defining unfair labour practices and authorizing the Board to proceed with prosecutions against violators of the Act.

In the past century the life span of man has been lengthened. During the same period productivity per worker has so materially increased that society is facing the serious problem of an increasing number of persons in the older brackets and a decreasing number of work opportunities. Labour seeks an adjustment through shorter work hours for those employed and income for the aged and involuntarily unemployed, the cost of which should be a charge on the industry to which the workers are attached.

The American Federation of Labor has declared its firm belief in the principle of high wages and contends that the workers' real wage, which is the purchasing power of their wages, should advance in proportion to man's increasing powers of production.

The Federation seeks a proportionate share of the returns from industry for the workers attached to that industry and contends that adequate wages for a satisfactory standard of living are as necessary for the welfare of industry as for the workers themselves. The American Federation of Labor seeks the ratification of the Child Labor Amendment and a complete elimination of child labour.

It favours mothers' pensions so that children may be kept in the home until maturity.

Publications.—The official publications of the American Federation of Labor are the Convention *Proceedings*, the *American Federationist*, a monthly magazine devoted to a discussion of Labour's problems and position on matters of vital concern to wage earners, and the *Weekly News Service* which furnishes news to the publications of the national and international unions and to 300 weekly labour papers throughout the country.

Fraternal Relations.—Since 1884 the American Federation of Labor has exchanged fraternal delegates with the British Trades and Labour Congress and also sends a fraternal delegate to the Canadian Trades and Labour Congress to attend their annual conventions.

Foreign.—Since the United States Government has affiliated with the International Labour Office, the American Federation of Labor has represented American Labour in that body and has a representative on its governing board.

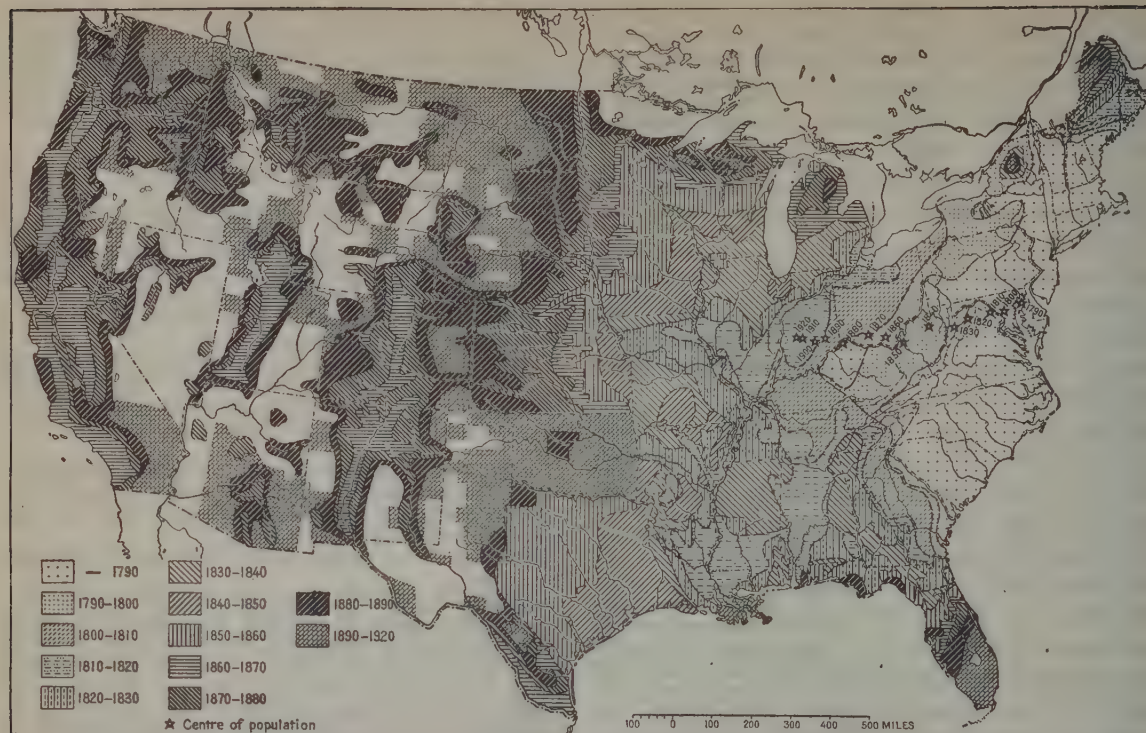
The Federation is a member of the International Federation of Trade Unions. (W. G.)

AMERICAN FRONTIER, THE. The American frontier, from an early period in the history of the continent, has affected the imagination of the pioneer who desired to exploit it, and of the visitor from afar who viewed it. Long before its existence and its significance attracted the attention of indigenous historians, it had drawn comment from the alien observer as an environment in which unusual processes were at work, and in which new human values were being born and old values were attaining new proportions. The various definitions that have been accorded it have depended largely upon the momentary use to which the frontier was being put by white men, or upon the functional relationship of the frontier as it has stood with settled society on one hand and with primitive virgin soil upon the other.

The cultural values of the frontier have come piecemeal. First, there was the explorer's frontier, as the European invader brought one geographic region after another within the field of recorded human knowledge. Next came the frontiers of the missionary, the soldier and the trapper, upon which each of these scouts of society lived his life. The first of these worked upon the souls of the native inhabitants, who were destined to recede as the world became aware of their existence; the second was staking in a new world, for one great Power or another, the claims that it was hoped one day to exploit; the third, the trapper, differed from his priestly or his military fore-runner in that he, first among white men, lived on the land he found and derived from its products a basis for existence. None of these changed the face of nature. All gave way, eventually, when the frontier of the farmer made its appearance and dotted the land with cabins and cleared fields. There is a long succession of later frontiers that may be traced in American history, as alongside the farmer's frontier emerged also the frontiers of the miner, the lumberman and the railroad; and out of them came the frontiers of established local government, of locally created capital, of industrial society and of the various aspects of culture or religion. In each of these several fields the frontier provides a means for studying institutions while they are in the formative stage, and before they have become



BY COURTESY OF THE UNIVERSAL PICTURES CORPORATION
A TRAPPER AND GUIDE, WEARING A COON CAP, A FAMILIAR FIGURE DURING AMERICA'S EARLY EXPANSION



MAP SHOWING THE EXPANSION OF THE AMERICAN FRONTIER EVERY 10 YEARS FROM 1790 TO 1890. THE AREAS SETTLED FROM 1890 TO 1920 ARE SHOWN COMBINED. THE MAP IS BASED ON A POPULATION OF NOT LESS THAN TWO INHABITANTS PER SQUARE MILE

inextricably involved in the complex of a progressive and sophisticated society.

From a different point of view the frontier may be described as a region, a process or a fixed line. As a region, it may be considered as a place in which the new forces of western civilized life are being applied for the first time, and in which a new social group is finding itself and is creating its internal bonds. As a process, it concerns itself with the ways and means whereby the institutions of older society are being worked over and selected according to their survival values, within the territorial limits of the frontier region. As a geographic line, it may be shown upon a map for any period at which statistical evidence is available; and in this connection it is always the line that may be drawn separating territory possessing an arbitrarily selected average of residents per square mile, from territory of less than that average number. The decennial census of the U.S. Government, since 1790, has provided the basis for this cartographic identification of the frontier. In most of the recent census reports maps are shown for each decennial period, with shadings indicating the distribution of populations of under two inhabitants per square mile, of 2 to 6, of 6 to 18, of 18 to 45, of 45 to 90 and of over 90. The steps in this scale that American historians have commonly accepted for their study of frontier lines are the first and the second. Most frontier lines are drawn at under two, or over six; and in either case the line thus drawn shows, for the period of the census concerned, the region near which the frontier process was most typically at work. A series of frontier line maps, made ten years apart, from 1790 until 1890, shows that invariably the zone of contact between settled America and the wilderness ran irregularly from north to south; and that at each decennial census it had made a perceptible advance along most of its front towards the west. At the date of the first census the line ran not far from the watershed of the Appalachians; after 1890 it had passed beyond the Great Plains, and the whole of the United States was so nearly occupied that no sharp frontier line can be indicated. The duration of the period in American history in which a frontier

line can always be shown runs, therefore, from the moment of the initial settlements in the 17th century until the close of the 19th century. To-day, there is no frontier in the true sense, and the frontier episode is closed.

The history of the frontier in America falls easily into three major divisions, that may be separated roughly by the treaties that closed the Seven Years' War (1763), and by the panic of 1837. Each of these periods has characteristics that warrant its treatment as a logical unit.

The first period is dominated by the planting and extension of the English colonies in North America. No serious damage is done by ruling out both the French and the Spanish. The French, confined mostly to the valley of the St. Lawrence, failed to develop a pioneering population; and their settlements existed chiefly as a residence for the missionaries, the military men and the trappers who were uncovering the interior of the continent without changing its aspect. The Spanish settlements in the southern portions of the United States were even less aggressive in the spreading of civilization than the French. And both French and Spanish proved themselves unable to stand up against the competition of the invaders from the British settlements.

Nature of Early Frontier.—Throughout most of the period that ran from the planting of Virginia and Massachusetts until the middle of the 18th century, the frontier in America was really a frontier of Europe, along which the institutions of the western European countries, and particularly of England, were being tested in the wilderness. This is a part of European quite as much as of American history; and every European court felt that to some extent the basis of survival among themselves was to be found among the American plantations. The period does not come to an end until, at the close of the Seven Years' War, the superior weight of the English possessions asserted itself, and it was possible for the English diplomats to claim and secure compensation by ejecting France from North America, and by pushing Spain west of the Mississippi. During the century and a half from Jamestown to the Treaty of Paris, the settlements had spread

from the beach where the earliest English colonies were planted. Up the river valleys and the bays they advanced. By 1700 they had reached and were passing the "falls line" (a line that may be shown on a map by connecting the lowest rapids or waterfalls of the successive Atlantic rivers). Beyond the "falls line" they entered the *piedmont* of the Appalachians; and by 1763 scattered areas along the upper reaches of the Mohawk, the Connecticut, the Delaware, the Susquehanna, the Potomac, the Shenandoah and the James, were alive with the activities of the pioneers. But the period preserves its unity because of the omnipresence of the European connection, because of the dependence of the settlements upon rivers flowing into the Atlantic ocean, and because the future of the continent in its relation to European suzerainty was not certain until after the expulsion of the French.

The Second Period.—The second period of the frontier in America extends from the expulsion of the French until the occupation of the Mississippi valley (that was to ripen in modern times into the Middle West); its zone stretches from the valleys of western Pennsylvania to the bend of the Missouri river, where the Kansas enters from the west. It has a striking difference from the first period for it is now an American frontier, since the new life is an offshoot from the older American establishments. In this period indeed the United States prided itself upon its aloofness from Europe and from European interests, and gave birth not only to a new breed of democracy that was identified with Andrew Jackson, but to the American system of Henry Clay, and to the international doctrine of James Monroe. The European flavour has largely disappeared, and no considerable body of new European settlers takes a part during this second period in the movement towards the West.

The Third Period.—There is a common quality in the first and second periods of frontier extension that is lacking in the third which covers the years between the panic of 1837 and the panic of 1893. This is primitive transportation. The routes of the pioneers of the earlier periods, as they sought new homes, were those of the natural roads and trails, and the river valleys that lay in the course of the movement. Until the second period was nearly at an end there were no improvements in these natural means of transport, except here and there a fragment of stone road like the Lancaster pike or the Cumberland road (each of which, however, ran close to an improved beaten way), and once

little later the completed continental railroads put an end to pioneer traffic of the older sort, and speedily brought a conclusion to the era of the frontier. The frontiersman himself was vastly changed by these improvements in his methods of travel; while the introduction of elaborate machinery on the farm, like the reapers that spread in use on the prairies, brought capital to his aid and changed the technique of his work.

Characteristics.—In each of these three periods of frontier expansion, there are vital problems which have as yet received little treatment from the historian or the economist. First and fundamental was the relation of the settler to his piece of land; for this was generally an agrarian advance. The land economics of each region had much to do with the course of development as the frontiersmen came in; and after a region had been taken up, no set of problems was more searching than that which had to do with the escape of the frontier from the burden of land encumbrance. Second was the financial problem; varying according to region and period, but pressing in every aspect. The personnel of the advance included a low proportion of persons with enough money to be free. The others had to borrow, not only to buy their land, but to pay the costs of outfit and transportation to the new homes, and for maintenance until the new farm became self-supporting. The most rapid advance of the frontier occurred after the introduction of banking brought formal credit to the aid of the frontiersman. But interest was high and his collateral was sketchy, and it nearly always happened that the debts incurred during the hopeful period of speculative development became a burden and a curse in moments of economic depression. Third, and indispensable, was the problem of marketing the surplus that has lasted over from the frontier period into modern western agriculture. The farming communities had no means of meeting land payments or absolving debts other than that of marketing a surplus of agricultural goods. In a community wholly agricultural there was no market; and long distances and high freight rates separated every good market from the source of supply. The search for a market is thus a third of the frontiersman's fundamentals, and one that has never been permanently solved except in narrow regions where agricultural diversification could enter, or where local industrial societies grew up to consume the surplus.

As the frontiersmen met their problems certain conditions were emphasized that were not unique or new, but that were not so clearly visible in older and more complicated societies. Striking among these conditions was a trend towards equalitarianism, with its resulting consequence in social and political democracy. For the bulk of any frontier group, and during a period of years that averaged perhaps 20 in a single frontier community, nearly the whole attention of society was devoted to the primary physical tasks of reclaiming the land and erecting the dwellings. The period begins when the earliest pioneer makes his appearance; it ends, normally, when the first of the native-born children leave the home cabin to move on to a new frontier. The uniformity of activity necessary for survival placed a high premium on physical and moral virtues, and threw into the discard matters of social standing, cultivation of taste, birth and even financial status. There were few things on a frontier that could be bought; least of all personal service. With all at work each resented the occasional individual who escaped work. There was a tendency to dislike those not in step with the community. Men equal in actual status found it easy to generalize upon equality, and to resent artificial prominence. A rough and ready democracy grew up, that gave tone and character to all the frontiers that appeared and passed.

Another condition of frontier life was an unusual openness of mind in certain directions. In most settled societies of the world, personal status was so nearly fixed at birth that it was safe to assume a future without change. But to the frontiersman change was the orderly expectation of life. Within two decades the successful pioneer saw his virgin claim develop and improve, his acreage increase, his cleared fields spread, his herds multiply. He saw grow around him the roads, schools, churches, county towns and institutions of government. He saw the transition



BY COURTESY OF FIRST NATIONAL PICTURES
A MODERN RECONSTRUCTION OF A PIONEER'S LOG CABIN IN THE BACK SETTLEMENTS

in a while a steamboat on some of the western rivers. The successful development of the steamboat for up-river traffic, the construction of numerous canals, of which the Erie canal was first and greatest, and the building of the railroads served to introduce new tendencies in migration. The routes were materially changed, speed was quickened, and the carrying capacity of the highways grew as freights declined. The zone of occupation in the third period was west of the Mississippi bend. Across the plains and mountains to the Pacific, the overland trails guided most of the migrants in the early part of the third period. A

from Indian country to sparse farming, the progress from arbitrary territorial government to full participation by the autonomous State, the spread of the available country towards the west as the Government bought land from the Indian or took it over from Spain or Mexico. And in his mind grew an idea of progress that time has scarcely dimmed in the American mind. His community was less than usually bound to rigid classifications



BY COURTESY OF PARAMOUNT PICTURES

AN OXWAGON TRAIN, SHOWING THE COVERED WAGONS IN WHICH THE FRONTIERSMAN TRANSPORTED HIS FAMILY AND GOODS

and was abnormally ready to look upon and accept a change. He was always a romanticist as he brooded over his future; and in public affairs this state of mind turned easily into a spirit of expansion.

A more precise consequence of his economic status was his normal tendency towards the acceptance of inflationist theories of finance. Every frontier was improved, largely, by borrowed money. Although the capitalist with ready money to use or lend was not unknown, the average pioneer citizen was obliged to borrow in order to develop his farm. He borrowed amid the enthusiastic conditions of a boom period. By a kind of auto-intoxication the frontier community magnified its hope of profits, elevated the value of its land and multiplied its probable crop. Loans were made on inflated valuations; rates of interest were promised that could never be earned. Debt was spread over the whole farm, yet it was always a matter of years before more than a small fraction of the total acreage could be made to yield. The community borrowed to build its roads and public buildings; when railroads came, the community and its people bonded themselves to subsidize the railroad. From the mixture of blind enthusiasm, lack of skill and actual fraud that accompanied frontier promotion came a situation of heavy debt at a high interest rate that reduced the community to bankruptcy when the boom was over or hard times came. On such occasions, without fail, the local response to hard times and unpayable debts was the appearance of inflationist schemes and the suggestion of stay laws to prevent the forcible collection of debts. The land banks of New England, the paper money revolt of Shay, the banking restrictions of the Jackson period, the stay laws of Kentucky, the repudiation of State debts, the demand for greenbacks and the cry for free silver in turn indicated the frontier tendency to accept inflation as a remedy. And the tendency was given profound political meaning because of the uniformity of the frontier group and the lack of capitalistic dissenters among the debtor farmers. And the directness of the American representative system gave an easy route for the translation of this discontent into party action.

Repeatedly, in every region of the United States, the frontier set-up was prepared, and the resulting community fitted into the matrix and developed towards a balanced and normal life. The process was repeated so often, and under such nearly uniform conditions, that the American frontier affords one of the few places in which it is practicable to study human affairs as in a laboratory. The experiments were staged not by premeditation but by standard

conditions that repeated themselves for many generations. Raw nature and stark human power were again and again brought together; and from their contact emerged human self-governing groups. The effect of the process, as group after group selected for its use the institutions it valued, and abandoned the customs, restrictions and institutions that seemed to have lost their meaning, was to launch American society as a whole, and to transmute the person, of whatever race, into a new type that was already known as American when Benjamin Franklin made his appearance at the courts of Europe. Its constant tendency was towards direct popular government on a representative system, towards a broadening opportunity for all in affairs political, economic or social, and towards a new status for women. Enough has already been established by the historians of the frontier to indicate that herein is the most distinctive factor in the making of the United States.

In Political Life.—The political tendency of the American frontier has been unmistakable and fairly uniform. Before the American Revolution nearly every one of the English colonies was conscious of unrest among its newer settlements; and in Pennsylvania, Virginia and North Carolina this unrest had already drifted rapidly towards open conflict. In the colonies as a group, as within the several colonies, the frontier tendency created a distrust of absenteeism in finance and government. The most convincing of the explanations of the American Revolution is that it was a frontier revolt against the long-range control that emanated from Westminster, and that it was embittered because the width of the ocean had prevented the participants on either side from realizing that frontier life had created a new race across the Atlantic. The revolution was not built upon a passion to alter the scheme of life, but on the human determination to control it. The revolutionaries stopped their work when the power of England was broken and independence was attained. The new governments erected in America were direct descendants of the old colonial establishments, only sifted and modified by the normal tendencies of the frontier.

Twenty-five years after the separation from England there came a second wave of frontier discontent with the trend of affairs, and it was Thomas Jefferson who organized and led the democratic revolt. His political followers were scattered over every State, among the young and the little; but on the frontier his name aroused enthusiasm in the average mind. His democ-



"LAST CHANCE GULCH" AT HELENA, MONTANA, A SETTLEMENT WHICH SPANG INTO EXISTENCE AS A RESULT OF THE MIGRATION DUE TO THE DISCOVERY OF GOLD

cracy, more than a little derived from the French revolutionary philosophers, was instantly acceptable in a community where equality in fact was the common condition. He and his lieutenants governed the United States until their enthusiasm cooled, their youthful ideals settled into middle-aged conservatism, and until a new democracy of the Mississippi valley ranged itself behind the personality of Andrew Jackson.

In 1828 Andrew Jackson was elected president of the United States, and for a third time a frontier party took charge of American destiny. A minor revolt, but one with many re-

semblances to that of Jackson, took the government away from the Jacksonians in 1840, and placed the Whig Party in power. And 20 years later, the new Republican Party, whose enthusiasms ran highest among the newer communities of the north-western States, gained control of the government and entered upon the struggle to prevent the extension of slavery and for the maintenance of the Union, with a typical child of the frontier, Abraham Lincoln, at its head.

A generation after Lincoln, the new States of the western plains, where railway activity had promoted immigration faster than the country was able to support it, festered with discontent. And again there was the element of absenteeism, of inflation finance, of the protest of the common man against the power of the great, of the desire for a re-making of the institutions of administration and government. In this, as in the earlier revolts, there was lacking any great desire to change the basis of affairs, or to alter the philosophies of life. There was little of socialism or revolution but much of a desire to capture the organs of government and to operate them in the interest of the common people. The issue was fought in 1896, over the slogan of free silver and behind the crusading leadership of William Jennings Bryan. For once the western sequence of party creations was stopped. An embattled East resisted and prevented victory for free silver and Populism. But it was because the country had changed and the frontier had become a reminiscence rather than a living fact. No comprehension of American politics is possible without an understanding of the ways and means by which, for a century after independence, this democratic wave sequence kept alive the ideals of western democrats in protest against the rigid classifications of older and industrialized society.

The Frontier Disappears.—During the final decade of the 19th century the open frontier disappeared from the American map. During the boom years of the '80s the spread of settlements went farther and faster than was economically wise; and after 1890 there was an actual recession of the settled areas, so that there are now hundreds of counties in the western States that have fewer farming inhabitants than they had in 1890. With the completion of the continental railroads, no large area was left without easy means of contact and communication with the rest of the nation. Only three tracts remained that had not reached

statement is still under way, making progress as new studies develop the meaning of local affairs, or as new syntheses attempt to bring together the whole of the American story.

BIBLIOGRAPHY.—A brilliant synthesis giving the frontier full recognition, but with more economic determinism in it than most frontier specialists would approve, is that of Charles and Mary Beard, *The Rise of American Civilization* (1927). There is also a comprehensive survey, with its attention generally focused upon the frontier line as it swept across the country, in F. L. Paxson, *History of the American Frontier* (1924). The initial essay of Prof. Turner is most accessible in his *Frontier in American History* (1920). C. W. Alvord, *The Mississippi Valley in British Politics* (1917), and A. P. Whitaker, *The Spanish-American Frontier* (1927), are distinguished studies of the West as a stake in European diplomacy. S. J. Buck, *The Agrarian Crusade* (1919), traces the farmer movements that are an integral part of post-frontier reactions; and there is much useful detail in C. Goodwin, *The Trans-Mississippi West* (1922).

(F. L. P.)

AMERICAN GEOGRAPHICAL SOCIETY OF NEW YORK, founded in 1852, is the oldest geographical society in the U.S. The society maintains the third largest geographical library in the world. It publishes books, maps and the *Geographical Review*, a quarterly journal. These present the results of original work in all branches of geography, including research by the society's staff. Outstanding projects of recent years have been the compilation and publication of the map of Hispanic America on the scale of 1:1,000,000 (107 sheets) published in conformity with the International Millionth Map of the World, research in photogrammetry, and extensive studies of pioneer settlement problems, polar geography and exploration, the development of New England's resources, etc. The society recognizes distinguished contributions to geography by the award of medals. An annual program of lectures is arranged for its Fellows.

AMERICAN INSTITUTE OF CO-OPERATION, an educational institution incorporated in 1925 in the District of Columbia and holding a session for a month each summer. The idea originated in 1923 in the National Co-operative Milk Producers' Federation and readily gained the support of other agricultural organizations. The purpose of the institute is to collect and disseminate accurate information on the economic, sociological and legal phases of co-operation. So far its attention has been restricted to agricultural co-operation, but it expects in the future to broaden its field. Representatives of the important agricultural co-operative associations and other farm organizations, and economists from universities and research institutions participate in the annual sessions. These are held at various universities. The proceedings, published annually under the title *American Co-operation*, constitute a valuable compendium of principles, practices and ideals maintained in the co-operative movement in the United States.

AMERICANISM, a term first used by John Witherspoon, president of Princeton university, in 1781, designates (a) any word or combination of words which, taken into the English language in the United States, has not gained acceptance in England, or, if accepted, has retained its sense of foreignness; and (b) any word or combination of words which, becoming archaic in England, has continued in good usage in the United States. The first class is the larger and has the longer history. The earliest settlers in Virginia and New England, confronted by plants and animals that were unfamiliar to them, either borrowed the Indian names or invented names of their own.

Examples are afforded by *raccoon* (1608), *chinkapin* (1608), *opossum* (1610) and *squash* (1642) among Indian words, and by *bull-frog*, *canvasback*, *cat-bird* and *live-oak* among inventions. The former tended to take anglicized forms. Thus the Indian *isquontersquash* (at least, that is how the early chroniclers recorded it) became *squantersquash* and was then reduced to *squash*, and *otchock* became *woodchuck*. Many other words came in as the pioneers gained familiarity with the Indian life. Such words as *hominny*, *moccasin*, *pone*, *tapioca* and *succotash* remain everyday Americanisms.

The archaisms, of course, showed themselves more slowly. They had to go out of use in England before their survival in America was noticeable. But by the beginning of the 18th century there was already a considerable body of them, and all



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THE STAGE COACH, THE CHIEF MEANS OF TRANSPORTATION IN THE EARLY WEST. AFTER THE COVERED WAGONS WENT AND BEFORE THE RAILROADS CAME

the full dignity of Statehood; and these, Oklahoma, Arizona and New Mexico were admitted to the Union early in the present century.

The significance of the frontier in American life was never clearly expressed until in 1893 Frederick Jackson Turner, a professor in the University of Wisconsin and himself a child of the north-western frontier, published a monograph, "The Significance of the Frontier in American History." Thereafter, by its sheer convincing quality, Turner's idea gave a new reasonableness to American history that young historians absorbed without knowing it; and that older historians, almost without exception or protest, adopted. It forced a general restatement of American history, now that the organizing principle was recognized. And this re-

through that century they increased. The English language in Great Britain, chiefly under the influence of pedantry in the age of Anne, was changing rapidly, but in America it was holding to its old forms. There was very little fresh emigration to the Colonies, and their own people seldom visited England. Thus by the end of the century "*I guess*" was already an Americanism, though it had been in almost universal use in England in Shakespeare's day. So, too, with many other verbs: *to wilt*, *to whittle*, *to fellowship* and *to approbate*; and with not a few adjectives: *burly*, *catty-cornered*, *likely* and *clever* (in the sense of amiable); and with multitudes of nouns: *cesspool*, *greenhorn*, *cordwood*, *jeans*, *flap-jack*, *bay-window*, *swingle-tree*, *muss* (in the sense of a row), *stock* (for cattle) and *fall* (for autumn). A few of these archaisms, in late years, have been taken back into English usage by the force of American example.

Meanwhile, American English had begun to borrow words, chiefly nouns, from the non-English settlers, and to develop many new words of its own. To the former class the Dutch contributed *cruller*, *cold-slaw*, *cookie*, *scow*, *boss*, *smearcase* and *Santa Claus*, and the French contributed *gopher*, *prairie*, *chowder*, *carry-all* and *bureau* (a chest of drawers). Other contributions came from the Germans of Pennsylvania, the Spaniards of the south-west and negro slaves. The native coinages were large in number, and full of boldness and novelty. To this period belong, for example, *backwoods*, *hoe-cake*, *pop-corn*, *land-slide*, *shell-road*, *half-breed*, *hired-girl*, *spelling-bee*, *moss-back*, *crazy-quilt*, *stamping-ground* and *cat-boat*. These words were all made of the common materials of English, but there was something in them that was redolent of a pioneer people and a new world. In their coinage the elegances were disdained; the thing aimed at was simply vividness. At the same time, verbs were made out of nouns, nouns out of verbs and adjectives out of both.

In 1789 Benjamin Franklin, who had lived in England, denounced to *advocate*, to *progress* and to *oppose* as barbarisms, but all of them are good American to-day, and even good English. Noah Webster, the lexicographer, gave his imprimatur to *to appreciate* (in value); *to eventuate* was popularized by Gouverneur Morris; and no less a hero than Washington is said to have launched to *derange*. Many inventions of that daring era have succumbed to pedagogical criticism, e.g., *to happily*, *to compromit* and *to homologize*. But others equally harsh have gradually gained acceptance, e.g., *to placate* and *to deputize*. And with them have come in a vast number of characteristic American nouns, e.g., *breadstuffs*, *mileage*, *balance* (in the sense of remainder) and *elevator* (a place for storing grain).

Divergent Meanings of Words.—It was during the same period that a number of important words, in daily use, began to show different meanings in England and America. Some familiar examples are *store*, *rock*, *lumber* and *corn*. What Englishmen call a *shop* was called a *store* by Americans as early as 1770, and long before that time *corn*, in American, had come to signify, not grains in general, but only maize. The use of *rock* to designate any stone, however small, goes back still farther, and so does the use of *lumber* for *timber*. Many of these differences were produced by changes in English usage. Thus *cracker*, in England, once meant precisely what it now means in the United States. When the English abandoned it for *biscuit* the Americans stuck to *cracker*, and used *biscuit* to designate something else. How *shoe* came to be substituted in America for the English *boot* has yet to be determined. There is indeed much that remains obscure in the early history of such Americanisms. Until very lately, American philologists kept aloof from the subject, which they apparently regarded as low. Until George P. Krapp of Columbia university took it up, there was not even any serious investigation of the history of American pronunciation.

Thus the American dialect of English was firmly established by the time the Republic was well started, and in the half-century following it departed more and more from standard English. The settlement of the West, by taking large numbers of young men beyond the pale of urbane society, made for grotesque looseness in speech. Neologisms of the most extravagant sorts arose by the thousand, and many of them worked their way

back to the East. During the two decades before the Civil War everyday American became almost unintelligible to an Englishman; every English visitor marked and denounced its vagaries. It was bold and lawless in its vocabulary, careless of grammatical niceties, and further disfigured by a drawing manner of speech. The congressional debates of the time were full of its phrases; soon they were to show themselves in the national literature.

Policing the Language.—After the Civil War there was an increase of national self-consciousness, and efforts were made to police the language. Free schools multiplied in the land, and the schoolmarm revealed all her immemorial preciosity. A clan of professional grammarians arose, led by Richard Grant White; it got help from certain of the literati, including Lowell. The campaign went to great lengths. "*It is me*" was banned as barbarous, though it is perfectly sound historically; *eye-ther* was substituted in polite usage for *ee-ther*, though *ee-ther* is correct and *eye-ther* is on the part of an American an absurd affectation.

But the spirit of the language, and of the American people no less, was against such reforms. They were attacked on philological grounds by such iconoclasts as Thomas R. Lounsbury; they were reduced to vanity by the unconquerable speech habits of the folk. Under the very noses of the purists a new and vigorous American slang came into being, and simultaneously the common speech began to run amuck. That common speech is to-day almost lawless. As Ring Lardner reports it—and he reports it very accurately—it seems destined in a few generations to dispose altogether of the few inflexions that remain in English. "Me and her woulda went" will never, perhaps, force its way into the grammar-books, but it is used daily, or something like it, by a large part of the people of the United States, and the rest know precisely what it means.

On higher levels the language of the Americans is more decorous, but even there it is a genuinely living speech, taking in loan-words with vast hospitality and incessantly manufacturing neologisms of its own. The argot of sport enriches it almost daily. It runs to brilliantly vivid tropes. It is disdainful of grammatical pruderies. In the face of a new situation the American shows a far greater linguistic resourcefulness and daring than the Englishman. *Movie* is obviously better than *cinema*, just as *cow-catcher* is better than *plough* and *job-holder* is better than *public servant*. The English seldom devise any thing as pungent as *rubber-neck*, *ticket-scalper*, *lame-duck*, *pork-barrel*, *boot-legger* or *steam-roller* (in its political sense). Such exhilarating novel-ties are produced in the United States every day, and large numbers of them come into universal use, and gradually take on literary dignity. They are opposed violently, but they prevail. The visiting Englishman finds them very difficult. They puzzle him even more than do American peculiarities of pronunciation.

The common vocabularies in England and the United States show important differences in the meaning of words. Here are a few examples:

American	English
ash-can	dust-bin
ash-cart	dust-cart
ashman	dustman
backyard	garden
baggage	luggage
baggage-car	luggage-van
ballast (railroad)	metal
bath-robe	dressing-gown
beet	beet-root
bid (on a contract)	tender
bill-board	hoarding
brakeman	brakesman
bumper (car)	buffer
calendar (court)	cause-list
campaign (political)	canvass
can (noun)	tin
candy	sweets
car (railroad)	carriage, van or wagon
carom (billiards)	cannon
catalog (university)	calendar

<i>American</i>	<i>English</i>	<i>American</i>	<i>English</i>
checkers (game)	draughts	parcels room	left-luggage room
cheese-cloth	butter-muslin	patrolman (police)	constable
chicken-yard	fowl-run	peanut	ground-nut, monkey-nut
chief of police	chief constable	pen point	nib
city editor (newspaper)	chief reporter	pitcher	jug
city ordinance	by-law	poorhouse	workhouse
clipping (newspaper)	cutting	postpaid	post-free
coal	coals	potpie	pie
coal-oil	paraffin	prepaid	carriage-paid
collar-button	stud	press (printing)	machine
commutation ticket	season ticket	pressroom	machine-room
corn	maize or Indian corn	program (of a meeting)	agenda
counterfeiter	coiner	public school	board-school
cow-catcher	plough	railroad man	railway servant
cracker	biscuit	Rhine wine	hock
crazy-bone	funny-bone	roadbed (railroad)	permanent way
cross-tie	sleeper	roast (of meat)	joint
crystal (watch)	watch-glass	roll call	division
daylight time	summer time	rooster	cock
derby (hat)	bowler	round-trip ticket	return ticket
dime novel	penny dreadful	saloon	public-house
district (political)	division	shirtwaist	blouse
druggist	chemist	shoe shine	boot polish
drug-store	chemist's shop	shoestrings	boot-lace
drummer	traveller	sick	ill
dry goods store	draper's shop	sidewalk	footpath or pavement
editorial (noun)	leader	sight-seeing bus	charabanc
elevator	lift	silver (collectively)	plate
elevator boy	liftman	sled	sledge
enlisted man	private soldier	soft drinks	minerals
express train (subway)	non-stop train	spigot	tap
fire department	fire brigade	sponge (surgical)	wipe
fish-dealer	fishmonger	stem-winder	keyless watch
floorwalker	shopwalker	stockholder	shareholder
fraternal order	friendly society	stocks	shares
freight	goods	store fixtures	shop-fittings
freight car	goods wagon	street railway	tramway
frog (railway)	crossing-plate	street car	tramcar
garters (men's)	sock-suspenders	suspenders (men's)	braces
gasoline	petrol	switch (noun, railway)	points
grade (railway)	gradient	switch (verb)	shunt
grain	corn	taxes (municipal)	rates
grain broker	corn factor	taxpayer (local)	ratepayer
groceries	stores	tenderloin (beef)	under-cut or fillet
hardware dealer	ironmonger	ten-pins	ninepins
headliner (vaudeville)	topliner	thumb-tack	drawing-pin
hodcarrier	hodman	ticket-office	booking-office
hog-pen	piggery	trained nurse	hospital nurse or nursing sister
hood (automobile)	bonnet		
hospital (private)	nursing-home	transom (door)	fanlight
huckster	coster (monger)	trolley car	tram-car
hunting	shooting	truck (vehicle)	lorry
Indian	Red Indian	undershirt	vest
instalment business	credit trade	warden (of a prison)	governor
instalment plan	hire-purchase plan	wash-rag	face-cloth
internal revenue	inland revenue	washstand	washhand-stand
janitor	caretaker	wastebasket	wastepaper-basket
laborer	navvy	witness stand	witness box
legal holiday	bank holiday		
letter-box	pillar-box		
letter-carrier	postman		
locomotive engineer	engine driver		
long-distance call	trunk call		
lumber	deals		
lumber-yard	timber-yard		
mad	angry		
molasses	treacle		
notions	small wares		
office-holder	public servant		
orchestra (seats)	stalls		
outbuildings (farm)	offices		

Of late the increase of travel and other intercommunication between England and America has tended to halt the differentiation of the two dialects. It was more marked, perhaps, before the World War than since. But if it ever vanishes altogether the fact will mark a victory for American.

The American "movie" floods England (and the rest of the English-speaking world) with American neologisms, but there is very little movement in the other direction. Thus the tail begins to wag the dog. How far the change has gone may be observed in Australia. There a cockneyfied pronunciation holds out, but the American vocabulary is increasingly triumphant. In Canada it long ago overcame the last vestiges of opposition.

BIBLIOGRAPHY.—There is no satisfactory dictionary of Americanisms,

The best is Richard H. Thornton's *American Glossary* (1912), but it is based wholly on written records and is thus incomplete. George Philip Krapp's *The English Language in America* (1925) is valuable to the student of American pronunciation, and contains much miscellaneous matter of interest, but there are gaps in it, and the author opposes his own evidence by arguing that English and American show few important differences. In *A Comprehensive Guide to Good English* (1927), by the same author, many Americanisms are listed, but the collection is by no means exhaustive. Many are also listed in the American edition of *The Pocket Oxford Dictionary of Current English* (1927), the American editor of which is George van Santvoord. Some valuable observations upon American pronunciation are in *The Pronunciation of Standard English in America*, by Krapp (1919), and in *A Dictionary of English Pronunciation with American Variants*, by H. E. Palmer, J. Victor Martin and F. G. Blandford (1926). An extensive bibliography is in H. L. Mencken's *The American Language*, 3rd ed. (1923). In 1925 Dr. Louise Pound, of the University of Nebraska, began the publication of a monthly, *American Speech* (Baltimore). It became a quarterly in 1927. (H. L. M.)

AMERICANIZATION. The popular use of the word Americanization, and the general acceptance in the United States of the idea it stands for, date from the early months of the World War. Long before the United States became an actual belligerent, American reactions to European hostilities had revealed the fact, long familiar to close students of the immigration problem, that the population of the United States contained vast sections of foreigners who, in spite of long residence in America, were still completely alien in sympathy, loyalty and general social and emotional affiliations. These persons were clearly thinking and feeling as Germans, Irish, English or Italians, not as Americans. Most disturbing of all was the inescapable realization that these foreign-minded elements included many naturalized American citizens, sometimes of long standing. It was perhaps a premonition that the United States must eventually become involved in the great conflict that made these facts produce such widespread consternation. The Americanization movement, therefore, as a distinct sociological phenomenon, may justly be considered a product of war conditions, though it is quite probable that in this, as in so many other cases of social movement, the war merely accelerated a change that was destined to come eventually in any case.

The objective of Americanization is nothing new. It is merely assimilation, the harmonization of alien with native elements into a homogeneous socio-political unit. The novelty lies in the method. Before the revelations of the war it had been generally assumed that assimilation took place in the United States spontaneously, without the exertion or necessity of any conscious effort on the part of anybody. The metaphor of the "melting pot" had been introduced and enthusiastically accepted to symbolize the mystical potency of the great democracy whereby peoples from every corner of the earth were fused into a harmonious and presumably admirable blend. Once this illusion was shattered it was inevitable that the American people should determine to do something about it. The Americanization movement represents a determination to accomplish by deliberate, purposeful means the indispensable assimilation which it was clear could no longer be trusted to natural, spontaneous forces. It was also characteristic of the American people that the means chosen should be organization, particularly through committees, and education. The two foremost committees, which promoted and stimulated the movement in its early phases, were the Committee for Immigrants in America and the closely related National Americanization committee. These worked in close co-operation with the Federal Bureau of Education which, through its Americanization division, published a special periodical, *Americanization*, promoted conferences and fostered the movement in various ways. The idea won immediate popularity. It became a favourite form of patriotic service, particularly after the entry of the United States into the war, for countless individuals whose available time was not engrossed by other war activities. Americanization agencies and activities in almost unlimited variety sprang up throughout the country. The unifying principle was the general educational conception of the problem. The logic was simple. These unassimilated foreign individuals lacked some of the important characteristics of genuine Americans. This was dangerous for America. Therefore they must be taught the missing qualities. The basic theory of Amer-

icanization at this stage of its development was that assimilation can be accomplished through an educational programme.

The deficiencies selected for correction were naturally the most conspicuous, specifically lack of mastery of the English language and of knowledge of American civics and history. These three subjects constituted the backbone of the Americanization curriculum. To them, however, were soon added many supplementary accomplishments such as millinery, cooking, social amenities and the care of babies, all treated in the American manner, and all to be attained by means of an educational régime. For this expansive programme all available educational agencies, with necessary modifications and adjustments, were mobilized and many special agencies were created. The public schools organized night schools and opened various kinds of special classes, State departments of education formed Americanization divisions, universities and city governments appointed Americanization directors, and many industrial concerns co-operated eagerly in the establishment of special classes for alien workers. A national conference on Americanization in industries was held in Boston in 1919.

Enthusiasm for Americanization persisted throughout the war period, and was prolonged into the reconstruction period, largely stimulated by the "Red Radical hysteria" which infected the country for two or three years. Gradually, however, interest diminished. One after another the subsidiary features were dropped, until Americanization became synonymous with teaching foreigners English, civics and history, and eventually English alone in many cases. This was due to several causes: first, the subsidence of war-time apprehensions themselves, and preoccupation with other matters; secondly, the tremendous decline in immigration due to war conditions and special restrictive legislation.

With the decline of the war-time attitude of extreme nationalism, many broad-minded Americans began to regard it as not only bigoted but also unwise to insist upon the complete transformation of the foreigner into the American type. They became convinced that the culture of the United States could be profitably enriched by the incorporation of some of the more admirable features of the various foreign nationalities. Attempts were made to supplant the metaphor of the melting-pot by other symbols, such as a "weaving-machine," which should suggest the harmonious combination of traits, not blended but preserved in their pristine quality. Americanization was presented as a two-sided process of give-and-take. Simultaneously, many students and practitioners of Americanization began to question whether, after all, it is possible to attain the objectives aimed at by means of an educational programme. The truth seemed to be that genuine assimilation is attained not by learning but by living. The process involved represents a prolonged and difficult reaction to a social environment much more vital, involved and inclusive than that of a class-room. So deeply did these convictions penetrate that within less than a decade after the armistice, many workers were reluctant to apply the word Americanization to the most well-conceived and constructive activities. As a result it has been customary to refer to those permanent and unemotional features of the program which still remain as "adult education of the foreign-born" (see ADULT EDUCATION), intimating that as far as the rising generation is concerned the educational phases of assimilation have been resigned to the regular public schools.

Rightly to judge these latter developments, it is necessary to comprehend clearly the process and the desirability of assimilation. On both of these points there is still considerable divergence of opinion. Some prominent thinkers, native as well as foreign, believe that assimilation in its accepted sense is not a desirable goal, but that the United States will reach its highest pinnacle by preserving many separate cultures side by side within its boundaries. Others continue to insist that assimilation is a two-way process. The outstanding trend of opinion, however, is probably toward the conclusion that assimilation is indispensable to national dignity, prosperity, and even existence, and that in a situation so complicated as that of the United States the only practicable means to that end is to accept one national culture, the American, as the norm and to insist that all foreign cultures must be sub-

merged in it. At least, one anomalous war-time development has been almost completely abandoned, viz., that of coerced naturalization, the insistence that the foreigner, whether willing or not, whether assimilated or not, must be compelled to acquire American citizenship on pain of deportation or some other penalty.

(H. P. F.)

AMERICAN LAW. Speaking in a technical sense there is no American law. Except within a field constitutionally restricted, there is no national supreme tribunal to unify legal doctrine. Neither is there a common law of the United States as a sovereign State. Each of the States has its own common law, unrestrained otherwise than by certain provisions of the Federal Constitution; and none of these necessarily tends to produce unity of law except the clause requiring that "full faith and credit shall be given in each State to the public acts, records and judicial proceedings of every other State"; a provision which does somewhat tend to unify doctrines respecting the conflict of laws. It is also possible that the decisions of the lower Federal courts that sit in every State and the decisions of the Supreme Court tend to regularize and nationalize judicial doctrine. This is true within the field of "general commercial law," in which the Supreme Court has held since 1842 that the Federal courts sitting within the several States are not bound to follow the judicial doctrines of the local courts; and have in fact been developing a national body of Federal commercial law, which the States have tended to follow, although not bound to do so. The importance of this was greater, however, before the spread of the various uniform acts which in recent decades have been prepared by the American Bar Association for adoption by all the States. These statutes illustrate the sense in which there does exist an American law,—there is a great body of judicial tradition, and a vast mass of legislation, embodying the rules and standards by which the American people, regardless of State lines, are content to guide their lives; and all this law presents broad features of unity. Indeed, nothing is more astonishing than the rapid spread of statutes, in a few years, into dozens or even scores of States—thus evidencing popular convictions nationally dominant; nothing more certain than the slower spread of a judicial doctrine that is felt to have adjusted justice to new conditions.

Of the civil law that once prevailed in territory subject to France and Spain little trace remains to-day except in Louisiana and in the variant marital community systems in seven other States.

In the sense just explained American law is marked by four periods of development.

(I.) **To 1776.**—It is a traditional judicial tenet that the colonists brought with them as a birthright, along with English political traditions and precedents, the common law; its concepts of property, liberty and justice; and such of its rules as fitted colonial conditions. They did indeed claim the general liberties of Englishmen. They did not claim or desire the common law; they had suffered too much from governmental tyranny which they deemed part and parcel of that system. All of the New England Colonies, by practice or explicitly, denied its binding character. Half a dozen of the other Colonies endeavoured to follow it from an early day. All the Colonies, however, had codes, some notably complete, that covered their essential needs, so that, at best, the common law was but a subsidiary system; and in several even this position was accorded, not to that law but to the Scriptures. Only three Colonies gave statutory recognition to the English law in the colonial period.

For these reasons, and because the colonies were isolated and imperial control slight, the 17th century, in particular, was a period of experiment and creativeness. The colonists were well aware of the proposals of reform and codification made by Lord Bacon and under the Commonwealth, and some of their codes were prepared in England by men who evidently sympathized with those proposals. Dozens of striking innovations—some of them of singularly modern semblance—were made upon the common law; some persisted into the later law—among which the most important was perhaps the recording of conveyances. For two reasons, however, the history of this period, although pro-

foundly interesting in itself, must be regarded as apart from the general legal development of the country. In the first place, because its practices were too divergent from the tradition of the common law. There were almost no law books—original, reprinted or imported; in most of the Colonies there were extremely few trained lawyers; even the chief justices were rarely lawyers; the highest courts were legislative or executive. Laymen administered a sort of natural equity. In the second place, because most of the valuable innovations were abandoned as soon as a reception of the common law began.

In the 18th century something like an independent judiciary developed. Imperial control became a reality; colonial statutes were disallowed (400 of them) for departures from established law; judicial appeals to England became steadily more numerous. A professional bar—for which there was evidently no place in the preceding century—gradually developed. Many of its leaders studied in the Inns of Court (perhaps 50 before 1760; 115 between 1760 and 1783); and to a very remarkable degree it was composed, otherwise, of graduates of American colleges. When the Revolution came it was entirely dominant, and this pre-eminence it retained for a century. This period was one of absorption of the English law, marked by the disappearance of older innovations and the development of few new ones. That it is in the truest sense an integral part of American legal evolution could be illustrated in many ways. Sufficient is a reference, in the field of procedure, to its system of courts, the most characteristic feature of which—the multiplication of local tribunals that brought justice near to every man, instead of a circuit system—has persisted (for similar reasons born of frontier conditions and self-government) to the present day; and, in substantive law, the origin of the American doctrine that in libel truth (subject indeed to commentary for which there is no room) is a defence.

The whole of colonial experience was of course continuous and so the spirit of the earlier century lived on through the later. Demonstrably, various of its positive innovations, clearly adapted to colonial conditions, persisted against the English reception. As for many innovations of omission, doubtless "mere ignorance had freed the colonies of a great mass of antiquated and useless rubbish" (32 N.H. 231), but what was once overlooked in ignorance must later have been excluded in wisdom.

(II.) **1776–1828.**—The formal adoption of the common law, after the Revolution, as the basis of American law—but in all the States, explicitly or in judicial practice, only so far as suited to American conditions—set an ideal which the next period was reasonably well to realize. The present continued to be essentially one of reception of the English law. This was inevitable. There was still no independent body of American law; the first volume of American reports was published in 1789; less than a dozen volumes were in print in 1800. When Kent was appointed to the New York bench in 1798 there were no reports of that State. "English authority," he says, "did not stand very high in these early feverish times, and this led me a hundred times to bear down opposition or shame it by exhaustive research and overwhelming authority." Free from hampering precedents, in his 25 years as judge and chancellor he not only gave form to the entire law of that State but made an unrivalled contribution to the law of the whole country. In this, his *Commentaries* (1826–30) played a large part; by universal consent they are worthy of comparison with Blackstone's. He set himself to the task of establishing the common law, and he succeeded. That he had not a reformer's spirit is shown by his sigh over "the piles of learning," "the profound logic, skilful criticism and refined distinctions," doomed to destruction by the New York statute abolishing the Rule in Shelley's Case. He did, however, reject the doctrine of market overt, extended replevin to any wrongful taking, and lauded the establishment of the lien-theory in mortgages.

Notable statutes of the period are fairly numerous; permitting grants in fee without mention of heirs; granting powers *in rem* to courts of equity; legitimizing children by subsequent marriage of their parents; abolishing entails and the Rule in Shelley's Case; abolishing primogeniture and establishing inheritance equally by all children; modifying the law of devises in favour of after-

born children and the issue of predeceased children; conferring limited liability upon corporations; providing a general law under which corporations might freely organize. Pennsylvania—"the first of civilized countries to do so"—provided in 1776 for a penitentiary; presumably under the influence of Beccaria, whose book had already been published in America and was soon to be found on the remotest frontiers. At the same time she introduced relief for insolvent debtors, and within a generation they were "scheduled out" of jail in remote western territories. New York, in 1827, made a complete revision of her statute-book; altering fundamentally the law of realty and providing a system which exists to-day in various States. Very notable also were reforms due to popular disuse, such as the dying-out of feoffments, fines and recoveries; all of which were used in colonial times and were provided for in the statutes of this period. These illustrations sufficiently indicate the experimental spirit of the time. It was not displayed in equal degree by the judiciary. Preferable to Kent's lament was the denunciation of demurrers by a contemporary farmer judge, as "an invention of the bar to prevent justice . . . a cursed cheat!"

(III.) 1828-68.—Almost as distinctly as in political history, the triumph of frontier democracy in the elections of 1828 marks the transition to a new era in the law. It is a period great for its critical spirit. Also, though individualism was the dominant notion of the contemporary world, in politics and in economics, and though the frontier influence might have been expected to exalt its influence, it is a period remarkable for its social spirit. Both judicial and legislative improvements reveal its originality. What Wigmore has said of the law of evidence could be said of other fields of law: "Partly because of the lack of treatises and reports, partly because of the tendency to question important rules and therefore to defend on grounds of principle and policy whatever could be defended, partly because of the moral obligation of the judiciary, in new communities, to vindicate by intellectual effort its right to supremacy over the bar, and partly, also, because of the advent, coincidently, of the same rationalizing spirit which led to the reformatory legislation—this very necessity of restatement led to a finely reasoned system." Very important in this period, rivalling the influence of James Kent in the preceding, was the work of Joseph Story, who in 13 years (1832-45) published nine remarkable text-books, which in rapidly succeeding editions had a profound effect in forming American law.

Thus, in the law of evidence, "the period from 1840 to 1870 saw the enactment, in the various jurisdictions in this country, of most of the reformatory legislation which had been carried or proposed in England," and the promulgation of a body of opinions "superior (on the whole) to the judgments uttered in the native home of our law." Notable innovations were the repudiation of the merger of torts in crimes and of postponement of the civil action; repudiation of the doctrine of ancient lights (impossible in a new country); introduction of apportionability of rent; the first decisions permitting suits upon a contract by the beneficiary (now the general doctrine); the first decisions treating divorce as a proceeding *in rem* and recognizing a woman's separate domicile for purpose of divorce; notable decisions—though with precedents "from the first colonization" (Chief Justice Waite)—upholding the regulation of private business "affected with a public interest"; and the first of many decisions forbidding the malicious use of a land owner's privileges.

Many changes plainly reflect the special conditions of the country. Examples of such were the substitution of navigability for the tidal test of admiralty jurisdiction, thus adapting it to the inland seas and rivers of the country; the introduction of the doctrine of "colour of title" in adverse possession, and other minor changes in that subject due to frontier conditions; fence laws reversing the common law duties respecting trespass by animals; decisions concerning grain elevators that made novel changes in the law of bailments and confusion of goods. American deeds began to assume forms suitable to the simple descriptions and titles of the country; quitclaim deeds became primary and original conveyances; disseisees acquired the right to make conveyances. Great modifications were made in equitable doc-

trines of laches and forfeitures in specific performance of contracts for the purchase of land on instalments—modifications due to the fact that in America land has always been a subject of commerce, as Kent pointed out a century ago. The amazing persistence of benefit of clergy down to (and indeed through) this period was certainly due to the illiteracy of even prominent citizens in frontier society. A very remarkable adoption of frontier customs in this period (though mainly by statute) was that of the mining and water laws developed in western mining camps.

Even more distinctive than the work of the courts was the legislation of this period. At this time reform by statute became, and has remained, the primary characteristic of American Government and law. "The establishment of self-government on a new soil realized the idea of the people as the source of political power as it had not been realized in historic times" (Freund); and on a scale equally unique they proceeded to illustrate the dictum that democracy relies on laws rather than on men. Religious and property qualifications for voting, office-holding and jury service were swept away by the middle of the century. To these triumphs of liberalism a third was added in the creation of a public school system before the Civil War. A prelude to the use of the police power in the following period appears in the elaborate constitutional provisions, beginning before 1850, respecting banks, railroads and canals; and in statutes requiring periodical or cash payments of wages. Income taxes of the modern sense were adopted in the 1830s and '40s in six States. A great moral movement in the political field—for prohibition, anti-slavery and women's rights—and an altruistic effort on a vast scale in favour of the poor and defective marked the entire period. Exemption laws (which came down from colonial times) became general and liberal. Very notable was the appearance of the homestead (1836) and its inclusion in the exemption statutes. Save for slight vestiges, imprisonment for debt was everywhere abolished. The narrow protection in property rights accorded married women by equity was widened by statutes which have placed them on an equality with their husbands; although not until 1913 were the disabilities of coverture abolished in the last State. Judicial liberalism supplemented this legislation, e.g., in recognizing a wife's right in the society of her consort. It was recognition of woman's equal participation in the hazards and hardships of frontier life that wrote this entire chapter of the law. Children were protected against parental cruelty by imposing criminal responsibility; reformatories were established for minor delinquents—but their criminal liability was not much altered. In the law of property rules of inheritance were greatly changed in favour of parents, surviving spouses, the half-blood and illegitimate children. Heirs and next of kin became generally identical. Howsoever acquired, and whether from the paternal or maternal side, estates were made to descend in the same manner. All real estate became liable to execution and administration assets for payment of debts with few preferences. The fictions of ejectment disappeared. In this whole field, however, legislative reform has always been partial, casual and unsatisfactory. Variations from State to State remain to the present day innumerable. The distinctions between realty and personalty and between legal and equitable estates are still fundamental. The doctrines of tenure, and the devices to evade them that fill the law of future interests, remain in most States untouched except by fragmentary tinkering. Entails are still theoretically possible in various States. Shelley's Case has life in about half the States. Dumper's Case, and others of ill repute, still pervert legal doctrine.

Equity, on the other hand, was developed with relative consistency. The erratic state of the property law still extends, however, to mortgages, which are hardly the same in any two States; although everywhere the legal incidents tend toward obsolescence. The equitable doctrine of priorities has from colonial days been fundamentally modified by the recording system. For historical reasons the spread of the equity system was delayed in various States, proceeding piecemeal by statutory grant; even Massachusetts having no complete system until 1877, nor Pennsylvania one to-day. The infiltration of equity into law, in such States, was a unique detail of American legal experiment. No American

court exercises the full jurisdiction of English courts of chancery, its administrative portions having been given to separate tribunals. The development of probate courts was a noteworthy feature of the period before the Civil War. During it, also, the equitable jurisdiction was generally entrusted to courts of double jurisdiction (in five States they still remain distinct and some others maintain distinct chancery terms). Under the codes of civil procedure which have been adopted since 1848 in many States the administrative fusion has been complete; the common law actions and the distinction between law and equity being abolished, in the sense that rights and reliefs formerly "legal" or "equitable" are all enforced in one "civil action." It is certain that under both these systems the principles of equity, enforced by judges trained primarily in the common law system, have somewhat suffered; the separate equity courts are, as a group, the strongest in the country to-day. On the other hand, not only did the adoption of the codes hasten the spread of equity throughout the country, but there is a steady and beneficent infiltration of its doctrines into law cases which must ultimately result in complete fusion and the general dominance of equity.

The adoption of these codes of civil procedure is the most remarkable feature of the third period, and on the whole, the most ambitious systematic reform yet undertaken in American law. The ideals of these codes have been only imperfectly realized. For various reasons (not the least, the hostility of the courts when the codes were first created) their construction has been hardly less balefully technical (and perhaps less certain) than the old common law system. Constant legislative tinkering increased uncertainty and resulted in monstrosities of bulk and complexity. While their fundamental reforms will doubtless never be abandoned, there has been in recent years a strong agitation for the regulation of strictly procedural matters by rules of court. As yet this movement has had slight success.

In some ways popular control in this period debased the judiciary. Of particularly evil consequence was a tendency to restrict the power of the trial judge in charging the jury, forbidding more than a bare restatement of the evidence. This remains to-day general practice. Down to 1798 all the judges were appointed by the governor or elected by the legislatures; by 1840 popular election was characteristic, and since then it has become increasingly predominant. A tendency to shorten the term of tenure sprang from democratic distrust of irresponsible authority. The powers of practically any judge to declare legislation unconstitutional and to issue injunctions have kept alive such distrust. Elective terms, however, have always been long as compared with those of other officials, and no frontier State ever made judicial tenure so short and precarious as did two of the oldest States in New England. There is decidedly an increasing tendency to-day to re-elect worthy judges and to make their salaries adequate. Few leaders of the bar can be drawn from practice by any feasible salary, unless under tenure for good behaviour; but the rising level of judicial ability and the many instances of brilliant men who have already served on the bench justify the belief that judicial competence is obtainable under the elective system. The gravest charge that can be brought against the frontier democracy of the period before the Civil War is that it greatly lowered the standards of admission to the bar.

The bench was both able—in some States, notably in the South, brilliant—and liberal. The legislatures were characterized by rationalism and enlightenment. The bar, whatever its defects, dominated the legislatures and enjoyed in general a social and political prestige far beyond that which it holds to-day. On the whole, the period is the greatest in the legal history of the country.

(IV.) 1868–1928.—The ultimate protection of private rights rests to-day upon guaranties in the Federal Constitution. No State may deprive any person "of life, liberty or property without due process of law," "deny to any person within its jurisdiction the equal protection of the laws," or "impair the obligation of contracts." The 14th Amendment of 1868, containing the first two of these provisions, has profoundly altered the rela-

tion between the State and Federal courts and distinctly marks a new period in the legal development of the country. Attempts to define due process and the police power—which is not restrained by the constitutional guaranties—have made the Federal courts the battle ground of the social legislation of the last half century that has sprung from the complex economic and industrial conditions developed since the Civil War. All important cases involving corporations (which were for decades parties to approximately half of all litigation) are also thrown into the same tribunals, for they are "persons" under these clauses and their charters are contracts with the State. And as corporations carry on most of the business and own a very large percentage of all the property in the country (Mr. Justice Field of the Supreme Court estimated it as four-fifths in 1890), the matter has immense social significance.

The establishment of unbridled democracy a century ago only slightly affected the treatment of industrial property. "For at least 60 years after the adoption of universal suffrage the tendency was all in the other direction—to legislate for the property owner rather than against him; to strengthen the powers of capital rather than diminish them. . . . The small protection given to the rights of man, as compared with that which was accorded to the rights of property, is a salient feature in the early history of every American State—and sometimes of its later history also" (Hadley). The explanation of this fact lies undoubtedly in the loose economic framework of society. Cheap land created a people of freeholders without class distinctions, among whom any man who aimed high might rise high. Radicalism, in such a society, could gain no headway. That came with the development of great urban centres and an industrialized society: the rural population was nine-tenths of the total in 1800, and little less in 1850, but less than half in 1920.

Industrial regulation of modern type began about 1870 with the railroads, and its assertion "shook the foundation of State and national politics for a generation." The subsequent increase of administrative commissions, with inquisitorial powers and free from judicial procedure and review, is perhaps the most striking phenomenon in recent legislation. There is a present tendency to standardize procedure and there seems to be developing in this way a great field of administrative law. Trade regulation, though with some history for 100 years, has only very recently increased with extraordinary rapidity; for example, pure food laws, now universal, began in 1892.

The purely legal status of the American industrial worker is unique. The exemption statutes have lessened the effectiveness of the law's remedy of damages; the 13th Amendment of the Federal Constitution, prohibiting "involuntary servitude," makes specific performance impossible, even were equity minded to try it. Yet these immunities were relatively worthless so long as the worker was unprotected against unfair agreements secured through his economic needs. The tendency is strongly toward increasing restriction upon "freedom" of contract and "right" to labour, although this has only very recently begun to overcome constitutional obstacles. As late as 1905 the Supreme Court held unconstitutional a law regulating the hours of bakers, but the case is already without vitality; it was killed by a dissenting epigram of Mr. Justice Holmes—"the 14th Amendment does not enact Mr. Herbert Spencer's Social Statics." In the field of tort nothing had been done up to 1900 beyond limitations upon the rules of fellow servant, contributory negligence, and assumption of risk, sometimes through and sometimes outside of employers' liability laws; thus leaving wholly unprovided for at least half of all industrial accidents. Since 1910, however, all the States have adopted workmen's compensation acts (first, 1902), and most of them industrial insurance acts. Social insurance, otherwise, is still incipient.

The range of other social legislation has been immense. Much is purely moralistic (against gambling, racing, cigarettes, liquor, sexual sin, etc.). The treatment of women merits, perhaps, special mention. Within the family the married woman has been placed in substantial equality with her husband. In industry the attempt to give her special protection has been a storm centre of agitation.

In general women enjoy to-day such protection and to some extent a favoured position in property and domestic relations. Divorce is in one State not allowed at all; elsewhere causes run from adultery only to a score and more, including mental cruelty and incompatibility. Such causes are in many instances a cover for mutual consent. As a State need not recognize a foreign divorce improperly obtained by or against its citizens, a woman's status might possibly be that of lawful spouse, divorcee or bigamist in different jurisdictions. Suits for breach of promise to marry and for alienation of affection (both almost exclusively brought by women) are curiosities of American law. "Common-law" marriage still exists in many States. Desertion of wife or children, a very common offence, is generally a crime and a score of States have adopted a uniform act on this subject prepared by the American Bar Association. In recent years there has been considerable eugenic legislation restraining freedom of marriage.

Defects of the System.—Dissatisfaction with the legal profession has been acute during recent decades. The bar has lost its one-time leadership because it has ceased to lead, to make a social contribution commensurate with its political pre-eminence. The judges have been forced to invalidate many legislative reforms demanded by popular opinion; but, even when free, few of them have been guided by a liberal appreciation of expanding public interests. "Most of the common law has developed in that atmosphere of indifferent neutrality which has enabled courts to be impartial but also keeps them out of touch with vital needs" (Freund). Even the intelligent layman in America rarely knows anything of law except through the newspaper. There he reads only of constitutional questions—seemingly mere matter of policy of which any man may judge and which often seem irrational; of criminal cases—which blazon all the vices of criminal procedure; of labour decisions and of injunctions—often recklessly vague and sweeping—which cause excessive irritation. Hence the discontent which precipitated 20 years ago the demand for the "recall" of judges and judicial decisions by popular vote, and for limitations upon the power of divided courts to invalidate statutes; all of which demands became law in a few states. The administration of justice is to-day the paramount problem in national life. Not only in many cities are the trial dockets filled for two to four years ahead; even in rural jurisdictions the same is sometimes true. General verdicts are the basis for repeated retrials of the facts. The reports of representative States show that a few years ago appellate decisions turned on pleadings in from 5 to 25% of all cases—and the higher number was much the nearer to the mean. Reversals for all causes are still given in a large proportion of all cases appealed. Innumerable reversals are still based, even in civil cases, upon errors that could not affect substantial rights, although this is now statutorily prohibited in about two-thirds of the states. The efforts of reformers are being directed toward strengthening the authority of the trial judge; re-establishing the original practice at common law of permitting the appellate court, even on writs of error, to render final judgment on the facts without ordering a new trial, as in appeals in equity; regulating procedure in higher courts by rules of court, as in England, in place of the legislative enactments, sometimes of infinite detail, which have been the almost exclusive system of the past and have been prolific of delay and appeals; and abolishing appellate reversals for immaterial defects. As regards the last there has become evident a marked improvement in the attitude of appellate judges. A great reform, rapidly spreading, is the declaratory judgment; 12 States have adopted since 1922 the uniform act drafted by the American Bar Association. Very recently statutes of Congress and of various States have made arbitration agreements specifically enforceable. Much has also been accomplished in expediting and cheapening the petty litigation of great urban centres by reorganizing them into appropriate branches under a simplified procedure. In more than 60 cities there are legal-aid societies which dispose of a vast amount of litigation substantially without charge. Regular courts for small claims and poor litigants are being established. In some States summary judgments are now being introduced, as in England, in debt collections, vastly relieving the congestion of trial dockets.

The non-inclusion of counsel fees in costs is universal American practice, but its importance as a handicap upon the poor and a weapon in the hand of the unscrupulous is at last being recognized.

All the evils of procedure present in civil suits exist in more aggravated form in criminal suits, with many others in addition. Homicides alone are estimated by many authorities at about 10,000 yearly. That many kinds of urban crime are an organized business seems to be unquestionable. That lawyers are essential to, when not part of, this business, prepared with every legal device to delay and evade justice for their criminal clients, is often manifest. Cases of worthless bail bonds, of criminals at large under several bonds at once, given in different cases, are notorious. Equally alarming is the actual inequality of men, rich or poor in money, before the law, in consequence of its delays; and of those rich or poor in influence in being brought before it. In 1909 President Taft declared the administration of the criminal law in all the States, with possibly "one or two exceptions" to be "a disgrace to our civilization." Frequently hundreds, sometimes thousands, of veniremen are examined before a jury is secured; usually days, sometimes months, are thus utilized. Delays in trial are even greater than in civil cases. Indictments are still found deficient in appellate courts, though here recent years have witnessed great improvement, for flaws of unbelievable triviality. The defendant is nowhere compelled to testify. Punishments for the same crime vary amazingly from State to State. In some States the jury has large discretion in fixing the punishment; in many it is judge of both the law and facts. The requirement of unanimous verdicts is universal in criminal cases.

Legislation is at present extremely active in remedying many of these evils. Eight States in 1926-27 adopted habitual-criminal acts which, among other things, impose life-imprisonment upon a defendant with a record of a small number (usually four) of earlier convictions. Minors have been given greater protection (since 1900) by greatly raising the age of criminal responsibility (to 16 or 18); and establishing special courts to deal with the younger delinquents, subjecting these to the State's guardianship somewhat, as under the old doctrines of equity. In the field of punishment notable reforms have been introduced: suspended and indeterminate sentences, commutations for good behaviour and parole. But even these are perverted. Weak or calculating judges abuse the first with a leniency so excessive that it approaches immunity; the second appear plainly to be over-generous to hardened offenders; the most vicious of criminals are often paroled. The primary cause is probably politics; indubitably so in some States, where every step—whether or not an arrest shall be made, the defendant held to the grand jury, the case dismissed, the convict paroled—seems to be seriously entwined with political corruption.

For these evils, and equally for the evils in trial and appellate courts, in civil and criminal cases, which spring from a deep-rooted attitude toward litigation as a mere game of wit, there is no cure except in an increased power and awakened conscience of the bench, and a general betterment in the moral tone of the bar. At least as regards intellectual improvement much has been accomplished. The university law schools are of distinguished excellence and enjoy a high professional prestige. Higher standards of education are being enforced through requirements for admission to the bar—the American Bar Association now advocating a minimum pre-legal education of two years in college and a minimum professional training of three years in law-school—but less than a dozen States meet these standards. Disbarment is in the hands of the courts and has been far too sparingly resorted to. A few States have very recently incorporated their bars as self-governing bodies, with exclusive power over admission and discipline.

Codification, after the period of activity which began before the Civil War, temporarily ceased, but has recently begun again in a new form. Five codes of penal and of the substantive civil law, 30 codes of civil procedure and about thirty of criminal procedure are mainly the products of the earlier movement. The American Bar Association, acting with State commissioners, have prepared since 1892 43 uniform acts. Of these five in the commercial field (on negotiable instruments, warehouse receipts,

bills of lading, sales and stock transfers) have been adopted in from half to all jurisdictions. An American Law institute, in which teachers of law are dominant, is preparing a "restatement" of various branches of the substantive law and a model code of criminal procedure; all designed to promote uniformity in essential principles. The "Complete" or "Revised Statutes" that exist in every State of course merely "supplement" the unenacted law, but which of the two is in many States to-day of greater scope it would be hazardous to say. Legislative drafting bureaux (the earliest of 1890) exist in practically every State.

The impulse to codification has come from the unmanageable bulk of judicial law and the consequent uncertainty of legal knowledge. The number of volumes of American reports in 1917 was 17,000. The cases cited by the court in any volume run into hundreds and frequently into thousands, from many jurisdictions. In the five years 1909-13 there were passed by the National and State Governments 62,014 statutes; and there were rendered by the courts of last resort 65,379 decisions. The law is beyond the power of any layman to discover or to comprehend.

Very much has been wisely said on the necessity of guiding legislation and judicial decision by the functional test of social utility; but no efficient instrumentality has existed or now exists through which to supply objective evidence of the relative working of substantive legal rules. On the other hand it is expected that precisely this will be accomplished in the procedural field by the "judicial councils" which have been created since 1922 in nine States for the consistent study and improvement of judicial organization and procedure. Altogether, the immense significance of the new spirit manifest in the profession cannot be doubted. Most important of all is the fact that the revolt against unsocial law created by the labour struggle has spread to social workers, social scientists, the law school and finally even to the bar. It may well be that this spirit will prove to have inaugurated a new epoch in the law of the country.

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PUBLIC LAW

The public law of the United States largely revolves around (1) the Federal system; (2) the written Constitution; and (3) the judicial construction of written Constitutions. These three elements are closely related, for the United States Supreme Court has from an early day been the final arbiter to determine the respective powers of the United States and of the States under the written Constitution of the nation; and the State courts (each within its own territory) are the final arbiters of State governmental power under the written Constitutions of the States.

The Federal System.—Plans of colonial federation were several times proposed before the period of the American Revolution. The movement that finally led to independence forced some degree of unity, and the first Continental Congress assembled in Philadelphia in 1774 was the outward symbol of unity of political action. What political direction there was of the revolutionary

movement came through the continuance of such an organization, without any formal written instrument of union, and this system was highly inefficient. It was replaced by the Articles of Confederation in 1781.

The Articles of Confederation established a loose union, with little in the way of a national Government, and with no power in that Government to raise revenue or to enforce its orders by action directed immediately to the citizens of the United States. The Confederation had authority to ask the States to act, but not to compel action either by the State or its citizens. It had power to make treaties but no power to enforce State observance of such treaties. Each State had power to impose restrictions upon trade with other States, and a State with the geographical advantages of New York was in a position to impose and did impose burdensome restrictions upon the commerce of the neighbouring States of New Jersey and Connecticut.

Such conditions could not long continue. They led to the assembling of the Federal Convention of 1787 and to the framing and adoption of the present Constitution of the United States, under which the present Government was instituted in 1789. The Constitution was framed with specific reference to the difficulties presenting themselves before its adoption. A governmental organization was set up independent of that in the States, and with power to enforce its commands directly up the citizens of the States. Large powers were conferred, the most important of which were the powers to control interstate and foreign commerce, to levy taxes and to raise Federal revenues independently of the States, and the control of foreign relations. Thus a central Government was constituted with real authority. The history of the Federal system since 1789 is to a large extent a history of the expansion of the importance and authority of the national Government under this Constitution. This expansion has been accomplished in several ways: (1) by a broadened construction of the original provisions of the Constitution of 1787; (2) by amendment of this Constitution; (3) by the development of means of transportation and communication which enormously increase the number of transactions in interstate and foreign commerce, subject to national control; (4) by the increased number of States, the larger portion of which were created out of territory belonging to the national Government.

Construction of the National Constitution.—The Constitution of the United States has been authoritatively and finally construed by the United States Supreme Court, an organ of the national Government. In substantially all matters this court determines the limits of national power on the one hand and of State power on the other. No matter how impartial such a tribunal may have sought to be, it has almost of necessity tended to favour the Government of which it is an organ. Under the chief justiceship of John Marshall (1801-35) it was an essential factor in establishing broad national authority. *McCulloch v. Maryland*, 4 Wheat. 316 (1819) determined that the nation had not only the powers expressly conferred upon its legislative, executive and judicial departments, but also all authority "appropriate" to carry such powers into execution. The Constitution uses the words "necessary and proper," but the court held that there was no need to show actual necessity in order to uphold national power. Under the chief justiceship of Roger Brooke Taney (1836-64) there was an occasional tendency in dicta of the court to regard State power as of greater importance, but no actual reduction of national power took place. In fact two of the broadest extensions of national power were made under Taney through reversals of views taken under Marshall. In one of these cases admiralty jurisdiction was extended to all navigable waters (*Genesee Chief v. Fitzburgh*, 12 How. 443, 1851). In the other the Federal courts acquired an extensive jurisdiction in corporate matters (*L.C. & C.R.R. Co. v. Letson*, 2 How. 497, 1844).

Although the powers of the national Government under the Constitution have been expanded, the Supreme Court has at the same time sought to prevent the destruction of State powers by construction. The power of the national Government to tax cannot be used as a mere cloak for regulation of child labour in the States under the guise of taxation; nor can the power to regulate

interstate commerce be used for such a purpose (*Hammer v. Dagenhart*, 247 U.S. 251, 1918; *Child Labor Tax Cases*, 259 U.S. 20, 1922). While the nation's powers have been extended, there remains a large sphere of State power upon which the nation may not encroach. No national power exists except as it is found in the terms of the written Constitution, and the United States Supreme Court can expand such powers only as they may be derived from the terms of the written Constitution. The terms of this document are broad and expansible, yet judicial construction of these terms has definite limits.

Amendment of the National Constitution.—But by constitutional amendment the terms of the written Constitution may be changed. Twenty-two amendments to the Constitution of the United States have been adopted. The first 10 of these amendments are limitations upon the national Government, but in no material respect do they narrow the powers exercisable by that Government. The 11th amendment safeguards the States against suits; the 12th, with reference to the election of the president, does not affect governmental power. The 13th affirmed the judgment of war that slavery should be abolished. As now construed by the courts, the "due process of law" and "equal protection of the laws" clauses of the 14th amendment have transferred the protection of individual rights from the States to the national Government. The 15th and 19th amendments, and to some extent the 14th, limit the determination by the State as to who shall have the right to vote. The 17th, by providing for the popular election of senators, somewhat diminishes the importance of the States as units in the Federal system. The 18th amendment, until repealed by the 21st, brought the Government into closer contact with the lives of citizens. The 16th gave the national Government a new source of revenue and made possible a system of subsidies through which the Government gained increased control of State policy. The 20th set the dates for presidential and congressional terms and made provisions for succession in case of death of the President-elect. The 22nd prohibited a third elective presidential term.

Increased Contacts of a National Character.—In 1789 transactions in interstate commerce were few, and the means of conducting such commerce slow and cumbersome. As new agencies of commerce have developed, the Federal regulatory power has applied to them. With the transition from the horse and the stage-coach to the steamboat, the railroad, the telegraph, the telephone, the radio and the aeroplane, portions of the country once distant have been brought into closer relation, and the transactions controllable by the national Government have been infinitely multiplied. These changes have necessarily brought increased exercise of national power.

Federal regulation of interstate railroad rates and service came in 1887, and has rapidly expanded. The relations between interstate commerce and purely domestic commerce within a single State are necessarily close when both transactions are handled by the same agency. And so by legislation of 1920 and by judicial decision, the Federal Government has come largely to control the railroad rates for domestic transportation within the States, as an incident to the control of interstate commerce (*Railroad Commission of Wisconsin v. C.B. & Q.R.R.*, 257 U.S. 563, 1922). In the same manner the nation has come to control safety appliances of railroads in both interstate and domestic commerce (*Southern Railway v. United States*, 222 U.S. 20, 1911).

Congress began in 1890 the regulation of combinations in restraint of interstate commerce, and has in this field largely replaced State action. As an incident, the regulation of labour unions has largely been transferred to national jurisdiction by a recent decision of the United States Supreme Court (*Bedford Cut Stone Co. v. Journeymen Stone Cutters' Association*, 274 U.S. 73, 1927). By the expansion of the national banking system and the creation of the Federal Reserve system, the Federal Government largely controls the banking business of the country. There is now an extensive national control of industry, banking, labour, railroads and of the protection of individual rights.

These expansions of national authority are natural, and were to be expected. But they make the national system differ materially from any that could have been thought of in 1787.

Increased Number of States.—The national Government was created by a small number of States. The States were the creators of the nation. States as units in a Federal system were naturally more important when their number was 13 than when their number is 48. The influence of increased numbers becomes more important when we consider that 21 of these additional States were wholly created out of territory acquired by the nation and were never a part of the original States. These new States, forming more than half of the continental area of the country, are in a very real sense creatures rather than creators of the national Government. With the increased importance of interstate relations, State boundaries have largely become artificial lines, and national consciousness, greatly strengthened by the Civil War, has become politically dominant, since State elections in all but one State (Maine) are held upon the same day as national elections.

Yet, though the States have come to be less important politically as units in a Federal system and have lost all political status in international affairs, they have come, with increased complexity of social and economic needs, to have a heavier burden of governmental tasks than ever before. For upon them fall the burdens of administering criminal and civil justice in the daily affairs of life, and the tasks of more detailed regulation of industry, as well as the conduct of schools, the administration of charities and the protection of persons and property.

The Written Constitution.—The written Constitution is an essential element of the Federal system in the United States, for there must be some authoritative statement of the respective powers of nation and States. The written Constitution is not an essential device of State Government in the United States, but each State has from its beginning had such a Constitution. Tradition has now become so strong that a State without a written Constitution is hardly to be contemplated.

The national Constitution is a relatively brief document, as are a few of the earlier State Constitutions. But the typical State Constitution has now come to be a lengthy document, that not only organizes and imposes limitations upon the State Government, but also contains a great mass of detailed legislation. This legislative detail is frequently altered by State constitutional amendments. In theory the national Government has only such powers as are granted it by the national Constitution, and a State Government has all powers not denied it by the national Constitution and the Constitution of the State. This might naturally imply a strict construction against national powers and a liberal construction in favour of State legislative authority. But with long and detailed State Constitutions, we have the opposite result. Under broad constitutional grants of national authority, the United States Supreme Court has, from the first, been liberal in the construction of national power. Under detailed State Constitutions, hedging about the powers of State legislatures, the tendency of State courts has been toward a narrow construction of such powers.

Judicial Construction of Written Constitutions.—Some device is necessary in a Federal system to preserve the barriers between Federal and State powers. The United States Supreme Court serves as this agency. In addition it serves as the final agency in other cases for the determination of the powers of Congress under the Constitution; and the highest court of each State serves as the agency to determine the powers of its State legislature under the written Constitution of that State. The courts of both State and nation decline to pass upon certain questions that they term political, but apart from this they construe the written Constitutions of State and nation. The power of the courts to determine the constitutionality of legislation was first asserted in New Jersey in 1780, and has been generally recognized since the decision of the United States Supreme Court in *Marbury v. Madison*, 1 Cranch, 137 (1803).

The more detailed the Constitutions and the greater the tendency to exercise governmental power to meet new industrial and social needs, the more often are the courts called upon to construe written Constitutions. With numerous restrictions imposed on legislative action by constitutional texts, practically every important Federal and State legislative enactment now comes to

the courts for the determination of its validity. This gives to judicial decisions an emphasis proportionately greater than they deserve in the constitutional system of the United States, for in most cases the courts reach results not dissimilar from those in the countries where legislative determinations are final. But in the United States the courts have the last word, and this often leads to an emphasis upon the technical issues of constitutional construction, rather than upon the actual merits of legislation. Problems of constitutional construction have become increasingly important in the fields of (1) administrative law and (2) the administration of criminal law.

New economic and social problems have necessitated the delegation of wide authority to permanent Federal and State boards for various purposes, such as sanitation, regulation of public service corporations and of banking and insurance, workmen's compensation, and the grant and revocation of licenses to practise trades and professions. National and State Constitutions organize Governments into three departments, and impliedly forbid the delegation of legislative authority. The courts must answer the questions as to what are the functions of each department, and what are legislative powers that may not be delegated. Under pressure of practical need, the courts have found it possible to sustain wide delegations of rule-making power to administrative bodies, and also wide authority in such bodies to make determinations that may appear judicial in character. These results have been obtained through the construction of broad constitutional provisions, and have been wise ones, though the logical devices employed to distinguish later from earlier cases have often been amusing.

In the administration of criminal law the result has not been so satisfactory. Many constitutions contain detailed provisions regarding the grand jury, the jury, bail and the conduct of cases, and a number designate the precise words with which indictments shall terminate. These provisions promote technicality in judicial proceedings and retard progress, and although a number of Constitutions are easy to change, others are difficult if not impossible to amend. The courts cannot ignore these constitutional provisions, but must enforce them, though something is accomplished by liberal judicial construction. For example, the Constitution of Missouri requires that indictments conclude with the words "against the peace and dignity of the State." The Missouri Supreme Court at first said that the omission of the second "the" was fatal to an indictment, but later took the opposite view (*State v. Campbell*, 210 Mo. 202, 1908; *State v. Adkins*, 284 Mo. 680, 1920). But however liberal the courts may be, simplification of criminal procedure is retarded by placing regulations as to such matters in the text of the State Constitution.

The problems faced by the courts in constitutional construction are well illustrated by the developments in administrative law and in the administration of criminal law. Constitutional provisions creating three departments of Government and providing that each shall exercise separate powers are general and vague in character. A court may and does construe these provisions to permit what the present needs require, even though earlier decisions may have taken a different view. The only harm done by such action, if it is a harm, is the occasional use of bad logic in the effort to harmonize judicial decisions that are obviously not capable of reconciliation. The specific constitutional provisions as to criminal procedure do not give a court as great a latitude of construction, though even where a Constitution requires certain precise language, the courts may permit some variation of that language.

Constitutional provisions vary from the specific to the highly indefinite, but in the construction of all, the courts have some discretion. The discretion is greatest under the 14th amendment to the Constitution of the United States, which prescribes that no State shall "deprive any person of life, liberty or property without due process of law," and under similar clauses in State Constitutions. The United States Supreme Court has declined to define "due process of law," but reserves freedom of decision in each case. A minimum wage law for women deprives of due process of law and is unconstitutional (*Adkins v. Children's Hospital*,

261 U.S. 525, 1923). Laws limiting the labour of women to eight hours a day or forbidding night labour by women do not deprive of due process of law (*Miller v. Wilson*, 236 U.S. 373, 1915; *Radice v. New York*, 264 U.S. 292, 1924). The regulation of charges for rental is due process of law if in the opinion of the court an emergency exists, but is not due process of law if the court feels that the emergency has ceased (*Block v. Hirsch*, 256 U.S. 136, 1921; *Chastleton Corporation v. Sinclair*, 264 U.S. 543, 1924). A similar discretion rests with the courts in the construction and application of other indefinite provisions of State and national Constitutions. And the courts exercise a broad discretion even with respect to the constitutional provisions that appear most definite.

In American constitutional law there is a tendency to decide the specific case before the court, without affording much guidance as to the law applicable to similar cases in the future. And the constitutional law of the United States is found not so much in the texts of written Constitutions as in the judicial decisions construing such Constitutions. A distinguished French publicist has called this system "government by the judges." Whatever justification this may have, Bishop Hoadly's statement that "whoever hath an absolute authority to interpret any written or spoken laws, it is he who is truly the law-giver to all intents and purposes, and not the person who first spoke or wrote them," is peculiarly applicable to the constitutional law of State and nation in the United States. And constitutional law is the basis for the whole body of public law of State and nation.

See W. W. Willoughby, *The Constitutional Law of the United States* (2 vols., 1910); C. K. Burdick, *The Law of the American Constitution* (1922); C. Warren, *The Supreme Court in United States History* (3 vols., Boston, 1922); C. E. Martin, *Introduction to the Study of the American Constitution* (Los Angeles, 1925); Walter F. Dodd, *State Government* (new ed., 1928). (W. F. D.)

AMERICAN LEGION, an organization of World War veterans who served honourably in the armed forces of the United States or who, as American citizens, entered the armed forces of a government associated with the United States in the war. Organization was effected and a national charter was granted by Congress in September 1919.

The membership stood at 1,032,989 as of Dec. 31, 1939. In May, 1940 it went over 1,000,000 for the third time in the Legion history. Its activities have been directed effectively towards strengthening the national defence, with the National Defence Act (1920), the basic policy and revisions to cover advances in other military developments. It supported the movement to create the U.S. Veterans' Administration, a Federal agency charged with handling claims of the disabled. The greatest chain of government hospitals in history was created at Legion request. It is designed to provide one bed for each 40 veterans, with total bed capacity of 100,000. Adjusted compensation certificates were issued and paid by Federal Government at its request to adjust pay status between civil and military life on basis of \$1 a day for home service and \$1.25 for foreign service. Certificates were single payment 20-year endowment policies with accruing interest, and maximum basis of \$500 home service, \$625 foreign service. Child welfare program designed to help the whole child operates under child welfare division with approximately 30,000 volunteer workers engaged annually. Care of disabled and child welfare program financed largely by income from \$5,000,000 endowment fund raised in 1925. Effort to give support to established republican form of government in United States provides study of government by Boys' States, recreational youth activities, widely diverse community activities, and continued opposition to communism and nazism. Headquarters, Indianapolis, Indiana. Legislative and rehabilitation offices, Washington, D. C. Magazine editorial and advertising offices, New York. Publishes, monthly, *American Legion Magazine*, *National Legionnaire*, *Legion Heir*.

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AMERICAN LITERATURE. Like other national literatures, American literature was shaped by the history of the country which produced it. For almost a century and a half, America was merely a group of colonies scattered along the eastern seaboard of the North American continent—colonies from which a few hardy souls tentatively ventured westward. After a successful rebellion against the motherland, America became the United States, a nation. By the end of the 19th century this nation extended southward to the Gulf of Mexico, northward to the 49th parallel and westward to the Pacific. By the end of the 19th century, too, it had taken its place among the powers of the world—its fortunes so interrelated with those of other nations that inevitably it became involved in two world wars and, following these conflicts, with the problems of Europe and the far east. Meanwhile, the rise of science and industry, as well as changes in ways of thinking and feeling, wrought many modifications in men's lives. All these factors in the development of the United States moulded the literature of the country.

SEVENTEENTH CENTURY

American literature at first was naturally a colonial literature, by authors who were Englishmen and who thought and wrote as such. An instance is that soldier of fortune, John Smith, who is credited with initiating American literature. His chief books included *A True Relation of such occurrences and accidents . . . as hath hapned in Virginia . . .* (1608); *Description of New England* (1616); and *The Generall Historie of Virginia, New-England, and the Summer Isles* (1624). Although these volumes set forth much in praise of their far from modest author, they were written avowedly to make known to Englishmen colonizing opportunities in the new world. In time, each colony was similarly described in one or more books: John Hammond's *Leah and Rachel* (1656) was subtitled *or, The Two Fruitfull Sisters Virginia and Maryland*; Daniel Denton wrote a *Brief Description of New York* (1670); William Penn, *Some Account of the Province of Pennsylvania* (1681); Thomas Ashe, *Carolina* (1682)—and these were only a few of many works praising America as a land of economic promise for English colonists.

Such early writers tacitly acknowledged British allegiance. Others, however, wrote works which stressed some of the differences of opinion which spurred the colonists to leave their homeland—works which attacked certain doctrines of opposing sects and defended doctrines of their own. More important (according to modern thought, at least), they argued the questions of government, ordinarily questions which involved the relationships between church and state. The attitude which most of the authors attacked was jauntily set forth by Nathaniel Ward of Massachusetts Bay in a quaint book, *The Simple Cobbler of Aggawam in America* (1647). Here Ward amusingly defended the *status quo* and railed at colonists who sponsored newfangled notions. He was, for instance, against tolerance: "He," wrote Ward, "that is willing to tolerate any unsound opinion, that his own may also be tolerated, will for a need hang God's Bible at the Devil's girdle." A variety of counterarguments to such a conservative view were published. Stern John Winthrop's *Journal*, covering the years 1630 to 1649, told sympathetically of the attempt of Massachusetts Bay colony to form a theocracy—a state with God at its head and with its laws based upon the Bible. A theocracy, Winthrop thought, was "a mixed aristocracy"; a democracy, he believed, was "the meanest and worst form of government." Later defenders of the theocratic ideal were Increase Mather (1639-1723) and his son Cotton (1663-1728). William Bradford, in *The History of Plymouth Plantation*, told the story to 1646, of another colony. His history revealed that, unlike Winthrop's Puritan group, who merely wished to purify the Anglican church, Bradford's Pilgrim companions—Separatists—broke completely with Anglicanism. More radical than the Puritans, they conceived of their government as a covenant, as evidenced by the Mayflower compact in which the Pilgrims agreed to "covenant and combine ourselves together into a civil body politic . . . and by virtue hereof to enact . . . such just and equal laws . . . as shall be thought most meet and

convenient for the general good of the Colony, unto which we promise all due submission and obedience." Even more radical than Bradford was Roger Williams who left the Separatists to become a Baptist, the Baptists to become a Seeker. Williams, in a series of controversial pamphlets (1643-52) advocated concepts such as the separation of church and state, the vesting of power in the people and the tolerance of different religious beliefs. Although Williams' writings made very dull reading they contained important ideas, many of which were put into practice in the colony which he founded—Rhode Island, the first democratic commonwealth in America.

The factual or utilitarian writings of the 17th century included many sorts—not only promotion tracts, controversial works and autobiographies, but also biographies, treatises, accounts of voyages and sermons—and there were many works of each of these kinds. In this practical period of strenuous colonizing, belles-lettres loomed small. Yet there were some achievements in this field—not in drama or fiction, since there was a deep and widespread prejudice against these forms which Cotton Mather and others held were shelved in "the library of the powers of darkness," but rather, in the field of poetry. There was some very bad poetry in such works as the famous *Bay Psalm Book* (1640) which literally translated the psalms, and in Michael Wigglesworth's popular summary in doggerel verse of Calvinistic belief, *The Day of Doom* (1662). But there was some poetry, at least, of a higher order. Anne Bradstreet of Ipswich and North Andover, Mass., wrote some lyrics, published in her book, *The Tenth Muse*, (1650), which movingly conveyed her feelings concerning religion and her family. Engaging though some of her poems were, modern critics rank above her, a poet whose works were not discovered and published until 1937. This shy poet was Edward Taylor (1644?-1729), an English-born minister and physician who lived in Boston and Westfield, Mass. Less touched by gloom than the typical Puritan, Taylor wrote conceited lyrics which showed his delight in Christian belief and experience—poems which still have power to charm the reader.

All 17th century writings, not surprisingly, are in the manner of British writings of the same—or even an earlier—period. John Smith wrote in the tradition of the geographical literature of the day; Bradford echoed the cadences of the King James Bible; the Mathers and Roger Williams, dissimilar as they were in their beliefs, wrote bejewelled prose typical of the day. Anne Bradstreet's poetic style derived from a long line of British poets, among them Spenser, Sidney, Quarles and Sylvester. Taylor was in the tradition of such metaphysical poets as Herbert, Donne and Crashaw; and he seems clearly to have been influenced by at least the first of these British poets. Both the content and form of the literature of this 17th century in America were thus markedly English.

EIGHTEENTH CENTURY

In the early years of the 18th century, some writers carried on the older traditions. Cotton Mather, for instance, produced his huge *Magnalia Christi Americana* in 1702, his vigorous *Manuductio ad Ministerium* in 1726. Both these learned books were defenses of old beliefs, reiterations of ancient Puritan convictions. More effective as an advocate for old attitudes was Jonathan Edwards, born in Connecticut in 1703 and educated at Yale—an influential preacher in Massachusetts. Though a frail and intellectual man, Edwards was feverishly active as a religionist. He initiated the Great Awakening, a revival which stirred the eastern seacoast for many years. And he wrote much in behalf of his burning belief in Calvinistic doctrine—of the concept that man, born totally depraved, could attain virtue and salvation only through God's grace. Supporting this old belief, he wrote some truly great philosophical treatises, notably the one on *The Freedom of the Will* (1754). This philosopher's philosopher supported his claims by relating them to a complex and poetic metaphysical system, by reasoning brilliantly and by stating his thoughts in clear and often beautiful prose.

But Mather and Edwards were defending a doomed cause. Such liberal New England ministers as John Wise (1652-1725)

and Jonathan Mayhew (1720-66) showed in their writings a movement away from the older beliefs and toward a less rigid religion. In other ways, Samuel Sewall (1652-1730), a magistrate and merchant of Boston, heralded a change in his famous and amusing *Diary* which covered the years 1673-1729. Sincerely religious though Sewall was, he showed in his daily records how life in commercial New England led him to love the more worldly things—to modify rigid Puritanism into what Parrington has called a “tradesman’s conception of religion.” Again, there was the *Journal* of another Bostonian, Mme. Sarah Knight, comically detailing a journey she took to New York in 1704. Mme. Knight, a woman with a keen eye for life and character along the way, wrote vividly of what she saw and commented upon it from the standpoint of an orthodox believer. But there was a quality of levity in her witty writings—even when some jocose impieties were involved—which showed that she was much less fervent than the Pilgrim founders had been.

In the south, a short time afterward, William Byrd II of Westover plantation, Va., showed how aristocratic plantation living had wrought to create an urbane and witty author who contrasted sharply with gloomier predecessors. His record of a surveying trip in 1728, *The History of the Dividing Line*, and his account of a visit to his frontier properties in 1733, *A Journey to the Land of Eden*, were his chief works. That this American’s years in England, on the continent and among the social gentry of the south had created gaiety and grace of expression is evident in these sparkling journals. Although a sincerely devout Anglican, Byrd was far from being obsessed by religion; on the contrary, he was as playful as the Restoration wits whose works he clearly admired.

The wrench of the American Revolution emphasized differences which had been growing, perhaps without being voiced, between American and British political concepts. As the colonists moved to the belief that rebellion was inevitable, as they fought the bitter war and as they worked to found the new nation’s government, their thoughts, feelings and actions were influenced by a number of very effective political writers.

Important in the early stages of the war were such authors as Samuel Adams (1722-1803) of Boston, Mass., John Dickinson (1732-1808) of Philadelphia, Pa., both of whom favoured the colonists—and Loyalist Joseph Galloway (1731-1803) of Philadelphia. But two figures loomed above these—Benjamin Franklin and Thomas Paine.

Franklin, born in Boston in 1706, had started to publish his writings in his brother’s newspaper as early as 1722. This newspaper, the *New England Courant*, which championed the cause of the leather apron man and the farmer, had attempted to appeal by using easily understood language and by using practical arguments. The style of writing probably had wielded its influence from the first upon this Yankee who took naturally to the idea that practical common sense was a good guide. The influence at any rate had been clear in the popular *Poor Richard’s Almanack*, which Franklin edited between 1733 and 1758, annually filled with prudent and witty aphorisms purportedly written by uneducated but experienced Richard Saunders. The influence had been clear also in the author’s *Autobiography*, written between 1771 and 1789, a record of his rise from humble circumstances which offered his descendants worldly-wise suggestions for future success.

Franklin had been moulded by still other forces. Reared by a Puritan family, he had acquired the Puritan love for virtue. Since, however, he had lived for years in Philadelphia, his Puritanism had been tempered by the tolerance of the Quakers. Furthermore he had been a wide reader—one whose culture, though self-attained, was deep and wide. All of these qualities gave substance and skill to the varied articles, pamphlets and reports which he wrote concerning the dispute with Great Britain—extremely effective in stating and shaping the colonists’ cause.

Thomas Paine, an Englishman, was a failure when he sought out Franklin in London to propound a scientific question. “Impressed,” as Franklin explained, “by those wonderful eyes of his,”

the American persuaded Paine to try his fortunes in the new world. Paine went to Philadelphia, became a magazine editor and then, about 14 months later, the most effective propagandist for the colonial cause. His pamphlet, *Common Sense* (Jan. 1776), probably did more than any other agency to influence the colonists to declare their independence. His series, the *Crisis* papers (Dec. 1776-April 1783) spurred Americans to fight on through the blackest years of the war. One reason for the effectiveness of both works was the fact that the papers, based upon the simple deistic beliefs of Paine, showed the conflict as a stirring melodrama in which the angelic colonists arrayed themselves against the forces of evil. Such white and black picturings here, as often before, were highly effective as propaganda. Another reason for his success was the fact that Paine’s poetic fervour found expression in impassioned words and phrases, many of which were long to be remembered and quoted.

An author of the war period who did not engage actively in the controversy was French-born Michel-Guillaume Jean de Crèvecoeur. After serving in the French army in Canada, settling in New York and becoming a farmer and a naturalized citizen, Crèvecoeur wrote and published *Letters from an American Farmer* (1782). These commentaries picture the lives of Americans, at times idyllically, and at other times voice many of the advanced ideas afloat in tumultuous days of change.

The New Nation.—When the postwar period came, some of these eloquent men were no longer able to win a hearing. Thomas Paine and Samuel Adams, for instance, lacked constructive ideas which appealed to those interested in forming a new government. Others fared better, for example Franklin, whose tolerance and common sense showed themselves in addresses to the constitutional convention. A different group of authors, however, became leaders in the new period—the talented writers of the *Federalist* papers and Thomas Jefferson.

The Federalist was a series of 85 essays, published in 1787 and 1788, urging the virtues of the new constitution. They were written by Alexander Hamilton (1757-1804), James Madison (1751-1836) and John Jay (1745-1829). More distinguished for their insight into problems of government and for their cool logic than for their eloquence, these works became a classic statement of American governmental theory. At the time they were highly effective in influencing legislators who voted on the new constitution. Hamilton, who wrote the bulk of the series (perhaps as many as 51 essays), became, with John Adams (1735-1826), a leader of the Federalist party. A series of messages which he wrote as first secretary of the treasury (1789-95) were influential in increasing the power of national government at the expense of the state governments.

Thomas Jefferson, like Franklin, was a writer on politics who was influential both during the war and the postwar period. The merits of his great summary, the Declaration of Independence, consisted, as Madison pointed out, “in a lucid communication of human rights, a condensed enumeration of the reasons for such an exercise of them, and in a style and tone appropriate to the great occasion, and to the spirit of the American people.” After the war this philosophic statesman—probably the most cultured of the 18th century American political thinkers—formulated in more detail the exact tenets of his faith. In various papers, but most richly in his letters and his inaugural addresses, he stated a belief at odds with that of Hamilton. Where Hamilton urged strong federal government, Jefferson urged individual freedom and local autonomy—decentralization. Thus far his life upon the frontier shaped his creed. Yet, being a Virginian, he had faith in aristocrats as leaders, and he thought that “a natural aristocracy” with “virtue and talents” should be trusted with high governmental positions. Though he held that all men are created equal, Jefferson did not hold that all are equally qualified as leaders. Jeffersonian democracy was a transitional stage between aristocratic belief and Jacksonian democracy.

Poets and Poetry.—Poetry became a weapon during the American Revolution, with both Loyalists and Continentals urging their forces on, stating their arguments and celebrating their heroes in verse. Some of the songs of wartime, such as “Yankee

Doodle," "Nathan Hale" and "The Epilogue," are lively pieces, and most have more polish, say, than *The Bay Psalm Book* or *The Battle of the Kegs*. Most, however, were set to popular British melodies of the time, and were in manner like the British poems of the period.

The period also was productive of a school of poets, a group centred in Hartford, Conn., and called the Hartford Wits. Most famed were John Trumbull (1750-1831), Timothy Dwight (1752-1817) and Joel Barlow (1754-1812). Most were Federalists in politics, and all tended to be as conservative in their methods of poetic composition. They wrote many satires, mock heroic poems and several dull epics. In general the poems show that these authors, adept though they were, were nothing more than skilled imitators of their contemporaries in England. One poet in the group, on one occasion, did better than the rest. This was Joel Barlow, who in 1793 composed "Hasty Pudding." Though this was a mock heroic poem in Popeian couplets and hence in general form like other imitative poems, it contained lively and vivid descriptions of rural New England scenes which gave it a momentary native flavour if not a completely native quality.

The most memorable poet of the period was Philip Freneau (1752-1832), a native New Yorker of Huguenot ancestry who became interested in writing while a student at Princeton. His first well known poems were Revolutionary War satires which were effective propaganda, but later he turned to various aspects of the American scene. Although he wrote much in the stilted manner of the neoclassicists, such poems of his as "The Wild Honey Suckle," "To a Caty-did" and "On a Honey Bee" were romantic lyrics of real grace and feeling which were forerunners of a literary movement which was to be important in the 19th century.

Drama and the Novel.—In the years toward the close of the 18th century, both dramas and novels of at least some historical importance were produced. Despite the fact that theatrical groups had long been active in America, the first American comedy presented professionally was Royall Tyler's *The Contrast* (1787). This drama was full of echoes of Goldsmith and Sheridan, but it contained a Yankee character (the predecessor of many such in years to follow) who brought something native onto the stage. Tyler wrote only this one important play, but William Dunlap (1766-1839) wrote many dramas and encouraged other dramatists to try their skill.

William Hill Brown wrote the first American novel, *The Power of Sympathy* (1789), which showed authors how to overcome ancient prejudices against this form by following the preachy, sentimental novel form which had been invented by Samuel Richardson. A flood of sentimental novels followed, down to the end of the 19th century. Shortly H. H. Brackenridge followed other models—Cervantes and Fielding—with some popular success, in *Modern Chivalry* (1792-1815), amusing because of its satire on democracy and interesting for its portrayal of frontier life. Gothic thrillers were nationalized to some extent at least in Charles Brockden Brown's *Wieland* (1798), *Arthur Mervyn* (1799-1800) and *Edgar Huntly* (1799). But all such works were more interesting as beginnings rather than as outstanding artistic achievements.

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EARLY NINETEENTH CENTURY

In a commencement poem at Princeton in 1771, young Philip Freneau, celebrating "The Rising Glory of America," urged his compatriots to create a literature of their own. The prologue to *The Contrast*, in 1787, boasted that the play was one which the people of the nation "might fairly call their own." After the Revolution, and increasingly after the War of 1812, writers were

exhorted to produce a literature which was truly national. Although the most ambitious dramas were Elizabethan in form (if not in excellence), some dramas began to depict native characters. But this was not to be a great period in the American theatre. Nevertheless, to satisfy the demand for national writing, four authors of very respectable stature appeared. William Cullen Bryant, Washington Irving, James Fenimore Cooper and Edgar Allan Poe initiated a great half century of literary development.

Bryant (1794-1878), a New Englander by birth, attracted attention in his 23rd year when the first version of his poem, "Thanatopsis," appeared. This early poem showed, as later ones did, that his first training had been in the 18th century school of poetry. Later, under the influence of Wordsworth and other romantics, he wrote nature lyrics which vividly represented the New England scene. In such poems as "To a Waterfowl," "A Forest Hymn," "Robert of Lincoln" and "The Prairies," he achieved truly impressive expressions of thought and feeling. Turning to journalism, he had a long career as the fighting liberal editor of the *Evening Post*. As a member of the so-called Knickerbocker Group Bryant overshadowed such earlier poets as Joseph Rodman Drake (1795-1820) and Fitz-Greene Halleck (1790-1867). He himself was overshadowed, in renown at least, by a native-born New Yorker, Washington Irving.

Irving, the youngest member of a prosperous merchant family, joined with some of the other gay young leaders of the town in producing *Salmagundi* papers (1807-1808) which took off on the foibles of Manhattan's citizenry. This was followed by *A History of New York* by "Diedrich Knickerbocker" (1809), a burlesque history which mocked pedantic scholarship and sniped at the old Dutch families. Irving's models in these works were obviously such neoclassical Englishmen as Addison, Steele, Goldsmith and Swift, from whom he had learned to write in a polished, bright style. When the family business was in dire straits in 1815, Irving went abroad to do what he could to save it. The business failed but Irving, having met Scott and having become acquainted with some of the imaginative German literature, introduced a new romantic note in *The Sketch Book* (1819-20), *Bracebridge Hall* (1822) and other works. He was at his best in essaylike narratives wherein his fancy and his charming personality were gracefully set forth. Irving was the first American writer to win the ungrudging (if somewhat surprised) respect of the British critics.

James Fenimore Cooper, born six years after Irving, won even wider fame. The son of a prosperous squire, he lived as a boy on Otsego lake in New York, then attended Yale briefly, went to sea briefly and settled down to be a country squire himself. Almost by accident he turned to the writing of fiction. Following the pattern of the Waverley novels, he did his best work in the Leather-stocking Tales (1823-41) a five-volume series celebrating the career of the great frontiersman Natty Bumppo. His skill in weaving history into inventive plots and in characterizing his compatriots brought his acclaim not only in America and England but on the continent as well. He also wrote novels of the American Revolution, of life upon the sea and several novels of social purpose which embodied his vigorous social and political beliefs.

Edgar Allan Poe, reared in the south, lived and worked as an author and editor in Baltimore, Md., Philadelphia, Richmond, Va., and New York city. A neurotic and somewhat theatrical personality, he was the sort of figure about whom legends naturally tended to develop; his poems and stories, many of them weird and strange, were associated by many with his unhappy career. His work instead was shaped largely by his analytical skill which showed clearly in his role as an editor: time after time he gauged the tastes of readers so accurately that the circulation figures of the magazines under his direction soared impressively. It showed itself in his critical articles, wherein he lucidly explained and logically applied his criteria. His Gothic tales of terror were written in accordance with his findings when he studied the most popular magazines of the day. Moreover, his masterpieces of terror—"The Fall of the House of Usher" (1839), "The Masque of the Red Death" (1842) and "The Cask of Amontillado" (1846) and others—were written according to a carefully worked out psychological method. So were his detective

stories such as "The Murders in the Rue Morgue," (1841) which historians credit as the earliest of the genre. As a poet, too, Poe wrote with a careful artistry—and at least some of his songs had melody and suggestive imagery of a high order. In general his methods and effects were too obviously contrived, but in his rather limited sphere he was an impressive craftsman.

Two southern novelists were also outstanding in this period: John Pendleton Kennedy and William Gilmore Simms. Kennedy, a citizen of Maryland, came to know Virginia when he visited his mother's family there. He wrote delightfully—if somewhat idyllically—of life on the plantations in *Swallow Barn* (1832); and in *Horse-Shoe Robinson* (1835) he told an interesting story of Virginia and the Carolinas during the Revolution. William Gilmore Simms of Charleston started his career in fiction with a melodramatic novel in 1833, then in 1834 he found his real bent. His forte was the writing of historical novels, like those of Scott and Cooper, which treated the history of the frontier and South Carolina. *The Yemassee* (1835) and a series of Revolutionary romances (1835–1836) showed him at his best—particularly when he portrayed (usually in minor roles) a group of amusing rogues.

AMERICAN RENAISSANCE (1829–1870)

The lives of the authors just discussed overlapped those of others who came into prominence in the 1830s and were active until about the end of the Civil War. But the new group—the humorists, the classic New Englanders, Herman Melville, Walt Whitman and others—were of a new breed. In various ways they were influenced, as their predecessors had been, by the literature of other lands. But they did their work in a new spirit and their achievements were of a new sort. Partly this was because all of them in one way or another were influenced by the broadening democratic concepts which in 1829 triumphed in Jackson's inauguration as president. Partly it was because, in this romantic period of emphasis upon native scenes and characters in many literatures, they put much of America into their books.

Particularly full of vivid touches were the writings of two groups of American humorists whose works appeared between 1830 and 1867. One group created several down-east Yankees who used common-sense arguments to comment upon the political and social scene. The most important included Seba Smith (1792–1868), whose chief figure was Jack Downing; James Russell Lowell (1819–91) who quoted the rhymed remarks of pious Hosea Biglow and rascally Birdofredum Sawin; and Benjamin P. Shillaber (1814–90), creator of Mrs. Partington and her nephew Ike. Despite their concern with preachments, these authors caught the talk, the characters, the ways of living in New England at the time as no one else did. In the old southwest, meanwhile, such writers as Davy Crockett (1786–1836), Augustus Baldwin Longstreet (1790–1870), Johnson J. Hooper (1815–63), Thomas Bangs Thorpe (1815–78), Joseph G. Baldwin (1815–64) and George W. Harris (1814–69) limned lively pictures of the people of the ebullient frontier. Though less interested in preachments than their New England counterparts, and though rather more boisterous and masculine, these authors accomplished the same sort of realistic sectional portrayal. All showed the kind of interest in the common man which was a part of Jacksonian democracy.

New England Brahmins.—Although one of their members, Lowell, for a time joined the writers of a native humour, the group of New England writers who were associated with Harvard and Cambridge in this period—the Brahmins, as they came to be called—were at an opposite extreme. Henry Wadsworth Longfellow (1807–82), Oliver Wendell Holmes (1809–94) and James Russell Lowell were all aristocrats, all steeped in foreign culture, all active as professors in Harvard. They wrote genteel literature which was at times touched by pedantry, at other times too close to foreign models. Yet each, thanks to his travels and study and to his interest in the American scene, had valuable gifts for his countrymen. Longfellow adapted European methods of storytelling and versifying to narrative poems dealing with American history, and a few of his less didactic lyrics perfectly married technique and subject matter. Holmes, in his occasional poems

and his Breakfast Table series (1858–91) brought touches of urbanity and jocosity to a perhaps oversober polite literature. And Lowell, in poems descriptive of the out of doors in America, and in his *Biglow Papers* (1847, 1867) put much of his homeland into verse. His odes—particularly the "Commemoration Ode" (1865)—gave fine expression to noble sentiments. His chief importations from abroad were a set of critical standards and a method of criticism which made him one of America's most readable as well as incisive critics.

The Transcendentalists.—Concord, Mass., a village not far from Cambridge, was the home of the leaders of another important New England group. The way for this group had been prepared by the rise of a theological system, Unitarianism, which early in the 19th century had replaced Calvinism as the faith of a large share of the New Englanders. Ralph Waldo Emerson, the most famous of the Concord philosophers, started as a Unitarian minister but found even that liberal doctrine too confining for his broad beliefs. He became a Transcendentalist who, like other ancient and modern Platonists, trusted to insights transcending logic and experience for the revelations of the deepest truths. He was not, however, a perpetual dweller in cloudland for, as Lowell pointed out, if he had a "Greek head," it was set on "right Yankee shoulders." His scheme of things ranged all the way from the lowest objects and the most practical chores to soaring flights of imagination and inspired beliefs. He had theories too of writing which helped him phrase his thoughts in simple and concrete words, so that his prose was dotted with aphorisms. His *Essays* (1841, 1844), *Representative Men* (1850) and *English Traits* (1856) were thoughtful and poetic explanations of his beliefs; and his roughhewn lyrics, packed with thought and feeling, were as close to 17th century metaphysical poems as any produced in his period.

An associate of Emerson with a salty personality of his own and an individual way of thinking was Henry David Thoreau. A sometime surveyor, labourer and naturalist, Thoreau was closer to the earthy and the practical than even Emerson was. He also was more of a humorist—a dry Yankee commentator with a flair for paradoxical phrases and sentences. Finally, he was a learned man, widely read in the western classics and the books of the orient. These qualities gave distinction to *A Week on the Concord and Merrimack Rivers* (1849) and to *Walden* (1854). The latter was a record of his experiences and ponderings during the time he lived in a hut by Walden pond—a defense of his belief that modern man should simplify his demands if need be to "suck out all the marrow of life." In his essay, "Civil Disobedience" (1849), Thoreau expounded his anarchistic views of government, insisting that if an injustice of government is "of such a nature that it requires injustice to another [you should] break the law [and] let your life be a counter friction to stop the machine." The concept of American individualism here reached one of its climaxes.

Associated with these two major figures were such minor Transcendentalists as dreamy Amos Bronson Alcott (1799–1888), George Ripley (1802–80), Orestes Brownson (1803–76), Margaret Fuller (1810–50) and Jones Very (1813–80). Margaret Fuller, a brilliant bluestocking, was for a time the editor of the organ of the movement, the *Dial* (published 1840–44) wherein some of the best writings by minor Transcendentalists appeared. Her *Woman in the Nineteenth Century* (1845) was historically important in the feminist movement.

New England Reformers and Historians.—The world-wide movement for change which exploded in the revolutions of 1848 naturally attracted numerous Americans. Reform was in the air, particularly in New England, and even the aloof Brahmins at times were drawn into the controversies raging during the period. Several Transcendentalists allied themselves with workers for change: not only Thoreau but also Alcott (at Fruitlands) and Ripley (at Brook Farm) experimented with anarchistic, socialistic or communistic schemes for living. Suffrage for women, better conditions for workers, temperance for all and even modifications of dress and diet all had their fiery defenders. And the advocates of the abolition of slavery made their mark upon U.S. history.

William Lloyd Garrison (1805-79), ascetic and fanatical, was the moving spirit in the fight against slavery; his weekly newspaper, *The Liberator* (1831-65), despite its rather small circulation, was its most influential organ. A contributor to the newspaper (who was more famous, however, as an eloquent lecturer) was aristocratic Wendell Phillips (1811-84). Still another contributor—probably the greatest writer associated with the movement—was John Greenleaf Whittier. His simple but emotional poems in behalf of abolition were collected in such volumes as *Poems Written During the Progress of the Abolition Question* . . . (1837), *Voices of Freedom* (1846) and *Songs of Labor* (1850). These had the melodramatic quality of rhetoric and therefore lacked excellence as poetry; his less controversial poems, some of them written after the war, were to have a more lasting appeal. The outstanding novelist of the movement—so far as effect was concerned—was Harriet Beecher Stowe. Her *Uncle Tom's Cabin* (1852) combined the elements of contemporary humour and sentimental fiction to dramatize the plight of the Negro. Probably no other American literary work, in that period or later, had so widespread an effect.

One other group of writers—and one great novelist—contributed to the literature of New England in this period of its greatest glory. The group consisted of several historians who combined scholarly methods learned abroad with vivid and dramatic methods of narration. These included George Bancroft, author of an impressive (though somewhat overpious) *History of the United States* (1834-76), and John Lothrop Motley, who traced the history of the Dutch republic and the United Netherlands in nine fascinating volumes (1856-74). The greatest member of the group was Francis Parkman, descendant of a prominent Boston family who, in a series of books (1851-92), wrote as a historian of the fierce contests between France and England which marked the advance of the American frontier. His record of his own westward journey, *The Oregon Trail* (1849), is an absorbing picture of life along the trail and of a sojourn among the Sioux.

Hawthorne.—History also figured in the tales and romances of the leading New England fictionist of the period, Nathaniel Hawthorne. He was convinced, as he said, that such a writer as he succeeded best if he located his fictions in "a neutral territory . . . where the Actual and the Imaginary may meet, and each imbue itself with the nature of the other." Therefore many of his tales and longer works; e.g., his masterpiece, *The Scarlet Letter* (1850), and "The Minister's Black Veil" were set against the background of colonial America with emphasis upon their distance from 19th-century New England. Others; e.g., *The House of the Seven Gables* (1851), dealt with the past as well as the present. Still others; e.g., "The Birthmark," "Rappaccini's Daughter" and *The Marble Faun* (1860), were set in distant countries. Remote though these narratives were at times from what Hawthorne called "the light of common day," they showed deep psychological insight and probed into complex ethical problems. Weaving allegory and symbolism firmly into the texture of his poetic fables, Hawthorne made them rich commentaries upon such subjects as the nature of sin and the relationship between the individual and his fellow men.

Melville and Whitman.—Another great fiction writer, for a time a neighbour and associate of Hawthorne, was New York-born Herman Melville. After relatively little schooling, Melville went to sea; a whaling ship, as he put it, was his "Yale College and his Harvard." His first books were fiction in the guise of factual writing based upon his experiences as a sailor—*Typee* (1846) and *Omoo* (1847); so were such later works as *Redburn* (1849) and *White Jacket* (1850). Between 1846 and 1851, however, Melville's reading in philosophy and the literary classics, as well as in the writings of Hawthorne, gave him new literary interests and ambitions. The first sign of this interest was *Mardi* (1849), an uneven and disjointed transitional book which used allegory after the model of Rabelais to comment upon all sorts of ideas afloat in the period—nations, politics, institutions, literature and religion. The new interest came to its finest fruition in *Moby Dick; or The White Whale* (1851), a richly symbolic work, complex but brilliantly integrated, which gave the pursuit of the white whale

by mad Ahab and his crew significant philosophical meanings. Only in short stories, "Benito Cereno"—a masterpiece of its genre—and others, in the psychological novel, *Pierre* (1852), and in the novelette, *Billy Budd* (1890?) was Melville again to show sporadic flashes of the genius which created *Moby Dick*.

Another New Yorker and one of the most ardent singers of the praise of Manhattan saw much less of the dark side of life than Melville did. He was a great optimist, and hence a voice for a period of general hopefulness. He was, in addition, a believer in Jacksonian democracy, in the splendour of the common man. Inspired by the romantic concept of the poet as prophet and also by the Transcendental philosophy of Emerson, Walt Whitman in 1855 published the first edition of *Leaves of Grass*. As the years passed, nine other editions of this singular work were published, always with the revision of old poems and the adding of new ones. This autobiography in verse was intended to show the ideas, beliefs, emotions and experiences of the common man in this great period of American individualism. Whitman had a hard time winning a following, because he was frank and unconventional in his Transcendental thinking, because he used free verse rather than rhymed or regularly metred verse and because his poems were not conventionally organized. Nevertheless (assisted somewhat by enthusiastic friends), this poet steadily gained the approval of the critics and in time came to be recognized as one of the great poets of America. Modern critics see form where some of Whitman's contemporaries saw only chaos—in such fine poems as "Crossing Brooklyn Ferry," "Out of the Cradle Endlessly Rocking," "When Lilacs Last in the Dooryard Bloom'd" and "Passage to India." With the passage of time, too, readers came to be less shocked by Whitman's frankness, his thought, his strange diction and his irregular rhythms.

Southern Poets and Orators.—In the south meanwhile, the authors tended to be overshadowed by their New England neighbours. The humorists of the southwest, to be sure, were unsurpassed, and Poe (who considered the south his home) wrote within certain limits important stories, poems and critical works. But, with one exception, other southern writers of significance were quantitatively and qualitatively surpassed. Henry Timrod (1828-67) and Paul Hamilton Hayne (1830-86) were the best of the poets. The former, in particular, achieved memorable expressions in behalf of the south in poems such as "Ethnogenesis," "Ode" and "The Cotton Boll." The south's best answer in poetry to the abolitionist songs of Whittier was William J. Grayson's "The Hireling and the Slave" (1854) wherein, in heroic couplets often very well turned, the author stated the case for slavery.

More noteworthy in a period of great oratory, were the orators of the south. New England, of course, had as its spokesman the "godlike" Daniel Webster whose eloquence many considered unsurpassed. But the southerners held with some reason that they had finer representation in the halls of congress than the north had managed to produce. John Randolph of Roanoke (1773-1833), a picturesque aristocrat, found the best expression for his flamboyant personality in his stirring addresses. Henry Clay (1777-1852), who was born in Virginia but represented Kentucky in Washington, was at the time esteemed as the greatest of the orators; doubtless his speeches did much to bring about the adoption of his various proposals for compromise. More to the taste of later readers (and admired at the time) was John C. Calhoun (1782-1850) of South Carolina. His simplicity of style, his grasp of history and his sharp logic made the most impressive case possible for his beloved south.

Abraham Lincoln.—Kentucky and Illinois produced the one orator who managed to speak to future generations in utterances which rose above the bitterness of wartime. His prewar speeches, including the famous debates with Stephen Douglas in 1858, were more effective upon the immediate audience than upon later readers. There were speeches even after his nomination for the presidency which, though historically important, were ephemeral in thought and form. But at least four of his speeches—Farewell to Springfield (1861), First Inaugural (1861), The Gettysburg Address (1863) and Second Inaugural Address (1865)—whether



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AMERICAN AUTHORS OF THE 19TH AND 20TH CENTURIES

1. Washington Irving, 1783-1859. 2. James Fenimore Cooper, 1789-1851. 3. Edgar Allan Poe, 1809-49. 4. Henry David Thoreau, 1817-62. 5. John Greenleaf Whittier, 1807-92. 6. Henry Wadsworth Longfellow, 1807-82. 7. Harriet Beecher Stowe, 1811-96. 8. Nathaniel Hawthorne, 1804-64. 9. Ralph Waldo Emerson, 1803-82. 10. James Russell Lowell, 1819-91. 11. Oliver Wendell Holmes, 1809-94. 12. Emily Dickinson, 1830-86. 13. Walt Whitman, 1819-92. 14. Herman Melville, 1819-91. 15. Mark Twain (Samuel Langhorne Clemens), 1835-1910. 16. Edwin Arlington Robinson, 1869-1935. 17. Robert Frost, 1875-. 18. Willa Cather, 1876-1947. 19. Sinclair Lewis, 1885-1951. 20. Eugene O'Neill, 1888-. 21. Theodore Dreiser, 1871-1945. 22. Ernest Hemingway, 1898-. 23. Sherwood Anderson, 1876-1941. 24. Carl Sandburg, 1878-. 25. Edna St. Vincent Millay, 1892-1950.



or not one agrees with their interpretation of history, were great utterances. Lincoln was able thus to stir listeners beyond his own times because he was at this stage in his career a sincere believer in democracy and a man profoundly aware of the sorrow and the suffering of war. He was also a devoted reader of two literary classics which moulded his simple but eloquent style—Shakespeare and the King James version of the Bible. He was, finally, a man of real poetic ability who took great pains to seek out the words, the images and the rhythms which best expressed his thought and emotion.

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THE CIVIL WAR TO 1914

Like the Revolution and the election of Andrew Jackson, the Civil War marked a turning point in U.S. history. To some degree a result of certain changes under way in the prewar decades, to some extent an accelerator of those changes, the Civil War marked the beginning of new ways of living. Industry became increasingly important as factories rose and cities grew and agrarian pre-eminence declined. Science contributed to the growth of industry, influenced men's thinking about philosophical problems and wrought great changes in everyone's life. The frontier, which always before had been an important factor in the economic scheme, moved steadily westward, and toward the end of the 19th century vanished. All these changes brought modifications in the ethical and political beliefs of many Americans. The rise of modern America was accompanied, naturally, by important mutations in literature.

Literary Comedians.—U.S. humour, the type of writing which appealed most directly perhaps to popular taste, shortly embodied important changes. Although they continued to employ some of the devices of the older humorists, the group of comic writers which now rose to prominence was different in important ways from the older group. Charles Farrar Browne (1834-67), David Ross Locke (1833-88), Charles Henry Smith (1826-1903), Henry Wheeler Shaw (1818-85) and Edgar W. Nye (1850-96), wrote, respectively, as Artemus Ward, Petroleum V. (for Vesuvius) Nasby, Bill Arp, Josh Billings and Bill Nye. Appealing to a national audience, these authors forsook the sectional characterizations of earlier humorists and assumed the roles of literary comedians. This meant that the characters they pretended to be became blurred or unlocalized—that instead of writing in the roles, say, of Yankee farmers, Georgia planters or Tennessee mountaineers, they wrote (to use Clemens' phrase) as "genial idiots" whose characteristics were not particularized. In such guises they could often comment obliquely and amusingly upon current affairs. In such guises, too, they could use all sorts of verbal devices—slang, bad spelling, poor grammar and antipathetic sentences, incongruously combined with learned allusions and Latinate words for humorous effects. The nature of the humour thus shifted from that of character portrayal to that of diction. Most that they wrote wore badly, but thousands of Americans in their time and some in later times found these authors vastly amusing.

Fiction and Local Colourists.—Since the achievements of short-story writers and novelists were to be both historically important and aesthetically appealing, the pre-eminent form in this period was destined to be fiction. The first group of fiction writers to become popular—the local colourists—took over to some extent the task of portraying sectional groups which had been abandoned by writers of the new humour. Bret Harte, the first of these writers to achieve great success, admitted indebtedness to the prewar sectional humorists, as did some others; and all showed resemblances to the earlier group. Some, it is probable, went to school to more respectable poets and novelists of

the early 19th century. Whittier, for instance, before the war had written much poetry which authentically pictured New England life, and now was to write more including his masterpiece "Snow-Bound" (1866). Too, Cooper and innumerable other writers in the tradition of Scott had before the war pictured hundreds of characters with clearly displayed sectional traits.

Whoever their antecedents were, the local colourists quickly became pre-eminent. Within a brief period, books by pioneers in the movement appeared—Harriet Beecher Stowe's *Oldtown Folks* (1869) and Sam Lawson's *Oldtown Fireside Stories* (1871), delightful vignettes of New England; Bret Harte's *The Luck of Roaring Camp and Other Sketches* (1870), humorous and sentimental tales of California mining camp life; and Edward Eggleston's *The Hoosier Schoolmaster* (1871), a novel of the early days of the settlement of Indiana. Down into the 20th century, short stories (and a relatively small number of novels) in patterns set by these three appeared. In time, practically every corner of the country had been portrayed in local colour fiction. Additional important writings were the depictions of Louisiana creoles by George Washington Cable (1844-1925), of Virginia Negroes by Thomas Nelson Page (1853-1922), of Georgia Negroes by Joel Chandler Harris (1848-1908), of Tennessee mountaineers by Mary Noailles Murfree (1850-1922), of tight-lipped folk of New England by Sarah Orne Jewett (1849-1909) and by Mary E. Wilkins Freeman (1852-1930), of the people of New York city by Henry Cuyler Bunner (1855-1896) and by William Sydney Porter—"O. Henry"—(1862-1910). The avowed aim of some of these writers was to portray realistically the lives of various sections and thus to promote understanding in a united nation. The stories as a rule were only partially realistic, though, because: (1) the authors often set their narratives in the past or, if they showed the contemporary scene, winnowed out the less glamorous aspects of life in their section; (2) they were often too much coloured by sentiment or humour, or (typically) by both; (3) they exploited the picturesque or the quaint rather than the typical. Some have suggested that the authors tended to revisit the past instead of portraying their own time, because of their nostalgia for an America which had disappeared. Touched by romance though they were, these fictional works were transitional to realism, for they did portray common folk sympathetically; they did concern themselves with dialect and mores; and some at least avoided the older sentimental or romantic formulas.

Mark Twain.—Samuel L. Clemens, Mark Twain, was allied with the literary comedians and the local colourists. As a printer's apprentice on his brother's newspaper in Hannibal, Mo., he knew and emulated the prewar sectional humorists. He rose to prominence in the days when Artemus Ward, Bret Harte and their followers were the idols of the public. His first books, *The Innocents Abroad* (1869) and *Roughing It* (1872), like several of later periods, were travel books in which the affiliations with the postwar professional humorists were clearest. *The Adventures of Tom Sawyer* (1876), *Life on the Mississippi* (1883) and *The Adventures of Huckleberry Finn* (1884), his best works, which recreated the life of the Mississippi valley in the past, were closest to the work of the older humorists and the local colourists. Even in his best work, however, he succumbed now and then to the temptation to play the buffoon or sink into burlesque.

Despite his flaws, Mark Twain was one of America's greatest writers. He had more skill than his teachers in selecting rich details of the life in his section; he had a genius for creating character; he had unusual inventive powers and he was master of a poetic and masculine style.

William Dean Howells.—The local colourists and Mark Twain thought of themselves as portrayals of life as it really was, although they frequently let a nostalgic haze blur actuality. Nearer to the later concept of realism were some of the books of a long neglected New Englander, John William De Forest—*Miss Ravenel's Conversion from Secession to Loyalty* (1867) which told truths about the Civil War and which portrayed some very lifelike characters, and *Honest John Vane* (1875), a novel whose theme was the Crédit Mobilier scandal. Even nearer to the later concept were three novels produced in the middle west in

the 1880s—E. W. Howe's *The Story of a Country Town* (1883), which showed the pinched life of a village in Kansas, and Joseph Kirkland's *Zury, the Meanest Man in Spring County* (1887); a rather grim picture of the Illinois frontier. Howe was unaware that he was influenced by anybody; but Kirkland gladly acknowledged his indebtedness to the English realist, Thomas Hardy. A greater writer and a more conscious realist than any of these was another midwesterner, born and raised in Ohio, William Dean Howells.

Howells went abroad for consular service, then returned to live in the east. An avid reader from childhood, he apparently became enthusiastic about realistic writing when, in Italy, he encountered the plays of 18th-century Carlo Goldoni; but as the years passed he learned lessons from other authors as well. And as an influential editor and as an author, he was the most effective advocate of the new mode of fiction writing.

At the start, Howells conceived of realism as the truthful portrayal of ordinary facets of life—with some limitations; he preferred comedy to tragedy, and he tended to be reticent to the point of prudishness. The formula was displayed at its best in *Their Wedding Journey* (1872), *A Modern Instance* (1882) and *The Rise of Silas Lapham* (1885). Howells preferred later novels written after he had encountered Tolstoy's writings, and had been persuaded by them, as he said, to "set art forever below humanity." In such later novels as *Annie Kilburn* (1889), *A Hazard of New Fortunes* (1890) and *The World of Chance* (1893), he chose his characters not only because they were commonplace but also because the stories he told about them were commentaries upon society, government and economics.

The Naturalists.—Other writers toward the close of the 19th century moved toward naturalism, a more advanced stage of realism. Hamlin Garland was one whose writings marked some aspects of this development. When this young midwesterner called on Howells for the first time in 1885, his views were much like those of the older writer. In his short stories and novels, however, he departed from the practices of the Howells of the pre-Tolstoy period: he made his narratives vehicles for philosophical and social preachments; and he was franker than Howells in treating some aspects of life—the harsher details of the farmer's struggles and the subject of sex. His *Main-Travelled Roads* (1891) and *Rose of Dutcher's Cooily* (1895) displayed Garland's particular talents. These and his critical manifesto for the new fiction, *Crumbling Idols* (1894), were his effective contributions to the developing movement. He was to live well into the 20th century and to produce, in a new period, fine autobiographical works, notably *Son of the Middle Border* (1917) and *A Daughter of the Middle Border* (1921).

Garland thought of himself as a "veritist." Other authors of the same period or slightly later were avowed followers of the group of French naturalists led by Émile Zola (1840–1902). Theodore Dreiser, for instance, treated subjects which had seemed too daring to the earlier realists and, like other naturalists, illustrated his own beliefs by his depictions of characters and his unfolding of plots. Holding that men's deeds were "chemical compulsions," he showed characters unable to direct their actions. Holding, also, that "the race was to the swift and the battle to the strong," he showed characters defeated by stronger and more ruthless opponents. His important books included *Sister Carrie* (1900), *Jennie Gerhardt* (1911), *The Financier* (1912), *The Titan* (1914) and—much later—*An American Tragedy* (1925).

Dreiser did not bother with—or did not care for—some of the niceties of style such as were found in some French naturalistic works. Frank Norris and Stephen Crane were more concerned with such matters. As a result, they embodied many symbolic details in their writings. In his short novels *Maggie: A Girl of the Streets* (1892) and *The Red Badge of Courage* (1895) and in some of his short stories, Crane was an impressionist who made his details and his setting forth of them embody his conception of man overwhelmed by circumstance and environment. Frank Norris, who admired Crane's "aptitude for making phrases—sparks that cast a momentary gleam upon whole phases of life," himself tried to make phrases, scenes and whole narratives cast

such gleams in *McTeague* (1899), *The Octopus* (1901) and *The Pit* (1903). Both Norris and Crane died young, their full abilities undeveloped, but their experiments foreshadowed later achievements in the 20th century novel.

Henry James.—In the books of Henry James, born in New England but later an expatriate in England, fiction took a different pathway. Like the realists and naturalists of his time, he thought that fiction should reproduce reality. He saw reality as fiction presented it, however, as twice translated: (1) through the author's peculiar experiencing of it; and (2) through his depicting of it. Deep insight and thorough experience were no more important, in his thinking, than the highly complicated and delicate task of the artist. His *The Art of Fiction* (1884), his essays on novelists and his brilliant prefaces to his collected works showed him struggling very thoroughly and consciously with the problems of his craft. Together, they formed an important body of discussion of fictional artistry.

Excellent as a short story writer, James nevertheless was chiefly important for novels in which his doctrines found concrete embodiment. Outstanding were *The American* (1877), *The Portrait of a Lady* (1881), *The Spoils of Poynton* (1897), *What Maisie Knew* (1897), *The Wings of the Dove* (1902), *The Ambassadors* (1903) and *The Golden Bowl* (1904). The earliest of these were international novels wherein conflicts arose from the relationships between Americans and Europeans—each group with its own characteristics and morals. As time passed, he became increasingly interested in the psychological processes of his characters and in the rendering of their limited insights, their perceptions, their emotions, in subtle and complex but interesting and true narratives. His later novels, in particular, fascinated the readers and critics who, beginning in the 1930s, gave James a higher place in U.S. fictional history than he had achieved during his lifetime.

Critics of the Gilded Age.—Writers of many types of works contributed to a great body of literature which flourished between the Civil War and 1914—literature of social revolt. Novels attacked the growing power of business, the growing corruption of government, and some novelists outlined utopias. In 1873, Mark Twain and Charles Dudley Warner produced a chaotic novel, *The Gilded Age*, which featured the growth of corruption in government. The same theme, as well as political inefficiency, figured in Henry Adams' novel *Democracy* (1880). Edward Bellamy's *Looking Backward* (1888) was both an indictment of the capitalistic system and an imaginative picturing of a utopia achieved by a collectivist society in the year 2000. Howells' *A Traveler from Altruria* (1894) pleaded for an egalitarian state in which the government regimented men's lives. The year 1906 saw the publication of Upton Sinclair's *The Jungle*, the first of a library of novels and treatises by that author which criticized U.S. economic and political life and which urged socialism as the remedy.

Two poets became famous for the criticisms which they embodied in songs. Edwin Markham, a California schoolteacher, in 1899 published "The Man With the Hoe," protesting against the exploitation of labour and vaguely threatening revolution; it immediately stimulated nation-wide interest. A year later William Vaughan Moody's "An Ode in Time of Hesitation" denounced growing U.S. imperialism as a desertion of earlier principles. "On a Soldier Fallen in the Philippines" (1901) even more effectively developed the same theme.

With the rise of the journalistic magazines, a group of journalists became important as critics of America—the group dubbed "the muckrakers" by Theodore Roosevelt. Ida M. Tarbell's *History of the Standard Oil Company* (1903) and Lincoln Steffens' *The Shame of the Cities* (1904) were typical contributions by two members of a large group of journalistic crusaders.

Henry Adams.—One of the most devastating as well as one of the most literate of the attacks on modern life was the autobiography of a scion of an ancient New England family, the Adamses. Educated at Harvard and abroad, Henry Adams was a great teacher and a great historian (*History of the United States* [1889–91] and *Mont Saint-Michel and Chartres* [1904]). His *The Education of Henry Adams* (1906), however, complained that his lifelong hunt for some sort of order in the world, some sort of

faith for man, in the end left him completely baffled. The quiet, urbane style served well to underline, in an ironic way, the message of this pessimistic book.

Poetry.—The latter 19th century and the early years of the 20th century were a poor period for poetry; yet (in addition to Moody) two poets of distinction wrote songs which survived long after scores of minor poets had been forgotten. One was southern-born Sidney Lanier, a talented musician who utilized the rhythms of music and the thematic developments of symphonies in such fine songs as "Corn" (1875), "The Symphony" (1875) and "The Marshes of Glynn" (1878). Distressed, like many of his contemporaries, by the changes in U.S. life, he wove his doubts, fears and suggestions into his richest poems.

The other poet was a New Englander, Emily Dickinson, probably the outstanding U.S. woman poet. A shy, playful, odd personality, Miss Dickinson allowed practically none of her writings to be published during her lifetime. Not until 1890, four years after her death, was the first book of her poems published, to be followed at intervals by other collections down to 1946. Later poets were to be influenced by her individual techniques—the use of imperfect or eye rhymes, the avoidance of regular rhythms, the tendency to pack her brief stanzas with cryptic meanings. Like Lanier, she rediscovered the value of conceits for setting forth her thought and feeling. Such poems as "The Snake," "I Like to See It Lap the Miles," "The Chariot," "Farther in Summer than the Birds" and "There's a Certain Slant of Light" represented her unusual talent at its best.

AFTER 1914

Looking back after several years, literary historians could see that modern movements in drama, poetry, fiction and criticism took form in the years before, during and after World War I. The eventful period which followed left its imprint upon books of all kinds, for it was a time when writers were much concerned with the life about them. World War I, the peace that followed it; the prosperous 1920s, the depression beginning in 1929; the New Deal, the drift to World War II, World War II itself and the new postwar period all shaped literary expression.

The literary forms of the period were extraordinarily varied, but one thing was true of every genre: in drama, poetry and fiction the leading authors tended to experiment with radical innovations in technique. So many deviations from older techniques occurred that some members of the reading public found the new literature, at first, beyond their comprehension. In time, however, the most startling innovations tended to disappear, and readers tended to approve of some of the changes.

Experiments in Drama.—U.S. drama in the 19th century had not been a pre-eminent form. During the American Renaissance the outstanding dramas had been grandiloquent blank verse tragedies such as Robert Montgomery Bird's *The Gladiator* (1831) and George Henry Boker's *Francesca da Rimini* (1855). The extraordinarily popular dramatizations of *Uncle Tom's Cabin* (1852) and Dion Boucicault's melodramas; e.g., *The Octoroon* (1859), dated even more obviously. Nor did the post-Civil War stage fare much better. James A. Herne's *Hearts of Oak* (1879), *Margaret Fleming* (1890) and *Shore Acres* (1892) were praised as realistic plays, but were more stagey than lifelike. Bronson Howard (1842-1908), Augustus Thomas (1857-1934) and Clyde Fitch (1865-1909) were successful playwrights each of whom was, in his day, much admired. The works of these writers, however, in retrospect appear to have been rather shallow, good theatre rather than good drama.

No type of writing embodied wider experimentation than the new drama which arose as a result of a rebellion against the glib commercial stage. In the early years of the 20th century many young Americans, travelling abroad, found a vital theatre flourishing in Europe. Returning to their homeland, these young men and women became active in founding a little theatre movement in every corner of the country, experimenting with dramatic forms and methods of production free from commercial limitations. In time the movement supplied producers, actors and playwrights trained in community playhouses and college class-

rooms. And some little theatre groups became important commercial producers; e.g., the Washington Square Players, founded in 1915, became the Theatre Guild in 1918. The drama which resulted was marked by a spirit of experimentation and by a new seriousness and a new maturity.

Eugene O'Neill, by general consent America's greatest dramatist in the period, was a product of the movement. Having been trained in George Baker's drama class at Harvard university, he worked with the Provincetown Players before his plays were commercially produced. His dramas showed a remarkable range of experimentation. Some, such as *Beyond the Horizon* (1920), *Anna Christie* (1922), *Desire Under the Elms* (1924) and *The Iceman Cometh* (1946), were naturalistic. Some used expressionistic techniques; e.g., *The Emperor Jones* (1921) and *The Hairy Ape* (1922). He made use of a stream-of-consciousness dramatic form in *Strange Interlude* (1928) and of psychological analysis in *Mourning Becomes Electra* (1931). All his best plays, however, set forth O'Neill's tragic view of life in words of real poetic power.

Although no other dramatist was as generally praised as O'Neill, many others wrote plays—often in the same experimental spirit—which were of a high order. Marc Connelly collaborated with George S. Kaufman in writing the expressionistic *Beggar on Horseback* (1924) and himself wrote touching fantasy in a Negro folk Biblical play, *The Green Pastures* (1930). Elmer Rice wrote *The Adding Machine* (1923), an expressionistic drama, and the naturalistic *Street Scene* (1929). Maxwell Anderson began as a realist, then turned to poetic dramas such as *Elizabeth the Queen* (1930) and *Winterset* (1935), then to a musical comedy satire, *Knickerbocker Holiday* (1938). Robert Sherwood wrote distinguished plays in the forms of comedy; e.g., *Reunion in Vienna* (1931) melodrama, *The Petrified Forest* (1935), historical chronicle, *Abe Lincoln in Illinois* (1938) and tragedy, *There Shall Be No Night* (1940). Clifford Odets, in *Waiting for Lefty* (1935), a plea for labour unionism, utilized the auditorium as well as the stage for action, and in *Awake and Sing* (1935) wrote in the vein of naturalism. Thornton Wilder used stylized settings and poetic dialogue in *Our Town* (1938) and turned to fantasy in *The Skin of Our Teeth* (1942). Tennessee Williams utilized a narrator and poetic dialogue in *The Glass Menagerie* (produced 1944) and a multiple setting in *A Streetcar Named Desire* (produced 1947). A multiple setting also helped Arthur Miller in his fine tragedy, *Death of a Salesman* (1949). These dramatists and others were thus alike in their catholicity of form and their eagerness to make their plays, of whatever sort, convey significant commentaries.

The New Poetry.—*Robinson and Frost.*—In form, poetry ranged between older sorts of versification and sorts which departed greatly from the older procedures. Two New England poets who did not diverge from Victorian methods of writing won both critical and popular acclaim in the new period. Edwin Arlington Robinson, whose first book had appeared in 1896, found sonnets, ballad stanzas and blank verse satisfactory to set forth his thought; yet, in the 1920s, he won three Pulitzer prizes—for his *Collected Poems* (1922), *The Man Who Died Twice* (1925) and *Tristram* (1928). Like Robinson, Robert Frost used established stanzas and blank verse. His first book, *A Boy's Will* (London, 1913) was followed by such volumes as *North of Boston* (London, 1914), *Mountain Interval* (1916), *New Hampshire* (1923), *A Further Range* (1936) and *Masque of Reason* (1945). Both Robinson and Frost were admired because their concepts and emotions chimed with those of the time. Both saw tragic aspects of life, both commented upon the complexities of human existence and both were skeptical about pat solutions.

Midwestern Poets.—Just as modern U.S. drama had its beginnings in little theatres, modern U.S. poetry took form in little magazines. Particularly important was *Poetry: A Magazine of Verse* founded by Harriet Monroe (1860-1936) in Chicago in 1912. The region around Chicago—the midwest—soon became prominent as the home of three poets. One was Vachel Lindsay, born and reared in Springfield, Ill. Adapting legendary

lore and native oratory to irregular odelike forms, Lindsay wrote poetry in a style well adapted to oral presentation. His lively reading on lecture tours contributed to the success of such books as *General William Booth Enters into Heaven, and Other Poems* (1913) and *The Congo, and Other Poems* (1914). Carl Sandburg of Galesburg, Ill., wrote Whitmanesque free verse about life on the prairies and in the cities, which appeared in such volumes as *Chicago Poems* (1916), *Cornhuskers* (1918), *Smoke and Steel* (1920) and *The People, Yes* (1936). Edgar Lee Masters, a native Kansan, was in Chicago when he wrote his very popular *Spoon River Anthology* (1915); free verse monologues of the village men and women most of whom spoke bitterly of their frustrated lives. All these poets experimented with new forms; all commented upon the ironic or bitter aspects of life; all were concerned in one way or another with the changes wrought by the rise of science and industry.

Changing Forms, Changing Ideas.—Modern readers, it soon developed, were hospitable to poets who experimented with new forms, or who expressed new attitudes, or who did both. Sara Teasdale (1884-1933) and Edna St. Vincent Millay (1892-1950) wrote traditional sonnets and brief, personal lyrics which were unusually frank (according to old standards) for women poets. Three fine Negro poets—James Weldon Johnson (1871-1938), Langston Hughes (1902-) and Countee Cullen (1903-46) told of the problems of their race in poetic forms which were only on rare occasions radically experimental. These typified a number of poets who found old moulds satisfactory for new ideas.

Other poets tried a great range of experiments. Amy Lowell (1874-1925) was spokesman for the Imagists, a group with radical theories about the diction, the rhythms and the imagery (though not the subject matter) of poetry. Conrad Aiken (1889-) experimented with poetical imitations of symphonic forms often mingled with stream-of-consciousness techniques. Marianne Moore (1887-) invented and employed brilliantly a different kind of free verse. E. E. Cummings (1894-) abolished capital letters, used unusual punctuation and divided his lines in a novel fashion to produce poems which often had surprisingly fresh impacts. Stephen Vincent Benét (1898-1943), though ordinarily a rather conventional poet, ranged through many forms, from the ballad stanza to free verse: many of these he wove into his stirring novel in verse, *John Brown's Body* (1928). Robinson Jeffers (1887-) used violent imagery and interestingly modified Whitmanesque and blank verse lines to express what were perhaps the most bitter views of any major poet writing in the period.

The Metaphysicals.—The most complex modern poets proved to be a varied group who were strongly influenced by the 17th century British poets, especially John Donne. Like Donne, these poets used unusual figures—conceits—and freighted their lines with philosophical thought, often of an obscure sort. Their ideas and emotions were unusual for poetry, and their lines often harshly departed from romantic rhythms and melodies. Lovers of poetry found them difficult to read, but often agreed that an understanding was worth the trouble.

The giant of the group and the acknowledged master of many of its members was T. S. Eliot. Eliot, himself, was much indebted to an unstable genius, Ezra Pound (1885-), whose critical ideas and fragmentary poetical works provided a great stimulus to Eliot and others. But, beginning with *The Waste Land* (1922) Eliot rapidly progressed in general esteem; and such volumes as *Ash-Wednesday* (1930), *The Rock* (1934) and *Four Quartets* (1943)—as well as his brilliant critical studies—led to the greatest respect. Not only was his style rich and complex: his thoughts and feelings were shared by many who, like him, moved from complete despair in a world that seemed chaotic to a faith of some sort.

The influence of Eliot was very clear in the writings of Archibald MacLeish (1892-); his earlier poems were similar both in manner and thought to *The Waste Land*, and in later poems he voiced a positive belief—a belief, however, in social advance rather than in the religious attitude advocated by Eliot. A num-

ber of southern poets showed affiliations, though not so clearly—John Crowe Ransom (1888-), Donald Davidson (1893-) and Allen Tate (1899-); their poems were particularly concerned with the south—its past and its problems. Hart Crane (1899-1932) was similar in manner but had matter of his own. Others of the metaphysicals with individual qualities of thought and method were Louise Bogan (1897-), Léonie Adams (1899-), Muriel Rukeyser (1913-), Delmore Schwartz (1913-) and Karl Shapiro (1913-).

Fiction.—The little magazines which helped the growth of poetry were also influential in the growth of modern U.S. fiction. Not only did they print short stories which diverged from the older patterns; they also published attacks upon the established writers and stressed the merits of unconventional fiction. The *Dial* (1880-1929), the *Little Review* (1914-1929), the *Seven Arts* (1916-1917) and others encouraged rebellion. More potent than any of these were two magazines edited by that ferocious but humorous journalist-critic, H. L. Mencken (1880-)—*Smart Set*, which he edited from 1914 to 1923, and *American Mercury*, under his charge from 1924 to 1933. Mencken published short stories in the new manner, attacked established U.S. beliefs and institutions and praised fiction writers who were unconventional in thought and manner. A powerful influence, he helped launch the new fiction.

The trend was indicated by one of Mencken's favourites, James Branch Cabell. Cabell, who had been writing since 1905, sprang to fame with *Jurgen* (1919)—a novel which attacked America's orthodoxies and institutions by telling a cynical story full of Freudian symbolism. Other authors whom Mencken favoured launched "a revolt against the village," pointing out the narrow, frustrated qualities of life in rural communities; e.g., Zona Gale (1874-1938) and Ruth Suckow (1892-). The most famous of the village writers was Sherwood Anderson. His *Winesburg, Ohio* (1919) and *Triumph of the Egg* (1921) were collections of short stories which showed villagers suffering from all sorts of phobias and suppressions. Anderson in time wrote several novels of superior quality, the best being *Poor White* (1920), which treated both a frustrated character and the impact of industry upon American living.

In 1920, critics noticed that a new school of fiction had risen to prominence with the success of books such as F. Scott Fitzgerald's *This Side of Paradise* and Sinclair Lewis' *Main Street*. Thereafter, fiction took on new qualities related to the modern period. Writers tended toward realism and naturalism—frank portrayals of contemporary life. There was a trend, however, from completely documented realism toward the selection of detail and, eventually, to the use of detail to give symbolic meanings. The novelists' portrayal of characters and motives, and even their selection of detail, consistently were much influenced by the psychology of Freud and others.

And the novel tended to be particularly concerned with problems of the day. In the decades which followed, fiction voiced reactions to changing times: novels of the '20s voiced disillusionment and protest against established institutions and ideologies. Some of those of the '30s protested against the economic and political system; others advocated remedies of some sort—told of new-found hope and faith. The drift toward World War II and the war itself led many novelists to see qualities of excellence in American life not before realized, to voice patriotic enthusiasm. No great new trend following World War II was discernable immediately, unless it was a tendency to suggest remedies for certain injustices such as racial discrimination. Some authors wrote works which fell into one or two of these periods; others ran the gamut from disillusion to the acquisition of a new faith. The number of competent—even superior—novelists was huge, so large that the following study can discuss only a few of those who generally were felt to be outstanding.

Critics of Society.—F. Scott Fitzgerald's *This Side of Paradise* (1920) showed the disillusionment, the moral disintegration of, postwar America. The book initiated a career of great promise which found its finest fruition in *The Great Gatsby* (1925), a more poignant and more unified development of the same theme.

These two books of criticism of American society were destined to be Fitzgerald's best achievements. Like Fitzgerald, Sinclair Lewis was best as a social critic. His onslaught against the "village virus," *Main Street* (1920); against average businessmen, *Babbitt* (1922); against materialistic scientists, *Arrowsmith* (1925); and against the racially prejudiced, *Kingsblood Royal* (1947) were satirically sharp and thoroughly documented. Similar careful documentation, though little satire, characterized James T. Farrell's naturalistic *Studs Lonigan* trilogy (1932-35), all of which indignantly underlined social inequalities. Similar in pattern were Richard Wright's books which protested against the position of the Negro—*Uncle Tom's Children* (1938) and *Native Son* (1940). A number of authors wrote proletarian novels attacking capitalistic exploitation; e.g., Albert Halper wrote *The Foundry* (1934) and *The Chute* (1937). Satire, directed against some of the aristocratic New England groups, featured the rather lighter indictments of J. P. Marquand, *The Late George Apley* (1937) and *Wickford Point* (1939). In *All the King's Men* (1946), Robert Penn Warren wrote a more subtly ironic but nevertheless stirring novel about the rise of a potential dictator in the U.S.—a forceful warning against tendencies to exalt such a figure.

Particularly admired as a novelist of protest was John Dos Passos, who first attracted attention with an anti-World War I novel, *Three Soldiers* (1921). His most sweeping indictments of the modern social and economic system, *Manhattan Transfer* (1925) and the U.S.A. trilogy (*42nd Parallel* [1930]; *1919* [1932]; *The Big Money* [1936]); used various distinctive devices; e.g., "The Camera Eye" and "Newsreel," to attack from the left. Later, after he had undergone changes in belief, he wrote *Adventures of a Young Man* (1939) and *Number One* (1943), attacks upon the leftists.

Hemingway, Faulkner, Steinbeck.—Three authors whose writings showed the shift from disillusionment were Ernest Hemingway, William Faulkner and John Steinbeck. Hemingway's early short stories and his first novels, *The Sun Also Rises* (1926) and *A Farewell to Arms* (1929) were full of the disillusionments of the lost generation concerning both war and peace. The Spanish war, however, led him to believe in the possibility of collective action to solve social problems, and his novels *To Have and Have Not* (1937) and *For Whom the Bell Tolls* (1940) embodied the new belief. At his best, Hemingway showed a power to select and arrange details and to write simple, hard-hitting prose which critics found most effective.

Less controlled but equally distinctive, at its best was the prose of William Faulkner. His handling of point of view, his use of stream-of-consciousness techniques and even some of his descriptions of backgrounds and actions all at times led to the puzzlement of the reader. But such novels as *The Sound and the Fury* (1929), *As I Lay Dying* (1930), *Light in August* (1932) and *The Hamlet* (1940) overcame handicaps of occasional obscurity. Many of his short stories and novels were parts of the unfolding of a history of Yoknapatawpha county, a mythical Mississippi community, which showed his convictions about the decadence of the south. The picture as a whole was grim and dark, but Faulkner had convictions about the solutions to the problem which became increasingly clear. These were set forth most clearly and explicitly in *Intruder in the Dust* (1948).

Steinbeck's career—marked by uneven achievements—began with a historical novel, *Cup of Gold* (1929), wherein he voiced the distrust of society, the glorification of the anarchistic individualist typical of the rebellious '20s. Later, however, he appeared to move toward a belief in the possibilities of collectivist action as a pathway to man's salvation. Such, at least, was the implication of *In Dubious Battle* (1936) and *The Grapes of Wrath* (1939), generally considered to be his best books. The latter was a narrative, interrupted by prose poem interludes, of the migration of a dust bowl family to California. Their great discovery, symbolically set forth, was the necessity for co-operation between the poor and downtrodden for the betterment of the lot of men.

Lyric Fictionists.—One of the interesting developments in

fiction was a movement in the direction of poetry. The increased tendency to select details and to endow them with symbolic meaning, the tendency to set down the thought processes and emotions of the characters and the tendency to make use of rhythmical prose gave fiction more of a lyrical quality than it had had. In varied ways, Crane, Norris, Cabell, Dos Passos, Hemingway, Steinbeck and Faulkner all showed the trend—in passages, in short stories, even in entire novels.

Lyricism bulked increasingly in the writings of Willa Cather. *O Pioneers* (1913), *The Song of the Lark* (1915) and *My Antonia* (1918) contained poetic passages about the disappearing frontier and the creative efforts of frontier folk. *A Lost Lady* (1923) was elegaic in form, and *Death Comes for the Archbishop* (1927) was an exaltation of the past and of spiritual pioneering. Katherine Anne Porter, whose works took the form of novelettes, wrote more in the style of the metaphysical poets. Her use of the stream-of-consciousness method in *Flowering Judas* (1930) and *Pale Horse, Pale Rider* (1939) had the complexity, the irony and the symbolic sophistication characteristic of this group.

Another leading poetic fictionist was Thomas Wolfe, the author of four large novels which in effect were one long lyrical recording of the author's life—of his strivings, his thoughts and his feelings turned into fiction. *Look Homeward, Angel* (1929), *Of Time and the River* (1935), *The Web and the Rock* (1939) and *You Can't Go Home Again* (1940) dealt with a figure much like Wolfe—his youth in the south, his young manhood in the north and his eternal search to fulfil a vision. The memories of the author of details of his past and his contemplations upon the significances and meanings of his experiences were set forth in prose reminiscent of Walt Whitman's poetry. The books, despite their chaotic qualities (or perhaps because of them) were essentially lyrical achievements.

Criticism.—Some historians, looking back over the first half of the 20th century, were inclined to think that it was particularly noteworthy for its achievements in literary criticism. Beyond doubt, it was true that criticism thrived as it had not for several generations, that it was an important influence on the shaping of literature and that it quickened the perceptions of readers.

The period began with a battle between a group who called themselves the Humanists—a group which stood for the older values in judging literature—and a group who urged that old standards be overthrown and new ones adopted. The Humanists, allied in some ways with the earlier Brahmin critics of New England, were led by Irving Babbitt, Harvard university professor whose scholarly books included *The New Laokoön* (1910), *Rousseau and Romanticism* (1919), *Democracy and Leadership* (1924) and *On Being Creative* (1932). In these books and in vigorous essays Babbitt preached his belief that man has a tendency toward the good, the true and the beautiful and a contrary tendency toward evil. The application of this scheme was that modern writers with their tendency toward naturalism—the base in man's nature—were a vicious influence. Such associates of Babbitt as Paul Elmer More (1864-1937), Norman Foerster (1887-) and Stuart Sherman (1881-1926) upheld this claim. The leader of the opposition was the pugnacious H. L. Mencken, who doubted that the values of the Humanists existed and who claimed that, regardless, the duty of writers was to present "the unvarnished truth" about life. His magazine articles and books of *Prejudices* (1919-27) shouted this claim, as did the writings of his associates, a number of figures of lesser fame. In the end, the results were the liberation of literature from a number of ancient restrictions and the progress of naturalism.

Socio-Literary Critics.—In this period of social change, it was natural for a number of critics to consider literature in its relationships to society and to politics. Their study took many forms, but consistently this group judged books: (1) as reflections of society; or (2) as expressions of social truth. Van Wyck Brooks and V. L. Parrington illustrated the two chief approaches. Brooks, who wrote numerous studies which embodied such an interest, in *America's Coming of Age* (1915) and *The Ordeal of Mark Twain* (1920) scolded the U.S. public for making it all

but impossible for an author to realize his genius fully. Later books by him presented rather different pictures, but developed from the same interest: *The Flowering of New England* (1936), *New England: Indian Summer* (1940), *The World of Washington Irving* (1944) and *The Times of Melville and Whitman* (1947) showed how in the past many authors had expressed their time and their locality. Parrington, in *Main Currents in American Thought* (1927-30) re-evaluated American literature in terms of its expression of the truths of Jeffersonian democracy.

The growth of Marxian influence upon thinking in the 1920s and 1930s was shown in several books. V. F. Calverton set forth the general principles of Marxian evaluations of literature in *The Newer Spirit* (1925), and in *The Liberation of American Literature* (1932) he judged literary figures on the basis of their representation of life and their implementation of the rise of the proletariat. Granville Hicks's *The Great Tradition* (1933) applied similar yardsticks. Many writers for a time followed the same lines of thinking, but beginning in 1939, as enthusiasm for communism waned, many (including Hicks) renounced the dogmas of the party. Some critics, however, found that some Marxian suggestions for critical procedures could be adapted and amended so as to be of service. Two outstanding critics in this group were Edmund Wilson (1895-) and Kenneth Burke (1897-).

Moral-Aesthetic Critics.—But Wilson and Burke, like many critics of the time, were interested in other matters than the relationships between literature and society; they were interested in both analyzing and evaluating literary creations. In a sense, they, like other moral-aesthetic critics, were eager to see in detail how a literary work was constructed; but they were equally eager to assess the sensitivity which the literary work embodied. Morton D. Zabel (1901-), himself a leading critic and scholar of modern criticism, suggested that Henry James had aptly formulated the aim of this group when he said, "The critic's judgment, being in the best analysis an estimate of the artist's quality of mind, is at once moral and aesthetic." The group was distinguished, as a result, for its close attention to the creative process involved in a work and also for its care in ranking the work.

As in poetry, T. S. Eliot here proved a leader. In essays and books; e.g., *The Use of Poetry and the Use of Criticism* (1933), he subjected writings and writers to careful analyses, and developed the thesis that "the 'greatness' of literature cannot be determined solely by literary standards; though we must remember that whether it is literature or not can be determined only by literary standards." Others used various ways of discussing relationships between form and value—R. P. Blackmur in *The Double Agent* (1935), Allen Tate in *Reactionary Essays on Poetry and Ideas* (1936), John Crowe Ransom in *The World's Body* (1938), Yvor Winters in *Maule's Curse* (1938) and Cleanth Brooks in *The Well Wrought Urn* (1947). This new school greatly advanced ways of discussing literary structure; it also distinguished and applied contrasting methods of evaluation. Like other groups, it therefore did much to advance the understanding and appreciation of literature.

Post-World War II.—Following the end of World War II, readers tended to expect a renaissance in literature similar to the one which had followed World War I. Every new talent which rose was carefully scanned for new tendencies. Magazines published articles speculating upon the directions which literature would take, and some books; e.g., J. Donald Adams, *The Shape of Books to Come* (1944), offered predictions. No new trends or schools were clearly discernible, however, and so far as critics could see, radical changes were not occurring.

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(W. BL.)

Despite the emergence of publishing as a big business during World War II, and an increasing tendency to retail books with an assured popular appeal, the general level of competence was high. Most authors wrote in a vivid, colloquial style that was unpretentious but accurate. Most books moved rapidly without too great sacrifice of whatever depth the authors were able to penetrate. This was true even of the mystery stories circulating widely in the various pocket book series and of the many I-was-there books.

The field of social criticism was added to from three new avenues: semantics, anthropology and psychoanalysis. Semanticists such as S. I. Hayakawa, Stuart Chase and Wendell Johnson hoped to make people more aware of the merely verbal sources of many social misunderstandings. In anthropology, Ruth Benedict's *The Chrysanthemum and the Sword* (1946) was a notable attempt to analyze social conduct in a nonprimitive society, in this case Japan, while Margaret Meade's *Keep Your Powder Dry* (1942) applied a similarly objective rationality to civilization in the U.S. Among psychoanalysts, Karl Menninger and Karen Horney tried to show modern man how he could better sublimate his inherent irrationality.

No account of U.S. writing after the 1920s would be complete without mention of such unclassifiable writers as Henry Miller, Gertrude Stein and James Thurber. Thurber was most generally known as a humorist, but he was also a serious critic. The writings of Gertrude Stein came to be taken seriously by many, but the excessive difficulty in reading them often caused her to be dismissed as an eccentric. In similar fashion, Henry Miller was often dismissed as a pornographer but many readers and critics found a special appeal in the eloquent savagery of his writing.

AMERICAN MEDICAL ASSOCIATION, a federation of 54 constituent state and territorial medical associations, was organized in 1847. The objects of the association are to promote the science and art of medicine and the betterment of public health. All policies of the association are established by its house of delegates which meets once each year at the annual session.

The delegates are chosen by the houses of delegates of the state medical societies which, in turn, are chosen by the various county medical societies. The affairs of the association are conducted by trustees representing various sections of the country, elected two each year by the house of delegates to serve a term of five years.

In the headquarters office of the association are departments which produce the publications of the association and also the secretariats of the various councils. The councils of the association include pharmacy and chemistry, foods, physical therapy, medical education and hospitals, industrial health, the judicial council and the council on scientific assembly. The bureaus of the association include those on legal medicine and legislation, health education, investigation, medical economics and exhibits. The association also maintains a chemical laboratory for the verification of the composition of pharmaceutical products, and a library which receives more than 1,500 medical periodicals.

Significant achievements of these councils include assembling of data concerning every doctor, hospital, medical school or institution for graduate medical education in the U.S. There are also more than 300,000 cards, cross-indexing every form of quackery and charlatanism. Available also are about 3,000 addresses on health for use on the radio. In the legal bureau are assembled all the laws and all higher court decisions in the individual states having to do with medical practice and public health.

Publications of the association include *The Journal of the American Medical Association* (weekly), *Archives of Internal Medicine*, *American Journal of Diseases of Children*, *Archives of Pathology and Laboratory Medicine*, *Archives of Neurology and Psychiatry*, *Archives of Dermatology and Syphilology*, *Archives of Surgery*, *Archives of Otolaryngology*, *Archives of Ophthalmology*, *Quarterly Cumulative Index Medicus* and *Hygeia*, the *Health Magazine* (for the general public). The headquarters are at Chicago, Ill.

(M. FI.; X.)

AMERICAN NEWSPAPER PUBLISHERS' ASSOCIATION, an organization of newspaper publishers of the United States and Canada. It comprises about 500 of the leading

newspapers. The purpose of the organization is to standardize and stabilize the newspaper publishing business. Its activities are divided into three different divisions: (1) traffic; (2) labour; and (3) mechanical. The traffic department deals with matters connected with the handling of freight. It employs an expert in transport who checks freight charges for the various members and assists in securing rebates where overcharges have been made. He also acts as a representative of the members in securing satisfactory service and proper adjustment of rates from various carriers. The labour department acts as the official representative with the labour unions in making contracts and adjusting differences. It also operates what is called the open shop department which may be called upon for help in acute labour troubles but the association claims that this "is by no means a strike-breaking organization."

(H. E. A.)

AMERICAN RADIATOR & STANDARD SANITARY CORPORATION, a corporation directly and through a group of subsidiary companies manufacturing and supplying mechanical equipment for buildings, was organized in 1929 as a Delaware corporation through a merger of the interests of the American Radiator Company and the Standard Sanitary Manufacturing Company. Together, these two companies have manufactured more than half the heating and plumbing equipment in existence in the world.

The American Radiator Company, manufacturers of heating and air conditioning equipment, was formed in 1892, by a merger of the Pierce Steam Heating Company, established in 1872, with the Michigan Radiator and Iron Company and the Detroit Radiator Company. The Standard Sanitary Manufacturing Company, manufacturers of plumbing fixtures, was organized in 1899 by merger of the Standard Manufacturing Company, formed in 1883, with six other companies, the Ahrens & Ott Manufacturing Company, Dawes and Myler, Buick and Sherwood Manufacturing Company, Vollrath Manufacturing Company, Pennsylvania Bath Tub Company, and Cribben and Sexton. Both American Radiator Company and Standard Sanitary Manufacturing Company were dissolved on Jan. 31, 1939, and their assets taken over directly by American Radiator & Standard Sanitary Corporation.

Subsidiary companies include American Blower Corporation, Canadian Sirocco Company, Ltd., C. F. Church Manufacturing Company, Detroit Lubricator Company, Dominion Radiator & Boiler Company, Ltd., Heating & Plumbing Finance Corporation, Kewanee Boiler Corporation, Ross Heater & Manufacturing Company, Inc., Standard Air Conditioning, Inc., Standard Sanitary Manufacturing Company, Ltd., and Standard Sanitary Manufacturing Company of Mexico, S. A., in addition to 11 affiliates in European countries.

Factories maintained by the Corporation and its subsidiaries in the United States and Canada number 37, with 16 plants in European countries. Sales branches are maintained in 82 American and Canadian cities, and in 18 principal European cities. Products of the companies include heating, plumbing, and air conditioning equipment and special industrial equipment.

(H. M. R.E.)

AMERICAN RAILS, a term used on the London Stock Exchange to describe the stock and bonds of the United States railways, which are dealt in by a distinct market. The shares and bonds of American railroads are issued in a way which almost constitutes them bearer securities, for they bear a transfer form on their backs. (See STOCK EXCHANGE.)

AMERICAN RAILWAY EXPRESS, THE: see RAILWAY EXPRESS AGENCY, INC., THE.

AMERICAN REVOLUTION, THE (1775-1781), known also as the American War of Independence. This war, by which the United States definitely separated themselves from the British connection, began with the affair of Lexington in Massachusetts, on April 19, 1775, and was virtually ended by the capitulation of Cornwallis at Yorktown, Va., on Oct. 19, 1781. In this article the progress of the war itself is alone considered, its political side being treated under UNITED STATES: History. From a military standpoint as well as politically it was a conspicuous and instructive conflict. It was conspicuous as being the most famous struggle in history where colonial dependencies defeated

their mighty parent state, though the powerful aid of France, Spain and Holland must never be forgotten. It was instructive as presenting exceptional conditions and consequent errors in the attempt to break down the revolt. The reasons for Great Britain's failure appear in the progress of the war, which assumed two distinct stages: operations in the north, followed by operations in the south. In point of time and energy military activity was



AFTER THE PAINTING, "THE DAWN OF LIBERTY," BY COURTESY OF THE LEXINGTON (MASS.) HISTORICAL SOCIETY

THE FIRST ARMED CONFLICT OF THE REVOLUTION, A SKIRMISH AT LEXINGTON ON APRIL 19, 1775, BETWEEN THE "MINUTEMEN" UNDER CAPTAIN JOHN PARKER AND BRITISH REGULARS UNDER MAJOR JOHN PITCAIRN

about equally divided between these two fields. As the naval operations in connection with the war have a European interest as well, they are dealt with in a separate section.

Land Operations.—To strike at the rebellion first in the north was natural and inevitable. To King George and his ministry, Massachusetts was the hotbed of disloyalty, the head and front of opposition to their colonial policy, and there coercion should begin. It was also a convenient point for a prompt display of authority, as the town of Boston was the headquarters of Gen. Gage, recently appointed royal governor of Massachusetts and commander of the king's troops in North America. He had with him four regiments of regulars, the initial force with which to overawe the restless and defiant population in his vicinity. While Gage is to be credited with advising his government that not less than 20,000 men would be necessary for the work in hand, he proceeded after some delay to suppress warlike preparations near Boston. His first determined effort brought about the skirmish of April 19, 1775 (see LEXINGTON), in which a detachment sent to seize some military stores collected at Concord suffered heavily at Lexington, Concord and other places, at the hands of the surrounding militia. This encounter roused the New England colonies, and in a few days some 16,000 of their townsmen marched in small bands upon Boston to protest against and resist further incursions; and in this irregular body we have the nucleus of the colonial forces which carried the war through. A noteworthy incident of the Lexington affair, and characteristic of the attitude which the provincials had maintained and continued to maintain for another year, was the official representation to the king that the regulars were the first to fire, and that the colonials returned the fire and fought through the day in strict defence of their rights and homes as Englishmen. Who actually fired the first shot, no man knows. They repeated their professions of loyalty to his majesty and the principles of the English constitution. Conscious, nevertheless, that a struggle impended, they instantly sent word to all the other colonies, whose whig elements sympathetically responded to the alarm. The war had opened.

The home government extended its precautions and preparations. General (Sir) William Howe, who succeeded Gage in the chief command in October, and Gens. (Sir) Henry Clinton and John Burgoyne were sent out at once with reinforcements. Cornwallis followed later. These four generals were identified with the conduct of the principal operations on the side of the British. The force at Boston was increased. The American Congress at Philadelphia, acting for the 13 colonies, voted general defensive

measures, called out troops and appointed George Washington of Virginia commander-in-chief. Before he reached the camp forming around Boston, a second and more important collision took place. On June 17, 1775, occurred the battle of Bunker Hill (*q.v.*), in which, although victorious, the British suffered heavily, losing one-third of their force in storming the hastily constructed lines of the "rebels." In moral effect the battle proved anything but a defeat to the Americans, who now drew a cordon of works around Boston, hemming Howe's army in a contracted, and, as it proved, untenable, position. On July 3, Washington took command of the American army at Cambridge and proceeded with what is known as the "siege of Boston," which was marked by no special incident, and closed with the American seizure of Dorchester Heights and the evacuation of the town by the British on March 17, 1776, Howe sailing away to Halifax, Nova Scotia. While the main interest centred at this point, the year 1775 was marked by two enterprises elsewhere. Fort Ticonderoga, the key to the passage of Lakes George and Champlain to Canada, was surprised and taken on May 10 by a small band under Col. Ethan Allen, while Col. Benedict Arnold headed an expedition through the Maine woods to effect the capture of Quebec, where Sir Guy Carleton commanded. Arnold joined Gen. Richard Montgomery, who was already near the city, and the combined force assaulted Quebec on Dec. 31, only to meet with complete defeat. Montgomery was killed and many of his men taken prisoners. Demonstrations against Canada were soon discontinued, Arnold drawing off the remnant of his army in May 1776.

The events of 1775, though partly favourable to America, were but a prelude to the real struggle to come. For the campaign of 1776 both sides made extensive preparations. To the home government the purely military problem, although assuming larger dimensions and more difficulties, still seemed to admit of a simple solution, namely, to strike hard where the rebellion was most active and capable of the longest resistance. Defeated there, it would quickly dissipate in all quarters. As much more than one-half of the population and resources of the colonists lay north of Chesapeake Bay—New England alone having an estimated population of over 700,000 persons—it was only a question as to what point in this area should be made the future base of operations. Largely upon the representations of Howe, Burgoyne and others, it was determined to shift the field from Boston to New York city, from there to hold the line of the Hudson river in co-operation with a force to move down from Canada under Carleton and Burgoyne, and thus effectually to isolate New England.

Upon this plan the new campaign opened in June, 1776. Howe, heavily reinforced from home, sailed on June 10 from Halifax

directed movements upon the American left. On Aug. 22 he crossed the Narrows to the Long Island shore with 15,000 troops, increasing the number to 20,000 on the 25th, and on the 27th surprised the Americans, driving them into their Brooklyn works and inflicting a loss of about 1,400 men. Among the prisoners were Gens. J. Sullivan and W. Alexander. (*See LONG ISLAND.*) Howe has been criticized, rightly or wrongly, for failing to make



AFTER A CONTEMPORARY SKETCH ATTRIBUTED TO LORD RAWDON, ENGINEER OFFICER ON CORNWALLIS'S STAFF. BY COURTESY OF THE N.Y. PUBLIC LIBRARY

THE LANDING OF THE BRITISH FORCES IN NEW JERSEY

After the capture of Ft. Washington in New York the British crossed the Hudson under the Palisades and pushed across New Jersey with designs on Philadelphia

full use of his victory. Washington skilfully evacuated his Brooklyn lines on the night of the 29th, and in a measure relieved the depression which the defeat had produced in his army. On Sept. 15, Howe crossed the East river above the city, captured 300 of the militia defending the lines and occupied the city. Washington had withdrawn his main army to the upper part of the island. A skirmish, fought the next day, opposite the west front of the present Columbia university, and known as the affair of Harlem Heights, cost the British a loss of 70 of their light infantry. Delaying until Oct. 12, Howe again moved forward by water into Westchester county, and marching toward White Plains forced another retreat on Washington. In the fight on Chatterton Hill at the Plains, on Oct. 28, an American brigade was defeated. Instead of pressing Washington further, Howe then returned to Manhattan Island, and, Nov. 16, captured Fort Washington with nearly 3,000 prisoners. This was the heaviest blow to the Americans throughout the war in the north. The British then pushed down through New Jersey with designs on Philadelphia. Washington, still retreating with a constantly diminishing force, suddenly turned upon Lieut.-Col. Rall's advanced corps of Hessians at Trenton on Dec. 26, and captured nearly 1,000 prisoners. This brilliant exploit was followed by another on Jan. 3, when Washington, again crossing the Delaware, outmarched Cornwallis at Trenton, and marching to his rear defeated three British regiments and three companies of light cavalry at Princeton, New Jersey. Marching on to Morristown, Washington encamped there on the flank of the British advance in New Jersey, thus ending the first campaign fought on the new issue of American Independence, which had been declared on July 4, 1776.

While these closing successes inspired the Americans, it was undeniable that the campaign had gone heavily against them. Having raised a permanent force for the war called the Continental Line, they awaited further operations of the enemy. Following up the occupation of New York, Howe proceeded in 1777 to capture Philadelphia. Complete success again crowned his movements. Taking his army by sea from New York to the head of the Chesapeake, he marched up into Pennsylvania, whither Washington had repaired to watch him, and on Sept. 26 entered the city. The Americans attempted to check the advance of the British at the river Brandywine, where an action occurred on the 11th resulting in their defeat (*see BRANDYWINE*); and on Oct. 4, Washington directed a well-planned attack upon the enemy's



AFTER A SKETCH BY AN ENGLISH OFFICER ABOARD ONE OF THE FLEET. BY COURTESY OF THE N.Y. PUBLIC LIBRARY

THE BRITISH FLEET UNDER ADMIRAL HOWE AT ANCHOR IN NEW YORK HARBOUR JUST AFTER THE BATTLE OF LONG ISLAND

to New York and on July 5 encamped on Staten Island. Washington, anticipating this move, had already marched from Boston and fortified the city. His left flank was thrown across the East river beyond the village of Brooklyn, while his front and right on the harbour and North or Hudson river were open to a combined naval and military attack. The position was untenable since the British absolutely dominated the waters about Manhattan. Howe drove Washington out of New York, and forced the abandonment of the whole of Manhattan Island by three well-

camp at Germantown on the outskirts of the city, but failed of success. (See GERMANTOWN.)

Howe's victorious progress in Pennsylvania was neutralized by disasters farther north. Indeed his whole expedition to seize "the enemy's capital" was nothing less than an abandonment of an expedition from the north with which he was expected to co-operate. Clinton, whom he left at New York, protested against



FROM "ANNALS OF PHILADELPHIA," 1830

BRITISH BARRACKS AT PHILADELPHIA DURING HOWE'S OCCUPATION

this folly to the last. Lord George Germain in England was only in part to blame. Burgoyne marched from Canada in June 1777, with a strong expeditionary force, to occupy Albany and put himself in touch with Howe who was expected to come up the Hudson. Driving the Americans under Gen. Arthur St. Clair out of Ticonderoga, and making his way through the deep woods with difficulty, he reached the Hudson at Fort Edward on July 30. Gen. Philip Schuyler, commanding the Americans in that quarter, retreated to Stillwater, 30m. above Albany, barricading the roads and impeding Burgoyne's progress. Unjustified dissatisfaction with his conduct led Congress to replace Philip Schuyler by Gen. Gates. On Aug. 13, Burgoyne despatched a force to Bennington, Vt., under the German colonel Friedrich Baum, to capture stores and overawe the country. On the 16th Baum was attacked by Gen. John Stark with the militia from the surrounding country, and was overwhelmed. Col. Breyman, marching to his relief, was also routed. The misfortune cost the British 1,000 men. Equally unfortunate was the fate of an expedition sent under Col. Barry St. Leger to co-operate with Burgoyne by way of the Mohawk Valley. On Aug. 16 he was met at Oriskany by Gen. Nicholas Herkimer and forced to retreat. Despite these disasters Burgoyne pushed south to Stillwater, where he was defeated by Gates's improvised army of continentals and militia in two battles on Sept. 10 (Freeman's Farm) and Oct. 7 (Bemis's Height). On the 17th he was forced to surrender. (See SARATOGA, BATTLES OF.) This disaster was followed by the alliance between America and France in 1778, and later by the addition of Spain and Holland to England's enemies—events of far-reaching importance.

A noteworthy movement, in 1778-79, was the expedition of George Rogers Clark, under the authority of the State of Virginia, against the British posts in the north-west. With a company of volunteers Clark captured Kaskaskia, the chief post in the Illinois country, on July 4, 1778, and later secured the submission of Vincennes, which, however, was recaptured by Gen. Henry Hamilton, the British commander at Detroit. In the spring of 1779 Clark raised another force, and recaptured Vincennes from Hamilton. This expedition did much to free the frontier from Indian raids, gave the Americans a hold upon the north-west, of which their diplomats probably took advantage in the peace negotiations, and later, by giving the States a community of interest in the western lands, greatly promoted the idea of union.

In 1778 Sir Henry Clinton succeeded Howe in the chief command in America. With fewer resources than his predecessor, he could accomplish practically nothing in the north. In June, 1778, he evacuated Philadelphia, with the intention of concentrating his force at New York. Washington, who had passed the winter at Valley Forge, overtook him at Monmouth, N.J., and in an action on June 28 both armies suffered about equal loss. Thereafter (except in the winter of 1779, at Morristown) Wash-

ington made West Point on the Hudson the headquarters of his army, but Clinton avowed himself too weak to attack him there. In 1779 he attempted to draw Washington out of the highlands, with the result that in the manoeuvres he lost the garrison at Stony Point, 700 strong, the position being stormed by Wayne with the American light infantry on July 16. During the summer Gen. J. Sullivan marched with a large force against the Indians (all the Iroquois tribes except the Oneidas and part of the Tuscaroras siding with the British during the war) and against the Loyalists of western New York, who had been committing great depredations along the frontier; and on Aug. 29 he inflicted a crushing defeat upon them at Newtown, on the site of the present Elmira. In addition several Indian villages and the crops of the Indians were destroyed in the lake region of western New York.

Meanwhile the co-operation of the French became active. In July Count Rochambeau arrived at Newport, R.I., occupied by the British from 1776 to the close of 1779. An unsuccessful attempt was made to drive them out in 1778 by the Americans assisted by the French admiral d'Estaing and a French corps. The year 1780 is also marked by the treason of Gen. Benedict Arnold (*q.v.*), and the consequent execution of Major André. Minor battles and skirmishes occurred until in Aug. 1781 Washington undertook the project of a combined American-French attack on Cornwallis at Yorktown, Va., the success of which was decisive of the war (*see p. 801*).

Campaign in Georgia.—The inadequate results of the British campaigns against the northern colonies in 1776 and 1777 led the home Government to turn its attention to the weaker colonies in the south. Operations in the north were not to cease, but a powerful diversion was now to be undertaken in the south with a view to the complete conquest of that section. Success there would facilitate further movements in the north. An isolated



AFTER A PAINTING BY HOWARD PYLE IN WILSON'S "HISTORY OF THE AMERICAN PEOPLE," BY COURTESY OF HARPER AND BROTHERS

WASHINGTON AND STEUBEN AT THE AMERICAN ENCAMPMENT AT VALLEY FORGE WHERE WASHINGTON, USING STEUBEN AS MILITARY INSTRUCTOR, PREPARED HIS ARMY FOR THE FINAL CAMPAIGNS

attack on Charleston, S.C., had been made by Sir Henry Clinton and Sir Peter Parker as early as June 1776, but this was foiled by the spirited resistance of Gen. William Moultrie; after 1778 the southern attempts, stimulated in part by the activity of the French in the West Indies, were vigorously sustained. On Dec. 29 of this year Col. Archibald Campbell with an expeditionary corps of 3,500 men from Clinton's army in New York, captured Savannah, Ga., defeating the American force under Gen. Robert Howe. In the following month he pushed into the interior and occupied Augusta. Gen. Benjamin Lincoln, succeeding Howe,

undertook to drive the British out of Georgia, but Gen. Augustine Prevost, who had commanded in Florida, moved up and compelled Lincoln to retire to Charleston. Prevost, making Savannah his headquarters, controlled Georgia. In Sept. 1779 he was besieged by Lincoln in conjunction with a French naval and military force under Admiral d'Estaing, but successfully repelled an assault (Oct. 9), and Lincoln again fell back to Charleston. In this assault Count Casimir Pulaski, on the American side, was mortally wounded.

The prestige thus won by the British in the south in 1779 was immensely increased in the following year, when they victoriously swept up through South and North Carolina. Failing to achieve any advantage in the north in 1779, Sir Henry Clinton, under instructions from his government, himself headed a combined military and naval expedition southward. He evacuated Newport, R.I. (Oct. 25), left New York in command of the German general Wilhelm von Knyphausen, and in December sailed with 8,500 men to join Prevost at Savannah. Cornwallis accompanied him, and later Lord Rawdon joined him with an additional force. Marching upon Charleston, Clinton cut off the city from relief, and after a brief siege compelled Lincoln to surrender on May 12. (See CHARLESTON.) The loss of this place and of the 5,000 troops included in the surrender was a serious blow to the American cause. The apparent submission of South Carolina followed. In June Clinton returned to New York, leaving Cornwallis in command, with instructions to reduce North Carolina also. Meanwhile an active and bitter partisan warfare opened. The British advance had been marked by more than the usual destruction of war; the Loyalists rose to arms; the Whig population scattered and without much organization formed groups of riflemen and mounted troopers to harass the enemy. Little mercy was shown on either side. The dashing rider, Col. Banastre Tarleton, cut to pieces (April 14, 1780) a detachment of Lincoln's cavalry, and followed it up by practically destroying Buford's Virginia regiment near the North Carolina border. On the other hand, daring and skilful leaders such as Francis Marion and Thomas Sumter kept the spirit of resistance alive by their sudden attacks and surprises of British outposts. Hanging Rock, Ninety-Six, Rocky Mount and other affairs brought their prowess and devotion into notice. By the month of Aug. 1780, with the main British force encamped near the North Carolina line, the field seemed clear for the next advance.

The threatening situation in the Carolinas alarmed Congress and Washington and measures were taken to protect the distressed section. Before Cornwallis could be brought to bay he was faced successively by four antagonists—Gens. Gates, Greene, Lafayette and Washington. They found in him the most capable and dangerous opponent of the war. Greene called him "the modern Hannibal." With Lincoln's surrender of nearly all the Continental soldiers in the south, a new force had to be supplied to meet the British veterans. Two thousand men, mainly the Maryland line, were hurried down from Washington's camp under Johann de Kalb; Virginia and North Carolina put new men into the field, and the entire force was placed under command of Gen. Gates. Gates marched towards Camden, S.C., and on Aug. 16 encountered Cornwallis near that place. Each army by a night march attempted to surprise the other, but the British tactics prevailed, and Gates was utterly routed. The reputation he had won at Saratoga was ruined on the occasion by over-confidence and incompetence; De Kalb was killed in the action. Gen. Greene, standing next to Washington as the ablest and most trusted officer of the Revolution, succeeded Gates. Cornwallis marched leisurely into North Carolina, but before meeting Greene some months later he suffered the loss of two detachments sent at intervals to disperse various partisan corps of the Americans. On Oct. 7, 1780, a force of 1,100 men under Major Patrick Ferguson was surrounded at King's Mountain, S.C., near the North Carolina line, by bands of riflemen under Cols. Isaac Shelby, James Williams, William Campbell and others, and after a desperate fight on the wooded and rocky slopes, surrendered. Ferguson himself was killed. On Jan. 17, 1781, Gen. Daniel Morgan was attacked at Cowpens, south-west of King's Mountain, by Col. Tarleton with

his legion. Both were leaders of repute, and a most stirring action occurred in which Morgan, with Col. William Washington leading his cavalry, practically destroyed Tarleton's corps. Despite the weakening his army suffered by these losses, Cornwallis marched rapidly through North Carolina, giving Greene a hard chase nearly to the Virginia line. On March 15 the two armies met at Guilford court house (near the present Greensboro, N.C.) and a virtually drawn battle was fought. The British, by holding their ground with their accustomed tenacity when engaged with superior numbers, were tactically victors, but were further weakened by a loss of nearly 600 men. Greene, cautiously avoiding another Camden, retreated with his forces intact. With his small army, less than 2,000 strong, Cornwallis declined to follow Greene into the back country, and retiring to Hillsborough, N.C., raised the royal standard, offered protection to the inhabitants, and for the moment appeared to be master of Georgia and the two Carolinas. In a few weeks, however, he abandoned the heart of the State and marched to the coast at Wilmington, N.C., to recruit and refit his command.

At Wilmington the British general faced a serious problem, the solution of which upon his own responsibility unexpectedly led to the close of the war within seven months. Instead of remaining in Carolina he determined to march into Virginia, justifying the move on the ground that until Virginia was reduced he could not firmly hold the more southern States he had just overrun. This decision was subsequently sharply criticized by Clinton as unilitary, and as having been made contrary to his instructions. To Cornwallis he wrote in May: "Had you intimated the probability of your intention, I should certainly have endeavoured to stop you, as I did then as well as now consider such a move likely to be dangerous to our interests in the Southern Colonies." The danger lay in the suddenly changed situation in that direction; as Gen. Greene, instead of following Cornwallis to the coast, boldly pushed down towards Camden and Charleston, S.C., with a view to drawing his antagonist after him to the points where he was the year before, as well as to driving back Lord Rawdon, whom Cornwallis had left in that field. In his main object, the recovery of the southern States, Greene succeeded by the close of the year; but not without hard fighting and repeated reverses. "We fight, get beaten, and fight again," were his words. On April 25, 1781, he was surprised in his camp at Hobkirk's Hill, near Camden, by Lord Rawdon and defeated, both sides suffering about an equal loss. On May 22 he attempted to storm the strong British post at Ninety-Six but was repulsed; and finally on Sept. 8 he fought the last battle of the war in the lower southern States at Eutaw Springs, S.C. In the first part of the action Greene was successful after a desperate conflict; in the pursuit, however, the Americans failed to dislodge the British from a stone house which they held, and their severe loss in both engagements was over 500 men. The British lost about 1,000, one-half of whom were prisoners. Better success attended the American partisan operations directed by Greene and conducted by Marion, Sumter, Andrew Pickens, Henry Lee and William Washington. They fell upon isolated British posts established to protect the Loyalist population, and generally captured or broke them up. Rawdon found himself unable with his diminishing force to cover the country beyond Charleston; and he fell back to that place, leaving the situation in the south as it had been in the early part of 1780. On the American side, Greene was hailed as the deliverer of that section.

Virginia Campaign.—Cornwallis, meantime, pursued his Virginia project. Leaving Wilmington, N.C., on April 25, 1781, he reached Petersburg on May 20. There he found British detachments, 2,000 strong, composed of troops whom Clinton had sent down separately under Gens. Benedict Arnold and William Phillips to establish a base on the Chesapeake, as a diversion in favour of the operations of Cornwallis in the Carolinas. Virginia at the moment presented a clear field to the British, and they overran the State as far north as Fredericksburg and west to Charlottesville. At the latter place Jefferson, governor of the State, barely escaped capture by Tarleton's men. A small American force under Lafayette, whom Wayne reinforced during the summer, partially

checked the enemy. At Green Spring, near Jamestown Island, Lafayette boldly attacked his antagonist on July 6, but had to save himself by a hasty retreat. Early in August Cornwallis retired to Yorktown to rest and await developments. There he fortified himself, and remained until the American-French military and naval combination, referred to on p. 799, appeared and compelled his surrender. (See YORKTOWN.)

With this event war operations ceased. Preliminary articles of peace, signed on Nov. 30, 1782, were followed by a definitive treaty concluded on Sept. 3, 1783. Charleston, S.C., was evacuated late in 1782; New York on Nov. 25, 1783. The reasons of Great Britain's misfortunes and failure may be summarized as follows: Misconception by the home Government of the temper and reserve strength of her colonists, a population mainly of good English blood and instincts; disbelief at the outset in the probability of a protracted struggle covering the immense territory in America; consequent failure to despatch sufficient forces to the field; the safe and Fabian generalship of Washington; and finally, most decisive of all, the French alliance and European combinations by which at the close of the conflict Britain was without a friend or ally on the continent.

BIBLIOGRAPHY.—Though now sadly out of date, the most exhaustive reference work for this period is vol. vi. of Winsor's *Narrative and Critical History of America* (Boston, 1887). Its nine chapters, prepared by different writers, give a complete review of the struggle, both military and naval, and each closes with numerous illustrative notes, editorial criticisms and a full list of authorities. The volume is interspersed, far more extensively and richly than any other treatise on the war, with reproductions of contemporary plans, maps, documents, portraits and prints. Supplementing Winsor and bringing the material down to recent date is C. H. Van Tyne's *American Revolution* (Harper's "Am. Nation" Series, 1905), chap. xviii., on bibliographical aids and authorities. General histories of the war are mainly of American authorship, such as: George Bancroft's *History of the United States* (Boston, 1883-85) which, in spite of minor errors of fact and judgment, will remain standard; J. Fiske's *American Revolution* (Boston, 1891); Carrington's *Battles of the American Revolution* (1876) is a critical study by a military officer; B. J. Lossing's *Pictorial Field Book of the Revolution* (1850-59) is not always accurate, but preserves local traditions and details. Monographs on single events or campaigns abound: A. French, *The Day of Concord and Lexington* (1925); H. Murdock, *Bunker Hill*; Dawson's papers on Ticonderoga, "Storming of Stony Point," etc. (1866-); Johnston's "Campaign of 1776 around New York" (L.I. Hist. Soc., 1877), "Yorktown Campaign" (1881), etc.; Sargent's *Life of Major John André* (Boston, 1861), one of the best Revolutionary biographies; Gen. William Striker's *Battles of Trenton and Princeton* (Boston, 1898); and *The Battle of Monmouth*; Justin Smith, *Struggle for the 14th Colony* (1907); and others mentioned in Winsor, Van Tyne and Channing. English works are Lord Mahon's *History of England*, vol. vi.; Sir George O. Trevelyan's *American Revolution*, a new study of cabinet and parliamentary politics of the period, with review of the military events; Hon. J. W. Fortescue, *History of the British Army*, vol. iii. (1902); H. Belcher, *The First American War*, Vol. I, ii.; F. J. Huddleston, *Gentleman Johnny Burgoyne*; H. Nickerson, *The Turning Point of the Revolution*; Lecky, *A History of England in the 18th Century* (1903); Burgoyne's *State of the Expedition from Canada in 1777* (1780). The naval warfare is best studied in G. W. Allen, *A Naval History of the American Revolution* (1913); C. O. Paulinus, *Navy of the American Revolution* (1906); Captain Mahan, *Major Operations of the Navies in the War of Independence* (1913).

(H. P. J.; C. H. VAN T.)

THE WAR AT SEA

The largely economic origin of the American Revolution took on a prominently maritime aspect in its early phases. Heavily in debt from recent wars, England was also faced with a constantly increasing demand for overseas markets and marine expansion, on account of the "industrial revolution" through which she was then passing. Beginning in 1764 a series of laws were passed by parliament having in view both the raising of revenue through taxing the sea-borne imports of the colonies, and the favouring of English maritime trade by discriminations against colonial shipping. Laws looking solely to the latter object had been in existence for many years, but custom had given them little attention, and a large prosperous colonial merchant marine had grown up on a technically illegal trade and had become an important element in the economic structure of the colonies. Consequently the enforcement of these "Navigation Acts" was the cause of much hardship

and resentment in America. As early as 1764 a British schooner so engaged was fired on in Rhode Island waters. In 1769 the sloop "Liberty," similarly employed, was seized and burnt at Newport. Such incidents became more common as British coercive measures increased, and when war finally broke there was a popular uprising on the sea quite comparable to that on land.

The onset of the Revolution found the colonies with no naval forces whatever, but with a large maritime population, and many merchant vessels commonly employed as the principal means of transport for both domestic and foreign trade. This merchant service was familiar not only with the sea, but also with warfare. Colonial ships and seamen had taken a prominent part in the large naval expeditions against Cartagena and Louisburg, had engaged in privateering during the more recent French war, and even during peace had habitually gone armed as a protection against pirates. In 1775 it was therefore natural that considerable numbers of colonial merchant vessels should turn to privateering; a general practice which was continued on a large scale until the close of the war, under legal authorization of individual colonies and of the Continental Congress. Records are incomplete but indicate that well over 2,000 private armed vessels were so employed during the course of the war, carrying upwards of 18,000 guns and 70,000 men. In addition, several of the colonies organized "State" navies which also engaged in preying upon hostile commerce. These operations were on such a scale that they must be regarded as a primary American military effort of the war. Together with the operations of a few "Continental" vessels they constituted the only sustained offensive pressure brought to bear by the Americans which materially affected the attitude of the British people towards peace. Such injury was done British commerce as to increase insurance rates to unprecedented figures, to seriously reduce available sources of revenue and to alarm the sea-coast population.

In its military-naval aspect the war followed two distinct phases; the first ending when France allied herself with the colonies in 1778, until which time Britain had no foreign enemy, and was free to concentrate her whole strength against the Americans. In the second phase England ultimately had to contend against the fleets of France, Spain and Holland, and her consequent inability to meet the naval necessities in American waters was a major influence in the final and decisive campaign ending at Yorktown. With the large navy available during the first three years of the Revolution it was repeatedly urged by Viscount Barrington, the British secretary for war, that: "Conquest [of the colonies] by land is unnecessary when the country can be reduced first by distress, and then to obedience by our marine totally interrupting all commerce and fishery, and even seizing all ships in the ports with very little expense and less bloodshed." Instead of adopting such strategy the British naval forces were used primarily in direct support of army operations and in the protection of their own maritime commerce.

The pressing want of munitions for the Colonial army was the chief impulse in the creation of regular American naval forces. This need caused Benedict Arnold, formerly a sea captain, to march from the siege of Boston, and in association with Ethan Allen to make a surprise capture of the well-stocked stronghold of Ft. Ticonderoga on Lake Champlain, so early as May 10, 1775. The seemingly minor event had far-reaching results. Not only were munitions obtained, but the prompt seizure of all lake watercraft also gave to the colonies control of the only practicable line of communications from the St. Lawrence river to the Hudson valley. At first provoked by this overt act the Continental Congress at Philadelphia, then debating ways of forming a constitutional union with England, soon reversed its attitude, voted general defensive measures, and appointed George Washington commander-in-chief of the army. A few weeks after taking command of the Continental army besieging Boston, Washington organized a naval force to prey upon the British water communications of that port, and in this way essential munitions were obtained. In Oct. 1775 Congress voted funds for the first units of a small fleet of eight vessels which sailed from the Delaware on Feb. 17, 1776, under Commodore Esek Hopkins. The objective was Nassau

in the Bahama islands, where a quantity of powder was known to be stored. This was captured on March 3, and the valuable munitions taken in to New London. Meantime the British army under Howe had evacuated Boston and gone by sea to Halifax. Correctly estimating the future probabilities, Washington marched to New York and also provided for the defence of Lake Champlain. For the campaign of 1776 the British plan was to isolate New England by capturing and holding the line of the Hudson river. With this end in view, Howe, heavily reinforced, sailed in June for New York, while other forces undertook an advance via Lake Champlain. Here Arnold had retreated after an unsuccessful attack on Quebec, and had actively begun the construction of a fleet to retain control of the lake.

During the summer a British army of nearly 13,000 men advanced from Quebec to the lake but was compelled to halt until a sufficient naval force could be constructed to cope with Arnold's rapidly growing fleet. This they were able to do after some months through the assistance of artisans from their ships in the St. Lawrence river, and by reassembling on the lake a large vessel whose dismantled parts had been transported in small boats from Quebec. In a series of naval actions on Oct. 11, 12 and 13, Arnold's fleet of 15 vessels was destroyed. Meantime Howe had gained possession of the lower Hudson, but the season was now so late that the British command on Lake Champlain decided to abandon further operations until spring, and retreated into Canada. When in June of the following year Burgoyne renewed the advance from the north, Howe had shifted his operations by sea to the vicinity of Philadelphia, and Burgoyne was forced to surrender at Saratoga (Oct. 17, 1777) from lack of support. Thus had Arnold's fleet, by delaying the British army for nearly a year, contributed largely to the decisive battle of Saratoga which proved to be a turning point in the war.

Impressed by the evidence of American strength given at Saratoga, and wishing to recover her losses to England in previous wars, France entered into a treaty of alliance with the United States in Feb. 1778. The event marked the beginning of an entirely new phase in the war. Henceforth naval power was to be employed on a great scale and to affect vitally military operations in America, as well as the course of European history, and the fate of valuable possessions from the West Indies to the East Indies. Herein can be considered at any length only those events which bore directly on the American Revolution.

A French fleet under d'Estaing sailed from Toulon in April 1778, bound for America. Advance news of its coming caused a hasty evacuation of the Delaware by the British fleet then acting in support of the army occupying Philadelphia. Fearing to risk the loss of the army in the event of meeting a superior French fleet at sea, the British command decided to march the troops, bereft of their line of supply, by land to New York, where a junction with the fleet was again made. D'Estaing appeared off the port a few days later, but having missed the opportunity of a decisive victory in the Delaware, he sailed for Newport in accordance with an understanding made with Washington. While preparations were in progress at Newport for a joint attack by Americans and French upon the British garrison of 6,000 troops, the British fleet approached, having been reinforced from England. D'Estaing hastily abandoned the land operations and put to sea to meet them. A partial engagement ensued, followed by a gale which so damaged the ships as to persuade the French admiral to go to Boston for extensive repairs (Aug. 1778). On this account the American army before Newport was withdrawn. Meantime a second and more powerful French fleet had been fitted out at Brest with the object of indirectly assisting their overseas naval forces by holding the main strength of the British navy to its home waters. In July 1778 a large but indecisive fleet action was fought off Ushant. Under cover of these major operations Captain John Paul Jones of the "Continental Navy" with a small squadron based on French ports, carried on a series of raids against British coastal shipping.

At this period of history considerations of weather during the winter season usually caused the transfer of naval operations from the Western Hemisphere to the West Indies, which held the

further attraction of being the richest of the world's commercial regions in value of products. Therefore when d'Estaing sailed from Boston in Nov. 1778, his destination was the Caribbean sea, for which locality most of the British fleet in America also sailed on the same day. The latter took 5,000 troops with them, thus greatly reducing the land forces opposed to the Continental army. During the next four years the West Indies were the scene of a large-scale naval war, the forces on each side being often augmented from home, and in the case of the French fleet, by Spanish reinforcements. D'Estaing was unsuccessful off St. Lucia in two attacks (Dec. 1778) upon the main British fleet, but, while the latter was guarding a trade convoy, during the following summer, he captured St. Vincent and then Grenada where an indecisive naval action was fought upon the return of the British fleet (July 1779). Meantime in the autumn of 1778 the British had sent a small expedition from New York, under naval convoy, to Savannah, which place was taken. These operations were extended to the neighbourhood of Charleston during the following year, and attracted the attention of d'Estaing. Arriving off Savannah from the West Indies with his whole fleet in Aug. 1779, he failed in an attempt to retake the place. Nevertheless upon receiving news of the Savannah affair, the British Gen. Clinton at New York was so concerned over the safety of his diminished army in the north that he abandoned Newport in order to concentrate his forces against possible French attack.

The summer of 1779 also saw the ill-starred "Penobscot Expedition." A British military-naval force having occupied what is now Castine, Me., the Massachusetts government undertook to dislodge it. A fleet of 40 vessels including three of the Continental navy and 20 transports, in all carrying 300 guns and 3,000 men sailed from Boston and began its attack on the British position on July 25. Fighting continued afloat and ashore until Aug. 13, when a superior British naval squadron arrived from New York and put the Americans to rout.

John Paul Jones, operating from French bases with a small squadron, made a cruise around the British Isles from Aug. to Oct. 1779. Many prizes were taken and the British frigate "Serapis" was captured after a memorable duel with the American flagship "Bon Homme Richard." The success of these operations was greatly aided by the fact of the absence in distant waters of practically the whole naval strength of Great Britain, and by the operations in the English channel of a large combined French and Spanish fleet in support of a threatened invasion of England from France.

On the American coast the year 1780 saw the inception of the British policy of conquering the Carolinas which involved such a division of forces as to bring about the ultimate loss of the war. An army detachment escorted by naval forces was sent from New York and captured Charleston in May. These operations were placed in some jeopardy by the arrival of a French squadron with 6,000 troops at Newport in July, but this was offset by British naval reinforcements reaching New York a day later. The British operations in the Carolinas were also covered by the activity in the West Indies of a large naval force under Admiral Rodney, which had been recently sent out from England. Three indecisive actions were fought, near Martinique in April and May 1780, against the French fleet under Admiral Guichen, which was finally reinforced by a Spanish squadron.

Not meeting with the success which had been anticipated, Cornwallis, commanding the southern British army in America decided upon a movement into Virginia where naval support could be utilized to better advantage. Meantime on the James river, Benedict Arnold (then under British allegiance) had been ravaging the country, and at the request of Washington the French squadron at Newport had proceeded to the Chesapeake; but after an indecisive action with a British squadron (March 1781), had returned to Newport. Cornwallis joined Arnold on March 20, at Petersburg, with the intention of undertaking vigorous offensive operations in Virginia. But the commander-in-chief, Gen. Clinton, who was at New York, felt that the forces available were insufficient for such an undertaking, and ordered Cornwallis to intrench himself in a strong position which would control a fleet

anchorage. Cornwallis complied by moving to Yorktown, where he arrived on Aug. 22 with 7,000 troops. It should be observed here that England's ability to support her forces in America at this stage was seriously impaired by Holland joining the alliance against her. In Aug. 1781 a severe naval action was fought in the North sea between the Dutch and British fleets. England's naval forces were further involved in the defence of Gibraltar, Minorca and India.

The joint military-naval combination which brought about the surrender of Cornwallis and the virtual end of the war in America, was very unusual. It involved the timely concentration at Yorktown of widespread forces; a co-ordination of effort which was very difficult to accomplish with the means of communication and the slow mobility of that period. The most important element in the situation was naval control, since Cornwallis' supplies and reinforcements must come by sea and Washington's army near New York could not be moved with sufficient celerity to the critical area except by utilizing water transport on Chesapeake bay.

The co-operation of the main French fleet, which for several years had been operating against the British fleet in the West Indies, was essential, and its aid was requested by both Washington and Rochambeau. Admiral de Grasse concurred in the plan and sailed from Haiti on Aug. 25, 1781, with 28 ships of the line.

Gaining advance information of this move through intercepted messages, the British admiral also left the West Indies and was the first to reach the Chesapeake, but not being certain of de Grasse's destination, continued on to New York. Here it became evident from the southerly movements of the united armies of Washington and Rochambeau, that Yorktown was the main Franco-American objective, and Admiral Graves hastily sailed on Aug. 31 for that locality.

Meantime Admiral de Grasse had arrived in the Chesapeake and had stationed cruisers in the James river to prevent Cornwallis from escaping to the south. On Sept. 5 the British fleet of 19 ships of the line appeared off the Chesapeake entrance where it was partially defeated by 24 French ships present. Admiral Graves remained in the vicinity for the next seven days, still hoping for an opportunity to reach Yorktown and assist in its defence, but the French fleet, increased to a total of 36 ships of the line by the arrival of the Newport squadron, took up an intervening position inside the bay. On Sept. 13 Graves therefore departed for New York. The control of the Chesapeake being then undisputed, the allied troops were transported by water from the north to Williamsburg whence they marched to the investment of Yorktown. Here, with his sea communications completely severed, Cornwallis surrendered on Oct. 19, 1781, virtually ending the war on the American continent.

The French admiral, having rendered this vital service to his ally, now returned to the West Indies, whither he was followed by Hood. In Jan. and Feb. 1782 he conquered St. Christopher, in spite of the most determined opposition of the British. The next purpose of the French was to combine with the Spaniards for an attack on Jamaica. Sir George Rodney, having returned to his command with reinforcements, baffled this plan by a series of operations which culminated in the battle of April 12, 1782. This, combined with the success of the British in withstanding repeated naval attacks against Gibraltar, took the heart out of the French and Spaniards and made them ready for peace. After preliminary articles had been signed in Nov. 1782, the naval campaign between British and French squadrons in India continued until June 1783.

In retrospect the American Revolution is seen to have developed from small beginnings into one of the greatest naval wars in history. During its progress the early issues of colonial maritime rights and independence became subordinated in European eyes to that of the control of the then commercially very valuable West Indies, and other objects. The fleet operations which in a few weeks decided the fate of Yorktown, and of the American cause, were merely incidental to the vast naval campaign carried on over a period of five years in Caribbean, European and Indian waters.

BIBLIOGRAPHY.—Captain A. T. Mahan's, *The Major Operations of the Navies in the War of American Independence* (1913) is the most authoritative, comprehensive and impartial work available; Gardner W. Allen's *A Naval History of the American Revolution* (1913), is a careful and more detailed account of American naval operations. See also Henry Cabot Lodge, *The Story of the Revolution* (1898); Sir W. Laird Clowes, *The Royal Navy: A History* (1897-1903); and Louis Edouard Chevalier, *Histoire de la Marine française pendant la Guerre de l'Indépendance Américaine* (1877). — (D. W. K.)

AMERICAN'S CREED, a U.S. patriotic document, written in 1917 by William Tyler Page, clerk of the U.S. house of representatives. The document was adjudged to be the best brief summary of the political faith of the United States of America from among the several thousand entries submitted in a national citizens' creed contest. On April 3, 1918, the U.S. commissioner of education read the American's Creed in public for the first time before a session of the house of representatives, where it was formally accepted in the name of the U.S. government. The creed reads as follows:

"I believe in the United States of America as a Government of the people, by the people, for the people; whose just powers are derived from the consent of the governed; a democracy in a republic; a sovereign Nation of many sovereign States; a perfect Union, one and inseparable; established upon those principles of freedom, equality, justice and humanity for which American patriots sacrificed their lives and fortunes.

"I therefore believe it is my duty to my country to love it; to support its Constitution; to obey its laws; to respect its flag; and to defend it against all enemies."

AMERICAN SMELTING AND REFINING COMPANY, THE, was first organized in 1899 as a consolidation of companies engaged in the business of custom lead smelting and refining. In 1901 a further consolidation was made with the interests of the Messrs. Guggenheim, who thereafter were in executive charge of the company. Under their administration the company went largely into custom copper smelting and refining, and later into custom zinc smelting. It also became an important miner of nonferrous metals.

The company in 1939 operated, either for its own account or under management contracts, gold, silver, copper, lead and zinc mines in Australia, Bolivia, British Columbia, Mexico, Newfoundland, Peru, Saudi Arabia and the United States. It also operated smelters and refineries in the United States and Mexico during the year 1939, which plants produced during that year 2,377,114 oz. of gold, 153,593,120 oz. of silver, 454,425 tons lead, 402,030 tons copper, 70,692 tons zinc.

The balance sheet as of December 31, 1939, was as follows:

ASSETS	
Property and investments	\$ 75,102,667.09
Cash and government securities	25,822,021.65
Inventories and other miscellaneous assets	71,090,204.37
Total assets	<u>\$172,014,893.11</u>
LIABILITIES AND CAPITAL	
Current and miscellaneous liabilities	\$ 26,622,583.13
Reserves	23,894,614.94
Profit and loss surplus	27,877,265.04
Preferred stock outstanding	\$50,000,000
Common stock outstanding	<u>43,620,430</u>
	<u>\$172,014,893.11</u>
(J. C. EM.)	

AMERICAN SOCIETY FOR THE PREVENTION OF CRUELTY TO ANIMALS, THE, was organized in 1866 and incorporated in New York state. Its charter gives it special prosecuting powers within that jurisdiction. Directly or indirectly, it is the parent of all humane societies in the United States and of many abroad. Its administrative work through its hospital and shelters is chiefly confined to New York city.

The society was founded by Henry Bergh, who, when secretary of the U.S. Legation in Russia, became incensed over the ill-treatment of animals on the streets and decided to start an anti-cruelty work in America. On his way home he studied the methods of the R.S.P.C.A. in England. There were at that time in the U.S. no effective laws for animal protection and no organ-

ization to enforce such as existed. Bergh spent his remaining 22 years in tireless activity on behalf of animals. After his death the society, with endowments by him and others, was developed administratively and is undoubtedly one of the wealthiest and strongest bodies of its kind in the world. A dispensary and hospital was erected in 1912 and doubled in 1927. Animal shelters are maintained in various parts of the city.

AMERICAN SOCIETY OF NATURALISTS is an "association of working naturalists for the discussion, advancement and diffusion of knowledge concerning the broader biological problems, including organic evolution, thus serving to correlate the various biological sciences into a common philosophy of biology." Membership is "limited to persons professionally engaged in some branch of natural history . . . who have essentially promoted natural history sciences by original contributions of any kind." It was founded at Springfield, Mass., in 1883. Meetings are held annually in association with the American Association for the Advancement of Science, and consist of an afternoon symposium and an evening address by the president, ordinarily on some general aspect of evolution.

Membership in 1940 was 531.

AMERICAN SOCIETY OF ZOOLOGISTS. This society is an association of workers in the field of zoology organized for the purpose of presenting and discussing new and important facts and problems in that science, and for the adoption of such measures as will tend toward the advancement of zoological knowledge. The American Morphological Society was organized in 1890 and was succeeded in 1903 by the American Society of Zoologists. Membership in the society includes two classes: active membership and associate membership. Total membership in the society in 1940 was 939. Publications of the society consist of the *Program of the Annual Meeting*, which includes abstracts of all papers presented before the society, and of the *Proceedings* of the society, which also are published annually. (E. G. Br.)

AMERICAN SUGAR REFINING COMPANY, THE, incorporated in New Jersey, U.S.A., on Jan. 10, 1891, succeeded the Sugar Refineries Company, organized in 1887. The capital stock in 1891 was \$50,000,000, was increased in 1892 to \$75,000,000, and in 1901 to \$90,000,000. The stock consists of 450,000 shares of 7% cumulative preferred and 450,000 shares of common. In 1922 \$30,000,000 of 15-year 6% debenture bonds were issued. All were redeemed by January 1, 1935. The stockholders number approximately 22,000, of whom about one-half are women.

The company, and its subsidiaries, own five refineries for manufacturing Domino and Franklin refined sugar from raw cane sugar, chiefly from Cuba, Porto Rico, Philippines, Hawaii and Louisiana. The daily melting capacity is about 16,000,000lb. It supplies about one-fifth of the refined sugar consumed in the whole United States. It has two modern raw sugar factories at Cunagua and Jaronu in Cuba, with 500sq.mi. of land, 183mi. of railroad and the capacity to produce 500,000,000lb. of raw sugar each year. The Brooklyn Cooperage Company, subsidiary, is one of the largest manufacturers of barrels in the world. (A. B. Wm.)

AMERICAN TELEPHONE AND TELEGRAPH COMPANY, THE. The first telephone company was formed in 1876 when the inventor, Alexander Graham Bell, assigned to the Bell Patent Association his first two telephone patents. On July 9, 1877, this first association was succeeded by the Bell Telephone Company, first as a trusteeship and later as an incorporation. This company in turn was succeeded, in 1879, by the National Bell Telephone Company, which represented the Bell interests until the American Bell Telephone Company was organized on March 20, 1880, and that in turn became the parent Bell company until Dec. 1, 1899, when the directors voted to transfer all the assets of the company, both in stock and in property, to the already existing American Telephone and Telegraph Company.

After this transfer, accomplished by an exchange of stock, the American Telephone and Telegraph Company became the central or parent company of the Bell system, which now furnishes telephone service in every State in the United States of America. This company owns about nine-tenths of the voting stock of the regional operating companies, called the Principal Telephone Sub-

sidaries, owns and operates directly long-distance lines interconnecting these regional companies and maintains a central organization which, together with the Bell Telephone Laboratories, provides scientific research and development, technical knowledge and standardization of methods in all departments of work. In addition to the Bell Telephone Laboratories, the American Telephone and Telegraph Company controls through stock ownership the Western Electric Company.

The American Telephone and Telegraph Company's charter, granted in 1885, stated that the purpose of the company was to build and operate telephone lines for long-distance communication connecting the regional operating companies, including "the constructing, buying, maintaining and operating of lines of electrical communication within the State of New York, and from points within the State of New York to points anywhere in the United States, in Canada and Mexico, and by cable and other appropriate means anywhere through the rest of the world."

The outstanding stock of the American Telephone and Telegraph Company was in Dec. 1939 \$1,868,679,400, par value. It was owned by 636,771 stockholders, of whom not one owned as much as 1% of the stock. The average holding was 29 shares. The total of all Bell system stocks was \$1,997,332,971, par value, owned by about 680,000 stockholders. The total assets of the Bell system amounted to \$5,227,361,850, of which \$4,590,509,972 represented telephone plant.

The Bell system companies on March 31, 1940, owned and operated 16,796,000 telephones in the United States. There were, in addition, 4,262,000 telephones, owned by nearly 6,500 independent telephone companies to which the Bell system gave telephone connection over its lines under contract. This made a total of 21,058,000 telephones served by the Bell system. This service was rendered over a network of more than 95,000,000mi. of wire, of which 86,264,000mi. were Bell owned. During the year 1939 the Bell system made a daily average of 73,802,000 telephone connections throughout the United States network.

In the Bell system (including the Western Electric Company and Bell Telephone Laboratories) there were in 1940 more than 299,000 employees, with a monthly payroll of over \$48,200,000.

By the steady improvement of telephone service the Bell system is increasing the range and improving the efficiency of American business and social life, while the extension of the service by trans-oceanic telephony, which began with the opening of telephone service between New York and London on Jan. 7, 1927, has made possible the connection of the American telephone system with the systems of a large part of the rest of the world. By 1940 only three countries in the world with more than 100,000 telephones each—Russia, China and New Zealand—could not be reached by telephone from the United States, and ninety-three per cent. of the world's telephones could be reached by any Bell System telephone under peace-time conditions. (W. S. G.)

AMERICAN TOBACCO COMPANY, THE, one of the world's largest manufacturers of tobacco, cigarettes, cigars and other tobacco products. So far as its name is concerned it goes back to 1890, and so far as its corporate organization is concerned goes back to Oct. 1904 when, under the laws of New Jersey, the old American Tobacco Company, the Consolidated Tobacco Company and the Continental Tobacco Company were merged into one company. The general offices of the company are in New York city; its manufacturing is done in Richmond, Va., Reidsville, N.C., Durham, N.C., Nashville, Tenn., Philadelphia, Pa., Charleston, S.C., Louisville, Ky., and Trenton, N.J. It has warehouses for the gathering and storage of leaf tobacco in Virginia, North Carolina, South Carolina, Kentucky, West Virginia, Tennessee and in a number of foreign countries.

The outstanding capitalization consists of \$52,699,700 of preferred stock, of the par value of \$100 a share; \$40,242,400 of common stock of the par value of \$25 a share, which has voting rights with the preferred stock; and \$78,354,425 of common stock B also of the par value of \$25 a share which receives the same rate of dividend and has the same rights in liquidation as the common stock, but has no voting power. The total surplus at the end of 1939 was \$58,764,982.47.

AMERICAN WAR OF 1812: *see* WAR OF 1812.

AMERICAN WOOLEN COMPANY, incorporated in 1899, is the largest manufacturer of men's and women's woollen and worsted fabrics in the U.S. At the end of 1942 the company owned and operated 25 mills, most of which are located in New England states, two in the state of New York and one at Louisville, Kentucky. The company normally employs about 25,000 people. As of Dec. 31, 1942 working capital was in excess of \$43,000,000 and total assets about \$107,000,000. The capitalization of the company at that date consisted of 350,000 shares of 7% cumulative preferred stock of \$100 par value, and 400,000 shares of no par value common stock. In 1931 the executive offices of the company were moved from Boston to New York City.

AMERICA'S CUP, an international yacht-racing trophy first won by the schooner "America" of the New York Yacht club in 1851. In 1850 an English merchant suggested to friends in the United States that one of the fast New York pilot boats be sent to England in the ensuing year to take part in a yacht race to be held during the time of the Great Exhibition at London. In response to this invitation, George Steers, of New York, designed and built for Commodore J. C. Stevens, of the New York Yacht club, the wooden-keel schooner-yacht "America," about 100 ft. long and of 170 tons displacement. Crossing the Atlantic in July 1851, this vessel took part on Aug. 22 in a race open to the yachts of all nations. In sailing the course, which was around the Isle of Wight, the "America" defeated the entire fleet of 14 vessels of the Royal Yacht squadron, thereby winning a silver cup valued at £100. In 1857 the owner of the "America" gave this cup to the New York Yacht club, to be held thereafter as an international yacht-racing trophy. From 1870, when the American schooner "Magic" defeated the British schooner "Cambria," to 1937, when the American yacht, Harold Vanderbilt's "Ranger," easily defeated Thomas M. Sopwith's "Endeavour II," all the attempts made by the many British challengers to recapture the cup met with defeat. After an unfortunate dispute over the defeat of the earl of Dunraven's "Valkyrie III" in 1895, a succession of challengers was sent by Sir Thomas Lipton, but from the first "Shamrock" in 1899 to the last, "Shamrock V" in 1930, all the sportsman's efforts were defeated. Thomas Sopwith, millionaire aeroplane manufacturer, took up the assault and his graceful "Endeavour" might have captured the trophy in 1934 if it had had a more expert crew. The victory of the American sloop, "Ranger," in 1937 over the Sopwith challenger, "Endeavour II," reflected an extraordinary advance in sail-driven racing craft. *See* YACHTING: *The United States*, for a detailed table.

See Ahmed John Kenealy, *Yacht Races for the America's Cup, 1851-1893* (1893); W. S. Quigley, *The America's Cup* (1903); Herbert Lawrence, *The America's Cup Races* (1914); and Alfred Johnson, "Harvard Men and the America's Cup," *Harvard Graduate's Magazine*, vol. xxxv, p. 53-66 (1926).

AMERICIUM: *see* TRANSURANUM ELEMENTS.

AMERICUS, a city of Georgia, U.S., about 71 mi. S.S.W. of Macon, on federal highways 19 and 280 and the Central of Georgia and the Seaboard Air Line railways; county seat of Sumter county. Pop. (1950) 2,617. Cotton, peanuts, oats, wheat and lespedeza are important crops. Sumter's livestock pens handle more than 2,500,000 cattle and hogs each year. Large quantities of pecans and pimiento peppers are grown for market.

Leading industries in Americus include shirts, baskets, stoves, oil mills, seed crushers and lumber processors. Americus was settled in 1832 and chartered as a city in 1855.

AMERIND or AMERINDIAN, a word coined by Major J. W. Powell, director of the bureau of American Ethnology, to designate the aboriginal inhabitants of the American continent. The term "American Indian" being too cumbersome for general use, was frequently abbreviated to "Indian," thereby leading to confusion with the inhabitants of the East Indies.

See *Handbook of American Indians North of Mexico* (1907), s.v. Amerind.

AMERIND FOLKLORE offers an exceptional field to the student, since its psychological factors are racially homogeneous and practically untouched by intrusive influences. Its cultural

complexes exhibit subtle intergradings all the way from simple hunting societies to town-building agricultural co-operative communities. The continuity of aboriginal cultures in Mexico with those of the United States, and the easily discoverable environmental influences, afford a unique opportunity for the study of diffusion by contact. Much has been lost by neglect, but there is compensatory gain in the employment of native Amerind scholars in collection and interpretation.

The basis of Amerind exoteric lore is the tribal origin and migration myth, which can be found in the form of simple hero cycles, more or less ritualized lays, or, as in the case of the New Mexican Pueblos, in epic form comparable in literary value to anything produced at similar cultural levels in Europe. Other exoteric material concerns itself with the explanation of natural phenomena and with social and economic practices. One of the most interesting groups of such rites and legends deals with the origin of wealth as "capital," with the invention of "interest" and the distribution of economic surplus.

Amerind myth in general refers chiefly to cultural rather than military exploits, and deals with heroes who seek prestige through social benefits conferred and the attainment of magical power. The esoteric myths relate to the methods by which such power is attained, its use in curing the sick, ensuring the food supply and the increase and security of the tribe. The happy ending of any Amerind tale is the certainty of having attained this "medicine," although in tales not primarily magical, all the usual primitive story elements can be found: lovers who die for love, tests for proving love, the devoted male friends, the animal helper, the magic talisman or fetish, the dull boy who becomes chief or shaman, and the beginnings of a Cinderella myth. Among magical happenings which have no esoteric significance are the animal wife, the star or moon maiden, deific twin brethren, other-world adventures, dwarfs, ogres and such supernaturals as underwater people, wind and thunder people. Ghosts play an important part in both exoteric and esoteric myth. Communication with them is a constant resort, and there are societies of personators of the ancestral spirits. Virgin birth, sacrificial death and resurrection occur in connection with vegetation rites, along with animal impersonators and masked metamorphic powers of nature. Rites and ceremonials achieve a high level of aesthetic presentation, approaching early Greek dance-drama and sacerdotal comedy. Music, poetry, colour design, dance and dramatic dialogue are not inferior to the sacred lore of other tribes at similar cultural levels.

The Amerind's concept of his universe is animistic, the *wakonda* or animating spirit being thought of as resident in some degree in everything, but concentrating in important natural objects, such as the sun, the sea, the buffalo. Personalization of these centres of spiritual energy is still rather a figure of speech than a belief among Amerinds, and a general concept of a Great Spirit, Father All Father, Universe Man, is found in the more advanced tribes.

(M. A.)

For examples of Amerind Folklore, *see* the works of Frank Hamilton Cushing and Alice Cunningham Fletcher. For Mexican Folklore, *see* Carl Lumholtz, *Unknown Mexico* (1903).

AMERSFOORT, town in the province of Utrecht, Holland, on the navigable Eem, and a junction station 14m. by rail N.E. by E. of Utrecht. Pop. (1900) 19,089, (1939) 48,081. It is situated among sandy heaths and woods. The Koppelpoort, an old gateway, ends an avenue bordering the canal. The large plain church of St. George dates from the 13th century. There is a Jansenist church, with seminary attached, a town hall and a court of primary jurisdiction. German troops captured the town in May 1940.

AMERSHAM, market town of south Buckinghamshire, England, placed in the narrow valley of the Misbourne stream, giving access to Wendover and Aylesbury via the Chiltern hills. Population of rural district (1951) 41,432. At the time of the Domesday survey Amersham was divided into six holdings. The manor was held by Geoffrey de Mandeville. Henry VIII. granted it to Sir John Russell, one of whose descendants, the earl of Bedford, conveyed it to the Drake family in 1638. Amersham was formerly a borough by prescription, but lost its privileges in 1832. The

church of St. Mary is almost entirely Perpendicular, and has a beautiful south porch and brasses of the 15th, 16th and 17th centuries. The town has flour mills and breweries; and straw-plaiting and lace making survived until the end of the 19th century. In modern times Amersham has developed as a residential centre, being served by the Met. and L.N.E. Joint Railway.

AMERY, LEOPOLD CHARLES MAURICE STENNETT (1873—), British politician, was born at Gorakhpur, North West Provinces, India, Nov. 22, 1873, and was educated at Harrow and Balliol college, Oxford. He was elected a fellow of All Souls college in 1897, and, after travelling for a year in the Near East, in 1899 joined the staff of *The Times*, London, and acted as chief correspondent to that paper during the first year of the South African War (1899–1900), remaining associated with it till 1909; during this period he edited and wrote the greater part of *The Times History of the South African War*. He began his political career in 1903, as a strong advocate of imperial preference and tariff reform and, having contested in the Unionist interest seats at Wolverhampton and Bow and Bromley, was elected in 1911 M.P. for the Sparkbrook division of Birmingham. During these years he also travelled extensively in Canada, Australia, New Zealand, South Africa and other parts of the British empire. From 1914 to 1916 he served with the British army, first in France and later in the Near East, and from 1917 to 1918 was a secretary of the War cabinet on the personal staff of the secretary for war and of the Imperial War cabinet, and a member of the inter-allied military staff at Versailles. In Jan. 1919 he became under-secretary for the Colonies and in 1921 parliamentary and financial secretary to the Admiralty. From Oct. 1922 to Jan. 1924 he was first lord of the Admiralty in the Unionist cabinet. In Nov. 1924 he became secretary of state for the Colonies, and from 1925 to 1929 was also secretary of state for dominion affairs. In 1940 he was appointed secretary of state for India and for Burma, serving in this office until 1945.

His works include *The Great Question* (1909); *Union and Strength* (1912); *A Plan of Action* (1932); *The German Colonial Claim* (1939); *Thoughts on the Constitution* (1947).

AMES, FISHER (1758–1808), American statesman, orator and political writer, was born at Dedham, Mass., on April 9, 1758. He graduated at Harvard college in 1774, and began the practice of the law at Dedham in 1781, but eventually abandoned that profession for the pursuit of politics. He was a prominent member of the Massachusetts convention which (Feb. 1788) ratified for that state the Federal Constitution, and in the same year in the lower house of the state legislature, he distinguished himself by his eloquence and readiness in debate. During the eight years of Washington's administration (1789–97) he was a prominent Federalist member of the national House of Representatives. On April 28, 1796, when the Republicans, hostile to the Jay Treaty, were on the point of holding up the appropriation necessary for its execution, Ames made what has been considered the greatest speech of his life and secured the passage of the appropriation. When Washington retired from the presidency, Congress voted him an address and chose Ames to deliver it. Ames was one of the group of New England ultra-Federalists known as the "Essex Junto," who opposed the French policy of President John Adams in 1798, and were conspicuous for their British sympathies. He died on July 4, 1808.

His writings and speeches, which display great fertility of imagination, were collected and published, with a memoir of the author, in 1809, by the Rev. Dr. J. T. Kirkland. A more complete edition was published by the statesman's son, Seth Ames, in 1854.

AMES, JAMES BARR (1846–1910), American educator and legal scholar, was born in Boston, Mass., on June 22, 1846. He graduated from Harvard university in 1868 and from its law school in 1872. Entering the faculty of Harvard as instructor in history, he was made associate professor of law in 1873 and professor of law in 1877. In 1895 he was appointed dean of Harvard law school, a post which he occupied with distinction until his death 15 years later. Because of his profound learning and rare power as a teacher he exercised marked influence both upon the development of law and upon legal instruction. He grasped the

relation of law and morals at a time when current legal thinking insisted upon contrasting them or upon absolutely divorcing them. In consequence, his ideas as to what ought to be the law have prevailed rather than those of his contemporaries who conceived that it was unnecessary to look outside of the positive legal materials. For the use of students he published valuable case books on the law of torts, equity jurisdiction, negotiable paper, suretyship, admiralty, pleading at common law and other divisions of law. His *Essays in Legal History* (1912), collected and published after his death, constitute an enduring contribution to historical jurisprudence. He died at Wilton, N.H., on Jan. 8, 1910.

See Charles W. Eliot, "James Barr Ames," *Harvard Law Review*, vol. xxiii, p. 321–324 (1910); and Joseph H. Beale, "James Barr Ames: His Life and Character," *ibid.*, p. 325–329.

AMES, JOSEPH (1689–1759), English author, was born at Yarmouth on Jan. 23, 1689. He wrote an account of printing in England from 1471 to 1600, *Typographical Antiquities* (1749). Ames disregarded printed lists and consulted the title-pages of the books themselves. An interleaved copy of the work with many notes in the author's hand is now in the British Museum. Editions of his works were published with added information by William Herbert (1785–90), and T. F. Dibdin (1810–19). Ames's occupation is variously given. It is uncertain whether he was a ship-chandler, a patten-maker, a plane-iron-maker, or an ironmonger; but he led a prosperous life at Wapping, and amassed valuable collections of antiquities. He died on Oct. 7, 1759. His other works are catalogues of English printers, of the collection of coins which belonged to the earl of Pembroke, of some 2,000 English portraits, and *Parentalia* (1750), a memoir of the Wrens, undertaken in conjunction with Sir Christopher Wren's grandson, Stephen Wren.

AMES, JOSEPH SWEETMAN (1864–1943), American physicist, was born in Manchester, Vt., on July 3, 1864. He graduated from Johns Hopkins university in 1886 and received his doctorate of philosophy in 1890. In 1899 he was made professor of physics and in 1901, director of the physical laboratories. His special interest was aeronautics, and as chairman of the National Advisory Committee for Aeronautics from 1927 to 1939, he was responsible for numerous improvements in the construction and safety of aircraft. He served as president of Johns Hopkins university, 1929–35, and as president emeritus from 1935 until his death June 24, 1943, in Baltimore, Md.

His published works include *Theory of Physics* (1897), *Manual of Experiments in Physics* (1898), *Free Expansion of Gases* (1898), *Prismatic and Diffraction Spectra* (1898), *Elements of Physics* (1900), *Induction of Electric Currents* (1900), *Text-book of General Physics* (1904) and *The Constitution of Matter* (1913).

AMES, OAKES (1804–1873), American manufacturer, capitalist and politician, was born in Easton, Mass., on Jan. 10, 1804. As a manufacturer of shovels, with his father and his brother Oliver (1807–77), he amassed a large fortune. From 1863 to 1873 he was a Republican member of the national House of Representatives. As a member of the committee on railroads he became interested in the project to build a trans-continental railway, connecting the eastern States with California. In 1865 he took charge of the work, and to him more than to any other one man the credit for the construction of the Union Pacific railway was due. The execution was effected largely through a construction company, the Crédit Mobilier Company of America. In disposing of the stock of this company, Ames, in 1867–71, sold shares to members of Congress at a price much below what they eventually proved to be worth. This gave rise in 1872–73 to a congressional scandal. After an investigation by a committee of the House, which recommended the expulsion of Ames, a resolution was passed on Feb. 28, 1873, "that the House absolutely condemns the conduct of Oakes Ames . . . in seeking to secure congressional attention to the affairs of a corporation in which he was interested, and whose interest directly depended upon the legislation of Congress, by inducing members of Congress to invest in the stocks of said corporation." Many have since attributed this resolution to partisanship, and the influence of popular clamour. In 1883 the legislature of Massachusetts passed a resolution vindicating Ames. He died at North Easton, Mass., on May 8, 1873.

See *CRÉDIT MOBILIER OF AMERICA* and the references there given. For a defense of Oakes Ames, see *Oakes Ames, A Memorial Volume* (Cambridge, Mass., 1884).

AMES, WILLIAM (1576–1633), English Puritan divine and controversialist, known as *AMESIUS*, was born at Ipswich, Suffolk, and died at Rotterdam. Ames was educated at Christ's college, Cambridge, and became a fellow of his college. He raised a great stir in 1609 by a sermon denouncing the "heathenish debauchery" attending the feast of St. Thomas. He was obliged eventually to leave England and spent the rest of his life in the Netherlands, where he engaged in numerous theological controversies. He was aided in leaving England by certain wealthy English merchants who wished him to convert the supporters of the English church in Leiden. At Rotterdam, clad in the fisherman's habit donned for the passage, he opposed Grevinchovius (Nicholas Grevinckhoven, d. 1632), minister of the Arminian or Remonstrant church, and overwhelmed him with his logical reasoning from Phil. ii, 13, "It is God that worketh in us both to will and to do." The fisherman-controversialist made a great stir, and from that day became known and honoured in the Low Countries.

Subsequently Ames entered into a controversy in print with Grevinchovius on universal redemption and election, and cognate problems. He brought together all he had maintained in his *Coronis ad Collationem hagiensem*—his most masterful book, which figured largely in Dutch church history. This work was prepared for the Synod of Dort, 1618–19.

He was for a short time chaplain to Sir Horatio Vere in Holland, then professor of theology at Franeker, Friesland (1622–33), and then removed to Rotterdam where he drew all hearts to him by his eloquence and fervour in the pulpit, and his irrepressible activity as a pastor. Home-controversy engaged him again, and he prepared his *Fresh Suit against Ceremonies*—the book which is said to have made Richard Baxter a Nonconformist. It was posthumously published, for Ames did not long survive his removal to Rotterdam, and died in Nov. 1633. His other works include *Medulla theologiae*, a manual of Calvinistic doctrine for his students; *De conscientia eius iure et casibus*; and Latin commentaries on the Psalms and St. Peter's epistle.

See John Quick's ms. *Icones Sacrae Anglicanae: Life* by Nethenus, prefixed to collected edition of Latin works (Amsterdam, 1658); Winwood's *Memorials*, vol. iii, pp. 346–47; Neal's *Puritans*, i, 532; Fuller's *Cambridge (Christ's College)*; Hanbury's *Hist. Memorials*, i, 533; *Collections of the Massachusetts Historical Society*, vol. vi, 4th series, pp. 576–577 (1863).

AMES, WINTHROP (1871–1937), American theatrical producer, was born in North Easton, Mass., on Nov. 25, 1871. He graduated at Harvard in 1895, and spent the following year in special study at the university. For eight years he edited and published art and architectural works in Boston. Then followed a year abroad where he studied the continental drama, and in 1905 he became manager, in association with Loren F. Deland, of the Castle theatre, Boston, where for three years they conducted a very notable stock company. In 1909 he became director of the New theatre (now the Century) in New York city, where he made the first attempt in recent years to establish a repertory theatre. With the passing of the New theatre, he began, in 1912, independent production and management, erecting two theatres, the Little and the Booth. He contributed a wide variety of productions, among them *Snow White*, the first play given in New York city especially for children. He also revived the Gilbert and Sullivan operas. He died in Boston, Mass., Nov. 3, 1937.

AMES, a city of Story county, Iowa, U.S., in the centre of the state, 30 mi. N. of Des Moines; on two lines of the Chicago and North Western, and on the Fort Dodge, Des Moines and Southern (electric) railway. The population, nearly all native white, increased from 2,422 in 1900 to 6,570 in 1920 and 23,105 in 1950 (federal census). The town was laid out in 1864 and incorporated in 1870. It was named after Oakes Ames, one of the owners of the railway. It is the headquarters of the state highway commission. A council-manager form of government was adopted in 1920.

Ames is the seat of the Iowa State College of Agriculture and Mechanic Arts, established in 1858, as a "state agricultural college

and model farm," and broadened in scope in 1862 to meet the conditions of the congressional "land-grant" act of that year. The central campus of 781 ac. is a beautiful park. An inner plaza of 20 ac., containing a campanile with a chime of 36 bells cast in Loughborough, England, is surrounded by stately buildings of white Bedford stone. The Institute for Atomic Research, established at the college in 1945, became one of the major research centres of the U.S. Atomic Energy commission.

AMESBURY, a market town, Wiltshire, England, lying in the rich and well-wooded valley of the Avon, amid the chalk downs of Salisbury Plain, 8 mi. N. of Salisbury; pop. of rural district (1951) 24,206. Area 9.9 sq.mi. The neighbourhood is rich in remains of prehistoric man, among which Stonehenge (*q.v.*), 1½ mi. W., is the greatest surviving megalithic structure in the British Isles. On a hill overlooking the village is a large earthwork, "the Ramparts," which perhaps marks a preceding settlement. At Amesbury (Ambresberia, Aumbresbery) a witenagemot was held in 932, while (*c.* 980) Ethelfrida, queen dowager of Edgar, erected here a nunnery in expiation of the murder of her stepson. At the time of Domesday, Amesbury was a royal manor. From the 12th century the nunnery was attached to the abbey of Fontevrault and was enriched by royal charters and private gifts. A weekly market and fair were granted in 1317. The church of St. Mary is largely Early English, with some richly decorated windows. Amesbury abbey, built by Inigo Jones for the dukes of Queensberry, stands close to the village.

Pipeclay abounds in the neighbourhood, and in the 17th century Amesbury was famous for its pipes. Its interests are largely agricultural, frequent sheep fairs being held. The town profits from the permanent army camps in the vicinity (particularly from Larkhill) and from the tourist traffic visiting Stonehenge and other objects of interest on the plain. Amesbury is served by a branch railway, running to the camp at Bulford, joining the S.R. between Andover and Salisbury.

AMESBURY, a town of Essex county, in northeast Massachusetts, U.S., on the Merrimack river, between the city of Newburyport and the New Hampshire border, 43 mi. N. of Boston. It is served by the Boston and Maine railroad and by bus and truck lines.

The town covers a land area of about 13 sq.mi. The surface is hilly. The population in 1950 was 9,678; in 1940 it was 10,862 by federal census.

A number of heavy and light industries have headquarters there. Amesbury was settled in 1642, as a part of Salisbury, and in 1654 became practically independent, although not legally a township until 1666. It was named (1667) after the English town in Wiltshire. Quakers settled there as early as 1701. Josiah Bartlett (1729–95), a signer of the Declaration of Independence, was born there. Shipbuilding was an important industry in the 18th and especially in the first quarter of the 19th century. A nail factory, one of the earliest in the country, was built in 1796. The manufacture of iron began about 1710; of hats in 1769; of carriages in 1800; and of cotton goods in 1812. Amesbury was the home of John G. Whittier from 1836 to 1892, and many of his poems describe the surrounding country and the life of the community.

See Joseph Merrill, *History of Amesbury* (Haverhill, 1880); S. T. Pickard, *Whittier-Land: a Handbook of North Essex* (Boston, New York, 1904).

AMETHYST, a violet or purple variety of quartz used as an ornamental stone. The name is generally said to be derived from the Gr. *a*, "not" and *μεθύσκεν*, "to intoxicate," expressing the old belief that the stone protected its owner from strong drink. It was held that wine drunk out of a cup of amethyst would not intoxicate. The colour of amethyst is usually attributed to the presence of manganese, but as it is capable of being much altered and even discharged by heat it has been referred by some authorities to an organic source. On exposure to heat, amethyst generally becomes yellow, and much of the cairngorm or yellow quartz of jewellery is heat treated amethyst.

The amethyst was used as a gem stone by the ancient Egyptians, and was largely employed in antiquity for intaglios. It is now used for episcopal rings. It is a very widely distributed mineral, but

fine, clear specimens fit for cutting as ornamental stones are confined to comparatively few localities. Such crystals occur either in cavities in mineral-veins and in granitic rocks, or as a lining in agate geodes. Many of the hollow agates of Brazil and Uruguay contain a crop of amethyst-crystals in the interior. Much fine amethyst comes from Russia, especially in the Ekaterinburg area.

AMETROPIA. The normal refractive condition of the eye is known as emmetropia. Any departure from this condition is called ametropia. Like a camera, the eye is provided with a lens and a light-sensitive membrane, the retina. The cornea and the transparent substances which fill the eyeball aid the refractive power of the lens. In an ideal eye at rest, parallel rays come to a clear focus on the retina. Although only about 2% of properly examined eyes exactly meet this standard, the majority of normal eyes closely approach it. When, however, due to defects in the refractive mechanism, parallel rays do not come to a clear focus on the retina of a resting eye, the condition is called ametropia. Such defects may be abnormalities in length of the eyeball or irregularities in the curvature of the cornea or lens, and the resulting varieties of ametropia are called myopia (shortsightedness) hyperopia (farsightedness) and astigmatism. (See ASTIGMATISM.)

AMHARA, the central province of Abyssinia. The chief town, Gondar (*q.v.*), by which name the province is also known, was the residence of the negus negust, or emperor, of Abyssinia from the middle ages up to 1854. Area, 76,235 sq.mi.; pop. 2,000,000.

AMHARIC. The most important language spoken in Abyssinia is Amharic, which belongs to the Semitic family (see SEMITIC LANGUAGES), but has been greatly modified by Hamitic influences. The order of the words is that usual in Hamitic speech, the verb coming last and subordinate words preceding those with which they are associated. Laryngeal consonants are absent and the system of writing, which dates from the 2nd century A.D., is remarkable for the great number of forms required, since each of the 26 consonants has seven vowel forms, while a special sign is added to mark the softened pronunciation in vogue. Very considerable phonetic modifications have taken place, resulting often in a total change of form. As regards syntax, the governed noun is placed after the genitive, while the attributive relative clause is placed before its substantive. Few traces remain of the feminine forms or of the ancient plural of the noun. Not more than half of the vocabulary—after allowing for phonetic modifications—can be found to tally with that of other Semitic languages. (See C. ARMbruster, *Initia Amharica*.)

AMHERST, JEFFREY AMHERST, BARON (1717-97), British field-marshal, served in Germany and the Low Countries as aide-de-camp to Gen. (Lord) Ligonier, and was present at Dettingen, Fontenoy and Roucoux. He then served on Cumberland's staff, and took part with the duke in the later campaigns of the Austrian Succession war, in the battle of Val, and the North German campaign of 1757, including the battle of Hastenbeck. In 1758 William Pitt gave Amherst command of an expedition to attack the French in North America.

The first victory of the expedition, the capture of Louisbourg (July 26, 1758), was followed by other successes, and Amherst was given the chief command of all the forces in the theatre of war. In the campaign of 1759 Amherst's own share was the capture of Ticonderoga and Crown Point, while Ft. Niagara fell to another column, and Quebec was taken by Wolfe. In 1760 a concentric march on Montreal was carried out with complete success. Amherst was immediately appointed governor-general of British North America. His conduct of the operations against the Indians under Pontiac was, however, far from being as successful as his generalship against regular troops; and he returned to England in 1763.

He was created a peer in 1776, was promoted to the rank of general in 1778, and aided in suppressing the Gordon Riots of 1780. For the rest of his active life, with a short interval in 1782-83, he was commander-in-chief. In 1796 Lord Amherst, who had retired from the Horse Guards in 1795, was made field-marshal; and he died Aug. 31, 1797 at "Montreal," his residence in Kent. Amherst college (*q.v.*) was named in his honour.

AMHERST, WILLIAM PITT AMHERST, EARL (1773-1857), governor-general of India, was the nephew of Jeffrey, Baron Amherst, and succeeded to his title in 1797. Upon his return from an abortive mission to China in 1816, his ship, the "Alceste," after a cruise along the coast of Korea and to the Luchu Islands, was wrecked on a sunken rock in Gaspar Strait.

The ship in which he returned to England in 1817 touched at St. Helena, and he had several interviews with the Emperor Napoleon (see Ellis's *Proceedings of the Late Embassy to China*, 1817; McLeod's *Narrative of a Voyage in H.M.S. "Alceste,"* 1817). Lord Amherst held the office of governor-general of India from Aug. 1823 to Feb. 1828. The principal event of his government was the first Burmese war of 1824, resulting in the cession of Arakan and Tenasserim to Great Britain. He was created Earl Amherst of Arakan in 1826. Upon his return to England, he lived in retirement till his death in March 1857.

AMHERST, a village and district in the Tenasserim division of Lower Burma. The village is about 30 mi. S. of Moulmein. It was founded by the British in 1826 on the restoration of the town of Martaban to the Burmese, and named in compliment to the governor general of India of that day; but in 1827 the headquarters were transferred to Moulmein. Amherst, a mere fishing village, was formerly a popular seaside resort for European residents of Moulmein.

AMHERST, county town, Cumberland county, port of entry in Nova Scotia, Can., at the head of Chignecto bay and on the Canadian National railway, 138 mi. from Halifax. Pop. (1951) 9,811. It is in a rich agricultural and mining district, contains factories and has large trade in lumber. It exports railway carriages, engines, boilers, stoves, shoes, woollens, trunks, etc. Named after Jeffrey, Lord Amherst, the town is near the sites of Fort Beauséjour and Fort Lawrence, the scene of the struggle for Acadia.

AMHERST, a town of Hampshire county, Mass., U.S., in the central part of the state, with a population in 1950 of 7,900 (federal census). The village of Amherst, about 100 mi. W. of Boston, is situated on a plateau within a rampart of hills on the east side of the Connecticut river; and is served by the Boston and Maine and the Central Vermont railways. It is a quiet, academic village, with shady streets and attractive homes.

Amherst college (*q.v.*) stands on a hilltop which commands a broad outlook. The University of Massachusetts (incorporated 1863; opened 1867) has a campus of 700 ac., about a mile north of the village centre, and a demonstration forest of 755 ac., six miles farther north. Undergraduate enrolment in 1950-51 was 3,200; graduate enrolment 300. Various short courses, including a two-year vocational school of agriculture, brought total registration to 4,000.

The town seems to have been settled in 1731. It was originally part of Hadley, was incorporated as a "district" in 1759 and as a town in 1775. It was named after Gen. Jeffrey Amherst (1717-97). Noah Webster lived in the village (1812-22) while working on his dictionary. Emily Dickinson (*q.v.*) and Helen M. Fiske (Helen Hunt Jackson, see JACKSON, HELEN MARIA) were born there.

See William Seymour Tyler, *A History of Amherst College* (1896); Carpenter and Morehouse, *The History of the Town of Amherst* (1896).

AMHERST COLLEGE, one of the best known of the so-called small New England colleges, is situated in a beautiful amphitheatre of hills in the town of Amherst (*q.v.*), Massachusetts. It was founded in 1821 but did not receive its charter until 1825. Like most early colleges of New England, it was established with the chief aim of preparing students for the ministry. Although soon after its founding the college began to widen the scope of its activities, it has preserved to the present day the idea of a liberal as opposed to a vocational training. Consistent with this purpose it has never added graduate or professional schools, adhering strictly to a course leading to the degree of A.B. with an ever real, though diminishing, emphasis upon the ancient classics.

The college grew rapidly for a score of years, but then experi-

enced a period of reaction which nearly cost the institution its life. There was a revival under the presidency of the eminent geologist, Edward Hitchcock (1845–54) and another reaction at the time of the Civil War. Since then its history has been one of quiet, but steady growth.

In 1942–43 it numbered 805 students and a faculty of 74 teachers. The material resources of the college amounted to \$3,000,000 in buildings and equipment, and to \$11,925,000 in invested funds. Its buildings consisted of four dormitories, five halls devoted to administration and instruction, two large laboratories, one of which is divided between physics and chemistry, and the other between biology and geology, a library, chapel, church, a gymnasium equipped with a natatorium and squash courts, a large indoor athletic field and skating rink, a music building and an observatory. The library, thoroughly modern in its appointments, contained approximately 236,500 books. The observatory is equipped with two domes, one housing a telescope with an 18-in. Clark objective, and the other with a 7-in. telescope (Clark objective) for student use. The geological and biological building contains the famous Hitchcock ichnological collection, the Adams shells, a part of the Audubon collection of birds, an extensive mineral collection including a rare assortment of meteorites, and fossil groups arranged to illustrate the theory of evolution. About 100 ac. of land are devoted to athletic sports, the larger portion being used for intramural sports upon which the college lays an ever increasing emphasis. For its size (6,000 graduates in the first hundred years), the college has had an exceptional number of graduates of distinction, among others being Henry Ward Beecher and Calvin Coolidge. It has been eminent in foreign missionary work, especially in the field of education. The Syrian Protestant college (now the American university) of Beirut, Syria, was founded by Daniel Bliss of the class of 1852; the Doshisha, the first institution of higher learning in Japan, by Joseph Neesima of the class of 1870; and Robert college, in Constantinople, owed a very large part of its early success to President George Washburn of the class of 1855.

(G. D. O.)

AMHURST, NICHOLAS (1697–1742), English political writer, was born at Marden, Kent, Oct. 16, 1697, and died at Twickenham, April 12, 1742. He was educated at Merchant Taylors' school and St. John's college, Oxford. At Oxford he wrote many satirical poems on university life, and in 1719 was expelled. Some of his satirical papers were published in 1726, as *Terrae Filius: or the secret history of the University of Oxford*. In London he became a pamphleteer against Walpole's government, editing *The Craftsman*, which was the organ of Lord Bolingbroke and William Pulteney. Amhurst was in prison for a short time in 1737 for suspected libel. When his political friends overthrew Walpole in 1742 they appear to have forgotten Amhurst.

AMIANTHUS, a name applied to the finer kinds of asbestos (*q.v.*), in consequence, it is said of the mineral being unaffected by fire (Gr. *ἀμύανθος*, undefiled). Some of the finest amianthus, with long silky flexible fibres, occurs in the district of the Tarentaise in Savoy. According to Dr. J. W. Evans, the ancient amianthus, derived mostly from Karystos in Euboea and from Cyprus, was probably a fibrous serpentine, or chrysotile (now called locally *παιμακόπετρα*, or cotton-stone).

AMICABLE NUMBERS (also known as *amiable numbers* or, less commonly, as *agreeable numbers*), two integers each of which is equal to the sum of the aliquot parts (*q.v.*) of the other. For example, 220 and 284 are amicable numbers, for the aliquot parts of 220 are 1, 2, 4, 5, 10, 11, 20, 22, 44, 55 and 110, the sum of which numbers is 284. Similarly, the sum of the aliquot parts of 284 (that is, of 1, 2, 4, 71 and 142) is 220. These two numbers are mentioned by the Greek arithmetician, Iamblichus (*c.* 325). Mathematicians have discovered 63 other pairs.

AMICE (Lat. *amictus*, from *amicire*, to wrap round), sometimes called *humeral* (from *humerus*, shoulder), a liturgical vestment of the Western church. It is a rectangular linen cloth, with a small cross sewn or embroidered in the middle, which is wrapped round the neck, shoulders and breast. It is first laid on the head, then allowed to fall on the shoulders, and finally folded round the chest and tied with the strings attached for that purpose. It

is worn under the alb, except at Milan and Lyons, where it is put on over it. The vestment was at first a perfectly plain white cloth, but from the 10th century onwards it was often richly embroidered, and the custom arose of decorating the upper border with an "apparel" forming a sort of stiff collar which appeared above the chasuble or dalmatic. The Latin word *amictus* was applied to any wrap-like garment, and, according to Father Braun, the liturgical amice originated in the ordinary neck-cloth worn by all classes of Romans. The first record of its liturgical use is in the 1st Roman Ordo (8th century), when it was worn only with the dalmatic and was known as the *anabolagium* (*anagolaium*, *anagolagium*, Gr. *ἀναβόλαιον*), a name it continued to bear at Rome till the 11th century. In the 9th century it spread to other countries: it is mentioned in an inventory of vestments given by Abbot Angilbert (d. 814) to the monastery at Centula (St. Riquier) and in the *de clericorum institutione* of Hrabanus Maurus (*c.* 820). The amice was worn first simply as a shoulder-cloth, but towards the end of the 9th century the custom grew up of putting it on over the head and of wearing it as a hood, either while the other vestments were being put on or, according to various local uses, until the celebrant reached the altar. This ceased at Rome in the 15th century, when the apparel disappeared; but two relics of it survive—(1) in the vesting directions of the Missal and the priest's prayer, "Place on my head the helmet of salvation," etc., (2) in the ordination of subdeacons, when the bishop lays the vestment on the ordinand's head with the words "Take the amice, which symbolizes discipline over speech."

The amice was rejected with the other "Mass vestments" in England at the Reformation. Its use has, however, been revived in many Anglican churches. (*See* VESTMENTS.) A vestment akin to the amice is worn in the Armenian and some other oriental churches, but it is unknown to the Orthodox Eastern church.

See Joseph Braun, S.J., *Die liturgische Gewandung*, pp. 21–56 (Freiburg im Breisgau, 1907), and bibliography to the article VESTMENTS.

AMICI, GIOVANNI BATTISTA (1786–1863), Italian astronomer and microscopist, was born March 25, 1786, at Modena and died at Florence, April 10, 1863. His name is best known for the improvements he effected in the mirrors of reflecting telescopes and in the development and construction of the microscope.

AMICIS, EDMONDO DE (1846–1908), Italian writer, was born at Oneglia, in Liguria, Oct. 21, 1846. He was educated for the army, and fought at the battle of Custoza in 1866. In 1867 he became director of the *Italia Militare*, Florence. In the following year he published *La Vita Militare*, a book of sketches of military life. After his retirement from the army in 1870 de Amicis travelled in Europe and Africa, and published a number of travel books which were long popular. The most important of these are his descriptions of London (1874), Spain (1873), Holland (1874), Constantinople (1877) and Morocco (1875). He died suddenly at Bordighera on March 12, 1908.

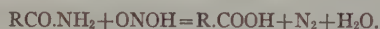
Among his other well known works are: *Il Romanzo d'un Maestro*, and the widely read *Il Cuore* (translated into English as *An Italian Schoolboy's Journal*). Later works are *La Carozza di tutti*, *Memorie, Speranze e glorie*, *Ricordi d'infanzia e di scuola*, *L'Idioma gentile*, and a volume of short stories, *Nel Regno dell' Amore*.

AMICUS CURIAE, a term used primarily in law, signifying a person (usually a member of the bar) who, having special knowledge but not being engaged in the action, intervenes during its hearing to give information for the assistance of the court, either upon some fact relevant to the issue or upon a point of law, such as the effect of a local custom, the precedent of some decided case, etc.

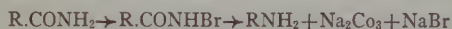
AMIDES (*Acid-Amides*), chemical compounds which may be considered as derived from ammonia by replacement of one or more of its hydrogen atoms with acyl residues. (An acyl residue is the characteristic group of an acid, from which it may be derived by removal of the acidic hydroxyl group or groups.) Amides are known as primary, secondary or tertiary if the number of hydrogen atoms replaced by acyl residues is one, two or three, respectively.

A few amides of inorganic acids are known, such as nitramide

$\text{H}_2\text{N}.\text{NO}_2$ (from nitric acid) and sulphamic acid $\text{H}_2\text{N}.\text{SO}_3\text{H}$ (from sulphuric acid), but the great majority are derived from organic acids. Of these latter compounds, the primary amides of the type $\text{R}.\text{CO}.\text{NH}_2$, which are derived from the carboxylic acids, are the most important, the group $\text{CO}.\text{NH}_2$ being called the amido group. They may be prepared by the dry distillation of the ammonium salts of the acids (A. W. Hofmann), by the partial hydrolysis of the nitriles, by the action of ammonia or ammonium carbonate on acid chlorides or anhydrides, or by heating the esters (*q.v.*) with ammonia. They are solid crystalline compounds (formamide excepted); the lower members of the series are soluble in water, the solubility, however, decreasing as the carbon content of the molecules increases. They are easily hydrolyzed, breaking up into organic acids and ammonia when boiled with acids or alkalis. They form compounds with hydrogen chloride when this gas is passed into their ethereal solution; these compounds, however, are very unstable, being readily decomposed by water. On the other hand, they show faintly acid properties, since the hydrogen of the amido group can be replaced by metals to give such compounds as mercury acetamide $(\text{CH}_3\text{CONH})_2\text{Hg}$. Nitrous acid decomposes them, with elimination of nitrogen and the formation of the corresponding acid:



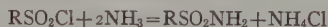
When distilled with phosphoric anhydride they yield nitriles. By the action of sodium hydroxide and either bromine or chlorine on the amides, they are converted into amines containing one carbon atom less than the original amide:



This reaction possesses great theoretical importance (A. W. Hofmann), and is also of industrial interest in the Badische synthesis of indigo (*q.v.*), for in accordance with Hofmann's reaction phthalimide is converted by alkali hypochlorite into anthranilic acid.

Formamide, $\text{H}.\text{CONH}_2$, is a liquid readily soluble in water, boiling at about 195°C . with partial decomposition. Acetamide, $\text{CH}_3.\text{CONH}_2$, a white deliquescent crystalline solid, which melts at $82-83^\circ \text{C}$. and boils at 222°C ., is usually prepared by distilling ammonium acetate. Benzamide, $\text{C}_6\text{H}_5.\text{CONH}_2$, crystallizing in leaflets which melt at 130°C ., is prepared by the action of ammonium carbonate on benzoyl chloride. It yields a silver salt which with ethyl iodide forms benzimidioethyl ether, $\text{C}_6\text{H}_5\text{C}(:\text{NH})\text{OC}_2\text{H}_5$.

The amides of the sulphonic acids are only slightly less important than those of the carboxylic acids discussed above. They are most conveniently prepared by the action of ammonia upon the corresponding sulphonyl chlorides:



Certain substances which either belong to this class or are derivatives of members of the class, and which are known as the "sulfa drugs," are of great importance in medicine. Sulfanilamide, $\text{H}_2\text{N}.\text{C}_6\text{H}_4.\text{SO}_2\text{NH}_2$, was the first of these drugs to be widely used; it may be considered the parent substance from which the remaining drugs are derived by structural modifications. (*See* SULFONAMIDES, THE.)

Among the important derivatives of the amides are those in which one or more of the hydrogen atoms attached to nitrogen have been replaced by alkyl or aryl groups. Such substances, like the above simpler ones, are also frequently designated as amides although, especially in the aromatic series, they may be named instead with reference to the aromatic amines from which they are derived. Thus, acetanilide, or *N*-phenylacetamide (*q.v.*), $\text{CH}_3\text{CONHC}_6\text{H}_5$ and acetotoluidide, or *N*-tolylacetamide, $\text{CH}_3\text{CONHC}_6\text{H}_4\text{CH}_3$, are obtained by the action of acetic acid, acetyl chloride, or acetic anhydride upon aniline (*q.v.*), $\text{C}_6\text{H}_5\text{NH}_2$, and toluidine, $\text{CH}_3\text{C}_6\text{H}_4\text{NH}_2$, respectively. (G. W. Wd.)

AMIDINES, the name given (a) to compounds of general formula $\text{RC}(:\text{NH})\text{NH}_2$, which may be considered as derived from amides of the type RCONH_2 (*see* AMIDES) by replacement of oxygen by the divalent imino ($:\text{NH}$) group; and (b) to compounds derived from the foregoing by the replacement of one or

more hydrogen atoms by alkyl or aryl groups. They may be prepared by the action of ammonia or amines on imide chlorides or on thiamides; by the action of ammonium chloride or hydrochlorides of amines on nitriles; by condensing amines and amides in presence of phosphorus trichloride; by the action of hydrochloric acid on acid amides; and by the action of ammonia or amines on imino-ethers. They are colourless crystalline bases, which are unstable; they readily take up the elements of water (when boiled with acids or alkalis), yielding amides and ammonia. On dry distillation they yield nitriles and ammonia. With β -ketonic esters, $\text{HO}(\text{CH}_2)\text{C}:\text{CH}.\text{CO}_2\text{R}$, they yield oxy-pyrimidines.

Formamidine, $\text{HC}(:\text{NH})\text{NH}_2$, is known only in the form of its salts, the crystalline hydrochloride being obtained by the action of ammonia on the hydrochloride of formimido-ethyl ether.

Acetamidine, $\text{CH}_3\text{C}(:\text{NH})\text{NH}_2$, is alkaline in reaction, and readily splits up into acetic acid and ammonia when warmed with acids. Its hydrochloride crystallizes from alcohol in colourless deliquescent prisms.

Benzamidine, $\text{C}_6\text{H}_5\text{C}(:\text{NH})\text{NH}_2$, forms colourless crystals which melt at $75-80^\circ \text{C}$.

AMIEL, HENRI FREDERIC (1821-1881), Swiss philosopher and critic, was born at Geneva Sept. 27, 1821. He studied philosophy at Berlin 1844-48. In 1849 he was appointed professor of aesthetics at the academy of Geneva, and in 1854 became professor of moral philosophy. These appointments, conferred by the democratic party, deprived him of the support of the aristocratic party which comprised nearly all the culture of the city. This isolation inspired the one book by which Amiel lives, the *Journal Intime*, which, published (2 vols. 1882-84) after his death, obtained a European reputation. It was translated into English by Mrs. Humphry Ward, and attracted many readers, partly because of the high praise given to it by Matthew Arnold, and partly because it interpreted many lonely souls to themselves. He died in Geneva, on May 11, 1881.

AMIENS, north France, capital of the department of Somme, on the left bank of the Somme, 81 mi. N. of Paris on the Northern railway to Calais. Pop. (1936) 90,870. The city was involved in both World Wars I and II and suffered severe damage especially during the former. The old town occupies the low-lying area between the arms of the rivers Somme and Avre. The site of the ancient ramparts is occupied by boulevards; and suburbs, bounded by another line of boulevards, have arisen beyond these limits, while the city also extends to the right bank of the Somme. The busy quarter lies between the river and the railway. The older quarter is situated directly on the Somme; its narrow and irregular streets intersected by the eleven arms of the river and skirted on the north by the canal derived therefrom.

Amiens occupies the site of the ancient *Samarobrica* capital of the Ambiani, from which it probably derives its name. At the beginning of the 4th century Christianity was preached there by St. Firmin, its first bishop. Its territory formed the mediaeval county of Amienois, and early in the 12th century the citizens profiting by rivalry of count and bishop gained a charter of enfranchisement. The fief became a dependency of the French crown in 1185. In 1435, by the treaty of Arras it fell to the dukes of Burgundy, until 1477. Surprised by the Spaniards in 1597, the city was recaptured from them after a long siege by Henry IV. Till 1790 it was the capital of the government of Picardy (*q.v.*). The famous treaty between Great Britain, France, Spain and Holland which took its name from Amiens was signed here in March 1802. In the Franco-German War (*q.v.*) Amiens, after an important action, fell into the hands of the Prussians on Nov. 28, 1870. In World War I the city was taken by the Germans on Aug. 30, 1914; but after the battle of the Marne the front was established some 20 mi. eastwards, where it remained till 1918. Amiens then became the first concentration point for British troops disembarking at Boulogne in 1914, and the first aircraft park was established here. It remained of high importance on the lines of communication and in March 1918 the Germans made a great effort to break through between the British and French armies at the Amiens salient. They advanced to with-

in eight miles of the town, which was evacuated by civilians and bombarded daily by heavy guns. The cathedral was struck nine times, and the roof pierced. Other buildings were damaged, and much havoc done in the Rue de Beauvais. Reconstruction, however, proceeded apace after the war.

Amiens has the park or Promenade de la Hotoie to the west and several fine squares, notably the Place Longueville and the Place St. Denis with the statue of the famous 17th century scholar Charles Ducange.

The cathedral of Notre Dame (*see* GOTHIC ARCHITECTURE; SCULPTURE; DOORWAY and ROSE WINDOW) is one of the finest Gothic churches in France. Erected on the plans of Robert de Luzarches, chiefly between 1220 and 1288, it consists of a nave, nearly 140 ft. in height, with aisles and lateral chapels, a transept with aisles, and a choir (with deambulatory) ending in an apse surrounded by chapels. The total length is 469 ft., the breadth 216 ft. The façade, which is flanked by two square towers, has three decorated portals, the central portal having a remarkable statue of Christ of the 13th century; they are surmounted by two galleries, the upper one containing 22 statues of the kings of Judah in its arcades, and by a fine rose window. A slender spire rises above the crossing. The southern portal is remarkable for a figure of the Virgin and other statuary. The interior contains beautifully carved stalls and a flamboyant choir-screen, and is remarkable for the height of the nave and the boldness of the columns supporting the vaulting. Of the other churches of Amiens, St. Germain (15th century) has good stained glass. The *hôtel de ville*, begun 1550, a belfry of the 14th and 18th centuries and several old mansions are of interest. The learned associations of Amiens include the *Société des Antiquaires de Picardie*, by whom the museum was built in 1854-64, and the early prehistoric collections illustrate the classic area of the Somme.

The city is the seat of a bishop, a prefect, a court of appeal and a court of assizes, and headquarters of the II army corps. There are also tribunals of first instance and of commerce, a board of trade arbitrators and a chamber of commerce.

The textile industries, celebrated since the middle ages, include velvet, cotton, wool, silk, hemp and flax-spinning, hosiery and a variety of mixed fabrics. Though seriously affected by World War I, the wool and textile industries had regained their prewar conditions. Manufactures of machinery and chemicals, and printing, dyeing, and iron-founding are also carried on. Market gardens, known as *hortillonnages*, intersected by small canals derived from the Somme and Avre, cover a considerable area northeast of Amiens; and the city trades in vegetables, grain, sugar, wool, oil-seeds and in the duck-pasties and macaroons for which it is renowned. A very important fair for all species of merchandise is held annually.

AMIENS, BATTLE OF (1918). This is the name for the offensive of the British 4th and French 1st Army under Sir Douglas Haig's orders, an offensive which, launched by surprise on Aug. 8, 1918, and coming close after the Allied counterstroke on the Marne (*see* WORLD WAR I; MARNE, SECOND BATTLE OF THE), inaugurated the unbroken tide of advance which culminated in the Armistice, on Nov. 11, 1918. After the German spring offensive had been finally stopped in front of Amiens, this sector had an interval of comparative quiet, except for frequent small raids by the Australians holding it, while the struggle developed on other parts of the front.

Towards the end of June, the 4th Army commander, Gen. Rawlinson, decided that an operation on rather a larger scale than the Australians had so far carried out had every chance of meeting with success. On July 4, six Australian battalions, working in close co-operation with some 60 tanks, together with four companies of the American 33rd division, which was attached to the 4th Army for training, attacked on a front of nearly three and a-half miles, and with consummate ease and only small losses captured the ridge running from Villers-Bretonneux down to the Somme at Hamel. This operation gave greater depth and valuable positions for observation to the British line, while at the same time it denied to the enemy important observation over much of the Somme valley. It also showed that the German infantry was no longer

the determined foe that it had been in 1916 and 1917, and that the enemy's defences were not formidable. The real significance of the operation was its evidence that on the 4th Army front a well organized attack, supported by tanks well trained beforehand to co-operate with infantry, would have every prospect of breaking through the enemy's defences, given the element of surprise.

On July 17 Rawlinson submitted proposals to Haig for an attack by the 4th Army on a front of approximately 16m. from Moreuil to Morlancourt. The plan was at once approved by Haig, who, in response to a request from Gen. Foch that the British should take the offensive on the Lys front with a view to recovering the important position on Kemmel hill, recommended that the venue for the British offensive should be changed to the Amiens front. To this proposal Foch assented with the modification that the French 1st Army (Debeney) should attack on the southern portion of the front between Moreuil and the River Luce (about three and a half miles) shoulder to shoulder with the British 4th Army, both armies operating under the direct orders of the British commander-in-chief.

On July 28 Foch issued his orders. "The object of the operation," he said, "is to disengage Amiens and the Amiens-Paris railway, as well as to beat and push back the enemy between the Somme and the Avre. The offensive, covered on the north by the Somme, is to push forward as far as possible in the direction of Roye." The Amiens-Roye road was fixed as the dividing line between French and British, and Aug. 10 was to be the day of attack. This date was subsequently advanced to Aug. 8.

Preparations for Surprise Attack.—On July 26 orders were received that the preparations, which Rawlinson had already begun in anticipation of sanction being given to his proposed operation, were to be pressed forward with all speed. The essence of the whole plan was secrecy. Unless the existing conditions both as regards the state of the hostile defences and the absence of reserves could be maintained success could not be guaranteed, and in consequence it was not until July 31 that divisional commanders even were told the true story of the operations, a false but adequate reason having been given for the preparations.

On Aug. 1 the strength of the 4th Army was seven divisions, one cavalry division, three tank battalions (about 110 tanks), 11 squadrons R.A.F. and 1,000 guns and howitzers. By zero hour on Aug. 8, this force had been increased to 13 divisions, three cavalry divisions, 12 tank battalions (about 456 tanks), 17 squadrons R.A.F., and over 2,000 guns and howitzers, of which 672 were "heavies." In addition, one division, retained in the hands of the commander-in-chief, was brought into the area, while two others arrived on the day of the battle. The cavalry, about 96 whippet tanks, and part of the artillery were moved by road, the remainder being brought up in some 290 special trains, 230 for personnel and guns and 60 for ammunition and *matériel*.

As the Canadian Corps, at the time in reserve near Arras, had not been involved in the desperate fighting earlier in the year, it was realized that wherever it was identified in the line by the enemy an early offensive would certainly be expected. The first problem, therefore, was to camouflage its move and to keep its presence secret up to the last possible moment. With this object a few Canadian units were moved into the line near Kemmel, whilst the remainder moved down to the Amiens front, though it was not allowed to take over its part of the front line until just before zero hour on Aug. 8. The task also of introducing and registering a very large number of guns without detection was no easy matter. All movements of artillery units and the formation of ammunition dumps had to be done at night. A strictly limited number of guns only were allowed to fire daily, nothing above the normal number of rounds being permitted.

General Plan of Attack.—The British front of attack was divided between the Canadian Corps (Currie, four divisions) from the Amiens-Roye road to the Amiens-Chaulnes railway, 7,500yds.; the Australian Corps (Monash, five divisions) thence to the Somme, 7,500yds.; and the 3rd Corps (Butler, four divisions) thence to the River Ancre, 5,000yds.; while to each corps a proportion of tanks was allotted. The task of the 3rd Corps was to form a defensive flank north of the Somme, whilst the French 1st

Army would carry out a similar task on the right of the Canadians. Three successive objectives were assigned at distances respectively of two to two and a-half, three to five, and six to eight miles from the original starting line. With the ample provision of tanks it was possible to repeat and improve upon the Cambrai experiment (*see CAMBRAI, BATTLE OF*) of Nov. 1917, and thus to gain the full value of surprise; a preliminary bombardment was omitted, the artillery, infantry and tank action commencing simultaneously at zero hour, up to which moment there was no divergence from the ordinary daily routine of trench warfare. With the French, however, the situation was different, as tanks were not available to assist them, and Debeney decided to bombard the enemy's defences for 40 minutes prior to the infantry advance. The zero hour, 4.20 A.M., of the 4th Army advance synchronised with the opening of the French bombardment.

The hostile forces believed to be available to oppose the British were six divisions in first line with eight in reserve of the German 2nd Army (Marwitz), while in front of the attacking corps of the French 1st Army were the two left divisions of the German 2nd Army and one division of the German 18th Army (Hutier). By the morning of Aug. 8 all preparations for the battle were complete, and the Allied forces, all unsuspected by the enemy, were about to enter upon the first stage of their march to the Rhine.

The British Attack, Aug. 8.—At 4.20 A.M. (approximately one hour before sunrise) Rawlinson's 4th Army, under cover of a powerful barrage, debouched to the assault. Thick ground mist veiled the advance from the eyes of the Germans, who were completely surprised and overwhelmed with little resistance along nearly the whole front. The Canadian Corps attacked with three divisions in line, the 3rd, 1st and 2nd in order from the right. The Canadian 3rd Division, making light of the difficult task of debouching from a narrow bridgehead on the south bank of the River Luce, captured Hangard and Demuin, and by noon had carried its front forward to the second objective, between Mézières and Cayeux. The 3rd Cavalry Division then went through, followed by the Canadian 4th Division, but, after taking Beaucourt, was held up by machine-gun fire. The infantry on coming up succeeded in pushing forward, though they were unable that day to capture Le Quesnel, the final objective.

The Canadian 1st Division in the centre reached the first objective by 6.20 A.M.; but the Canadian 2nd Division on its left only attained it an hour and a half later, having met with strong opposition at Marcelcave. At 8.20 A.M. the advance was resumed, the German machine-gunners putting up considerable resistance against the Canadian 2nd Division. The 1st Cavalry Division now sent forward two brigades, one of which passed through the Canadian 2nd Division and drove far into hostile territory, attaining the final objective in conjunction with the infantry, which followed up, clearing the ground in rear of the cavalry. By the end of the day's fighting the Canadian Corps had, with the exception already noted on the extreme right, carried out its appointed task, and captured over 5,000 prisoners and 161 guns.

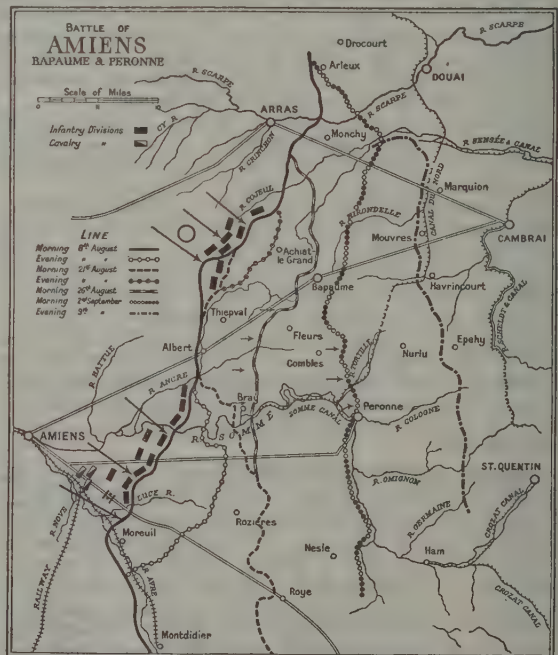
Progress in the Centre.—The Australian Corps in the centre of the British attack had their 2nd and 3rd Divisions in the front line with the 5th and 4th in support, the 1st Division being in reserve. The leading line, aided most effectively by the tanks, reached the first objective with little opposition. The 5th and 4th Divisions then continued the advance, pushing on beyond Bayonvillers and Morcourt, and occupied the second objective by about 10.30 A.M., when a brigade of the 1st Cavalry Division passed through towards Harbonnières and armoured cars raced forward down the Brie road, penetrating far into the enemy's back areas. Behind them, the Australians, throwing back their left to face the enemy on the north bank of the Somme, pushed forward their centre and right to the final objective just west of Vauvillers and Proyard, where they found the cavalry held up. During the day the Australians took nearly 8,000 prisoners and 173 guns.

North of the Somme the 3rd Corps had not met with the same measure of success. The plan had been disarranged by a local German attack near Morlancourt on Aug. 6, which forced back a

part of the Allied line some 800 yards. In addition the terrain was not so suitable for tank manoeuvres as south of the river. The attack opened with the 58th, 18th and 12th Divisions from right to left. After the first objective had been gained, the further advance broke down against the resistance of the enemy holding the Chipilly spur, while further north the enemy counter-attacked and drove back the advanced attacking troops. Nevertheless the 3rd Corps captured during the day nearly 2,400 prisoners and 40 guns.

The results of this most successful day's battle were the complete defeat and rout of 11 German divisions, a gain of ground to an average depth of six to seven miles on a front of eight miles, the capture of over 16,000 prisoners, 373 guns, several thousand machine-guns and quantities of ammunition and stores. Most important of all, the battle destroyed the last hope of German victory. "It was," said Ludendorff, "the black day of the German army in the war . . . To continue would be a gamble. The war would have to be ended."

The French Attack, Aug. 8.—At 4.20 A.M., simultaneous with the British assault, the French bombardment of the enemy's position on the commanding ground in the angle between the rivers Avre and Luce opened, and at 5.05 A.M. the French infantry in this sector debouched to the attack. For this operation Debeney allotted three divisions of the 31st Corps, of which one division was given the task of capturing Moreuil. Despite a stubborn defence, the enemy was gradually driven back and Moreuil wood



THE BATTLE OF AMIENS IN THE WORLD WAR, AUG.—SEPT. 1918
The successive stages of the great British advance initiated by the battle of Amiens, Aug. 8, 1918, brought the British to the outworks of the Hindenburg Line which they then attacked, breaking through at the end of September. The morale of the German Army was broken, and the way paved for the final victory three months later

taken. This feature was of great importance, as its capture secured the flank of the British advance. At 8.20 A.M. the next corps to the south, the 9th Corps, crossed the Avre, south of Moreuil, and extended the front of attack, which by the end of the day's fighting reached the general line Plessier-Fresnoy (excl.). Although the French attack did not quite reach its final objective for the day, its main task of securing the British flank was carried out, while some 3,000 prisoners and many guns were captured. The other two corps of the French 1st Army did not take an offensive rôle until next day. The result also enabled Gen. Fayolle, com-

manding the French reserve group of armies, to carry out his plan of extending the battle front farther to the south on Aug. 9.

Continuation of British Advance, Aug. 9-11.—It was decided by Rawlinson that the 4th Army should on Aug. 9 continue its advance to the line Roye-Chaulnes-Bray-Dernancourt. The main attack was entrusted to the Canadian Corps, which was to push south-east to the line Roye-Hallu, whilst the Australian corps was to secure its left between the latter place and Méricourt, and the 3rd Corps to advance to Etinehem and form a defensive flank north of the Somme.

Early in the morning the Canadians captured the village of Le Quesnel, thus completing the capture of all the objectives allotted to the main British attack for the 8th. During the day, assisted by cavalry, they advanced the line an average of five miles and halted for the night on a general line east of Rouvroy and Méharicourt. To the north the Australians reached Lihons hill and captured Framerville after stubborn fighting. The 3rd Corps, north of the Somme, cleared the Chipilly spur and occupied Morlancourt. During the day six German divisions reinforced the front from neighbouring armies. On Aug. 10 and 11 the advance continued against ever-stiffening resistance and hostile counter-attacks, eventually reaching the general line Le Quesnoy-Lihons-Raincourt, whilst north of the river the Etinehem spur was completely cleared.

It was now clear that to push the offensive farther would lead to disproportionate loss with little corresponding gain. The enemy had reformed his front, shattered on the 8th, by fresh troops from other portions of the line, and had settled down on the edge of the area devastated in the Somme battles of 1916, where a maze of old trenches, wire and shell holes rendered defence easy and rapid advance impracticable. Rawlinson had engaged all his 13 divisions, units were tired and in need of a breathing-space. He therefore decided to allow his troops a few days' rest while preparing for a renewal of the attack on Aug. 15. Units in the line were relieved and tired infantry and cavalry withdrawn into reserve.

French Operations, Aug. 9-11.—On Aug. 9 Debenedy made an encircling attack, south-east and north-east with his 10th and 35th Corps, his objective being Montdidier. The former was checked, and thus the garrison of the town managed to slip out, but the town was occupied and the rearguard captured on the morning of Aug. 10. In the meantime the 31st Corps to the north reached the line Pierrepont-Arvillers. By the night of the 11th it gained the western outskirts of Roye. On Aug. 10 Fayolle brought in the French 3rd Army (Humbert) on the right. Attacking on the front Courcelles-Gournay in the direction of Lassigny, it made an advance of an average depth of three to four miles. Next day the front was extended still farther southwards, but, owing to the enemy's resistance becoming stronger, progress was thenceforward slow.

British Operations, Aug. 12-21.—Owing to the difficulty of reorganizing the front of attack and of bringing up the guns, the attack arranged for Aug. 15 did not materialize, and up to the 21st only local actions took place on the 4th Army front. British attacks alternated with hostile counter-attacks, the line after hard fighting reaching Damery-Lihons-Proyart-Dernancourt. On Aug. 17 Haig decided to transfer temporarily the centre of gravity of the British offensive to the 3rd and 1st Army areas. The Canadian Corps was taken out of the line and the French 1st Army took over the British front as far north as Lihons. During the period Aug. 8-21 the 4th Army had forced back the Germans to a depth of 12 m., had defeated or engaged with its own 13 divisions no less than 27 of the enemy's, had taken over 23,000 prisoners and 400 guns and had killed and wounded more than an equivalent number, at a cost to itself of some 27,000 casualties.

French Operations, Aug. 12-21.—During this period the French 1st Army, which remained under Haig's command until the 16th, also came to a halt, but the French 3rd Army, whose advance was assisted by the French 10th Army's attack east of the Oise, after a hard and determined defence succeeded in occupying Lassigny on Aug. 21. In the 12 days' fighting Humbert's army of seven divisions had driven eight hostile divisions from their strong vantage-ground and had taken 5,000 prisoners and 100 guns.

General Results of the Battle.—The course and results of the fortnight's fighting may be summed up as follows: The three Allied armies (British 4th, French 1st and 3rd), with 32 divisions, had attacked and defeated the German 2nd and 18th Armies of 42 divisions. The Allies had advanced to a depth of 6-13 m. on a front of 47 m. taking 40,000 prisoners and 600 guns. Most important of all, the Allied lateral communications between Paris and the north had been cleared, and a wide breach had been made in the German front, susceptible, as events were to show, of being rapidly widened to either flank by further Allied attacks. A shattering blow had been dealt to the morale of the German Army and their high command, from the effects of which neither was destined to recover. The battle of Amiens was the first page in the story of the Allied victory of 1918.

THE BATTLE OF BAPAUME-PÉRONNE

This operation is dealt with here as it formed the immediate sequel to the battle of Amiens, in the scheme of the British offensive leading up to the assault of the Hindenburg Line. At the time the front of Byng's 3rd Army, which was the northern neighbour of Rawlinson's Army, was held as follows: 5th Corps (Shute, with three divisions) from the left of the 4th Army just north of Albert to Beaucourt, 4th Corps (Harper, with five divisions) thence as far as opposite Ablainzeville, 6th Corps (Haldane, with four divisions) thence to the army boundary south of Arras. Preparations were at once put in hand, the operations being timed to begin on Aug. 21, by which date the rapid advance of the 4th Army had been checked on the western edge of the old Somme battlefields of 1916.

Attack by 3rd Army.—On Aug. 21 a preliminary operation was carried out by the 4th and 6th Corps together with the left division of the 5th Corps, in order to get within striking distance of the enemy's main defensive position along the Arras-Albert railway. This attack, which was entirely successful and resulted in the capture of some 2,000 prisoners, enabled Byng to spend the 22nd in bringing up his guns preparatory to the main attack on the 23rd, on which date a general advance on the whole army front, together with that portion of the 4th Army which was north of the Somme, was timed to take place.

On the 23rd Byng attacked on a front of 16 m. from just north of Albert to the Cojeul. Though stubborn resistance was encountered considerable progress was made, the objective being reached all along the line. The 4th Corps, in the centre, pushed forward to Bihucourt and Loupart wood, while the 6th Corps captured Ervillers and established itself east of the Arras-Bapaume road in the vicinity of Boyelles. On the right the 5th Corps, in conjunction with the 3rd Corps (4th Army), pushed out its right and established itself on the hills overlooking the town of Albert just west of La Boisselle. During the day 5,000 prisoners and a number of guns were taken.

The advance was continued on the 24th and 25th, by the evening of which the 4th Corps had pushed forward as far as the line Favreuil-Mory, thus threatening the enemy's line of retreat from Bapaume. To the south the 5th Corps, after capturing the Thiepval stronghold on the 24th, attained a general line west of Contalmaison and Courcellette. On the left the 6th Corps occupied St. Léger and Henin-sur-Cojeul but was held up in front of Croisilles.

Fourth Army Operations.—The operations of the 3rd Army were closely supported by the 4th Army troops north of the Somme. On the 22nd the 3rd Corps and left Australian Division attacked on a front of 7,000 yd., reaching all their objectives to a depth of from 2,000 to 3,000 yards. In the afternoon a strong counter-attack developed against the 3rd Corps right division, and much of the ground won earlier in the day was lost. During the next three days the advance continued in conjunction with the 3rd Army, and on the evening of the 25th the front had reached a general line along the high ground west of Suzanne-Mametz. South of the Somme the Australian Corps on the 23rd advanced up to the edge of the old Somme battlefield, capturing 3,000 prisoners and 23 guns. As a result of the critical situation caused by these operations, the German Higher Command ordered

Von Boehm, commanding the group of armies between the Ancre and the Aisne, to fall back to the general line Quéant-east of Bapaume-Péronne-Ham. This movement was carried out on the 26th and 27th.

On the 26th the 5th Corps made a rapid advance, whilst the 4th Corps continued to swing round to the north-east of Bapaume, occupying Beugnâtre. On the evening of the 25th, the 17th Corps (Ferguson) relieved the 6th and undertook the difficult task of dispossessing the enemy of his strong position in the vicinity of Croisilles. During the next week a stubborn defence was shown all along the front, which by the evening of Sept. 2 had reached the enemy's position on the line Morval-Haplincourt-Noreuil. During the 13 days' fighting the 14 divisions of the 3rd Army had engaged 23 hostile divisions, had taken from them 11,000 prisoners and many guns and had driven them back a depth of 8-13 m. on a front of 20 m., besides inflicting heavy losses in killed and wounded.

On the 4th Army front north of the Somme, the 3rd Corps, together with the 3rd Australian Division, continued the advance in touch with the 3rd Army. South of the Somme the advance had been rapid, and on the evening of the 29th the river had been reached between Cizaucourt and Biaches, whence the line continued northwards to Combles. In view of the small prospect of success afforded by an attempt to force the strongly-held river line south of Péronne, Rawlinson decided that the next operation must be a strong advance by the centre and left towards Nurlu in order to turn the river line. Before that could be done, however, the key to it, the dominating height of Mont St. Quentin, which commanded all the country to the north and west, including all the river passages by which it could be approached, had to be captured.

Capture of Mont St. Quentin.—Although the operations which resulted in its capture by the Australians extended over only a few miles of front, they were of such importance to the general advance and so brilliantly executed that a description will be given in rather greater detail. On the 30th a bridge-head on the north bank of the river near Cléry was seized, and by 4 A.M. on the 31st the 5th Brigade (2nd Australian Division) had crossed over and by 7 A.M. had captured Mont St. Quentin village, the right being held up in front of Anvil wood. Shortly afterwards a strong counter-attack developed and drove the British line back to the road on the south-west side of the village. As a result of the day's fighting the 5th Brigade of some 1,200 rifles had penetrated to a depth of 2,000 yd., and, though reduced to only 600 rifles, had held out on a wide front of 4,000 yd. against repeated and desperate counter-blows.

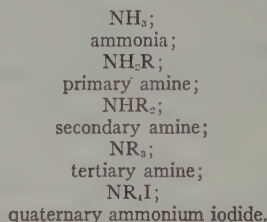
Next morning the 6th Brigade, which had crossed the river the evening before, passed through the 5th Brigade, and after a short bombardment stormed the village and wood and established itself on the height. Meanwhile the 14th Brigade (5th Australian Division) also passed through south of the 6th Brigade, and, brushing aside all opposition, entered and occupied Péronne, only a small portion of the suburbs on the north-east remaining in the enemy's hands. Next day the Australians occupied Allaines, and the 3rd Corps St. Pierre Vaast and Vaux woods. The line of the Somme had been turned, due, as a detailed account would show, to the brilliant initiative of every commander, from the army commander to the section leader, and to the magnificent fighting qualities of the Australian soldier. Between Aug. 22 and Sept. 2 the 4th Army of nine divisions had engaged 23 of the enemy's divisions and taken 23,000 prisoners and many guns.

Results of the Battle.—Byng's and Rawlinson's armies totaling together 23 divisions had defeated 46 German divisions. On a front of 28 m. they had advanced to a depth of six to 13 m., capturing 34,250 prisoners and 270 guns. The whole area of the Somme battlefields, which had cost the British five months of bitter fighting in 1916, had been reconquered in less than a fortnight; more than half the ground gained by the German spring advance had been recovered, the only good natural line of defence west of the Hindenburg system had been broken, and the shifting of the moral and material balance in favour of the British and against the Germans was not only heartening to the troops of the Allies but had become patent to the world.

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AMINES, in chemistry, derivatives of ammonia (*q.v.*) in which one or more of the three hydrogen atoms are replaced by alkyl or aryl groups. The replacement of one hydrogen atom by one alkyl or aryl group gives rise to primary amines; of two hydrogen atoms by two groups to secondary amines; of three hydrogen atoms by three groups to tertiary amines. The tertiary amines possess the power of combining with one molecular proportion of an alkyl iodide to form quaternary ammonium salts.

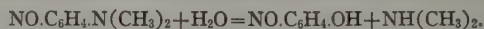
The structural relations of these compounds may be shown thus:



Aliphatic Amines.—An amine is said to be an aliphatic one if each carbon atom that is joined directly to the amino nitrogen atom is saturated. This is true even if aromatic rings are present in more distant parts of the molecule. (Cf. benzylamine, *below*.) The compounds of this type possess properties very similar to those of ammonia. The lowest members of the series are combustible gases and are readily soluble in water. The next higher members of the series are liquids of low boiling point and are also readily soluble in water, the solubility and volatility, however, decreasing with the increasing carbon content of the molecule. The highest members of the series are odourless solids of high boiling point and are insoluble in water. They are all moderately strong bases, readily forming salts with the mineral acids, and double salts with the chlorides of gold, platinum and mercury. They are ionized in aqueous solution to a somewhat greater extent than ammonia. The quaternary ammonium bases, NR_4OH , as distinct from the amines, are solids that are soluble in water; they are much more strongly basic than ammonia or any of the amines, and, in fact, are comparable in strength with sodium and potassium hydroxides.

Many methods have been devised for the preparation of primary amines. Methylamine was isolated in 1849 by A. Wurtz on boiling methyl isocyanate with potassium hydroxide, $\text{CH}_3\text{NCO} + 2\text{KOH} = \text{CH}_3\text{NH}_2 + \text{K}_2\text{CO}_3$. Other methods are: the reduction of nitriles with alcohol and sodium; the action of reducing agents on nitroparaffins; the action of zinc and hydrochloric acid on aldehyde ammonias; the reduction of phenyl hydrazones and oximes of aldehydes and ketones with sodium amalgam in the presence of alcohol and sodium acetate (J. Tafel and H. Goldschmidt, 1886); the acidic hydrolysis of the isonitriles, $\text{RNC} + 2\text{H}_2\text{O} = \text{RNH}_2 + \text{HCO}_2\text{H}$; heating the mustard oils with a mineral acid; the hydrolysis of the alkyl phthalimides (S. Gabriel, 1887); distillation of the aminoacids with barium hydroxide; the action of bromine and potassium hydroxide on the amides of carboxylic acids (A. W. Hofmann, 1885); and the hydrolysis of substituted urethanes (Th. Curtius, 1894).

The secondary amines are prepared, together with the primary and tertiary, by the action of ammonia on the alkyl iodides (see below), or by the hydrolysis of para-nitroso derivatives of tertiary aromatic amines, such as para-nitrosodimethylaniline, thus:



By the action of ammonia on the alkyl iodides a complex mixture of primary, secondary and tertiary amines, along with a

quaternary ammonium salt, is obtained, the separation of which is difficult. The method worked out by A. W. Hofmann in 1850 for the ethylamines is as follows:—the mixture is distilled with caustic (potassium hydroxide); the primary, secondary and tertiary amines distil over, and the quaternary ammonium salt remains behind unaffected. The aqueous solution of the amines is now shaken with diethyl oxalate; the primary amine forms a crystalline dialkylloxamate and the secondary amine an insoluble liquid, which is an ethyl dialkylloxamate, the tertiary amine not reacting: $(\text{CO}_2\text{C}_2\text{H}_5)_2 + 2\text{NH}_2\text{R} = (\text{CO.NHR})_2 + 2\text{C}_2\text{H}_5\text{OH}$; $(\text{CO}_2\text{C}_2\text{H}_5)_2 + \text{NHR}_2 = \text{C}_2\text{H}_5\text{O}_2\text{C.CONR}_2 + \text{C}_2\text{H}_5\text{OH}$. The tertiary amine is then distilled off, the residual products separated by filtration and finally hydrolysed by a caustic alkali.

A more general method due to O. Hinsberg (1890) consists in treating the mixed bases with benzene sulphonyl chloride (or *p*-toluene sulphonyl chloride). The primary base gives an acidic derivative, $\text{C}_6\text{H}_5\text{SO}_2\text{NHR}$ soluble in aqueous alkali, the secondary base furnishes the compound, $\text{C}_6\text{H}_5\text{SO}_2\text{NR}_2$, insoluble in alkali, whereas the tertiary base does not react. The process is applicable to both aliphatic and aromatic amines.

The primary, secondary and tertiary amines may be readily distinguished by their behaviour with various reagents. Primary amines when heated with alcoholic sodium hydroxide and chloroform yield isonitriles, which are readily detected by their offensive smell. The secondary and tertiary amines do not give this reaction. With nitrous acid, the primary amines yield alcohols, the secondary amines yield nitrosamines and the tertiary amines do not react: $\text{R.NH}_2 + \text{ONOH} = \text{R.OH} + \text{N}_2 + \text{H}_2\text{O}$; $\text{R}_2\text{NH} + \text{ONOH} = \text{R}_2\text{N.NO} + \text{H}_2\text{O}$. The condensation with benzene sulphonyl chloride in the presence of alkali also furnishes a method of diagnosis (*see above*). Primary amines heated with carbon disulphide in alcoholic solution are converted into mustard oils, when the dithiocarbamate first produced is heated with a solution of mercuric chloride. Primary and secondary amines condense with *o*-xylene dibromide giving two and one molecular proportions of hydrogen bromide, respectively. Tertiary aliphatic amines form additive compounds with this reagent (Scholtz 1898).

Methylamine, CH_3NH_2 , occurring in *Mercurialis perennis*, in bone-oil and herring brine, is also a decomposition product of many alkaloids. At ordinary temperatures it is a gas with a strong ammoniacal smell, burns readily and is exceedingly soluble in water. Dimethylamine $(\text{CH}_3)_2\text{NH}$, found in Peruvian guano, is a heavy vapour which liquefies at 7°C . and has a strong fish-like smell. Trimethylamine $(\text{CH}_3)_3\text{N}$, is a vapour very similar to dimethylamine, but liquefies at $3.2\text{--}3.8^\circ\text{C}$. It is usually obtained from "vinasse," the residue obtained from the distillation of beet sugar alcohol. The three methylamines can be obtained from ammonia and formaldehyde solution and a suitable separation for each of the three has been devised by E. Werner (1917). Tetramethylammonium iodide, $\text{N}(\text{CH}_3)_4\text{I}$, the chief product obtained by the action of methyl iodide on ammonia (Hofmann), crystallizes in quadratic prisms and has a bitter taste. By warming its aqueous solution with an excess of silver oxide, it is converted into tetramethylammonium hydroxide $\text{N}(\text{CH}_3)_4\text{OH}$, which crystallizes in hygroscopic needles, and has a very alkaline reaction. On dry distillation it is decomposed into trimethylamine and methyl alcohol. If the nitrogen atom in a quaternary ammonium salt is in combination with four different groups, then the molecule is asymmetric, and the salt can be resolved into optically active enantiomorphous isomerides (W. J. Pope and S. J. Peachey, 1899 [*see STEREOCHEMISTRY*]).

Benzylamine, $\text{C}_6\text{H}_5\text{CH}_2\text{NH}_2$, although it contains the phenyl group, C_6H_5 , is a typical aliphatic primary amine (*see above*). It may be prepared by reducing benzonitrile in alcoholic solution with zinc and acetic acid (O. Mendius, 1862), or by metallic sodium (E. Bamberger, 1887). It can also be obtained together with di- and tri-benzylamines by the action of ammonia on benzyl chloride (S. Cannizzaro, 1865). It is a liquid which boils at 183°C ., has an alkaline reaction, and is miscible in all proportions with water, alcohol and ether.

Diamines.—The diamines contain two amino groups and are of interest because two of them are identical with the ptomaines

produced by the putrefactive action of bacteria on albumen and other related substances. Ethylenediamine, $\text{C}_2\text{H}_4(\text{NH}_2)_2$, may be prepared by heating ethylene dibromide with alcoholic ammonia to 100°C . (F. S. Cloez, 1853); or by the action of tin and hydrochloric acid on cyanogen (T. Fairley, 1864). It is an alkaline liquid, which when anhydrous boils at 116.5°C . Nitrous acid converts it into ethylene oxide. It combines directly with many metallic salts. (S. F. Jørgensen, 1889.) Trimethylenediamine, $\text{NH}_2(\text{CH}_2)_3\text{NH}_2$, prepared by the action of ammonia on trimethylene bromide (E. Fischer, 1884) is a liquid which boils at $135\text{--}136^\circ\text{C}$. Tetramethylenediamine (putrescine), $\text{NH}_2(\text{CH}_2)_4\text{NH}_2$, is prepared by reducing ethylene dicyanide (succinonitrile) with sodium in absolute alcoholic solution (A. Ladenburg, 1886). It melts at 27°C . and is easily soluble in water. Pentamethylenediamine (cadaverine), $\text{NH}_2(\text{CH}_2)_5\text{NH}_2$, is prepared by reducing trimethylene cyanide in ether solution by zinc and hydrochloric acid (A. Ladenburg, 1883). Cadaverine is a syrup at ordinary temperatures and boils at $178\text{--}179^\circ\text{C}$. It is readily soluble in water and alcohol, but only slightly soluble in ether.

Aromatic Amines.—The aromatic amines are those in which the amino nitrogen atom is joined directly to at least one aromatic ring. These substances in some respects resemble the aliphatic amines, since they form salts with acids, and double salts with platinum chloride, and also distil without decomposition. On the other hand, they are much weaker bases than the aliphatic amines, their salts undergoing extensive hydrolysis in aqueous solution. The primary aromatic amines may be prepared by the reduction of the nitro-hydrocarbons, the reducing agents used being either alcoholic ammonium sulphide (N. Zinin), zinc and hydrochloric acid (A. W. Hofmann), an alcoholic solution of stannous chloride containing hydrochloric acid (R. Anschutz, 1886), tin and hydrochloric acid, or on the manufacturing scale iron and water acidified by hydrochloric acid. They may also be obtained by the reduction of nitroso compounds and of azo- and hydrazo-compounds and of hydrazones, by distilling the aminoacids with lime, by heating phenols with ammonio-zinc chloride (V. Merz, 1880), by the action of sodium hydroxide and bromine upon the amides of aromatic carboxylic acids, on the manufacturing scale by treatment of aryl chlorides with ammonia at high temperatures and pressures in the presence of a catalyst, and by heating the secondary and tertiary bases with concentrated hydrochloric acid to about 180°C . At about $300\text{--}400^\circ\text{C}$. the alkyl chloride formed in this last reaction attacks the benzene nucleus and replaces hydrogen by an alkyl group or groups, forming primary amines isomeric with the original amine; thus methylaniline hydrochloride is converted into para- and ortho-toluidine hydrochloride, and phenyltrimethylammonium iodide is converted into mesidine dihydriodide.

The primary aromatic amines are colourless liquids or crystalline solids which are sparingly soluble in water, but readily soluble in the common organic solvents. When heated with alkyl or aryl iodides they are converted into secondary and tertiary amines. When heated with concentrated sulphuric acid they become sulphonated. They form condensation products with aldehydes, benzaldehyde and aniline giving rise to benzylideneaniline, $\text{C}_6\text{H}_5\text{N}:\text{CHC}_6\text{H}_5$; and they form anilides when heated with organic acids. They give the isonitrile reaction (*see above*) when warmed with chloroform and a caustic alkali, and form aryl thioureas when heated with an alcoholic solution of carbon bisulphide. When warmed with a solution of nitrous acid, they are converted into phenols; if, however, nitrous acid be added to an ice-cold solution of a primary amine in excess of mineral acid, a diazonium salt is formed (*see ANILINE, AZO-COMPOUNDS AND DIAZO-COMPOUNDS*).

The secondary amines may be of two types—namely, the purely aromatic amines, and the mixed secondary amines, which contain an aromatic residue and an alkyl group. The purely aromatic amines are obtained by heating the primary amines with their hydrochlorides, and, in some cases, by heating a phenol with a primary aromatic amine and a catalyst (anhydrous zinc chloride or 1% of iodine). The mixed secondary amines are prepared by the action of alkyl iodides on the primary amines, or by heating salts of the primary amine with alcohols under pressure. (*See*

ANILINE.) The mixed secondary amines have basic properties, but the purely aromatic secondary amines are only very feeble bases. Both classes readily exchange the imide hydrogen for acid radicals and give nitrosamines with nitrous acid.

The tertiary amines may also be of two types, the purely aromatic and the mixed type. The mixed tertiary amines are produced by the action of alkyl halides on the primary amines. The simplest aromatic tertiary amine, triphenylamine, is prepared by the action of bromobenzene on sodium diphenylamine (C. Heydrich, 1885). Purely aromatic quaternary ammonium compounds are not known. The mixed quaternary hydroxides, such as trimethylanilinium hydroxide, $C_6H_5N(CH_3)_3OH$, are as strong bases as their purely aliphatic analogues.

Diphenylamine, $(C_6H_5)_2NH$, the simplest representative of the true aromatic secondary amines, crystallizes in white plates, which melt at $45^\circ C.$, and it boils at $302^\circ C.$

Aromatic Diamines.—The simplest aromatic diamines are prepared by reducing the three nitranilines. Ortho-phenylenediamine, $C_6H_4(NH_2)_2$, crystallizes from water in plates, which melt at $102-103^\circ C.$ and it boils at $256-258^\circ C.$

The ortho-diamines are characterized by the large number of condensation products they form (see GLYOXALINES). Meta-phenylenediamine crystallizes in rhombic plates which melt at $63^\circ C.$ and it boils at $287^\circ C.$ It is easily soluble in water and alcohol. Para-phenylenediamine may be prepared as above, and also by the reduction of aminoazobenzene. It crystallizes in tables which melt at $140^\circ C.$ and it boils at $267^\circ C.$ When heated with 10% hydrochloric acid to $180^\circ C.$ the three diamines yield the corresponding dihydroxybenzenes (J. Meyer, 1897). The three classes of aromatic diamines may be distinguished by their behaviour towards nitrous acid. The ortho-compounds condense to azimino benzenes, the meta-compounds yield azo-dyestuffs and the para-compounds yield bis-diazo compounds of the type $XN_2.C_6H_4.N_2X$. (See DIAZO-COMPOUNDS.)

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AMINOSIS, the abnormal presence of amino-acids in the organism. Proteins are made up of long chains of amino-acids. In the process of metabolism the proteins are split up into their constituent amino acids. Some of these acids are used in the synthesis (formation) of new body proteins, but the majority are further reduced by oxidation and deamination to carbon dioxide and water. The amine radical (NH_2) is synthesized into urea and excreted as such. In certain abnormalities of metabolism, this change does not take place and the body loses the power of converting the amino acids into their normal end products. In these circumstances we find amino acids in the urine. There are several types in this group. The most important form is when homogenistic acid is found in the urine. This substance, in the presence of oxygen and alkali, gives the urine a dark brown colour.

AMIOT, JEAN JOSEPH MARIE (1718-1793), French Jesuit missionary, was born at Toulon in Feb. 1718. He entered the Society of Jesus in 1737 and was sent in 1750 as a missionary to China. He soon won the confidence of the Emperor Kien-lung, and spent the remainder of his life at Peking, where he died Oct. 9, 1793. Amiot provided a key to the thought and life of the far east, by his *Dictionnaire tartare-manchou-français* (Paris, 1789). His other writings are to be found chiefly in the *Mémoires concernant l'histoire, les sciences et les arts des Chinois* (Paris, 1776-91).

The *Vie de Confucius*, the 12th volume of that collection, is complete and accurate.

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AMIR or **AMEER**, also spelt **EMIR**, a title common in the Mohammedan east (from the Arabic *amir*, meaning "commander," from the root 'mr, meaning "command").

The word originally signified any military commander but was

subsequently applied to governors of provinces and other high military officers. The title of *amir al-mu'minin*, "commander of the faithful," was assumed by the second caliph, Omar, and was adopted in later times by most of the various dynasties that claimed the caliphate.

In the 10th century the commander of the caliph's armies at Baghdad was styled *amir al-umarā*, which is translated "supreme commander" or "generalissimo." In later use *amir* was applied as a title of dignity to the descendants of the Prophet.

It was also used in combination with other terms, to denote office (as in *amir al-hajj*, "leader of the pilgrimage"). It was adopted also by the rulers of several independent states in central Asia, notably those of Bukhara and Afghanistan. As applied to naval commanders, it is the origin (through mediaeval Greek and Italian) of the English "admiral."

AMIR 'ALI, SEYYID (1849-1928), Indian jurist and Muslim leader, was born April 6, 1849, of an Arab family, tracing descent from the Prophet, which migrated from Persia and settled at Mohan in Oudh in the middle of the 18th century. At Hooghly college, Calcutta, he graduated in 1867. He came to London and was called to the bar of the Inner Temple in 1873. He had already published *A Critical Examination of the Life and Teachings of Mahomed*, the first of a series of books of Islamic modernist interpretation and apologetics, which have given him a recognized place in English literature. He was for some years a lecturer on Mohammedan law at the Presidency college, Calcutta, and afterwards president of the faculty of law at the university there. He was also chief presidency magistrate of Calcutta and in 1890 was appointed a judge of the Bengal high court, being the first Mohammedan to reach the bench in India. He was made a C.I.E. in 1887. In 1904 he retired and settled in England. He was the first Indian to be sworn (Nov. 1909) of the privy council and to serve on its judicial committee. But his chief ambition in life was the advancement of the Indian Muslims, both morally and materially, along practical and constitutional lines and his activities paved the way for the Morley-Minto and subsequent reforms. He died at his home at Rudgwick, Sussex, on Aug. 3, 1928.

AMIS ET AMILES, the title of an old French romance. In its earlier and simpler form it is the story of two friends, one of whom, Amis, was smitten with leprosy because he had committed perjury to save his friend. A vision informed him that he could only be cured by bathing in the blood of Amiles' children. When Amiles learned this he killed the children, who were, however, miraculously restored to life after the cure of Amis. The tale was probably of oriental origin, and was eventually attached to the Carolingian cycle as a 12th-century *chanson de geste*, written in decasyllabic assonanced verse, each stanza being terminated by a short line. Amis has married Lubias and become count of Blaives (Blaye), while Amiles has become seneschal at the court of Charlemagne, and is seduced by the emperor's daughter, Bellisant. The lovers are betrayed, and Amiles, fearing to fight in a false cause, goes in search of Amis, who personates him in the ordeal by combat. He thus saves his friend, but in so doing perjures himself. Then follows the leprosy of Amis, and, after a lapse of years, his discovery of Amiles and cure. The legend of Amis and Amiles occurs in many forms with slight variations.

See L. Gautier, *Bibl. des chansons de geste* (1897). The tale is published in good modern translations. The old French *chanson de geste* was edited by Konrad Hofmann (1852; 2nd ed., 1882).

AMITERNUM, an ancient town of the Sabines, about 5 mi. N. of Aquila, in the broad Aternum valley from which, says Varro, it took its name. Stormed by the Romans in 293 B.C. it suffered in the wars of the Republic, but its fertility made it prosperous under the empire. It lay at the point of junction of four roads—the Via Caecilia, the Via Claudia Nova and two branches of the Via Salaria. There are considerable remains of an aqueduct, an amphitheatre and a theatre, all of the imperial period, while in the hill on which the village of S. Vittorino is built are some Christian catacombs. Sallust was born at Amiternum.

AMLWCH (äm'loočh), market town of Anglesey, north Wales, situated on slightly rising ground on the northeast coast of the island, 15 mi. N.W. of Beaumaris. Rather more than three

miles distant on the coast are the remains of a Romano-British earthwork, while near at hand a mediaeval settlement is represented by the Llanllanau monastery. Amlwch seems to have been one of the fishing villages that grew up on the coast in association with these older sites.

In the 18th century the town came into prominence as the port for the rich copper mines of Parys mountain about two miles south of the town. There are traditions of the mines being worked intermittently from Roman days, but they reached their maximum activity between 1768 and 1870, and they are now derelict. The population in 1841 was 6,217 and in 1938 was 2,525. Industries at one time included slate-quarrying, still carried on to a limited extent, shipbuilding, iron and brass foundries, alum, vitriol, manure and tobacco works. Amlwch is the terminus of the branch line from Gaerwen to Amlwch, formerly the Anglesey Central Railway, and now run by the L.M.S.R.

AMMAN, JOHANN CONRAD (1669-c. 1730), Swiss physician, was born at Schaffhausen. He was one of the earliest writers on the instruction of the deaf and dumb and first called attention to his method in his *Surdus loquens* (Amsterdam, 1692), which was often reprinted and was reproduced by John Wallis in the *Philosophical Transactions* (1698).

See F. H. Garrison, *History of Medicine* pp. 653-654 (1929)

AMMAN, JOST (1539-1591), Swiss artist, celebrated chiefly for his engravings on wood, was born at Zürich. Of his personal history little is known beyond the fact that he removed in 1560 to Nuremberg, where he continued to reside until his death in March 1591. A large number of his original drawings are contained in the Berlin collection of engravings. The genuineness of not a few of the specimens to be seen elsewhere is at least questionable. A series of copperplate engravings by Amman of the kings of France, with short biographies, appeared at Frankfurt in 1576. He also executed many of the woodcut illustrations for the Bible published at Frankfurt by Sigismund Feierabend. Another serial work, the *Panoplia omnium liberalium mechanicarum et sedentiarum artium genera continens*, containing 115 plates, is of great value. Amman's drawing is correct and spirited, and his delineation of details is minute and accurate.

AMMAN, a city of Palestine (see PHILADELPHIA).

AMMANATI, BARTOLOMEO (1511-1592), Florentine architect and sculptor. He designed many buildings in Rome, Lucca and Florence, an addition to the Pitti palace being one of his most celebrated works. He also built the beautiful bridge over the Arno, known as Ponte della Trinità. The three arches are elliptic, and, though very light and elegant, have resisted the fury of the river, which has swept away several other bridges at different times. Another important work was the fountain for the Piazza della Signoria. In 1550 Ammanati married the poet Laura Battiferri.

AMMANFORD, urban district, Carmarthenshire, Wales. Pop. (1938) 6,906. Area, 1.5 sq.mi. Situated near the junction of the river Amman with the Loughor 17 mi. E. of Carmarthen town. This region has associations with Welsh folklore, particularly the hunting of Twrch Trwth (Mabinogion), and with the Physicians of Myddfaï (a village in East Carmarthenshire). In the 18th and 19th centuries considerable quantities of local carboniferous limestone were burned and carried long distances by road to west Wales for marling purposes. Ammanford grew with the export trade in coal, and its importance increased especially after 1885 as the use of anthracite spread. After 1900 rapid strides were made and Ammanford doubled its population in ten years—(1901) 3,500; (1911) 6,074. With the growing demand for anthracite in place of steam coal in modern industry and the amalgamation of almost all the anthracite collieries in south Wales into a large unit with world-wide influence and markets, Ammanford and district escaped to some extent the universal depression in the coal industry after 1918. New pits were sunk in 1928.

Ammanford has a station on the Pantyffynon-Garnant branch of the G.W.R., and is also served by Pantyffynon and Tirdail on the Llanelly and Llandilo branch line over parts of which the G.W.R. and L.M.S.R. have running powers. Ammanford was made

an urban district in 1903 and since 1918 is included in the East Carmarthenshire (Llanelly) parliamentary area.

AMMENDORF, a town lying on the river Elster between Halle and Merseburg, Prussian Saxony. Pop. (1939) 16,295. It is a centre for lignite and briquette industries, also producing machines, chemicals, paper and cardboard.

AMMETER: see INSTRUMENTS, ELECTRICAL.

AMMIANUS MARCELLINUS, Roman historian, was born about A.D. 325-330 at Antioch; the date of his death is unknown but he must have lived till 391, as he mentions Aurelius Victor as the city prefect for that year. He was a Greek of noble birth. He entered the army at an early age and was sent to serve under Ursicinus, governor of Nisibis and *magister militiae*. He returned to Italy with Ursicinus, when he was recalled by Constantius II and accompanied him on the expedition against Silvanus the Frank. With Ursicinus he went twice to the east and barely escaped with his life from Amida or Amid (mod. Diarbekr), when it was taken by the Persian king Shapur (Sapor) II. When Ursicinus lost his office and the favour of Constantius, Ammianus seems to have shared his downfall; but under Julian, Constantius's successor, he regained his position. He accompanied Julian in his campaigns against the Alamanni and the Persians; after the death of Julian he took part in the retreat of Jovian as far as Antioch, where he was living in 371. Eventually he settled in Rome, where, at an advanced age, he wrote (in Latin) a history of the Roman empire from the accession of Nerva to the death of Valens (96-378), thus forming a continuation of the work of Tacitus. This history (*Rerum Gestarum Libri XXXI*) was originally in 31 books; of these the first 13 are lost, the 18 which remain cover the period from 353 to 378. It is a clear, comprehensive and impartial account of events by a contemporary of soldierly honesty, independent judgment and wide reading. His style is generally harsh, often pompous and extremely obscure, occasionally even journalistic in tone, but the author's foreign origin and his military life and training partially explain this. Further, the work being intended for public recitation, some rhetorical embellishment was necessary, even at the cost of simplicity. Though a professional soldier Ammianus gives excellent pictures of social and economic problems, and in his attitude to the non-Roman peoples of the empire he is far more broadminded than Livy and Tacitus. In his description of the empire—the exhaustion produced by excessive taxation, the financial ruin of the middle classes, the progressive decline in the morale of the army—we find the explanation of its fall before the Goths 20 years after his death.

The work was discovered by Poggio, who copied the original ms. *Editio princeps* (bks. 14-26) by Sabinus, 1474; completed by Accursius, 1533; with variorum notes, by Wagner-Erfurt, 1808. Later editions of text, V. E. Gardthausen, 1874-75; C. U. Clark, 1910-15. English translations by P. Holland, 1609; C. D. Yonge, 1862. See F. Liesenberg, *Der Sprache des Ammianus Marcellinus* (1888-90); Max Büdinger, *Ammianus Marcellinus und die Eigenart seines Geschichtswerkes* (1895); S. Dill, *Roman Society in the Last Century of the Western Empire* (1898); T. R. Glover, *Life and Letters in the Fourth Century* (1901); A. M. Harmon, "The Clausula in Ammianus Marcellinus," *Conn. Acad. Arts and Sci., Trans.*, vol. xvi, pp. 119-245 (New Haven, 1910); W. Ennsin, *Zur Geschichtsschreibung und Weltanschauung des Ammianus Marcellinus* (1923).

AMMINES, in chemistry, compounds resulting from the addition of ammonia, NH₃, to metallic salts or other chemical compounds. The term is applied in a broader sense to compounds containing organic amines in place of part or all of the ammonia. (See CO-ORDINATION; VALENCY.)

See A. Werner, *New Ideas in Inorganic Chemistry* (1911); M. M. J. Sutherland, *The Metal Ammines*, vol. 10 in J. A. N. Friend, ed., *Text-book of Inorganic Chemistry*, 11 vol. (1928).

AMMIRATO, SCIPIONE (1531-1601), Italian historian, born at Lecce, in the kingdom of Naples, lived under the patronage of Duke Cosimo I, of Florence, who gave him a residence at the Medici palace and the Villa Zopaja on the understanding that he should write his *Istorie Fiorentine* (1600), the work by which he is best known.

AMMON: see AMON.

AMMONIA (NH₃) and its salts have long been known, sal ammoniac (NH₄Cl) being mentioned by Pliny and having served

as an article of commerce in antiquity. Sal ammoniac (*q.v.*) was first derived from organic material containing nitrogen by heating either camel's dung or a mixture of salt and urine. During the middle ages ammonia was obtained in aqueous solution by distilling the horns and hoofs of oxen; thus, its alchemical designation as "spirits of hartshorn." J. B. Priestley (1774) prepared ammonia gas, which he called "alkaline air," by heating sal ammoniac with lime. K. W. Scheele (1777) showed that ammonia contained nitrogen, but it remained for C. L. Berthollet (1785) to ascertain its exact composition.

Ammonia is found in small traces in the atmosphere and in rain water usually as the carbonate. It is formed when nitrogenous animal and vegetable matter undergoes putrefaction. It is found in humus-rich soils, in sea water and in plant and animal liquids (such as urine). It also occurs in variable but limited quantities in the vapours of lavas and in other volcanic effusions, in crater gases and is occasionally concentrated in the form of ammonium salts in the mineral incrustations adjoining fumaroles. It is present to the extent of about 0.1% in the vapours of the soffioni (natural steam vents) at Larderello (province of Tuscany), Italy, and is actually recovered on a commercial scale from this source.

The more important laboratory methods for the preparation of ammonia include: (1) the action of alkaline hydroxides upon ammonium salts (usually the chloride or the sulphate), $\text{NH}_4\text{Cl} + \text{NaOH} = \text{NaCl} + \text{NH}_3 + \text{H}_2\text{O}$, and (2) the hydrolysis (decomposition by water) of nitrides such as magnesium nitride, $\text{Mg}_3\text{N}_2 + 6\text{H}_2\text{O} = 3\text{Mg}(\text{OH})_2 + 2\text{NH}_3$. Large tonnages of ammonia and of ammonium sulphate are obtained as by-products in the manufacture of coke and gas from coal. For many purposes, however, synthetic ammonia is preferred. The latter is made directly from the elements by the Haber process, or a modification thereof, involving use of high pressures ranging from 200 to 1,000 atmospheres, temperatures between 400° to 500° C. and a variety of catalysts (*see* NITROGEN, FIXATION OF). The synthetic ammonia process is one of the most important industrial chemical processes now in operation and accounts for more than 70% of the total of ammonia production. An older process based upon the hydrolysis of calcium cyanamide is now used only to a limited extent.

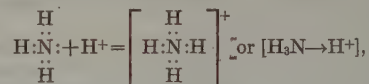
Ammonia is a colourless gas possessing a characteristic pungent odour. It is lighter than air, its relative density being 0.589 compared with air = 1. It is easily liquified either by cooling to the normal boiling point, -33.42°C ., or by compression. The most important physical properties are given in Table I.

TABLE I.—Physical Properties of Ammonia

Melting point	195.36°K (-77.74°C .)
Boiling point	239.68°K (-33.42°C .)
Density of liquid at triple point	0.735 g./ml.
" at boiling point	0.682 "
" at critical temperature	0.234 "
Density of solid at triple point	0.81 "
Vapour pressure at triple point	45.58 mm.
" at -40°C	538.3 "
" at 0°C	3,221.0 "
" at 30°C	8,749.0 "
" at critical temperature	112.3 atmospheres
Critical temperature	406.0°K (132.9°C .)
Specific heat at boiling point	1.07 cal./g.
" at freezing point	1.05 "
Heat of fusion	1,352 cal./mol.
Heat of vaporization (at boiling point)	5,581 cal./mol.
Ebullioscopic constant (observed)	0.34
Cryoscopic " (observed)	0.97
Dielectric constant at -60°C	26.7
" at 5°C	18.94
" at 25°C	16.26
Refractive index, $\lambda = 0.589\mu$ at 16°C	1.325

The ammonia molecule has been shown to possess a pyramidal structure with the nitrogen atom resonating between two equally stable positions at a distance of 0.360 Å.U. (Å., Angstrom unit = 10^{-8} cm.) above and below the plane occupied by the three hydrogen atoms. Its electronic structure is represented by three normal covalent bonds between the three hydrogen atoms and the nitrogen atom, leaving the latter with an unshared pair of electrons.

This structure accounts for many of the properties of ammonia (and of its derivatives), such as its tendency to act as a proton (hydrogen ion) acceptor to form the ammonium ion,



and its ability to form co-ordination compounds, such as the metal amines, also designated as ammoniates; *i.e.*, compounds containing ammonia of crystallization. The latter vary widely in stability, some, such as $\text{AgCl} \cdot 3\text{NH}_3$ losing ammonia readily on heating, while others such as the cobalt and chromium amines—*e.g.* $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$ and $[\text{Cr}(\text{NH}_3)_6](\text{NO}_3)_3$ —being stable (*see* AMMINES; CO-ORDINATION COMPOUNDS). It is of interest to note that M. Faraday liquified ammonia for the first time (1823) by heating the compound $\text{AgCl} \cdot 3\text{NH}_3$ in a sealed, two legged-tube, one leg of which was cooled in an ice-salt mixture to effect more ready condensation of ammonia vapour.

Ammonia undergoes thermal dissociation in the presence of certain catalysts to give nitrogen and hydrogen. Ammonia is therefore used as a convenient means for transporting hydrogen in the combined form since the gaseous mixture obtained by its decomposition contains 75% by volume of hydrogen and 25% by volume of nitrogen. Decomposition into the elements can also be effected by photochemical means and by passing a silent electrical discharge through the gas. Traces of hydrazine are obtained when such decomposition is brought about at low pressures, or when a highly heated tungsten filament is immersed in liquid ammonia. (A. W. Browne).

Ammonia does not support combustion, but it will burn when mixed with oxygen to give a variety of products, principally nitrogen and water with some oxides of nitrogen. Ammonia has been prominently mentioned as a constituent of various types of fuels, both for internal-combustion engines and for jet propulsion. A liquid mixture consisting of a solution of ammonium nitrate in liquid ammonia is stated to be a self-sustaining fuel combination requiring no addition of an oxidant, such as air.

The controlled oxidation of ammonia by air using platinum gauze as the catalyst is a technical process of great importance since it results in the formation of nitric oxide, this being the first step in the manufacture of synthetic nitric acid by the Ostwald process (*see* NITRIC ACID). Mixtures of nitrous oxide and ammonia, especially in the volume ratio of 3:2 can be made to detonate with violence yielding nitrogen and water as the reaction products: $3\text{N}_2\text{O} + 2\text{NH}_3 = 4\text{N}_2 + 3\text{H}_2\text{O}$. Ammonia reacts at higher temperatures with some metallic oxides, such as cupric oxide, to effect their reduction to the metals; in other cases, nitrides are formed. The hydrogen atoms of ammonia may be partially or completely replaced by metals to give either amides or nitrides. When ammonia is bubbled through molten sodium or potassium there are formed sodium amide, NaNH_2 , and potassium amide, KNH_2 , respectively; magnesium, on the other hand, is transformed into the nitride, Mg_3N_2 .

Chemical oxidation of ammonia in aqueous solution usually causes formation of nitrogen gas. Chlorine reacts to give ammonium chloride and nitrogen, but only if the ammonia is present in excess. Otherwise, the highly explosive nitrogen trichloride, NCl_3 , is also produced. Iodine yields a violently explosive substance commonly referred to as nitrogen triiodide. This black crystalline product was shown by D. Chattaway and by O. Silberrad to have the composition $\text{NI}_3 \cdot \text{NH}_3$. The commercial procedure for the manufacture of hydrazine is based upon the oxidation of aqueous ammonia by sodium hypochlorite solution, a process which appears to be successful only if a large excess of ammonia is employed together with certain catalytic materials which inhibit the decomposition of hydrazine: $2\text{NH}_3 + \text{NaClO} = \text{N}_2\text{H}_4 + \text{NaCl} + \text{H}_2\text{O}$. (*See* HYDRAZINE.)

The phase diagram of the system: ammonia-water reveals the existence of two solid hydrates, $\text{NH}_3 \cdot \text{H}_2\text{O}$ and $2\text{NH}_3 \cdot \text{H}_2\text{O}$, both melting at approximately -79°C . It is doubtful if either one of these is capable of existing at room temperature, even though

the solubility of ammonia in water is high. At 20° C. and normal pressures about 700 vol. of ammonia gas dissolve per volume of water. Ammonia gas may be expelled completely from the aqueous solution by boiling.

Since ammonia is a proton acceptor (combines with the hydrogen ion), that is, acts as a base, it undergoes reaction with water in accordance with the following equation: $\text{NH}_3 + \text{H}_2\text{O} \rightleftharpoons \text{NH}_4^+ + \text{OH}^-$. It is highly improbable that any appreciable concentration of molecular ammonium hydroxide, NH_4OH , exists in aqueous solution, even though water solutions of ammonia are generally referred to as "ammonium hydroxide." Ammonia is a weak base and therefore reacts with the solvent water only to a limited extent to produce ammonium and hydroxyl ions. A decinormal solution of ammonia (0.17% NH_3) in water reacts only to the extent of about 1% to form NH_4^+ and OH^- ions, the dissociation constant, K^b , for aqueous ammonia as a base being $K = 1.65 \times 10^{-5}$ at 25° C. The hydroxyl ion concentration is therefore low compared with that furnished by equivalent quantities of such strong electrolytes as sodium hydroxide.

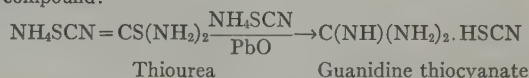
The ammonium ion, NH_4^+ , is a univalent radical resembling the alkali metal ions. Ammonium salts, for instance, are crystallographically similar to the corresponding potassium and rubidium salts. The ammonium radical may take the place of the alkali metals in such double salts as those represented by the type formula $\text{CuSO}_4 \cdot \text{M}_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$ and in the alums $\text{MAl}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$, where M represents NH_4 or some alkali metal. Many attempts have been made to prepare the free ammonium radical, but the evidence for its existence is at best circumstantial. H. H. Schlubach and F. Ballouf allowed potassium and ammonium chloride to interact in liquid ammonia at -70° C. and obtained only one-third of the theoretical quantity of hydrogen. They therefore assumed the existence of free ammonium in such a solution; at -40° C. the remainder of the hydrogen was evolved. The addition of sodium amalgam to a cold concentrated aqueous solution of ammonium chloride gives a spongy mass which resembles the amalgams of the alkali metals in some respects but not in others; this product decomposes readily into ammonia and hydrogen.

Ammonium salts are prepared either in the laboratory or technically by direct combination of gaseous or aqueous ammonia with the desired acids; thus, combination of ammonia with hydrochloric acid yields ammonium chloride (sal ammoniac), with nitric acid, ammonium nitrate. It has been claimed that ammonia and hydrogen chloride will not combine if both are perfectly dry (see DRYNESS, CHEMICAL); moreover, that perfectly dry ammonium chloride does not exhibit the reverse phenomenon of dissociation into its components, which is so characteristic of ammonium salts. More recent work by A. Smits has failed to substantiate this much disputed point. Ammonium salts of practically all acids, both inorganic and organic, have been isolated and characterized. The ammonium salts of strong acids dissolve in water to give an acid reaction, hydrolysis being caused by the fact that the following equilibrium is established: $\text{NH}_4^+ + \text{H}_2\text{O} \rightleftharpoons \text{NH}_3 + \text{H}_3\text{O}^+$. Rise in temperature shifts this equilibrium to the right as is evidenced by the fact that some ammonia is lost when solutions of ammonium salts are heated to boiling. Some ammonium salts, such as ammonium chloride, do not melt on heating but dissociate into their components in accordance with the equation: $\text{NH}_4\text{X} = \text{NH}_3 + \text{HX}$; others, such as ammonium nitrate and ammonium sulphamate have definite melting points and are stable at the melting point.

Ammonium salts have been shown by L. F. Audrieth and co-workers to behave as acids at higher temperatures. Ammonium chloride has long been used as a fluxing agent for removal of oxide films from metal surfaces prior to soldering operations; ammonium sulphate has been employed in the "opening up" of ores; fused ammonium nitrate reacts directly with many metallic oxides to give the corresponding nitrates. Characterization of ammonium salts as acids, per se, is accounted for by the fact that the ammonium ion is capable of releasing the proton; i.e., can in accordance with the modern concept of acidity behave as an acid. It should be pointed out in this connection that ammonium salts behave as acids when dissolved in liquid ammonia.

Ammonium salts have found wide application technically, but only the most important ones will be mentioned here. Ammonium chloride, NH_4Cl , also long known under the trade name sal ammoniac, is made commercially by the neutralization of hydrochloric acid with aqueous or gaseous ammonia. It is purified by sublimation. It is extensively used as a constituent of galvanizing, tinning and soldering fluxes, since it reacts readily at higher temperatures with metal corrosion products thus serving as a metal cleaner. In galvanizing operations a double salt with zinc chloride, either $\text{ZnCl}_2 \cdot 2\text{NH}_4\text{Cl}$ or $\text{ZnCl}_2 \cdot 3\text{NH}_4\text{Cl}$, is usually employed to serve first as a liquid protective layer over molten zinc; second, as a metal cleaner for the material to be coated with zinc and, third, to dry and preheat the work (sheet or article) which is to be coated with zinc. As a soldering flux it is employed either by itself, or in aqueous solution, or in admixture with rosin, paraffin waxes or oils, organic surface active agents and/or other acids. Ammonium chloride also finds use (1) as a pharmaceutical being a common constituent of many proprietary cold and cough medicines, (2) in dry cells, (3) in the manufacture of a number of dyes and as a weakly acid constituent of dyeing baths and (4) in the manufacture of iron cements and other ammonium salts. For further information concerning its manufacture in early times and its uses, particularly in medicine, see the more extensive article on SAL AMMONIAC.

On a tonnage basis more ammonium sulphate, $(\text{NH}_4)_2\text{SO}_4$, is produced than any other ammonium salt. It is obtained chiefly as a by-product in the manufacture of coke and gas from coal. It is one of the most important nitrogenous fertilizers, but also finds use in fireproofing fabrics and to a limited extent as a medicinal. Ammonium nitrate, NH_4NO_3 , is an important fertilizer ingredient; it also finds widespread technical application as a constituent of various military high-explosive compositions, in dynamites and blasting explosives, and as a source of nitrous oxide, since it decomposes on heating in accordance with the equation: $\text{NH}_4\text{NO}_3 = \text{N}_2\text{O} + 2\text{H}_2\text{O}$. Ammonium thiocyanate, NH_4SCN , can be obtained from carbon disulphide and ammonia. It isomerizes to thiourea on heating; if fused in the presence of desulphurizing agents such as lead oxide, PbO , it can be converted into a guanidine compound:



Both thiourea and guanidine are valuable industrial raw materials in the manufacture of rubber accelerators, plastics and medicinals.

Three ammonium phosphates, known respectively as the mono-, di- and triammonium phosphates, or as the monobasic, dibasic and tribasic salts, are obtainable by interaction of phosphoric acid with the requisite quantities of ammonia. The solid triammonium phosphate, $(\text{NH}_4)_3\text{PO}_4$, loses ammonia quite readily to go over into the diammonium salt, $(\text{NH}_4)_2\text{HPO}_4$. The monoammonium phosphate, $\text{NH}_4\text{H}_2\text{PO}_4$, is an important ingredient of baking powders. Both the monobasic and dibasic salts are used extensively in flameproofing of paper, wood and textiles, in the formulation of nutrient solutions and in the production of special fertilizer mixtures as, for instance, for use in the practice of hydroponics (soilless agriculture).

Ammonia and carbon dioxide react to give ammonium carbamate, $\text{NH}_2\text{COOH} \cdot \text{NH}_3$, which is formed as an intermediate product in the high-pressure synthesis of urea, $\text{CO}(\text{NH}_2)_2$. Ammonium carbamate hydrolyzes in water solution to form ammonium hydrogen carbonate, NH_4HCO_3 . Commercial ammonium carbonate, $(\text{NH}_4)_2\text{CO}_3$, is usually a mixture of the normal carbonate and the hydrogen carbonate. Ammonium perchlorate, NH_4ClO_4 , is of interest chiefly because it can be made to react with concentrated nitric acid to give nitrous oxide and perchloric acid. It is one of the less-soluble ammonium salts. The ammonium salts of high molecular weight fatty acids, $\text{RCOOH} \cdot \text{NH}_3$, such as ammonium stearate, find use as detergents, emulsifying agents, textile assistants and as surface active agents of the anionic type. For further information concerning preparation, properties and uses of ammonium salts see Johann Friedrich Gmelin's *Handbuch der*

Anorganischen Chemie, 8th ed., vols. 4 ("Nitrogen") and 23 ("Ammonium").

The Ammonia System of Compounds.—Particular reference is made to the fact that ammonia resembles water in many of its physical properties. This similarity is even more striking when consideration is given to the fact that ammonia occupies an anomalous position with respect to the other hydrogen compounds of the fifth group of the periodic system just as water is different from the remaining hydrides of the sixth group. Its boiling point, dielectric constant and heat of vaporization are abnormally high, as compared with phosphine, arsine and bismuth hydride, indicating that liquid ammonia consists of molecular aggregates, rather than of simple NH_3 molecules. Like water, liquid ammonia is not only an excellent solvent for many inorganic and organic compounds, but has been found to serve as a useful medium for carrying out a wide variety of chemical reactions. (For further details concerning reactions in liquid ammonia see SOLUTIONS.)

Related to its interesting properties as a solvent is the fact that ammonia may be looked upon as the parent substance of the "ammonia" or "nitrogen" system of compounds (see E. C. Franklin, *The Nitrogen System of Compounds* [1935]). Nitrogen compounds, both inorganic and organic, can be regarded as derivatives of ammonia much as the oxygen compounds may be considered as derivatives of water. This concept has been of tremendous value in classifying and systematizing the chemistry of nitrogen. The prefix "ammono" has been applied to these nitrogen compounds to distinguish them from the analogous "aquo" compounds derived from water as the parent substance. This concept has not merely been helpful in classifying nitrogen compounds but has received experimental confirmation by the study of behaviour of nitrogen compounds in liquid ammonia and other nonaqueous solvents. Typical ammono compounds are listed in table II together with the analogous aquo compounds. The relationship of these to the corresponding oxygen compounds is evident from a consideration of related groups derived from each parent solvent.

From water: HOH OH^- O^{2-}
From ammonia: HNH_2 NH_2^- NH^- and N^{3-} .

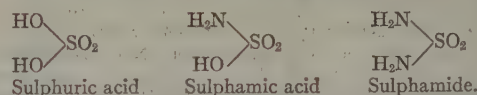
Accordingly, compounds containing the $-\text{NH}_2$ group should behave in ammonia as solvent in the same way that substances containing the OH group react in water. This concept has been confirmed experimentally.

TABLE II.—Ammono Compounds

Formula	Name	Character	Aquo analogue
KNH_2	potassium amide	ammono base	KOH
Hg_2N_2	mercuric nitride	anamonide	HgO
$\text{K}_2\text{Zn}(\text{NH}_2)_2$	potassium ammono zincate	amphoterite amide	K_2ZnO_2
$\text{SO}_2(\text{NH}_2)_2$	sulphamide	ammono sulphuric acid	$\text{SO}_2(\text{OH})_2$
$\text{C}(\text{NH})(\text{NH}_2)_2$	guanidine	ammono carbonic acid	$\text{CO}(\text{OH})_2$
$\text{CO}(\text{NH}_2)_2$	urea	ammono carbonic acid	$\text{CO}(\text{OH})_2$
H_2NCN	cyanamide	ammono carbonic acid	$\text{CO}(\text{OH})_2$
CH_3NH_2	methylamine	ammono alcohol	CH_3OH
$(\text{CH}_3)_3\text{N}$	trimethylamine	ammono ether	$(\text{CH}_3)_2\text{O}$
CH_3CONH_2	acetamide	ammono acetic acid	CH_3COOH
CH_3CONHNa	sodium acetamide	salt of ammono acetic acid	CH_3COONa
$\text{CH}_3\text{CONHC}_2\text{H}_5$	N-methylacetamide	ammono ester	$\text{CH}_3\text{COOCH}_3$
$\text{CaCl}_2 \cdot 8\text{NH}_3$	calcium chloride-8-ammonia	compound containing ammonia of crystallization	$\text{CaCl}_2 \cdot 6\text{H}_2\text{O}$

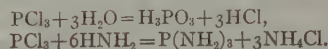
The true character of many nitrogen compounds becomes self-evident from this point of view. Such mercury compounds as HgNH_2Cl and $\text{HgCl}_2 \cdot 2\text{NH}_3$, known as the "infusible" and "fusible white precipitates" represent an ammono basic compound and a

compound containing co-ordinated ammonia, respectively (see MERCURY). Sulphamic acid, $\text{H}_2\text{NSO}_3\text{H}$, and sulphamide, $\text{SO}_2(\text{NH}_2)_2$, are both analogues of sulphuric acid as becomes obvious from the following structural relationship:



Sulphamic acid is now a commercially available chemical and has found widespread use as a nonhygroscopic, crystalline compound which in solution behaves as a strong acid. Ammonium sulphamate, $\text{NH}_4\text{SO}_3\text{NH}_2$, is an effective flame retardant and an outstanding herbicide. Potassium nitridotrisulphate, $\text{N}(\text{SO}_3\text{K})_3 \cdot 2\text{H}_2\text{O}$, is obtained as a crystalline precipitate by addition of excess potassium sulphite to a solution of potassium nitrite: $\text{KNO}_2 + 3\text{K}_2\text{SO}_3 + 2\text{H}_2\text{O} = \text{N}(\text{SO}_3\text{K})_3 + 4\text{KOH}$. On boiling with water it is converted successively into the imidodisulphate, $\text{HN}(\text{SO}_3\text{K})_2$, and finally into the sulphamate, KSO_3NH_2 . Reaction of sulphur trioxide with ammonia gives mixtures of the diammonium and triammonium salts of imidodisulphuric acid, $\text{HN}(\text{SO}_3\text{H})_2$. The earlier work of E. Divers and of F. Raschig (*Schwefel- und Stickstoffstudien*, 1924) and that of M. Cuperly and L. F. Audrieth should be consulted for further details concerning these nitrogen-sulphur compounds.

Ammonia is capable of converting active halogen compounds, such as the nonmetallic halides, thiohalides and oxyhalides, into the corresponding nitrogen compounds. These reactions of "ammonolysis" are similar to those effected by water (reactions of hydrolysis) as the following parallel equations demonstrate:



The nitrogen content of products obtained by these reactions depends upon conditions, particularly the temperature. While phosphorus (III) triamide, $\text{P}(\text{NH}_2)_3$, is obtained and appears to be stable at -33°C ., the product loses ammonia at room temperature to yield diphosphorus (III) triimide, $\text{P}_2(\text{NH})_3$, and undergoes complete deamination (analogous to dehydration) at 550°C . to give phosphorus (III) nitride

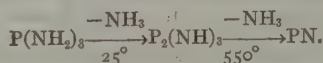


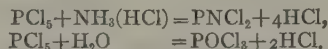
Table III gives a list of compounds obtained when specific non-metallic halides react with ammonia (see W. C. Fernelius and G. B. Bowman, *Chemical Reviews*, vol. 26, pp. 8-11 [1940] for further details).

TABLE III.—Reaction Products of Nonmetallic Halides with Ammonia

Compound treated with ammonia	Substance formed and conditions
BCl_3	$\text{B}(\text{NH}_2)_3$ ($-23^\circ, 0^\circ\text{C}$.)
BBr_3	$\text{B}_2(\text{NH})_3$ ($-10^\circ, +20^\circ\text{C}$.)
SiCl_4	$\text{Si}(\text{NH}_2)_4$ (-50° to 0°C .)
	$\text{Si}(\text{NH})_2$ (20°C .)
SiSCl_3	$\text{Si}(\text{NH})_2$
Si_2Cl_6	$[\text{Si}(\text{NH})\text{NH}_2]_2$ (low temperatures)
GeCl_4	$\text{Ge}(\text{NH}_2)_4$ (-80°C .)
SnCl_4	$2\text{Sn}(\text{NH}_2)_2\text{Cl} \cdot \text{NH}_4\text{Cl}$ (0°C .)
TiBr_4	$\text{TiNBr} \cdot x\text{NH}_3$
PCl_3	$\text{PN}(\text{NH}_2)_2$ (-70°C .)
PCl_5	$\text{P}(\text{NH}_2)_3$ plus $\text{P}_2(\text{NH})_3$
TaCl_5	$\text{Ta}(\text{NH}_2)_2\text{Cl}_3 \cdot 3\text{NH}_3$
SO_2Cl_2	$\text{SO}_2(\text{NH}_2)_2$ (-33°C .)
POCl_3	$\text{PO}(\text{NH})(\text{NH}_2)$ (0°C .)
VOCl_3	$\text{VO}(\text{NH}_2)_3$ (-80°C .)

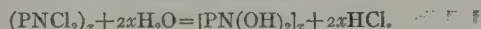
Attention is directed to the fact that only partial replacement of halogen is effected in the case of the halides of tin, titanium and vanadium under the given reaction conditions. The reaction between phosphorus pentachloride and ammonia can also be made to stop at an intermediate stage, especially when ammonium

chloride is used to effect ammonolysis. Here again parallel equations may be given to show the similarity between reactions of ammonia and water



Partial replacement of halogen in phosphorus pentachloride results in the formation of the phosphonitrilic chlorides, $(\text{PNCl}_2)_x$, where $x=3, 4, 5, 6, 8$ and ∞ . The lower members of this series undergo polymerization on heating to the "inorganic rubber" $(\text{PNCl}_2)_n$, a substance which resembles the better-known natural and synthetic elastomers in its physical properties. The publications of H. N. Stokes, R. Schenck and G. Roemer, A. M. de Fiquelmont, and R. Steinman and A. D. F. Toy should be consulted for detailed information.

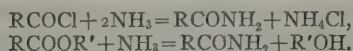
Hydrolysis of the phosphonitrilic chlorides yields the corresponding phosphonitrilic acids, also known as the metaphosphinic acids; as represented by the type equation:



These ammonio phosphoric acids are related to amido- and di-amido phosphoric acids $(\text{HO})_2\text{PONH}_2$ and $\text{HOPO}(\text{NH}_2)_2$ first isolated by Stokes. They constitute the simplest members of a large and interesting group of nitrogen derivatives of phosphoric acid.

Organic Derivatives of Ammonia (See AMIDES; AMIDINES; AMINES; ANILINE; CYANAMIDE; CYANIC ACID AND CYANATES; GUANIDINE; STEREOCHEMISTRY; UREA; URETHANE).—Ammonia finds wide application in organic chemistry as a synthetic agent. It reacts with the alkylhalides to form the alkylamines, RNH_2 (primary), R_2NH (secondary), R_3N (tertiary); with ethylene dihalide to yield ethylenediamine, $\text{H}_2\text{NCH}_2\text{CH}_2\text{NH}_2$, diethylene triamine, $\text{H}_2\text{NCH}_2\text{CH}_2\text{NHCH}_2\text{CH}_2\text{NH}_2$, together with the higher members of this series; with ethylene oxide or ethylene chlorohydrin to give the mono-, di- and triethanolamines $\text{H}_2\text{NC}_2\text{H}_4\text{OH}$, $\text{HN}(\text{C}_2\text{H}_4\text{OH})_2$ and $\text{N}(\text{C}_2\text{H}_4\text{OH})_3$. Under special conditions alcohols can be caused to react with ammonia in the presence of dehydrating catalysts such as activated alumina, to yield the corresponding primary, secondary or tertiary amines, depending upon the ratios of the reactants and upon the temperature. The amines are basic in character and form salts which in many respects resemble the corresponding ammonium salts. Tertiary amines, R_3N , combine with alkylhalides to form the quaternary or tetraalkylammonium salts; $\text{R}_3\text{N} + \text{RX} = \text{R}_4\text{NX}$. These compounds resemble the alkali metal salts even more strongly than do the ammonium salts. The tetraalkylammonium hydroxides are almost completely ionized and behave as strong bases in aqueous solution. The relative stability of the quaternary ammonium radical is further illustrated by the fact that the corresponding amalgams are much more stable than that of ammonium. H. N. McCoy and W. C. Moore obtained a tetramethylammonium amalgam which did not decompose below 10°C . Electrolysis of tetramethylammonium iodide in liquid ammonia results in the formation of a blue coloration in the cathode region. Since the alkali and alkaline earth metals produce this coloration in ammonia, it seems highly probable that the tetramethylammonium radical is actually discharged and thus capable of existence for a limited time. When all four alkyl groups of a quaternary ammonium salt are different, the compound can be resolved into optical isomerides.

Esters and acid chlorides react with ammonia to form amides:



At high temperatures and in the presence of dehydrating catalysts it is possible to convert the fatty acids of high molecular weight, such as those derived from fats and oils, into the corresponding nitriles:

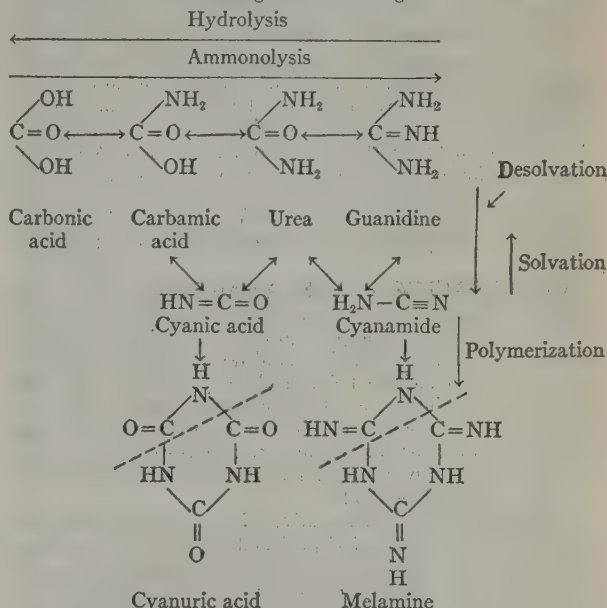


The nitriles can be converted by various indirect procedures into

the amidines, involving essentially addition of ammonia:



Of great technical importance is the high-pressure synthesis of urea from carbon dioxide and ammonia. Urea is, in fact, a carbonic acid derivative of ammonia and is related to such compounds as guanidine, cyanamide, cyanic acid and carbamic acid as indicated in the following schematic diagram:



Some ammonia derivatives of carbonic acid. The compounds cyanic acid and cyanamide are desolvation products, whereas cyanuric acid and melamine are polymerization products of simpler units.

Ammonia is the simplest hydronitrogen, the latter being defined as one of a series of compounds containing only hydrogen and nitrogen. The hydronitrogens, like the hydrocarbons, may be divided into several homologous series, but unlike their carbon analogues only a few (ammonia, hydrazine and hydrazoic acid) have actually been isolated in the free state. Most of them are known only in the form of their organic derivatives, but these constitute a large and variegated group of compounds. For further details see H. Wieland's *Die Hydrazine* and N. Sidgwick's *The Organic Chemistry of Nitrogen* (also DIAZO-COMPOUNDS; HYDRAZINE; HYDRAZONE).

TABLE IV.—The Hydronitrogens

	Empirical formula	Structural formula	Name
N_nH_{n+2} series	NH_3	NH_3	ammonia and its derivatives
	N_2H_4	$\text{H}_2\text{N}-\text{NH}_2$	hydrazine and its derivatives
	N_3H_5	$\text{H}_2\text{N}-\text{NH}-\text{NH}_2$	triazane, prozane
	N_4H_6	$\text{H}_2\text{N}-\text{NH}-\text{NH}-\text{NH}_2$	tetrazane, buzane, hydrotetrazane
N_nH_n series	N_2H_2	$\text{HN}=\text{NH}$	diazene, diimide, azo compounds
	N_3H_3	$\text{HN}=\text{N}-\text{NH}_2$	triazene, diazo-amino compounds
	N_4H_4	$\text{H}_2\text{N}-\text{N}=\text{N}-\text{NH}_2$	tetrazene, tetrazone
		$\text{HN}=\text{N}-\text{NH}-\text{NH}_2$	isotetrazene, diazohydrazine, buzylene
N_nH_{n-2} series	N_3H	$\text{HN}=\text{N}\equiv\text{N}$	hydrazoic acid, azoimide, hydronitrilic acid
N_nH_{n-4} series	N_5H_3	$\text{HN}=\text{N}-\text{NH}-\text{N}=\text{NH}$	bisdiazamine
	N_6H_4	$\text{HN}=\text{N}-\text{NH}-\text{N}=\text{N}-\text{NH}-\text{N}=\text{NH}$	octazotriene, octazones

Detection and Estimation.—Solutions of ammonia and ammonium salts, even if dilute, give a distinct yellow or yellowish-brown coloration with Nessler's solution, because of the formation of a complex iodide, $\text{NH}_4\text{I.H}_2\text{O}$, which is obtained as a precipitate from stronger solutions; this is also the basis of a colorimetric method for estimating minute traces of ammonia in drinking water. Larger quantities of ammonia or its salts can be detected by the evolution of the characteristic smell of the free ammonia on heating with caustic alkalis or lime. The quantitative estimation may be effected by (1) distillation of salts or ammoniacal liquors with sodium or potassium hydroxide and absorption of the liberated ammonia in an excess of standard sulphuric acid, the excess being titrated by alkali; (2) by absorption of ammonia in hydrochloric acid and precipitation as the chloroplatinate, $(\text{NH}_4)_2\text{PtCl}_6$, or (3) by the addition of neutral formaldehyde to a neutral solution of an ammonium salt, whereby hexamethylenetetramine is formed and the acid originally in combination with the ammonia is set free and may be titrated: $4\text{NH}_4\text{Cl} + 6\text{CH}_2\text{O} = (\text{CH}_2)_6\text{N}_4 + 4\text{HCl} + 6\text{H}_2\text{O}$. (See REFRIGERATION AND ITS APPLICATION.) (L. F. A.)

AMMONIACUM or **GUM AMMONIAC**, a gum resin exuded from the stem of a perennial herb (*Dorema ammoniacum*), family Umbelliferae. The plant grows to the height of eight or nine feet, and its whole stem is pervaded with a milky juice which oozes out on an incision being made at any part. This juice quickly hardens into round tearlike bodies, forming the "tear ammoniacum" of commerce. "Lump ammoniacum," the other form in which the substance is met with, consists of aggregations of "tears," frequently incorporating fragments of the plant itself, as well as other foreign bodies.

AMMONITE, a representative of a group of extinct Mollusca, belonging to the class Cephalopoda (q.v.). They possessed an external shell, coiled in a flat spiral and divided into chambers very similar to that of the modern nautilus (q.v.). Many reached a great size, the largest, *Pachydiscus seppenradensis*, from the Cretaceous of Westphalia, having a shell six feet eight inches in diameter. The Ammonites appeared in the Carboniferous period and became extinct at the end of the Cretaceous.

AMMONITES, a people of ancient Transjordan, believed to be allied to Israel, but still more closely to Moab. Their home was to the north and northeast of Moab, and their chief city, Rabbath-Ammon (later Philadelphia, the modern Amman) stood on the banks of a tributary of the Jabbok. Like the Moabites, the Ammonites seem to have combined the pastoral life with a limited amount of agriculture. Their religion was similar to that of their neighbours but was notorious for the extent to which human sacrifice was offered to their god Milcom or Melek. It is, of course, impossible to discuss the actual history of Ammon, but the tribe is occasionally mentioned in the annals of other peoples, especially those of Israel. Belonging to the same general Hebrew stock, they had dispossessed the aborigines, whom they called Zamzumim, and settled down before the time of the Exodus in a district bounded to the north by the river Jabbok. Expelled by Sihon from the northern parts of their territory and driven eastwards, they had been left unmolested by the Israelites in their passage to Palestine, but, nevertheless, had remained hostile to them. They were in alliance with David, but on the death of Nahash made an effort to escape from association with Israel. The country was overrun, Rabbath was captured and the people reduced to servitude.

We hear but little of Ammon during the period of the Hebrew kingdoms, but Shalmaneser III speaks of a small contingent (1,000 men) in the allied army which met him at Karkar (see AHAB), and a century later Tiglath-Pileser III and his successors received tribute from Ammon. They do not seem to have been concerned in the great revolt of 701, and Sennacherib was content to receive tribute from them. In 587 they supported Zedekiah at the beginning of his rebellion against Nebuchadnezzar, but, apparently, submitted; and Ammonite troops were amongst those that sacked Jerusalem. From this time onward implacable enmity seems to have existed between Israel and Ammon. It was at the instance of a king of Ammon that Gedaliah was murdered,

and the partial depopulation of Judah saw numbers of them entering the country. In his attempt to restore the purity of the Judean community, Nehemiah found that a certain Tobiah, an Ammonite, was one of his bitterest opponents, and this tribe offered a strenuous resistance to the aggrandizing policy of the Maccabean princes. They still formed a large community in the days of Justin Martyr. (T. H. R.)

AMMONIUM in a positive univalent ion. NH_4^+ , whose salts resemble those of potassium and univalent thallium in solubility and crystalline form. The free ammonium radical has been prepared as an amalgam. (See AMMONIA.)

AMMONIUS HERMIAE (5th century A.D.) Greek philosopher, the son of Hermias. He taught at Alexandria and had among his scholars Asclepius, John Philoponus, Damascius and Simplicius. His commentaries on Plato and Ptolemy are lost. Of his commentaries on Aristotle we have: (1) one on the *Isagoge* of Porphyry (Venice, 1,500 fol.); (2) one on the *Categories* (Venice, 1,503 fol.), the authenticity of which is doubted by Brandis; (3) one on the *De Interpretatione* (Venice, 1,503 fol.). They are printed in Brandis's scholia to Aristotle, forming the fourth volume of the Berlin *Aristotle*; they are also edited (1891-99) in A. Busse's *Commentaria in Aristot. Graeca*. The special section on fate was published separately by J. C. Orelli, *Alex. Aphrod., Ammonii, et aliorum de Fato quae supersunt* (Zürich, 1824). A life of Aristotle, ascribed to Ammonius, but with more accuracy to John Philoponus, is often prefixed to editions of Aristotle. It has been printed separately, with Latin translation and scholia, at Leyden, 1621, and Helmstadt, 1666, and at Paris, 1850. Other commentaries on the *Topics* and the first six books of the *Metaphysics* still exist in manuscript.

For a list of his works see J. A. Fabricius, *Bibliotheca Graeca*, v. 704-707; C. A. Brandis, *Über d. Reihenl. d. Bücher d. Aristot. Org.*, 283 f.; K. Prantl, *Gesch. d. Logik*, i. 642.

AMMONIUS SACCAS (c. 160-242), the founder of Neoplatonism, was originally an Alexandrian porter, and, according to Porphyry as quoted by Eusebius, a Christian. His self-instruction in philosophy was thorough enough to attract disciples of such calibre as Longinus, the grammarian, Origen and Plotinus. Since he designedly left no writings, practically nothing is known about his doctrines. From casual remarks of Nemisius and Hierocles, he is said to have taught the incorporeity of the soul and to have attempted a reconciliation of Plato and Aristotle. It is impossible to determine to what extent he influenced Plotinus.

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AMMUNITION, a term which includes projectiles and their propelling charges for small arms, artillery and trench mortars, also bombs, grenades, pyrotechnics and the components of these. In general, cartridges the projectile elements of which are less than one inch in diameter are classified as small arms ammunition—the larger calibres as artillery ammunition. In the first category, all components of a single round are commonly assembled into a compact unit which includes a metal (brass) case housing the powder, a projectile (affixed to one end of this case) and a primer (inserted in the other end). Artillery ammunition is likewise so assembled in the lesser calibres, and is then known as fixed ammunition, as contrasted with semifixed which, though loaded into the gun as a unit, embodies a missile which may, in order to adjust the propelling charge, be detached from the case and its contents. A third and final type, as commonly employed in pieces of medium and large bore, is separate-loading ammunition wherein powder, primer and missile are not brought together until placed in the gun from which fired, the propellant being supplied in one or more cloth (silk) bags. Here the naked projectile is first rammed into the chamber, to be followed by the bag or bags of powder, after which the primer is separately inserted into its seat in the breechblock. (Or the bags may be assembled into a preprimed case, in which instance the cartridge thereupon, assumes characteristics approaching those of the semifixed type.) The combination, in no matter what form (fixed, semifixed or separate-loading) of one full set of the elements (powder, pro-

jectile, primer) necessary for a single firing of a piece to which adapted, is known as a complete round.

I. ARTILLERY AMMUNITION

HISTORICAL

The introduction of instruments employing gunpowder to project missiles dates from early in the 14th century and Berthold Schwartz, a monk of Freiburg, Germany, is credited with their invention. The necessary propellant (black powder) had been described a full half century earlier by another cleric, the English friar, Roger Bacon, but he apparently remained unaware of its manifold military applications. The first ordnance projectiles were obviously adaptations of those already used in contemporary weapons (crossbow and longbow), being nothing more nor less than iron darts feathered with brass, their shafts wrapped with stuffings of leather to lessen leakage of powder gases. They could hardly have been large or heavy, for ancient records quoted by Napoleon III in his famous work on artillery disclose the fact that there existed at the royal arsenal at Rouen in 1338 a *pot-de-fer* (cannon) the weight of a dart for which he estimates at not over six and two-thirds ounces, the propelling charge therefore being about two-thirds of an ounce of black powder.

But the dart was ballistically unsound, though it and similar types of missiles continued occasionally to be discharged from firearms for centuries yet to come. Hence inventive minds soon began to cast about for something better and fastened on a form destined to rule supreme until the general introduction of rifled weapons (1850-70), to wit, the sphere. And since spherical stone shot had already seen use in throwing machines of various types since ages long forgot, stone was selected as the material for the new-type projectiles. References to these are found in France in 1346, Italy in 1364 and England, 1378. They proved so successful that spheres of other materials were soon being employed. Thus iron shot are mentioned as early as 1350, though they apparently did not come into general use until the reign of Charles VIII of France (1493-98). It would appear that the first projectiles of this material (used in firearms) were designed for use in hand and shoulder weapons, and that their application to heavy ordnance came later. Two ancient texts of the period of about 1400-50 both recommend that (small arms) balls be heated red hot when fired against troops sheltered in wooden structures, etc., while hot shot are said to have been used in cannon as early as 1418 (siege of Cherbourg). It is probable that these would have been employed still earlier but for the lack of adequate insurance against the propelling charge being set off ahead of time by the heat of the projectile.

That problem was ultimately solved, however, by interposing a thick wad of moist clay, wet straw or other insulating agent between powder and ball. Bronze shot enjoy an antiquity coequal with that of the stone projectile, for they are mentioned by Petrarch (1344 or earlier) as in use among the Italians of his day. The same is true of leaden missiles, for Napoleon III quotes from 14th century records to show that these were in use in France in 1345. For a period, metal shot of all three types just mentioned (iron, bronze, lead) appear to have been used indiscriminately. Thus the Venetians employed some of each in their action against the French at the battle of Taro (1491). Strange as it may appear, the material which survived most successfully the many field tests to which cannon missiles of the time were being subjected was stone. Such a choice was based on two very good reasons; viz., stone balls, even though their method of fabrication was painfully slow (gradual chipping into spherical form, with hammer and chisel, from rough blocks), were still cheaper than those of metal, for human labour commanded pitifully small recompense, and stone missiles, being lighter than metal ones of equal size, were started up the bore of a piece with smaller charges of powder, hence with less strain upon the fragile cannon of the period. Under the circumstances, it is easy to see that the life of one of the contemporary cannon, rudely fashioned as it was, was very likely to be more prolonged when balls of stone were fired from it than when those of metal were employed. And the same

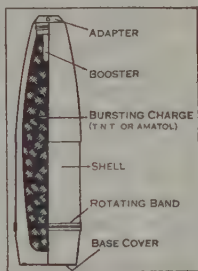
holds for the crews that served them. For the bursting of guns was a far from unusual occurrence, as evidenced by a contemporary manuscript which says that: "A cannoneer must always love and serve God, for every time he fires a gun or makes powder, he may be killed." This reference to powder making is pertinent, for each master gunner was then his own powder mixer, the art of incorporating the ingredients of this compound in such a manner that they would not separate on handling not having been developed. In separating, the heaviest ingredient, sulphur, settled to the bottom, while the lightest, carbon (charcoal), rose to the top, the result being a marked reduction in the potency of the product which, at best, was feeble and uncertain in action. Hence it became the practice to convey the components to the battlefield in separate containers and stir them together on the spot. And the danger undergone by him who undertook this was far from remote, for the glowing matches of any musketeers who happened about offered ready means for igniting the deadly brew before it could be gotten from mixing bowl to gun chamber.

Round (spherical) shot proved satisfactory for battering walls and buildings, and in the smaller sizes, as used in hand and shoulder weapons, against personnel. But a single cannon ball, no matter how large, was rarely very effective against troops, as it followed a given path and only those in the line of this were endangered. Hence, as the use of ordnance became more general, attention was directed toward devising means whereby a considerable number of small projectiles rather than a single large one could be delivered simultaneously into hostile ranks. This end had already been attained in a measure by the introduction and rather wide use of ribaudequins, which consisted in effect of a large number of shoulder pieces, or sometimes just the barrels of these, mounted like so many organ pipes on a cart and discharged simultaneously, or in sizable increments, at the enemy. But such contrivances were clumsy and slow in operation and, once all the barrels had been emptied, practically impossible to reload and fire again before the fate of the day had been decided. Hence the early development of the canister or case shot for great guns, consisting of a cylindrical metal container of bore diameter, filled with small projectiles of whatever nature happened to be handy—not infrequently simple pebbles of stone. This commonly went to pieces and released its deadly burden shortly after leaving the muzzle. The use of such projectiles is reliably reported as early as 1410 and they figured prominently in the siege of Belgrade three decades later. Faced by a more effective agency, the ribaudequin slowly disappeared from the scene, though the idea has persisted through the ages and took new life in the Billingham and Requa "machine gun" of the U.S. Civil War, which, in the last analysis, was nothing more than a row of musket barrels mounted on a wheeled carriage.

The next development in artillery ammunition was, quite logically, the shell, originally—and for centuries thereafter—a simple, hollow sphere of cast iron, filled with explosive (black powder) with a hole drilled through its wall into the explosive cavity and, fitted into this, a fuse of some sort to ignite the contents within. W. W. Greener in *The Gun and its Development* ascribes this invention to the Netherlands. Others; e.g., Ford, indicate that the Venetians (1376) antedated the Hollanders in the employment of shell in cannon, and that the invention would have come still earlier had means for preparing satisfactory fuses been available. The actual date of introduction aside, the shell soon began to experience wide use for land operations among all great nations and eventually became and has remained, with certain periodic fluctuations in the degree of favour enjoyed, the most important projectile available to the artilleryman. On the sea, however, the firing of explosive or incendiary missiles was long held too dangerous (to the user) to be considered. But one captain, a Frenchman, Deschiens, appears to have defied convention and employed shells horizontally from his long guns. (Practice on land countenanced their use only for high-angle fire from mortars.) The efficacy of this tactic was attested, however, in an engagement in 1690 wherein his vessel was beset by four British boats. Employing shells of his own contrivance he readily dispersed these.

In a later exchange with two Dutch ships he sank one and disabled the other. But apparently he was far ahead of his time, for none undertook to follow the precedent he established. Toward the close of the 18th and commencement of the 19th centuries, however, all nations began to realize that something must be done to make naval ordnance more effective. One incident which drove this fact keenly home was the battle of Trafalgar—in which not a single vessel was sunk by gunfire. Naval authorities commenced to look about for a remedy. They had not far to seek, for an excellent example lay before them.

In 1788 an Englishman, Sir Samuel Bentham, who had risen to high places in the naval service of the czar of Russia, had fitted out a flotilla of longboats, mounting brass cannon and amply supplied with shell, carcasses (incendiary projectiles) and solid shot. Attacking with these minuscule vessels a very considerable Turkish squadron, he gained a notable victory. His shell not only tore gaping holes in the sides of the enemy ships but started conflagrations which resulted in the destruction of the entire Turkish fleet. As not infrequently happens, however, Bentham's countrymen studiously ignored the lesson thus delivered. Actually there was method in this, for Britain feared that should the practice of firing shell horizontally from long guns become general, its preponderance in sea power might be neutralized, a smaller (but more modern) hostile navy equipped with shell guns being able to worst her numerically superior forces not similarly armed.



BY COURTESY OF THE U.S. WAR DEPARTMENT

FIG. 1.—155-MM. HIGH-EXPLOSIVE SHELL

So it fell to France to exploit the new agency, or rather the new adaptation of an old one. This it did assiduously over some decades, its efforts culminating with the development by Gen. Henri Paixhans (1822) of a comprehensive system of naval armament based upon a fleet of steam vessels especially designed to mount shell guns of high muzzle velocity and considerable range. Thenceforward the place of the shell in naval operations was assured.

The latter part of the 18th century also witnessed the adoption of the shell for horizontal fire in land operations, tests in England toward that end having been conducted as early as 1760 but discontinued when a number of the projectiles exploded in the bore. But the idea would not down, and was revived during the siege of Gibraltar (1779-83) when the British fired mortar shell from long 24-pounders into the Spanish lines. At about the same time, Lieut. (later Gen.) Henry Shrapnel was making the first official demonstrations of the spherical case shot of his invention. This differed from ordinary case in that it embodied a hollow spherical projectile, fused and filled with musket balls plus a small charge of black powder just sufficient to disrupt the container. When the fuse acted, the sphere was cleft open, and the balls continued forward in an ever-widening sheaf, laying low all enemy personnel in their path. As originally designed, no additional velocity was acquired by the musket balls when they left the shell beyond that possessed by the sphere at the instant of rupture. (In modern shrapnel, an added velocity of about 350 ft. per second is imparted by the powder charge now embodied in the missile.)

Other types of projectile once widely used (but now long obsolete) include the carcass, grape, bar shot, chain shot, etc. The first-named was composed of a hollow iron shell casing filled with inflammable materials which, ignited by the flash of the propelling charge, served to set afire wooden buildings or other vulnerable objects within enemy lines. Easier to manipulate than hot shot (which had to be heated to redness in a special furnace) it was handier to use and to transport (being naturally lighter than solid shot of equal diameter) but, by the same token, less far-ranging.

A round of grape comprised a number of iron spheres usually twice or more the diameter of the conventional musket ball as found in canister and shrapnel and commonly arranged in three layers separated by metal plates. This composite projectile fell

apart into its several components shortly after leaving the muzzle and was fearfully effective when fired at short ranges against assaulting troops, constituting, as it were, a sort of oversize canister.

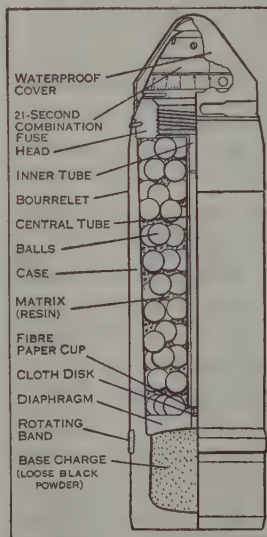
Bar shot were employed in naval operations, and consisted of two hemispheres of cast iron connected by a bar of the same material. Fired into the rigging of hostile vessels, they flew crazily through the air and caused great damage provided they found their targets.

Chain shot, designed for a similar purpose, embodied two hollow hemispheres linked by a section of stout chain, the two portions of the globe being fitted together before firing, with the chain nested into the cavity so formed. Shortly after leaving the muzzle the hemispheres flew apart—to the length of the connecting chain. As may be imagined, the effect on the spars, ropes and sails of an enemy vessel was far from negligible.

The shell had now (first half of 19th century) come into its own, as had the shrapnel. Neither of these, however, could attain full stature until the crude time fuses of the period had undergone material improvement and the detonating powder developed by Alexander Forsyth in 1807 and the years immediately following, harnessed in percussion caps and other devices, permitted the construction of a missile that would explode on the shock of striking its target; *i.e.*, the concussion or percussion shell. The time fuse *per se* was no novelty, for it required little ingenuity to pack a train of slow-burning powder into a wooden or metal tube and, knowing the distance travelled over varying periods of time by the shell in which this was to be used, and the burning rate of the powder train, to mark the tube surface with graduations corresponding to different ranges. This device was now driven into a fuse hole in the shell, first having been cut off, or otherwise set, for the range at which firing was to take place. If all went well, the missile burst at the point intended. Incidentally, the fuse which, when the projectile was rammed home, faced toward the muzzle of the piece, being situated on the side of the shell opposite that which rested on the propelling charge, was nevertheless ignited by the flash from this, the projectile always being sufficiently smaller in diameter than the bore of the gun firing it to

permit a considerable portion of the incandescent powder gases to escape past it and perform this important function. Obviously this clearance between projectile and bore resulted in the waste of no small percentage of the gases generated and a consequent reduction in the energy expended on propelling the missile. But this was considered a necessary evil and no serious steps were taken to remedy it until rifled pieces came upon the scene. This latter development, which was already beginning to take place (mid-19th century), had long been awaited, indeed foreseen. But the same difficulties that beset the infantryman in his search for a suitable rifled weapon operated in the case of artillery.

A projectile small enough to pass readily down the bore of a piece to its seat in the chamber was, by the same token, not large enough to expand into and acquire a motion of rotation from



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FIG. 2.—75-MM. SHRAPNEL

a set of rifling grooves leading from that point to the muzzle. Further, such rotation increased the effectiveness of a round missile so little as hardly to justify the expense and trouble involved. It did increase enormously the range and accuracy of an elongated (cylindroogival) bolt; indeed projectiles of this form could not be made to function properly save in a rifled piece, but these were obviously much heavier than spherical shot of equal diameter, and

called for greatly increased powder charges, which the older types of cannon were unable to withstand.

During the fourth, fifth and sixth decades of the 19th century, however, improvements in black powder and the materials and methods of gun construction made possible the building of ordnance capable of handling these charges. Coincidentally, inventors in widely separated parts of the world were developing systems of rifling, and projectiles adapted to these, which, while not at once wholly successful, presaged the early introduction of a new era. Among these systems may be mentioned that of Charles Lancaster, which involved the use of a projectile oval in section fired from a gun similarly bored (the oval spiralling from breech to muzzle); of Joseph Whitworth, who used a six-sided missile delivered from a tube the bore of which was a hexagon twisted upon itself (both of these designs were British); or the French in which were screwed into the surface of the projectile a series of studs that engaged the rifling grooves of the gun employed, guiding the missile first down, then up the bore, imparting to it the necessary rotatory motion.

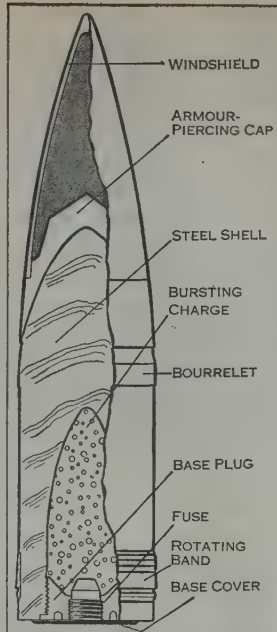
A variation on this which perhaps reached its highest degree of perfection in the U.S. Sawyer projectile, involved casting on the surface of the shell a series of longitudinal ribs or flanges, corresponding in number, position, angle and (slightly less in) dimensions, to the grooves of the gun bore so that the projectile, when its ribs were properly fitted into the rifling at the muzzle, could readily be rammed down to the chamber, turning with the spiral of the grooves meanwhile, its movement being reversed when the charge was fired. But all of these devices suffered initially from one of the chief faults of the smoothbore system; clearance between the surfaces of bore and missile was so considerable (and necessary, to permit easy loading) that much of the force of the powder charge was wasted in the gas that escaped past the projectile. To remedy this, scores of devices were employed, the commonest being a disk of some soft metal attached to the base of the shell, its edge curving slightly backward (toward the powder charge) all around its perimeter, exactly as though a pie pan had been nailed to the bottom of the missile.

When the powder was ignited, the free edge of this disk was forced forward and outward by the pressure of the burning gases, sealing the bore more or less effectively. But at best these were makeshift solutions, and it required the perfection of the breech-loading gun to provide a really satisfactory answer to the problem of gas leakage. This type of piece was as old as artillery itself, but had never proved practicable, not because of gas escape along the bore, but at the breech. However, during the 19th century breech-loading systems, each slightly better than its predecessor, followed one another in rapid succession; e.g., those of Major Cavalli (Sardinia), Baron Wahrendorf (Sweden), W. Armstrong (England), A. Krupp (Germany), De Bange (France), etc. It now became possible to introduce at the breech of a piece, a projectile part or all of which was of "groove diameter," i.e., equalled in over-all thickness the distance measured from the bottom of one groove to the bottom of that facing it on the opposite side of the bore. This meant that the lands, or elevated surfaces between the grooves, bit deeply into the outermost layer of the missile, forcing it to follow the spiral of the rifling. To avoid needless friction and

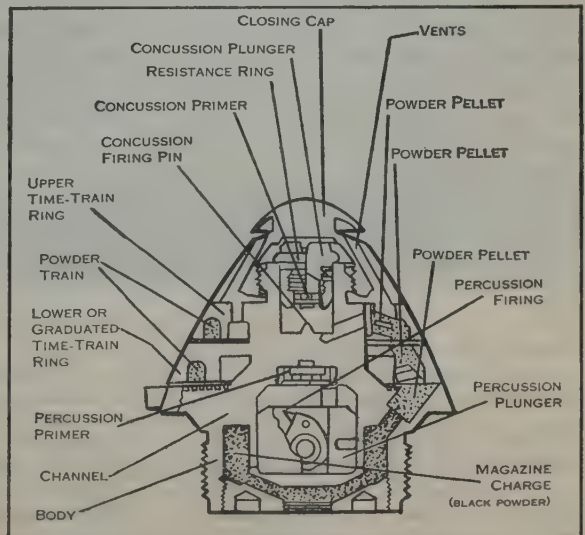
unnecessary wear, those portions of the projectile which were machined to groove (maximum) diameter were fabricated of some relatively soft material (the Armstrong shell, for instance, was shrouded in a lead envelope), the body of the missile never measuring more on its transverse axis than the distance across the lands; i.e., from the top of one land to the top of that opposite—technically known as bore diameter as contrasted with the groove diameter described above. It was soon found, however, that satisfactory rotation could be effected by encircling the projectile, near its base, with a single narrow band (rather than a full-length envelope) of ductile metal (copper), of groove diameter, the surface of the shell (which was of bore diameter) riding as it were, the tops of the lands, while the latter cut into the copper rotating band to a depth equal to that of the grooves adjacent. Thus was finally evolved the basic form of projectile thenceforward to find employment in ordnance of every size and type.

With the general adoption of rifled cannon and elongated projectiles, there occurred a confusion in nomenclature that was for a time quite disconcerting. During the centuries in which the round (cast-iron) sphere seemed best, guns had been classified according to the weights of the balls they carried. And since the specific gravity of the metal remained a constant, everyone knew that a "6-pounder" was a gun with a bore of about 3.67 in., since a cast-iron shot weighing 6 lb. had a diameter of 3.55 in., and it was customary to make the bore of a gun slightly larger than the missile it was designed to project. Similarly a 12-pounder had a bore of 4.62 in., 18-pounder—5.3 in., 24-pounder—5.82 in., 32-pounder—6.4 in., and 42-pounder—7 in. But with the advent of the cylindroogival missile, a 10-lb. shell (as in the Parrott rifle) came to be fired from a 3-in. gun, whereas had it been a solid sphere it would have required a bore diameter of at least $4\frac{1}{4}$ in. to handle it. Similarly a 12-in. cast-iron shot weighed about 229 $\frac{1}{2}$ lb., while the solid elongated projectile fired in the U.S. 12-in. rifle, model 1874, weighed 700 lb. Obviously, to describe this piece as a "700-pounder" came far from giving an idea of its actual dimensions, for only the ordnance expert knew the length and shape of the missile it fired. (Had this been spherical, it would have called for a bore of more than 17 in.) The result was that designations in pounds, after struggling hard for survival, finally went by the board, being replaced by others wherein the calibre of the piece was indicated by its (bore) diameter in inches or millimetres.

As artillery ammunition improved in range and effectiveness, the old wooden and metal tubes stuffed with slow-burning black powder which had served so long and so faithfully as fuses, gave way to more efficient (if more elaborate and more complicated)



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FIG. 3.—ARMOUR-PIERCING PROJECTILE



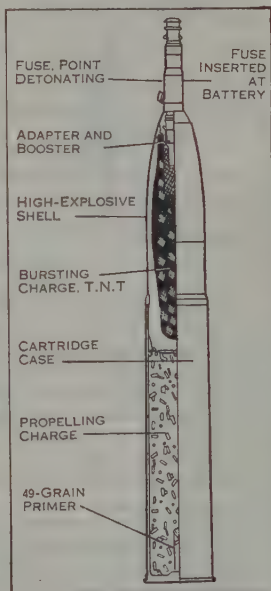
BY COURTESY OF THE U.S. WAR DEPARTMENT

FIG. 4.—21-SEC. COMBINATION FUSE

types wherein the rate of burning (and the instant of explosion) could be more accurately controlled. The vertical powder train was replaced by one annularly disposed in a stout metal casing, a type which, in the conventional "21-sec." fuse (the maximum burning period of which is 21 sec.), has survived. The fact had nevertheless long been recognized that any fuse containing black powder as a component was likely to be erratic in action by just so much as this ingredient might be affected by external influences (moisture content of the air, barometric pressure, etc.). Under ordinary conditions, these factors played but insignificant parts. But when anti-aircraft artillery came to be developed and widely used, in World War I, it was discovered that the rate of burning of the powder train varied markedly with the altitude to which a shell was fired, thus adding just one more correction to those the gunner had to make in an effort to cause his projectile to burst in the immediate path of an oncoming plane. This stimulated interest in a mechanical time fuse, the operation of which would obviously be independent of altitude effects and such fuses were developed and adopted by certain nations, although their complexity and cost of manufacture placed them distinctly in the luxury category among war munitions. The era of rifled ordnance resulted, as we have seen, in the introduction of tight-fitting, cylindrical projectiles, the rotating bands of which sealed the bore so perfectly that almost none of the burning powder gases escaped past them. But this set up a new problem for the ammunition maker, as it meant that the fuse was now no longer inflamed by the flash of discharge, and that some other means to effect this must be contrived. The solution was simple. A striker was located in a hole drilled in the long axis of the fuse body which capped the shell. At the base of this hole was a percussion cap and below this a powder train. On firing, the cap was carried forward with the

mass of the shell to impact against the striker which, floating freely in the drill hole, tended to remain stationary while the shell about it gathered momentum. The resulting flash ignited the powder train. This mechanism, technically known as setback, has since been widely employed in fuses of many types. As originally designed it lacked safety factors, for if the shell were accidentally dropped, detonation of the cap was likely to result. To correct this defect, devices were later installed which interposed a block between striker and cap until disengaged by the centrifugal force developed from rotation of the missile in the bore. Such fuses are known as "bore-safe," a number of rotations being required to arm the fuse; i.e., put it in a position to function, so that the missile has travelled an appreciable distance from the muzzle before the fuse is free to act. Some such safety mechanism has of necessity been embodied in all types of shell for a long period.

As rifled pieces increased in power and range, and suitable breech-loading mechanisms were perfected (latter half of 19th century), the materials used in the fabrication both of guns and ammunition underwent corresponding changes. Solid and hollow missiles of cast iron, the chief medium of which projectiles, and guns as well, had been made for centuries, began to give way to other types; e.g., the Armstrong segment shell. This embodied a thin outer casing of cast iron surrounding six layers of seven segments each of the same material, these in turn bordering a central cavity containing an explosive charge of black powder. This shell,



BY COURTESY OF THE U.S. WAR DEPARTMENT
FIG. 5.—ASSEMBLED ROUND 75-MM. AMMUNITION

in addition to incorporating a time fuse, was fitted also with one of percussion type. In this, a detonating cap at the forward end of an axially located tube received the impact, when the shell was suddenly arrested in its flight, of a striker at the rear end of this, which slid forward as the mass about it came to a stop—the action reversing that of setback described above. This arrangement, like the setback, has since figured quite generally in shell design. Such a shell was found most effective when used against personnel, but was obviously impotent against fixed fortifications or armoured vessels in the defense of which (wrought) iron plates of increasing thickness had begun to be employed as early as the 1850s. In order to render cast-iron projectiles effective against these, the following expedient was adopted. The shell was cast in a mould, as before, but the nose (point) was caused to cool rapidly through contact with a cast-iron chill, the body proper radiating its heat more slowly in a bed of sand. This resulted in greatly increased hardness and crushing strength at the point, without otherwise modifying the characteristics of the projectile, and such bolts proved most successful. But the defense now countered with the substitution of steel for wrought iron—a measure which would have been adopted sooner had the means for producing this material of good quality and reasonable price been earlier available. Against steel, the cast-iron shell proved unavailing, and the offense was forced to take recourse to missiles of like composition before it could make further headway. Thus projectiles of forged steel were already in common use by the late 1880s, while others cast from this metal had been experimented with, to no great profit, however.

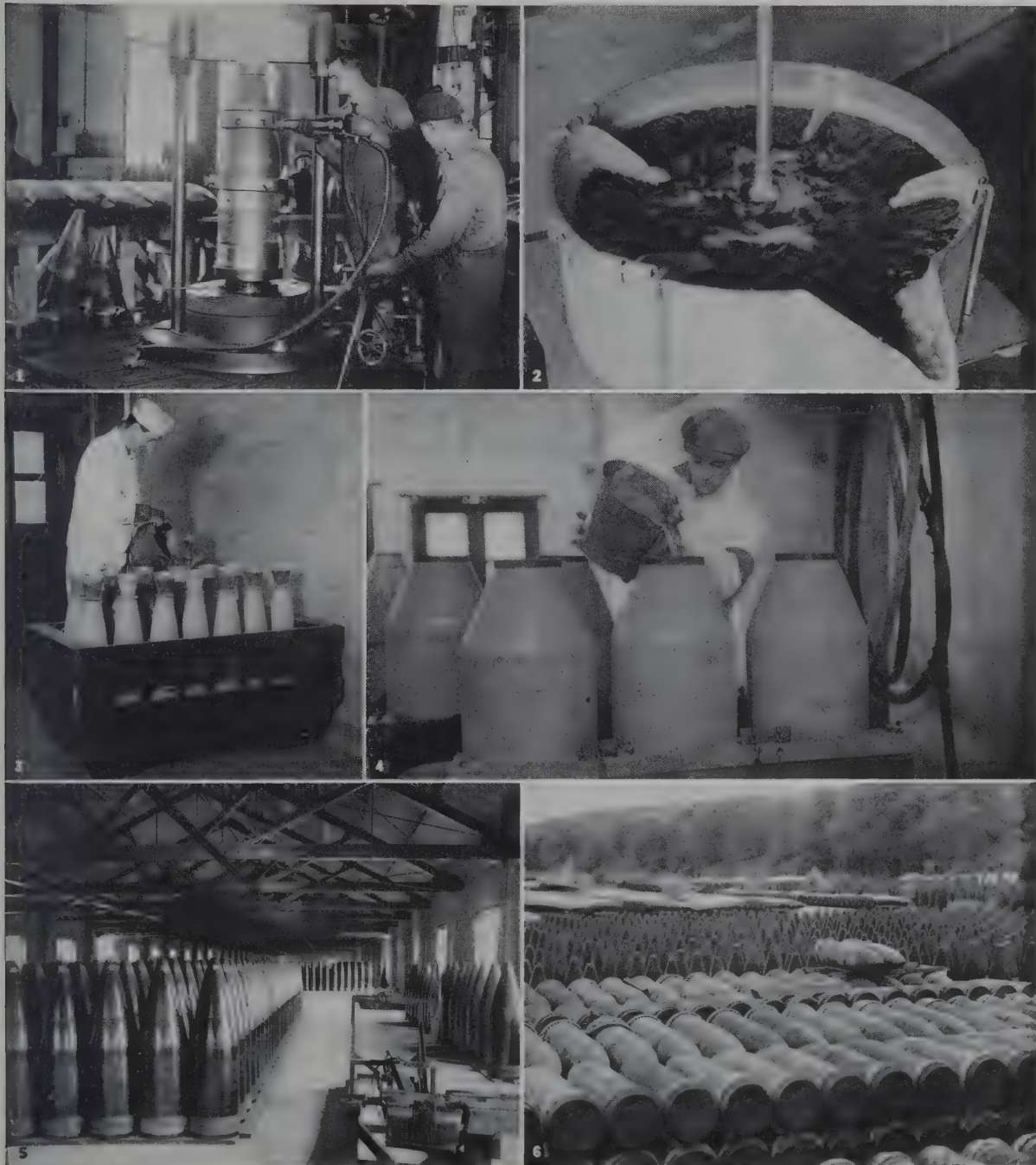
As the shell body improved, so did its bursting charge and its propellant. The explosive properties of guncotton and of picric acid and certain of its salts had long been known, and such substances made the subject of numberless experiments in efforts to produce them in forms suitable for use as shell fillers. Until the mid 1880s, however, none of these were attended with much success. But by 1886 the French had managed to control picric acid to a point where they commenced to employ this (under the name of melinite) in this capacity. The British followed with lyddite, the Japanese with shimose—all different names for the same substance. From this time, black powder saw less and less use as an explosive agency in shell, though it retained its place for this purpose in shrapnel.

The only thing now lacking to bring artillery ammunition to the state of technical development which it enjoyed when World War I engulfed an amazed civilization was a smokeless propellant. This came about coincidentally with the introduction of high explosives as bursting charges—the result of the work of the French chemist, P. Vieille (1884). Some time elapsed, however, after smokeless powders were functioning satisfactorily in small arms, before suitable types could be developed for heavy ordnance. Indeed the Spanish-American War of 1898 was fought, so far as artillery matériel was concerned, chiefly with black powder. This was the last major conflict in which this agency was to play an important part.

II. MODERN ARTILLERY AMMUNITION

This consists primarily of shell, shrapnel and canister, all of which have previously been discussed. Shell may be low explosive; i.e., loaded with black powder, or high explosive, and filled with compounds of a higher order of potency such as T.N.T. (trinitrotoluol), amatol (a mixture of T.N.T. and ammonium nitrate), explosive D (ammonium picrate), etc. In the ordinary high-explosive shell (for land operations) the weight of the explosive (commonly T.N.T. or amatol) equals about 10% that of the shell, while in armour-piercing varieties, in which explosive D is usually employed, it amounts to but 2%, the work called for from the projectile (penetration of huge thicknesses of steel) demanding a missile with extremely heavy walls—naturally to the sacrifice of the capacity of the explosive chamber within. (Deck-piercing shell, for high-angle fire, have somewhat thinner walls and a larger explosive content.)

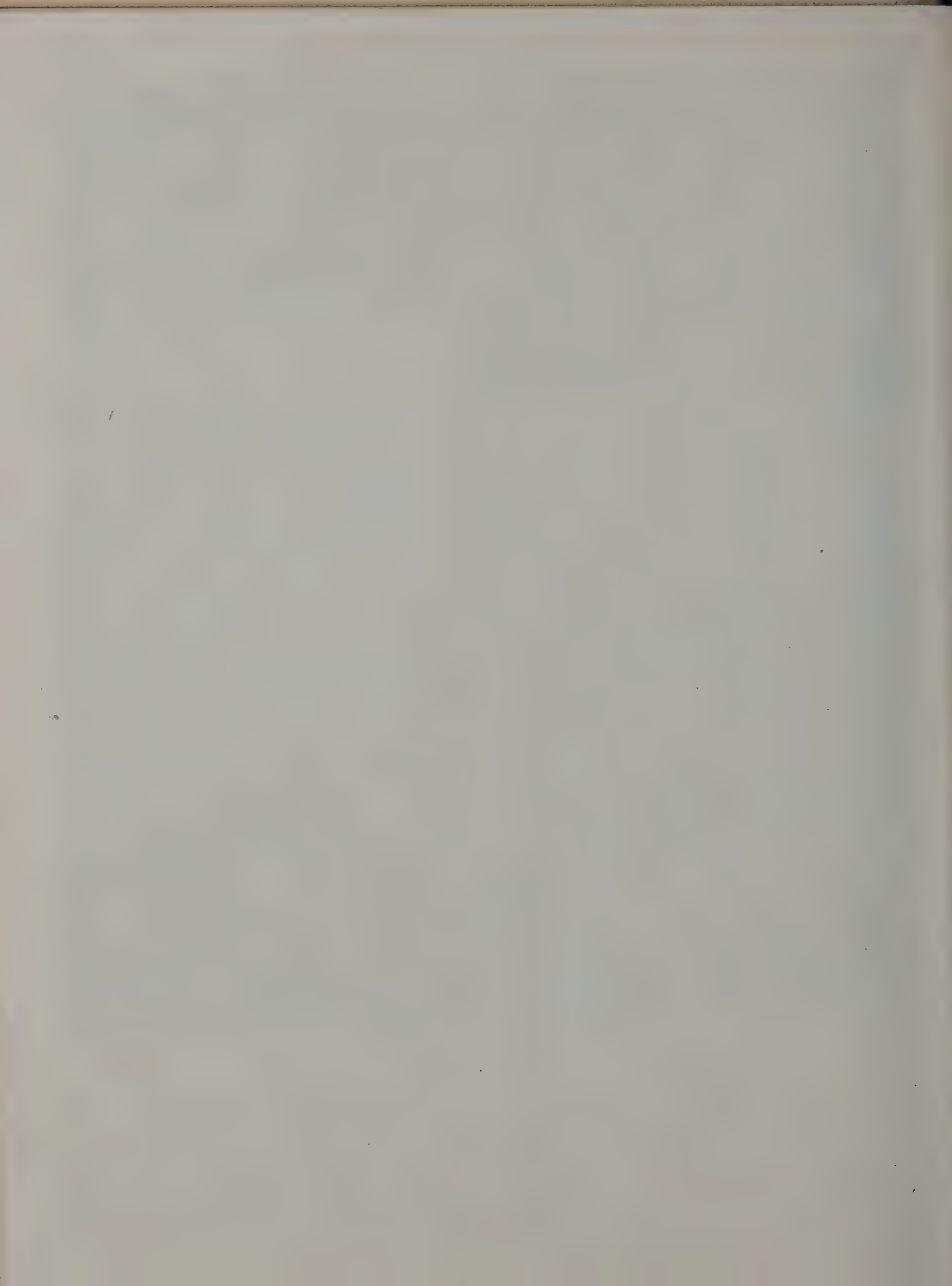
Shell bodies are normally of common steel, forged and machined to shape, though semisteel (practically a high grade of cast iron) was largely, and successfully, used as a substitute during World



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MANUFACTURING AND STORING HIGH EXPLOSIVE SHELLS

1. After the shell is forged, it is machined with great accuracy by high-speed tools
2. Melting TNT for filling a shell or bomb
3. Pouring TNT into 155-mm. shell
4. Pouring TNT into 600-lb. bombs
5. Loaded shell in magazine storage
6. Outdoor storage of large calibre shell



War I. In the 1930s, new methods of producing shell bodies were developed for certain of the lesser calibres. These involved, in one instance, the die-shaping of sections of seamless steel tubing, then screwing substantial base caps into the rear ends of the shells so formed. Even welded tubing gave promise of being workable into satisfactory products, and still another technique arose, wherein a solid forging was upset into the form of a shell by driving successively into one end of it a series of blunt punches of increasing size, the external surface of the forging being gradually moulded meanwhile into the proper shape by dies of varying contours in which it was grasped during the different operations. The punch forming of the explosive cavity in the base of armour-piercing shell forgings while hot had long been an accepted method of production, but this involved no increase in the external diameter of the billet. By this new method, however, the billet (also hot) was expanded from a small original diameter to a finished one more than twice as great. These practices involved substantial savings in materials. Thus the rough forging for a conventional three-inch anti-aircraft shell (U.S.) weighs 23 lb.; one to be treated by upsetting, 13.88 lb.; and a section of seamless tubing for the same purpose, 12 lb.

Chemicals of various types, commencing with the period of World War I, figured prominently as shell fillers, both for the purpose of producing screening effects (smokes), or harassing personnel. The typical chemical shell differs from that containing an explosive charge in respect of the threads of the adapter (*see below*), which are tapered; *i.e.*, pipe threads, in order to effect a gastight joint.

Cast iron as a material for shell fabrication is now practically limited to the production of missiles designed for target practice—not for use against hostile personnel or matériel. These, in order to possess the same ballistic qualities as live shell, are ordinarily supplied with a small central cavity which is filled with sand to bring them to the proper weight.

Shrapnel, as previously indicated, is still employed for its effect against personnel, though in much lesser percentages (as compared with high-explosive types) than formerly. Such a missile embodies (in 75-mm. calibre) a hollow steel casing filled with 270 lead balls hardened with antimony, one-half inch in diameter and embedded in a matrix of resin. It is capped with a combination time and percussion fuse, the functioning of either element of which produces a flash which travels down a centrally located tube connecting the fuse head with a black powder bursting charge housed in the base of the projectile and separated from the mass of balls by a metal diaphragm. When this charge explodes it does not rupture the case, but drives before it and out from the front end of the missile the diaphragm, balls, head and fuse. Thus it becomes, in effect, a small cannon delivering, from a given point in its trajectory, a charge of caseshot upon enemy ranks ahead. Its rotation, imparted to the mass of balls, causes these to spread out in a conical form as they travel forward, raining destruction upon a very considerable area of terrain.

Canister ammunition has very

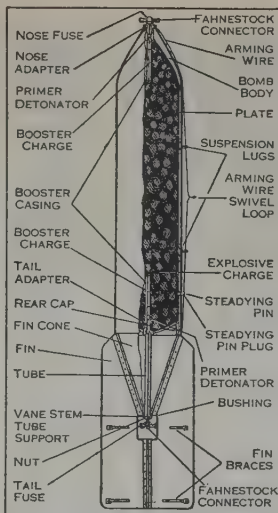


FIG. 7.—2,000-LB. DEMOLITION BOMB FOR AIRCRAFT

nearly completed its cycle, and though occasionally employed in the smaller calibres (37 mm. and 2.24 in.), has a very limited sphere of usefulness. As previously outlined, it comprises a light metal case filled with steel or lead balls, and without a bursting charge. Shortly after leaving the muzzle the case ruptures, scattering the contents in all directions.

Other special purpose types of artillery ammunition include the incendiary shell filled with thermite, phosphorus or similar materials, plus a bursting charge just large enough to rupture the containing walls; illuminating or star shell (for night operations) wherein a time fuse releases a flare which slowly floats to earth suspended from a parachute; tracer shell, which marks its path by the emission of smoke or flame, thus enabling the firer to alter his aim when incorrect; and so forth.

SHELL COMPONENTS AND NOMENCLATURE

The conventional shell has a cylindrical body, an ogival head and a flat base. The radius of the ogive, which materially affects the flight of the missile, is ordinarily from six to nine calibres (calibre equals the transverse diameter of the projectile). A short distance forward of the base is located the rotating band (known as the driving band in the British service), the function of which has already been explained. When that part of the shell to the rear of this band is cylindrical, the projectile is known as square-based, as contrasted with the boat-tailed type in which this portion is tapered. (Such tapering is employed to increase range and accuracy in certain instances.) At the point where the body of the missile joins the ogive is located a narrow surface known as the bourrelet. This is of a diameter very slightly greater than the body, and serves as a sort of bearing upon which the projectile rides up the bore from chamber to muzzle. Clearance between bourrelet and land surfaces is held to narrow limits—.005 in. for the 37-mm. (1½-in.) shell, and .02 in. for the 16-in. All shell loaded with high explosive have their bases covered with a separate steel disk designed to keep powder gases from finding their way into the cavity containing the explosive through possible flaws or defects in the base of the body.

Adapters and Boosters.—Mention has been made of the adapter. This is, in general, a bushing screwed into the nose of a shell and containing a recess into which may be inserted a fuse. Attached to it, in the form of a tube running down into the body cavity of the projectile, is a booster casing. This contains a quantity of some high explosive (commonly tetryl) more readily ignitable than the substance forming the main charge. This latter, for reasons of safety in manufacture, handling and loading, is always composed of a material as insensitive as possible to any but the most violent activators. Being thus comparatively inert, the ordinary primer will not ignite it, and it becomes necessary to interpose between charge and primer a booster (gaine in British terminology) which is readily set off by the priming element and which, itself an explosive of high potency, boosts the energy of the primer detonation by that of its own, thus finally touching off the main charge. Adapters and boosters are invariably assembled into a shell prior to its shipment. This is not equally true of fuses (*see below*). In the case of chemical shell, the function of the booster is to disrupt the shell walls sufficiently to permit the liberation and scattering of its contents. And since the filling is, in this instance, nonexplosive, a booster charge heavier than that employed in the explosive type of shell, is required. Anti-aircraft shell, being armed with time fuses rather than the detonating type employed in other high-explosive varieties, likewise demand a booster of special characteristics.

Fuses.—These are mechanical devices with or without explosive elements which detonate or ignite the charge of a shell, bomb, grenade or other projectile when and under the circumstances desired. Artillery ammunition fuses are of four varieties; *viz:* *point-detonating*; *base-*

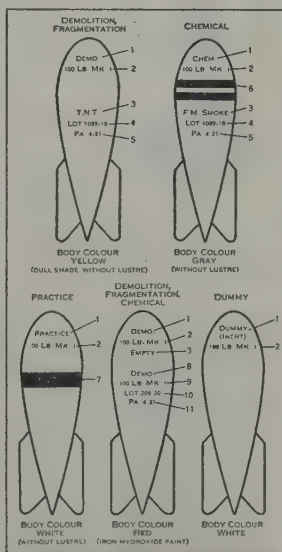


FIG. 6.—MARKING ON U.S. AIR-CRAFT BOMBS

1. Type of bomb; 2. Weight and mark number; 3. Kind of filler; 4. Lot number; 5. Initials of loading plant and date of loading (all stencilled); 6. One green band indicates nonpersistent chemical, two green bands indicate persistent chemical, one yellow band indicates smoke producer; 7. Two-inch blue band on all bombs below 100 lb. In weight, four-inch blue band on all bombs 100 lb. and over; 8. Type of bomb; 9. Weight and mark number; 10. Lot number; 11. Initials of manufacturer and date of manufacture (all stamped).

detonating; time; base-percussion.

A point-detonating fuse is intended for assembly in an adapter located in the nose of a shell. It is commonly shipped separately from the projectile, and inserted therein just before loading into the gun. It is designed to function on impact according to varying conditions of delay, being made generally in two forms, *i.e.*, the superquick, which embodies provisions for instantaneous detonation on impact, and prior to any penetration, and what might be called an all-purpose type, which, by varying slightly its construction, may be made to function with "non-delay" (this, despite its name, takes longer to function than the superquick), short-delay (.05sec.), and long-delay (.15sec.) action. One variety of the superquick, or instantaneous type, as elaborated for anti-aircraft use is known as the "supersensitive," and will function on impact against the fabric wing of an aeroplane or the envelope of a balloon. The construction of this fuse is particularly ingenious, its safety in flight being based on the principle of the total dynamic air pressure outside the striker head being less than the static air pressure within. Base-detonating fuses are normally used in shell designed for penetrating resistant substances (armour plate, concrete), where a point fuse might be crushed and rendered inoperative on impact. They are ordinarily assembled into the projectile at the same time that the explosive charge is inserted, and are made in both non-delay and delay varieties. Time fuses, constructed so as to function at a predetermined time after the projectile has left the gun, are employed in anti-aircraft shell and shrapnel (the latter type missile is used against both aircraft and ground troops). The time fuse supplied shrapnel intended for ground targets contains an added percussion feature which allows it to function on impact if the time element has previously failed to act. As already outlined, time fuses may be of the (21sec.) powder train type, or mechanical (clockwork mechanism), the latter being more costly but more certain in action.

Base-percussion fuses embody no detonating element (fulminate or booster), as they are intended for use in shells loaded with low explosive (black powder) the bursting charge of which may be ignited directly from a powder train. Such shell are practically obsolete.

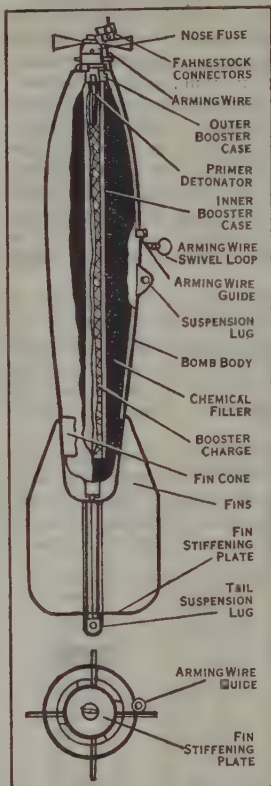
Primers for propellents are ammunition components used to ignite the smokeless powder charges employed in modern ordnance. They embody varying quantities of black powder plus a percussion element to ignite this. The latter always contains some agent (as mercury fulminate) highly sensitive to a blow, friction or heat, and hence easily detonated. For ammunition of lesser calibres, the black powder content of the primer itself suffices to effect ignition. In the larger sizes, additional (black) ignition powder is employed. With fixed and semi-fixed ammunition, the primer is pressed into a recess in the base of the cartridge case prior to the loading therein of the propellant, and is detonated by the impact of a mechanical striker against its percussion element. When separate-loading ammunition is employed (the powder being introduced into the bore in a bag or bags), the primer is inserted separately into the breech mechanism. Such primers have cases so thin that when their charges explode these expand and press tightly against the walls of the primer cavity, preventing the rearward escape of gases generated by the burning of the propelling charge. Primers are commonly classified as percussion, friction, electric, combination percussion-electric and igniting, the names largely explaining their modes of functioning. Thus the percussion type is fired by means of the blow of a firing-pin or striker. The friction primer (used in the U.S. service only in sea-coast cannon), is ignited by the heat developed on pulling a serrated plug through a friction composition which it contains and in which the plug is embedded with a free end (upon which the traction is to be applied) projecting. The electric primer (likewise for sea-coast use), functions when a short section of wire of high resistance built into it is heated to a glow by the passage through it of an electric current. The combination percussion-electric primer may, as its designation suggests, be fired either electrically or by the blow of a striker. It is used in certain naval and sea-coast guns. The igniting primer, used with subcalibre ammunition, is without a detonating cap, being provided instead with a hole piercing a dummy cap which permits the igniting flame from a service primer to reach the black powder charge which it contains.

Propelling Charges.—These are composed of smokeless powder of two general types, *viz.*, "single-base" (nitrocellulose alone) and "double base" (nitrocellulose plus nitroglycerin). The United States has ever been a proponent of the former—Great Britain of the latter. Charges for fixed ammunition are loaded loose into the cartridge case. Those for other types are prepared in silk bags which are in turn placed in the cases (semi-fixed types) or (for separate-loading ammunition) in storage containers of fibre or metal. The primary function of the case is to contain the propelling charge, but it serves another very important one as well in that, at the moment of firing, its thin walls expand against those of the gun chamber and block the rearward passage of any of the powder gases. Certain varieties of fixed and semi-fixed ammunition, likewise some separate-loading types which employ cases to hold the powder bags, have brass diaphragms soldered into the mouths of these to seal the contents against moisture. In calibres of above 105mm. powder charges are commonly prepared in bags. Raw silk is the material chosen since

it is almost entirely consumed on firing, and leaves no smouldering remains in the gun bore. A special igniting charge of black powder in an "igniter bag" is commonly attached to the base of the rearmost bag of smokeless powder. The igniter bag is also of silk, but more closely woven than that used in the standard cartridge type (to keep the fine-grained black powder from escaping).

The main powder charge is classified according to the number, construction, and arrangement of bags of which it is constituted: as single section or multi-section, the latter again being subdivided

into: (1) unequal related type, (2) equal type and (3) base and increment type. The single section type comprises just one bag filled with propellent powder and either wrapped or laced. A core of black powder extends longitudinally through the centre of the charge, and connects with a black powder igniter on either end. The unequal related section type involves one full charge divided into separate bags each constituting a fixed fraction of the whole, such as three sections of $\frac{1}{4}$, and two of $\frac{1}{8}$. Each section contains, in addition, an igniter pad of black powder. The equal section type consists of one full charge divided into a given number of equal sections. Usually one separate igniter pad is supplied for strapping to the base section. The use of these pads is based upon the fact that smokeless powder, like some of the higher explosives used as shell fillers, is not as readily ignited as certain other explosive compounds, *e.g.*, black powder. Hence it has become customary to supply a small quantity of the latter to receive the flash from the primer, the conflagration of this intermediary element being sufficient to activate the main smokeless powder charge. The equal section type, and the unequal related section type, are generally known as "aliquot part" charges and offer considerable flexibility in adjusting loadings to achieve certain reduced velocities, especially in the case of howitzers and mortars. The base and increment type consists of a full charge made up of a base section plus one or more increments of equal or unlike masses, but in any case of less weight than that of the base section. The grains of smokeless



BY COURTESY OF THE U.S. WAR DEPARTMENT
FIG. 8.—30LB. AERIAL CHEMICAL BOMB

powder employed in different loadings vary from tiny cylinders of a diameter of about $\frac{3}{32}$ in. and slightly over $\frac{1}{4}$ in. in length (for the 75mm. gun) to others $\frac{5}{16}$ in. in diameter and $1\frac{1}{4}$ in. long (14 in. gun) and larger, both types exhibiting seven perforations axially and equidistantly disposed (to permit propagation of the igniting flame from within as well as from without).

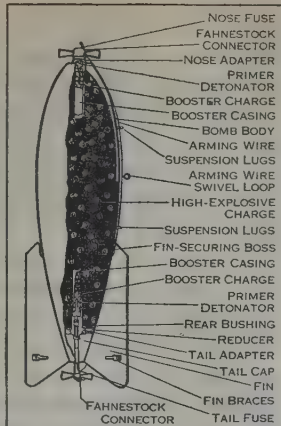
Since the World War of 1914-18, much attention has been devoted to the development of powder which would be practically flashless (and thus not reveal the location of guns employing it during night operations), and non-hygroscopic, (*i.e.*, without a tendency to absorb moisture, a material increase in the content of which in a smokeless powder charge will adversely affect the flight of the missile it projects). Considerable success has attended these efforts.

Trench Mortar Ammunition.—This differs from other types of artillery ammunition in that it is ordinarily designed to be fired from smooth bore pieces (though rifled trench-mortars are by no means unknown). One variety developed during and after the World War of 1914-18, is of in. calibre and entirely unstabilized (*i.e.*, lacks any device to keep it from tumbling end-over-end during flight). The propelling element is an ordinary 12-gauge shot-gun "blank," augmented by from one to three small doughnut shaped bags of smokeless powder which may be slipped over it, varying ranges being achieved by altering the amount of the charge, as well as the elevation of the mortar. The projectile weighs 12lb., has a minimum range of 150yd., and maximum of 750yd., and an effective radius of burst of about 30 yards. It is fired by dropping it base-downward into the muzzle of its projecting piece. Sliding down the smooth bore it is brought up suddenly against a fixed firing pin which projects upward at the breech. This flashes the cap in the shotgun shell, the ignition of the charge within which is communicated to the surround-

ing bags of smokeless propellant, whereupon the missile travels back up the bore and out the muzzle much more quickly than it entered. Post World War 75mm. mortars have achieved ranges of as high as 2,000yd., but other calibres, firing stabilized projectiles, such as the 60mm. and 81mm. types are now more favoured. The former delivers a 3lb. missile to a minimum range of 100yd. and maximum of 1,750yd., while the latter handles shells of two weights, 7.6 and 14.5lb., to ranges of from 100yd. to 3,280yd. for the lighter and 100yd. to 1,280yd. for the heavier. These are quite similar to an aeroplane drop bomb in appearance, and, like the 75mm., are projected by a blank 12-gauge shot-gun charge augmented in this instance by the contents of a varying number of small capsules filled with smokeless powder and attached as needed (according to the range desired) between a series of fins flaring outward from the tail of the missile (and assuring a steadiness in flight far different from the wobbling motion of the 3in. specimen). Apart from mortars firing explosive shell (as the 60mm. and 81mm.) others adapted especially to the projection of chemicals have been developed. That chosen for the U.S. service is of 4.2in. bore. The projectile, which much resembles those used in the mortars just described, weighs 25.5lb. (the weight of the chemical filling varying from 5.6 to 7.45lb. according to type), and has an extreme range of 2,400 yards.

Grenades—Hand.—These date from a period fully as remote as the origin of the explosive (artillery) shell, if not earlier. And since they are designed for use at very short ranges, and projection by the human hand, they have been extemporized on countless occasions from any suitable components readily available (*cf.* the British "jam tin" grenade of the early period of stabilized warfare, 1914-18). Not infrequently have artillery missiles been officially employed as grenades. Thus we find, in the *U.S. Ordnance Manual, 1861*, under the caption, "Grenades," the following: "Six pounder spherical case shot (*i.e.*, shrapnel) may be used for hand grenades, and shells of any calibre for rampart grenades." (The latter were rolled down upon an assaulting enemy from the tops of defensive earthworks, the fuses having been set to act with almost no delay.) Modern grenades are of many varieties, including the so-called defensive, offensive, gas (lachrymatory, sickening, etc.), smoke and incendiary (phosphorus or thermit) types. The first-named is that in most common use, and is known as the "Mills" grenade. Shaped somewhat like a tiny barrel, thus fitting readily the palm of the hand, and scored on its surface into a number of small squares (to facilitate fragmentation), this grenade breaks into some 40 pieces on exploding, with a danger radius of about 30 yards. Various substances are used as fillers, "E.C. blank powder" being perhaps that most widely employed. It can be thrown approximately 35yd. by the average man, detonation not taking place until five seconds after the operating lever is released. Because of its considerable danger radius, it is customary to project this missile only from the safety of trenches or other shelter. The offensive grenade, unlike the one just described, has a body composed of laminated paper which shatters into harmless shreds when fired. It contains, however, a loading of some explosive of much higher potency than that embodied in the defensive type. This detonates with great violence, but its action is limited to a small radius, hence the grenade may be thrown on open terrain without danger to him who projects it. Gas grenades have civil and military uses as well. They are employed as harassing agents when it is not desirable to cause permanent casualties (as in civil riots, driving into the open the occupants of a dugout in order to capture them uninjured, etc.). Smoke and incendiary grenades (those loaded with white phosphorus combine both properties) are employed as the military situation may indicate. The standard U.S. smoke grenade is phosphorus-loaded. Thermit hand grenades have been designed for high intensity incendiary effect, but are not in common use.

Grenades—Rifle.—These are of two types, the rodded (*i.e.*, fitted with a rod which is inserted into the bore of the infantry weapon down which it extends to rest on a blank cartridge which furnishes the energy of propulsion) and the "V.B." type which is projected by the powder gases of an ordinary rifle cartridge trapped behind it after the bullet has passed through an axial aperture in the grenade body. The former is commonly filled with a smoke-producing substance, and requires no special mechanism for firing other than the rod (which is screwed into it) and the blank cartridge. It embodies a fuse which burns for $4\frac{1}{2}$ sec., then explodes a detonator which ruptures the casing and liberates the contents. Its maximum range



BY COURTESY OF THE U.S. WAR DEPARTMENT
FIG. 9.—300LB. DEMOLITION BOMB

is about 185yd. (fired at 35° elevation). The primer of the "V.B." grenade (which contains a high explosive) is fired when the bullet from the rifle cartridge hits a striker placed obliquely in its path. The resulting flash ignites a detonator that touches off the main charge. This grenade, which is about 2½in. long and 2in. in diameter, requires a special cup-shaped discharger, attached to the muzzle of the infantry piece, for its projection. Its maximum range is some 235yd. (at 35° elevation) and the effective radius of its burst, 30 yards.

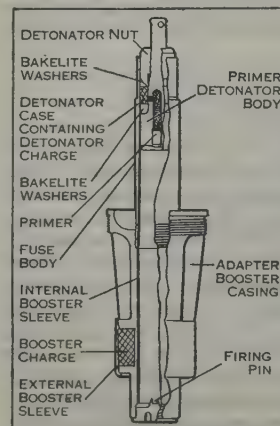
Pyrotechnics.—These are of two classes according as they are designed for air or ground use, *viz.*: aviation types (1) for illumination, *e.g.*, (a) aircraft flares, and (b) wing-tip flares, or (2) for signalling (air signal cartridges), and pyrotechnics for ground troops, (1) for illumination (position lights) and (2) for signalling (ground signals). Aircraft illumination flares are designed to be dropped by aircraft for the purpose of illuminating emergency landing fields during night operations. The standard (U.S.) flare when released burns for three minutes, being automatically ignited after it has safely cleared the plane. It is suspended in the air by a silk parachute 18ft. in diameter, and produces a white light of 300,000–400,000 candle power. Wing-tip flares are attached to special fixtures under the wings of an aeroplane and ignited by an electric current from the pilot's cockpit. They are intended particularly for illuminating the ground directly ahead of the plane as it lands. A standard type will produce a light of 13,000 candle power for a period of two minutes. Air signal cartridges are manufactured in an assortment of colours and displays for use in signalling either between aircraft or between air and ground. They resemble shot-gun cartridges of large calibre and are fired from special projectors. Position lights (known also as Bengal lights) are employed to outline the location of trenches to aerial observers. They are supplied in three colours—red, white and green. Ground signals find use in communication between ground troops. They are produced in a variety of colours and fired from a "ground signal projector" attached to the service rifle or to a special support in lieu of this. The projector contains its own firing mechanism, and the signal its own charge and primer. Another medium for ground communication is the Very signal cartridge. This is of shot-gun type, loaded with pyrotechnic compounds of various colours, and fired from a single-shot pistol of 25mm. (1in.) bore.

Aeroplane Bombs.—These commonly exhibit streamlined (teardrop) contours with the greatest diameter close to the nose, tapering thence rearward to the tail to which is attached a set of vanes for stabilization in flight. They fall into four general categories, *viz.*: practice, fragmentation, demolition, chemical. Of these, the fragmentation type is carried in external racks only—these located under wings or fuselage. Other types may be carried either in internal racks (built into and enclosed by the fuselage) or externally. Internal racks will handle bombs up to about 1,000lb. in weight; external types will carry those in any weight practicable for aeroplane transportation. All bombs, bomb fuses and bomb-release mechanisms are so designed that the pilot may drop his load to detonate—or not to detonate—on impact, according as he releases these over hostile or (in an emergency) over friendly territory. Bombs and bomb fuses are required to pass a test of dropping as much as 8,000ft. in the "safe" condition without detonating on ordinary soil.

Practice bombs are designed for use in the instruction of bombing personnel and possess the same form, weight, handling properties and accuracy as comparable service bombs. They are customarily loaded with sand, plus a small black powder charge (two to four pounds) which suffices to produce enough smoke by day or flash by night to permit a pilot to observe the point of impact from altitudes up to 8,000 feet. Such practice bombs are normally produced in sizes of from 17lb. up to 300lb. or more.

Fragmentation bombs are employed against personnel and depend on the fragmentation of their metal bodies at or above ground surface for the production of casualties. They are ordinarily manufactured in small sizes only, in order to distribute the total weight of a given bomb load over as large an area as possible, and fitted with instantaneous (nose) fuses, being fabricated (U.S.A.) in 17, 25 and 30lb. types, the first of which is a converted 3-in. artillery shell. They contain about 15% of high explosive by weight.

Demolition bombs are intended primarily for use against matériel upon which they exert great blast effect. They vary in size from 100 up to 2,000lb. or more, specimens weighing as much as 4,000lb. having been constructed and successfully detonated. The explosive



BY COURTESY OF THE U.S. WAR DEPARTMENT
FIG. 10.—TAIL FUSE FOR AIRCRAFT BOMB

charge (T.N.T.) comprises roughly 50% of the total weight. They usually carry fuses at both nose and tail, these being set for instantaneous or delay-action, as desired. When dropped in the latter state, the missile may penetrate from 6 to 30 ft. into the ground, displacing when it explodes about one-third of a cubic yard of earth for each pound of bomb weight.

Chemical bombs include all types adapted to chemical fillers—for the purpose of releasing harassing gases or obscurants (smoke). Those with smoke fillers can, when employed in quantity and under suitable atmospheric conditions, provide effective smoke screens on land or water. Dropped singly they afford means of spotting, signalling or ascertaining the direction of ground wind.

Incendiary bombs may contain any of a number of incendiary agents (phosphorus, thermit, etc.) but find only limited use inasmuch as the average demolition bomb exerts an incendiary effect in addition to its other characteristics.

Bomb fuses are commonly inert firing mechanisms which contain no explosive or inflammable elements. To supply these, a separate assembly known as the primer detonator is employed. (An exception is the U.S. Mk.XI fuse in the Mk.II fragmentation bomb—both now obsolete, however.) Fuses are armed (put in condition to fire) by means of an "arming vane" which, acted on by the rush of air past its fins as the projectile falls, unscrews and releases the firing pin. In nose fuses, the firing pin is actuated by the direct shock of impact. In tail fuses it moves forward under the action of inertia when the forward motion of the missile is suddenly arrested. A variation is embodied in the fuse for the U.S. Mk.III fragmentation bomb which incorporates an arming vane the rotation of which from wind pressure places the firing pin over the detonator through the action of a series of gear wheels. For use with this fuse, a special design of primer detonator is required.

In order that the fuse may be kept "safe" until such time as the pilot may wish to "arm" the bomb, it is fitted with an "arming wire" which passes through an eye in the bomb body, or some element rigidly attached thereto, and also through a hole in the arming vane. When this wire is in place, the vane cannot rotate, nor the fuse become armed. (In one type of fuse which lacks a vane, the safety wire passes through a hole in the arming pin instead.) Unless the wire is withdrawn the fuse will fail to function. Bomb racks are therefore so designed as to permit the pilot to withdraw the wire or not at his option.

Small Arms Ammunition.—The evolution and present applications of small arms ammunition are so closely interwoven with the development of the small arm itself, that they are discussed under that caption (see SMALL ARMS, THE DEVELOPMENT OF).

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AMMUNITION SHIPS: see FLEET AUXILIARY VESSELS.

AMNESIA, a term used in psychopathology for functional disturbances of memory (Gr. *ἀμνησία*, forgetfulness). An amnesia may be *general*, in which case all functions of memory are involved, or *partial*, in which case only certain groups of ideas, proper names, the meanings of words, events and their associations, and the like, are screened from memory. (See PSYCHIATRY.)

AMNESTY, an act of grace by which the supreme power in a State restores those who may have been guilty of any offence against it to the position of innocent persons. It includes more than pardon, inasmuch as it obliterates all legal remembrance of the offence. Amnesties, which may be granted by the Crown alone, or by act of parliament, were formerly usual on coronations and similar occasions, but are chiefly exercised towards associations of political criminals, and are sometimes granted absolutely, though more frequently there are certain specified exceptions. Thus, in the case of the earliest amnesty of which there is adequate record, that of Thrasylbulus at Athens, the 30 tyrants and a few others were expressly excluded from its operation; and the amnesty

proclaimed on the restoration of Charles II did not extend to those who had taken part in the execution of his father. Other celebrated amnesties are that proclaimed by Napoleon on March 13, 1815, from which 13 eminent persons, including Talleyrand, were excepted; the Prussian amnesty of Aug. 10, 1840; the general amnesty proclaimed by the emperor Francis Joseph of Austria in 1857; the general amnesty granted by President Johnson after the Civil War in 1868; and the French amnesty of 1905. The last act of amnesty passed in Great Britain was that of 1747, which proclaimed a pardon to those who had taken part in the second Jacobite rebellion.

An amnesty clause is usually inserted in peace treaties granting immunity from prosecution for acts committed contrary to laws and customs of war by members of the armed forces of the respective belligerents or by their subjects. Not infrequently, however, named persons or persons alleged to have committed war crimes, subjects of the defeated belligerent, are excepted from the amnesty clause and a stipulation for their surrender is expressly included in the treaty. Instances of such exceptions are the Treaty of Peace with the Boers in 1881, the Vereeninging Treaty of 1902, and the Peace Treaties between the Allies and Associated Powers and Germany and her allies after the World War. A belligerent may, however, punish his own subjects, unless the contrary is stipulated in the treaty of peace. For instance, Russia in 1878 stipulated that Turkey should grant an amnesty to such of her own subjects as had compromised themselves during the war. (H. H. L. B.)

AMOEBA, the name given to certain microscopic unicellular animals (see PROTOZOA) characterized by the ability to form



ADAPTED FROM DELLINGER IN "JOURNAL OF EXPERIMENTAL ZOOLOGY" (WISTAR)

FIG. 1.—COMMON AMOEBA MAGNIFIED 260 TIMES

The extensions of the body are pseudopodia. The nucleus is large and granular; the contractile vacuole is a clear spherical structure and the other large inclusions are food vacuoles

temporary extensions of the body, called pseudopodia or false feet. An amoeba moves along on the substrate by the formation of pseudopodia and consequently is continually changing its shape. This characteristic movement, known as "amoeboid movement," is exhibited also by certain cells of higher animals, for instance, by developing eggs of sponges and by the white corpuscles of the blood of many animals; the myxomycetes, some of the flagellates and certain of the sporozoa also have amoeboid stages in their life history. Amoebae are found in fresh water, in the sea, in damp soil; and many live on or in the bodies of other animals, both invertebrate and vertebrate; man himself may harbour six different species in his alimentary canal.

The outer surface of an amoeba, which is in contact with the surrounding fluid, is usually clear and comparatively firm; this layer is the ectoplasm. The interior endoplasm is more fluid and very often granular; the streaming movements that accompany pseudopodium formation can be followed by watching the circulation of these granules. There is no mouth or anus; food is taken in and the undigested remains cast out at any point on the surface. Amoebae living in ponds or in gently running streams feed on algae, diatoms and other protozoa; the amoebae in organic infusions devour bacteria, and the same is true of many of the endoparasites, which are probably really harmless scavengers. Feeding in the amoeba is a very interesting process to watch.

Extensions of the body flow out around the food organism and finally coalesce, resulting in the formation of a food vacuole enclosing the food organism within the body of the amoeba. Digestion occurs within the vacuole through the action of enzymes which are secreted into it. Numerous food

vacuoles are usually present in the endoplasm of the common amoebae.

In addition to food vacuoles, two other structures are usually conspicuous in the body of a fresh-water amoeba; a fluid-filled contractile vacuole and a hyaline, granular-appearing nucleus. The contractile vacuole opens to the surface by a pore through which it expels its contents. This structure is absent in marine and endoparasitic species, and it is probable that its chief function is to regulate the water content of the amoeba. Some workers consider that it also functions in excretion. Reproduction in the amoeba is an asexual process, by binary fission. In this process the amoeba rounds up into a spherical mass, the nucleus divides by a modified mitosis and the cytoplasm constricts until two daughter amoebae are produced, each containing a nucleus. That the nucleus functions in connection with other processes in addition to reproduction may be demonstrated by cutting the animal into two pieces, one with and the other without the nucleus.

The piece with the nucleus grows like an ordinary amoeba and eventually reproduces. The piece without the nucleus moves about for a time but it can not feed or digest food and it dies after the reserve food in its protoplasm has been used up.

During periods of adversity most species of amoeba are able to survive by encysting. In this process the amoeba rounds up, gives off a large amount of its water content and secretes a protective envelope or cyst membrane. Such cysts may be dispersed by air currents or other agencies; and, if they fall into a suitable environment, the envelope ruptures and the contained amoeba emerges.

Of the six species of amoeba that may live in man's alimentary tract, one, *Entamoeba histolytica*, is pathogenic. This organism is the cause of amoebic dysentery. It can penetrate the lining of the intestine, and in the intestinal wall produces a characteristic ulceration. In some cases these amoebae are carried in the blood to the liver where they produce abscesses. This amoeba ingests red blood corpuscles.

Transmission is by the cyst stage, and numerous cysts may be present in the faeces of infected individuals. These cysts, although they are killed by dessication, will remain viable for several days at ordinary temperature under moist conditions. The cysts are able to withstand the action of the digestive juices of the human stomach; viable cysts have been obtained in the faeces of flies and roaches.

Excystment, or emergence from the cyst, occurs in the intestine of man.

The amoeba is one of the most-studied animals in biology and zoology classes because of its relative simplicity. Many workers have been interested in amoeboid movement because it is one of the most primitive types of animal locomotion (see *LOCOMOTION OF ANIMALS*).

Most known species of amoeba can now be cultivated in the laboratory. However, it has not been possible to cultivate these animals in the absence of other living organisms, i.e., in sterile culture. (W. H. J.)

AMOK, RUNNING: see **AMUCK, RUNNING.**

AMON, the human-headed god of Thebes, was probably a local variety of the ancient god Min of Coptos. The temple of Karnak was his home; it was called "the Thrones of the Two Lands" (*Nesut-toui*). He had also a temple of later foundation in southern Epet (Luxor).

AMONTILLADO, one of the two chief types of sherry wine exported. It is sweet and full-bodied, and derives its name from the town of Montilla in southern Spain (see **SHERRY**).

AMONTONS, GUILLAUME (1663-1705), French physicist, was born in Paris Aug. 31, 1663, and died there Oct. 11, 1705. In 1687 he presented to the Academy of Sciences an hygrometer

of his own invention, and in 1695 he published his only book, *Remarques et expériences physiques sur la construction d'une nouvelle clepsydre, sur les baromètres, les thermomètres et les hygromètres*.

In 1699 he published some investigations on friction, and in 1702 and 1703 two noteworthy papers on thermometry. (See **COLD**.)

AMORA: see **TALMUD; GAÖN.**

AMORETTI, little loves, cupids. The title of a sequence of sonnets (published 1595), written by Edmund Spenser (*q.v.*) and dedicated to Elizabeth, probably the daughter of James Boyle, whom he married in 1594. The verses record the course of his wooing and close with the ode or *Epithalamion* celebrating his wedding.

See Emile Legouis, *Spenser*, chap. IV (1926).

AMORITES. The Amorites are known from the Bible (together with the Jebusites, Hivites, etc.), as a pre-Israelite people in Canaan, and also as the inhabitants of two trans-Jordan kingdoms (Num. xxi.). The later Israelites believed that this primitive race was one of giants (Amos ii. 9; Deut. iii. 11).

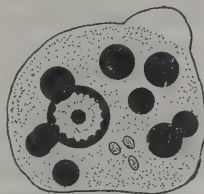
The non-biblical material has markedly increased our knowledge and has also complicated it. Egyptian illustrations of the New Kingdom show the Palestinian Amorites to have been a race much more like the northern Europeans than the Semites; long headed, with blue eyes, straight nose and thin lips. Even the royal name *Akūwawash*, the reputed contemporary of the ancient king Narām-Sin of Akkad (about 2530 B.C.), in the Hittite copy of an inscription of the latter, seems to be Aryan or Indo-European (cf. Forrer, *Die Boghas-köi-Texte in Umschrift*, II. 1, no. 3, col. 1, line 12.) The mixture of races, however, which went on from the earliest times in Canaan and over a considerable area of the surrounding countries must be taken into account.

Another impression is gained from the Babylonian material of the earliest period, where "west" (as one of the quarters of the heavens) and "the land of the Amorites" (*Amurru*, ideogr. *Mar-Tu*) were of identical meaning. The Amorites were inhabitants of a territory lying west of Babylonia, and the majority of them belonged (as forerunners of the Aramaeans) to the western Semitic race.

The motherland of these peoples was the region of the Middle Euphrates: Khana (near the modern Tell-Ishāra, south of the mouth of the Khabur), Mari (near the extensive ruin-mounds Werdi and El-Erzi), Shukhi (between the modern 'Ana and Hit), Subir-Subartu (the modern El-Jezireh, as far as the Tigris) and Naharina (the north-western part of El-Jezireh, near the old Harrān). According to the old king list a dynasty from Mari had actually reigned over Babylon about 2900 B.C., and the names and statues of old kings of the Sumerian period of the kingdom of Mari have been recovered. But the identification of this Mari with the old capital of the Amorites is still uncertain.

The Amorites were gradually driven out of their mother-territory by an invasion of the Kharri and Mittanni from the north. In Babylonia they settled at first in their own villages and townships (e.g., in Sippar) as merchants and as mercenary soldiers; but they soon began to reach out after sovereignty. About 2057 B.C. (according to Thureau-Dangin about 2105 B.C.) Sumu-abum founded the Amorite kingdom of Babylon. Hammurabi, his fifth successor, through his victory over the king Rim-Sin of Larsa, united the whole of Babylonia under his sway (1925 B.C.). This period of the Amorite dynasty meant for Babylonia the richest flowering of her culture. None the less, after 300 years, the Amorite kingdom in Babylonia fell before an invasion of the Hittites (under King Murshilish I., 1758 B.C.).

Meanwhile the Amorites had settled in the west of Lebanon and in the mountainous parts of Canaan, and perhaps even ruled Egypt for a short time. It is, in fact, probable that the foreign domination of Egypt, the so-called Hyksos (c. 1800-1580 B.C.), is connected with the wanderings of this Amorite people. This period was that of the Amorites' greatest power; what they lost in Babylonia was won in Egypt, Canaan and Syria. But after the downfall of the Hyksos kingdom the Amorites were in their turn subjugated by the native Egyptian Pharaohs of the 18th dynasty,



ADAPTED FROM DOFLEIN

FIG. 2.—DYSENTERY AMOEBA MAGNIFIED 2,250 TIMES

The dark circles are red blood corpuscles; the other circle with a beaded periphery is the nucleus

especially by Thutmose III. Only in Lebanon were they able to maintain what seems to have been a small Amorite kingdom, first under Egyptian and then under Hittite overlordship. The capital of this kingdom was probably Kadesh in Orontes, the modern Tell Nebi Mendi which is situated in the plain south of Homs (Emesa). From the Tell el-Amarna and Boghaz-keui cuneiform inscriptions we can follow the history of this kingdom for some 200 years (1400-1200 B.C.); we know, for instance, that under the rulers Abd-ashirta, Aziru and their successors, it extended its sway for a time to the rich Phoenician seaports. The trans-Jordan kingdoms of the monarchs Sihon and Og (Num. xxi.) must have been the final offshoots of the great Amorite kingdom.

The importance and influence of the Amorites were overrated by the late Professor A. T. Clay of Philadelphia; though his is the merit of having drawn attention to their importance. On the other hand, Bauer's careful researches have led him to an underestimation. According to him, *Amurru*, meaning the land to the west, or "the west," is a geographical term; the mercenary soldiers who dominated Babylon under the "dynasty of Amurru" were from a hill country of that name, lying, however, to the north-east; and the Amorite kingdom in the Lebanon and Orontes districts should be wholly separated from both of these. Thus the geographical and historical relations remain unintelligible.

There is a rich but scattered abundance of material on the language of the Amorites in the proper names and in the name-lists from the time of the first Babylonian dynasty, in the foreign words and proper names to be found in Egyptian texts, and, above all, in the foreign words and glosses of the El-Amarna letters. From this it is seen that the language represents an earlier stage of the Hebrew language (*q.v.*).

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AMOROSO (Ital.), a musical term signifying that the passage so marked is to be played in an amorous style, that is, with warmth and tenderness; *con amore* has the same meaning.

AMORPHISM is a term derived from *a*, privative, and *μορφή*, form, and is used in chemistry and mineralogy to denote the absence of regular or crystalline structure in a body; the adjective "amorphous" formless or lacking periodic structure, is used technically in the foregoing sciences and also in biology, etc.

AMORTISEMENT: see AMORTIZATION.

AMORTIZATION, the paying off of a debt or obligation, or the extinguishment of an asset by means of a series of partial payments or charges, prorated to extend over the period during which the obligation or asset will exist. Such amortization payments are usually in annual or semi-annual amounts, each of which is sufficient to cover the interest, if any, and also to provide for a certain reduction of the principal.

The amortization principle is used in finance for the purpose of obliterating the premium or discount on bonds which are bought or sold above or below their par value. As bonds approach their maturity date, at which time they will be paid off at par, their carrying value approaches their par value, actually reaching it at the time of redemption. If such bonds have been bought or sold at a premium or at a discount then such premium or discount must be amortized by the time of maturity in order to bring these two values to a point of coincidence in the accounts. If a bond is bought above par, at a premium, and repaid at par, the owner loses an amount equal to the premium; if it is bought below par, at a discount, and redeemed at par, the owner gains an amount equal to the discount. If the bond is sold above par, at a premium, and redeemed at par, the issuer gains an amount equal to the premium; if it is sold below par, at a discount, and redeemed at par, the issuer loses an amount equal to the discount.

This premium or discount which is gained or lost as the case may be, should be amortized over the life of the bond by periodic charges or credits.

The amortization of bond discount by the issuers will work out as follows. A thousand dollar 5% bond is sold at 80% of its face value. This increases the company's liabilities by \$1,000 and increases its assets by the amount of cash realized, \$800. The difference of \$200 is the bond discount and is entered under this name as an asset. This is, of course, only a balancing item or practically a dummy asset, and if the company is to make its real assets equal to its increased liabilities it must add to its property an amount equal to \$200. The most usual way is to lay aside from earnings annually a predetermined sum either fixed (approximate method) or varying (scientific method), which over the life of the bond will amount to the discount of \$200. Amortization of premiums may be accomplished in a similar manner.

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AMORY, THOMAS (c. 1691-1788), British author, published *Memoirs; containing the lives of several Ladies of Great Britain; a History of Antiquities, etc.* (1755) and *Life of John Bunce Esq.* (1756 and 1766). Both books are an extraordinary mixture of fiction, autobiography, scenic description and theological discussion. Of the two *John Bunce* is by far the more readable. "The hero," says George Saintsbury, "becomes less nebulous; in fact he is, at least, of the world of Dickens, when he sits down, in the highest state of contentment, and, in fact, of positive carol, to a pound of steak, a quart of peas, another (or several others) of strong ale and divers cuts of fine bread." "The soul of Rabelais," says Hazlitt, "passed into John (*sic*) Amory."

See an edition of the *Life of John Bunce* by E. A. Baker (1904); also W. Hazlitt, "On John Bunce," in vol. i. of the 1902 ed. of *Hazlitt's Works*; and G. Saintsbury, "Growth of the Modern Novel," in the *Cambridge History of English Literature*, vol. xi.

AMOS. I. The Book.—Like others of the Prophetic books of the Old Testament, the Book of Amos is a compilation which probably reached its present form long after the time of the prophet whose words it enshrines. We can trace the usual three types of source: (a) oracular matter, comprising most of this book; (b) reminiscences either written or dictated by the prophet himself, usually in prose (vii. 1-8, viii. 1-3, ix. 1-4)—these are accounts of the prophet's intercourse with his God while in the familiar condition of "ecstasy"; and (c) narrative by a third person describing an event in the life of the prophet (vii. 10-17). The passages under heading (a) consist of short, sometimes fragmentary, sections, each embodying an individual and separate message; some of them seem to be snatches from hymns of praise, which may or may not be the work of Amos himself (e.g., v. 7, 8-9), and the final compiler seems to have appended to his collection a hopeful section by a later hand (ix. 8b-15), which was intended to tone down the uniform gloom of the prophet's predictions. Possibly the prophet himself was responsible for the arrangement of the oracles on the nations (i. 3-ii. 7a); if not, then the compiler of this section shows a rhetorical and dramatic power not unlike that of the prophet himself.

II. The Man.—Amos, whose activity is to be dated about 760 B.C. (viii. 9 suggests that Amos had experienced the eclipse of 763), was a native of Tekoa, in southern Judah. He belonged therefore, to a social order which still remained largely pastoral, and, though he knew the agricultural and commercial life of central Palestine and its cities, he approached it as an outsider. He himself lived the life of the semi-nomad, accustomed to the wide spaces of the southern hills, where the appearance of two travellers together was a rarity to be explained only on the ground that they had planned to journey together. He knew the habits of the lion, the bear, the birds, the snakes, and of those who hunted them or feared them. Though clearly an "ecstatic" (Heb. *nābī'*), he indignantly repudiated the suggestion that he belonged to the professional party of "prophets" whose interference in politics had produced a revolution 100 years before his time. But he had the

clearness of insight which comes from lonely communion with nature, and he had, too, the intense conviction that it was the word of his God that he had to deliver.

III. His Message.—Since the days of David, Israel had been growing steadily out of the old nomad social and economic order into that of a commercial and agricultural state. Such a transition is always attended with risks, and these had become most obvious in the century preceding Amos. The old system of small proprietors, prevalent up to the middle of the 9th century, had given way to large estates worked by serf or slave labour. The result was a national emasculation, and the means by which the change was produced involved not only a failure to appreciate the demands of humanity, but also commercial immorality and shameless judicial corruption. Popular religion, to some extent inherited from the Canaanites, gave no help; on the contrary it condemned the would-be reformer (vii. 10 *seq.*), and its methods and ritual proved to be diametrically opposite to the real interests of morality. On the one hand, Amos found extravagant luxury, jingoism and oppression; on the other a proletariat from whom all virility had been crushed. Such a state could not hope to survive.

Unlike the Rechabites, who stood for a return to the simpler conditions of the nomad stage, Amos had no social programme to offer. Instead, he called men back to the God of their fathers, and insisted that the nation could find safety only in moral and spiritual reform. He presented men with a God who was essentially Law, acting not by casual whim but on invariable principle. To him the God of Israel was the Lord of creation, of history and of universal morality, and His supreme demand was for *justice*. That alone could save the people from their impending fate, for that alone would admit in practice the rights of human personality. The supreme contribution of Amos to the world's religious thinking was that he insisted that God is *good*.

Among English works on Amos the most advanced is Harper's Commentary (*Internat. Crit. Comm.*); see also Driver's *Joel and Amos* and Sir G. A. Smith's *Twelve Prophets*. More recent work of a popular type is J. E. McFadyen's *Cry for Justice* and the chapter on this book in *Prophecy and the Prophets in the Old Testament* by T. H. Robinson, who has also published a translation in colloquial English; Julian Morgenstern, *Amos Studies* (1941). (T. H. R.)

AMOSITE, a variety of asbestos characteristic of a definite geological horizon in the Lydenburg and Pietersburg districts of the north-eastern Transvaal; it possesses well developed fibrous structure and the colours range through greys and whites to yellowish greys. The material is a silicate of iron containing also magnesia and lime or soda. The deposits contain a high percentage of long fibres; spinning stock 4–7 in. in length is common and lengths up to 11 in. have been observed. The name is derived from the synthetic word *Amosa*, made by combining the initial letters of the name of one of the principal producing companies, Asbestos Mines of South Africa; the term was suggested as a distinctive trade name by A. L. Hall (Geol. Survey, Union of South Africa) in recognition of the distinctive characteristics of the fibre.

AMOY (24° 27' N. 118° 4' E.), former treaty port in the province of Fukien on the highly indented southeastern coast of China. It lies at the head of a wide bay, studded with islands, into which flows the Kiulung river, whose basin occupies the southeast of the province. The harbour lies in the lee, *i.e.*, to the west, of Amoy Island and is one of the finest on the coast. Its natural hinterland comprises only southeast Fukien and its trade with the interior is becoming more and more confined within these limits. In the past it had a much larger significance, for it lay on that part of the Chinese coast first reached by traders approaching China by sea from the Indian ocean. Both the English and Dutch first traded with China through Amoy which in the 18th century monopolized the Chinese junk trade to the "straits" and Java. It still retains close connections with Malaya, whose Chinese population is drawn largely from Fukien and emigrates mainly through Amoy. This relationship with Malaya is illustrated by the foundation of Amoy university by K. K. Tan, a Fukienese, by means of wealth acquired in Malaya. Moreover, Amoy had trading relations with Formosa, once part of Fukien, but after the cession of Formosa to Japan these became less intimate. Its tea export, once its staple trade, drawn originally from

Fukien itself and later from Formosa, dwindled away. Its main importance was as a port of call for coastal shipping, with ship repairing facilities, and cannery and sugar refining industries. Foreigners resided in the international settlement on Kulangsu Island opposite Amoy. After the Japanese invasion, when Amoy was occupied, May 1938, its coastal trade with Japanese influenced areas in southeastern Asia increased. After having failed in May 1939, Japan took over Kulangsu after Pearl Harbor. The U.S. and English treaties with China, Jan. 11, 1943, relinquished treaty-port privileges, thus abolishing the settlement.

AMPELIUS, LUCIUS, possibly a tutor or schoolmaster, and author of an extremely concise summary—a kind of index—of universal history (*Liber Memorialis*) from the earliest times to the reign of Trajan. The little work, in 50 chapters, gives a sketch of cosmography, geography, mythology (chaps. i–x.) and history (chap. x–end). The historical portion, dealing mainly with the republican period, is untrustworthy, and the text in many places corrupt; the earlier chapters are more valuable and contain some interesting information. In chap. viii. (*Miracula Mundi*) occurs a reference to the famous sculptures of Pergamum, discovered in 1871, excavated in 1878, and now at Berlin: "At Pergamum there is a great marble altar, 40ft. high, with colossal sculptures, representing a battle of the giants." Nothing is known of the author.

The first edition of Ampelius was published in 1638 by Salmassius (Saumaise) from the Dijon ms., since lost, together with the *Epitome* of Florus; the latest edition is by Wölfflin (1854), based on Salmassius's copy of the lost codex.

See Gläser, *Rheinisches Museum*, ii. (1843); Zink, *Eos*, ii. (1866); Wölfflin, *De L. Ampelii Libro Memoriali* (1854).

AMPELOPSIS, a genus of the vine family, Vitaceae, strongly resembling the grape-vine in habit, comprising some 25 species native to Asia and North America, some of which are cultivated as ornamental climbers. Of these, the pepper-vine (*A. arborea*), somewhat shrubby, with pinnate leaves, and the simple-leaved ampelopsis (*A. cordata*) occur in the southern United States and Mexico.

The Virginia creeper (*q.v.*) and the Boston or Japanese ivy were once placed in this genus but are now considered as belonging to *Parthenocissus*.

AMPÈRE, ANDRÉ MARIE (1775–1836), French physicist, was born at Polémieux, near Lyons, Jan. 22, 1775. When Lyons was taken by the army of the convention in 1793, the father of Ampère, holding the office of *juge de paix*, was thrown into prison, and soon after perished on the scaffold. This event produced a profound impression on the susceptible mind of André Marie, and for more than a year he remained sunk in apathy. From about 1796 he gave private lessons at Lyons in mathematics, chemistry and languages; and in 1801 he removed to Bourg, as professor of physics and chemistry, leaving his ailing wife and infant son at Lyons. His wife died in 1804 and he never recovered from the blow. In 1809 he became professor of mathematics at the École Polytechnique in Paris. Here he continued his scientific researches and multifarious studies with unabated diligence. He was admitted to the Institute in 1814.

It is on the service that he rendered to science in establishing the relation between electricity and magnetism and in developing the science of electro-magnetism, or, as he called it, electro-dynamics, that Ampère's fame mainly rests. On Sept. 11, 1820, he heard of H. C. Oersted's discovery that a magnetic needle is acted on by a voltaic current. On the 18th of the same month he presented a paper to the Academy, containing a far more complete exposition of that and kindred phenomena.

The whole field thus opened up M. Ampère explored with characteristic industry and care, and developed a mathematical theory which not only explained the electro-magnetic phenomena already observed but also predicted many new ones. His original memoirs on this subject may be found in the *Ann. Chim. Phys.* (1820–1828). Late in life he prepared a remarkable *Essai sur la philosophie des sciences*, and wrote many scientific papers, including two on the integration of partial differential equations (*Jour. École Polytechn.*, x., xi.). He died at Marseille on June 10, 1836. The great amiability and simplicity of Ampère's character are well brought out in his *Journal et correspondance* (1872).

AMPÈRE, JEAN JACQUES (1800–1864), French philologist and man of letters, only son of André Marie Ampère, born at Lyons. In an extended tour in northern Europe, he studied the folk-songs and popular poetry of the Scandinavian countries. Returning to France, he delivered in 1830 a series of lectures on Scandinavian and early German poetry at the Athenaeum in Marseille. The first of these was printed as *De l'Histoire de la poésie* (1830), and was practically the first introduction of the French public to the Scandinavian and German epics. Ampère became professor of the history of French literature at the Collège de France. A journey in northern Africa (1841) was followed by a tour in Greece and Italy, in company with Prosper Mérimée and others. This bore fruit in his *Voyage dantesque* (printed in his *Grèce, Rome et Dante*, 1848), which helped to popularize the study of Dante in France. In 1848 he became a member of the French Academy, and in 1851 he visited America. From this time until his death at Pau he was occupied with his chief work, *L'Histoire romaine à Rome* (1861–64).

BIBLIOGRAPHY.—The *Correspondance et souvenirs* of A. M. and J. J. Ampère (1805–54) was published in 1875. Notices of J. J. Ampère are to be found in Sainte-Beuve's *Portraits Littéraires*, vol. iv., and *Nouveaux Lundis*, vol. xiii.; and in P. Mérimée's *Portraits historiques et littéraires* (2nd. ed., 1875).

AMPÈRE, the practical unit of electric current. It is equal to 10^{-1} absolute electro-magnetic units. (See PHYSICAL UNITS.)

AMPÈRE METER or **AMMETER**, an instrument for measuring electric currents. Ammeters used for the measurement of direct current are moving iron or moving coil low resistance galvanometers (see GALVANOMETER). In the latter form of instrument the current passes through a coil hung in the field of a permanent magnet, and this causes a deflection of the coil to which a pointer is attached. This is more widely employed than the moving iron type on account of its more efficient damping, which is due to eddy currents set up in the instrument, and in the best types of precision instruments the pointer attains its equilibrium position in less than a second. For measuring alternating current by means of an electromagnet ammeter, the instrument is, in general, a form of dynamometer (*q.v.*). It measures, by their relative motion, the current flowing through two sets of coils which are connected in series, so that a change in direction of current affects both simultaneously, with the result that their relative movement is unchanged and depends on the magnitude of the current alone. The Duddell galvanometer is an alternating current electromagnetic ammeter which indicates the magnitude of the current by means of the relative motion of two straight parallel portions of a single wire carrying the current and situated in a permanent magnetic field. The *hot wire ammeter* may be used to measure either alternating or direct current, the movement of its pointer depending on the linear expansion of a wire when it is heated by the current.

AMPERSAND, the name of the sign, & or &, which is a combination of the letters *e*, *t*, of the Lat. *et*, and; a corruption of the mixed English and Latin phrase, "and *per se* and," of which dialect forms are, "ampussyand," or "amperseand."

AMPHIARAUS, a celebrated seer and prince of Argos, son of Oicles (or Apollo) and Hypermestra. He took part in the voyage of the Argonauts and in the chase of the Calydonian boar. He foresaw the disastrous issue of the war against Thebes and at first refused to share in it; but Eriphyle, bribed by Polyneices with the fatal necklace of Harmonia, persuaded him to set out on the expedition. Knowing his doom, he bade his sons, Alcmaeon and Amphilocheus, avenge his death upon their mother.

On the defeat of the Seven, Amphiarus, pursued by Periclymenus, would have been slain had not Zeus opened a chasm into which the seer, with his chariot and horses, disappeared. Henceforth he was numbered with the immortals and worshipped as a god. Near Oropus, on the supposed site of his passing, his sanctuary arose, with healing springs and an oracle famous for its interpretation of dreams (Pausanias i. 341–342). There was another temple dedicated to him on the road from Thebes to Potniae, and here was the oracle of Amphiarus consulted by Croesus and Mardonius.

See Herodotus viii. 134; Pindar, *Olymp.* vi., *Nem.* ix.

AMPHIBIA, the term applied to one of the several classes of vertebrate animals. Amphibians include frogs, toads, salamanders and caecilians, forms which stand in the zoological scale midway between the fishes and the reptiles. Many aquatic animals, such as crocodiles and seals, are "amphibious," but, as their organization shows, belong to some other class of vertebrates.

Amphibia, introduced by Linnaeus for both Reptilia and Amphibia, in the modern sense is preferable to the term Batrachia which will be found in many older works.

Amphibia are cold-blooded vertebrates with a smooth or rough,

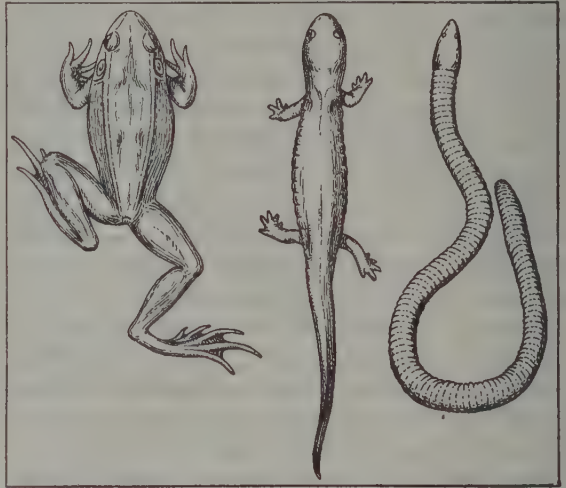


FIG. 1.—THE THREE TYPES OF LIVING AMPHIBIANS—FROG, SALAMANDER AND CAECILIAN

but not scaly skin, very rich in glands. Most have four legs and live on land, but, unlike other tetrapods, they respire to a large extent through their skin. The eggs are usually laid in the water, the larva passing through an aquatic existence before metamorphosing into the gill-less adult. The eggs, even when laid on land, are without a calcareous shell, and do not develop the amnion or allantois of higher vertebrates. Modern Amphibia are readily distinguished from reptiles by many differences of skeleton, but the most primitive fossils were so similar to the contemporary reptiles that no sharp distinction can be made between them. Palaeontological finds have also tended to bridge the gap between Amphibia and the fishes. Modern Amphibia are the specialized descendants of a great group of more or less aquatic forms living in late Palaeozoic and Triassic times. It is these extinct forms that represent the actual ancestors of reptiles and to them one must turn for the ground plan of skeletal organization from which all higher types evolved.

EVOLUTION

The First Land Vertebrates.—The most primitive of the fossil Amphibia are unquestionably the Embolomeri. In Carboniferous times the group contained, as shown by D. M. S. Watson, "primarily aquatic animals which show no signs of ever having possessed terrestrial ancestors," as well as others obviously terrestrial, and still others that had secondarily returned to life in the water. "Despite their diverse habits, the fundamental morphology of the skeleton is strikingly uniform throughout the group." It is clear from the researches of Watson that the ancestral fish changed to a tetrapod before the latter became permanently adapted to land life.

The first tetrapods, therefore, swam in the waters with their fish ancestors. *Eogyrinus*, the best known of these most primitive tetrapods, had a long body and probably a flattened tail. It very probably lived on fishes in the pools of a rather arid and quickly drying country. As the pools dried up *Eogyrinus* would move, or at least was equipped to move, in the manner of an eel

overland to other pools. Its skull agreed closely with that of its osteolepid ancestors differing chiefly in having a long tract of the basis cranii unossified, permitting a certain movement in the skull. The spiracular notch was very likely covered by a tympanic membrane, for, as shown in certain other Embolomeri, the hyomandibular had already been converted into a stapes, even though no opening for its insertion into the otic capsule had yet appeared. The pectoral girdle was attached to the skull by post-temporals as in many fish, and this girdle differed from the primitive bony fish apparatus only in the addition of the interclavicle, a new dermal element, to its ventral surface in the mid-line. The pelvis was not firmly attached to the vertebral column as in later vertebrates, but the ilia rested on long sacral ribs and were held by muscles very much in the same way that the scapula is secured in the thorax. The limbs were small and capable of only a limited motion in any direction.

The Embolomeri are the most primitive labyrinthodonts and gave rise directly to the Rachitomi, and the latter in turn to the Stereospondyli. The Phyllospondyls and Lepospondyls, already present in the Carboniferous, evolved either from specialized Embolomeri or primitive Rachitomi. There is no good evidence of these having arisen independently from fishes. The salamanders and frogs have come from Phyllospondyls, while the caecilians seem to have arisen from Lepospondyls. Fossil intermediates between any modern Amphibia and these ancient orders are lacking and our conclusions are based on a comparison of their skeletal characters.

The Skeleton.—Once vertebrate life was established on land it reverted not once but many times to the aquatic habitat long before the modern Amphibia appeared. Despite the frequent change of habitat the skeletal organization of the first Amphibia continued to evolve steadily in definite directions with time. In recent Amphibia, too, the fundamental structure has changed slowly while the various groups may show the widest adaptations. Ranids may be arboreal, aquatic or fossorial; plethodontids may be the same.

Skull.—The first tetrapods inherited a skull very similar to that of their fish ancestors. It consisted of a cartilaginous box or chondocranium, covered completely above by dermal bones and internally strengthened by bones which replaced the cartilage in part. This skull, the prototype of all tetrapod skulls, differed remarkably from that of modern Amphibia by the far greater number of skull elements it contained, by the greater ossification of the chondocranium and by its reptile-like form.

The skull of the Embolomeri agreed in most details with that of the osteolepid fishes. The skull roofs were similar (figs. 2 and

3) and the almost identical position of the palatal and jaw bones (fig. 3). The large pterygoids are bordered externally by the prevomers, palatines and ectopterygoids. The distribution and replacement of the large teeth are identical in fish and tetrapod. An internal nares is present in all osteolepids and "is identical in position, size and borders with that of certain Embolomeri." The osteolepids very probably breathed air in the manner of the Embolomeri.

The lower jaw of the first tetrapods differed greatly from that of modern Amphibia in the far greater number of elements it contained. It was, however, identical with that of the osteolepid jaw.

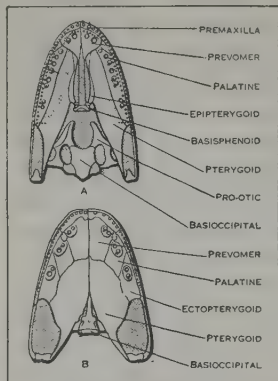
The brain case of osteolepids and Embolomeri were very similar but not identical. In both the basioccipital formed a circular condyle perforated by the notochord. The exoccipitals extended upwards to a well developed supraoccipital. The basisphenoids of both had definite basiptyergoid processes with which epipterygoids articulated. The great difference is seen in the palatal view. The osteolepids had a large part of their basis cranii unossified. In this they differed from all other vertebrates, save their descendants, the coelacanth.

This character would seem to exclude the osteolepids from the immediate ancestorship to the tetrapods, but the numerous resemblances of brain case, skull roof and jaws show that the osteolepids must have been closely allied to the ancestor fish.

Once this reptile-like, highly ossified and complex skull of the ancestral fish became established in land forms, it underwent an enormous specialization. The successive stages in its specialization may be traced in the Rachitomi and Stereospondyli and to a lesser extent in the other orders of Amphibia. Very soon there began a progressive fenestration, the bones tending to segregate along lines of greatest stress. The solid dome-like skull roof progressively lost various dermal elements until in the modern frogs only the premaxillary, maxillary, nasal, quadratojugal, squamosal, frontal and parietal are left. The more primitive salamanders still retain a lachrymal and prefrontal in addition to the frog's equipment. The quadratojugal, although appearing as a separate element during ontogeny in the Caudata, later fuses with the quadrate. This loss of elements was perhaps largely due to a shortening of the skull. The Embolomeri had 12 cranial nerves; and in the evolution of this group and the Rachitomi the hypoglossal foramen in the exoccipital is carried farther backward until in the most specialized labyrinthodonts, the Stereospondylia of the Upper Trias, it no longer perforates the skull wall, the twelfth nerve passing out behind the skull as in modern Amphibia.

The second great change that developed as the tetrapod series evolved was the gradual flattening of skull. It changed from tropibasic to platybasic, not the reverse as some embryologists have maintained. The trabeculae were no longer squeezed together, and the interorbital septum became hollowed out into a trough.

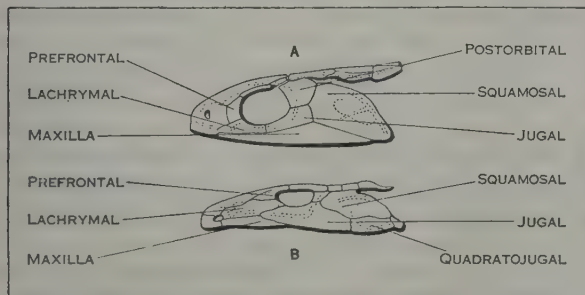
The third fundamental change was a progressive weakening of the bony organization of the skull. The brain case became progressively less well ossified. Basioccipital, basisphenoid and supraoccipital became reduced and disappeared. Hence, the original tripartite condyle became converted into a pair of well-separated exoccipital condyles. The tripartite condyle is retained in many reptiles, but in the promammals a withdrawal of the basioccipital parallels exactly the condition in modern Amphibia,



FROM WATSON, "EVOLUTION AND ORIGIN OF AMPHIBIA," BY COURTESY OF THE ROYAL SOCIETY

FIG. 3.—PALATAL VIEW OF THE SKULL OF AN EMBOLOMEROUS AMPHIBIAN COMPARED WITH THAT OF AN OSTEOLEPID FISH

A. Eusthenopteron
B. Baphetes



ILLUSTRATIONS FROM WATSON, "EVOLUTION AND ORIGIN OF AMPHIBIA," BY COURTESY OF THE ROYAL SOCIETY

FIG. 2.—SIDE VIEW OF THE SKULL OF A REPRESENTATIVE OF THE EMBOLOMERI, PRIMITIVE AMPHIBIANS, WHICH LIVED MILLIONS OF YEARS AGO, COMPARED WITH THAT OF AN OSTEOLEPID ANCESTOR, AN EXTINCT FISH WHOSE FOSSILS HAVE BEEN FOUND IN SCOTLAND

A. Osteolepis macrolepidotus
B. Palaeogyrinus decorus

3), except for a cluster of small bones in the nasal region in osteolepids. The distribution of the lateral line canals in both skulls facilitates the identification of lachrymal, prefrontal, jugal, post-orbital, postfrontal, supra and intertemporals. The spiracular notch of *Osteolepis* has become the otic notch and the elements bordering this and the orbit may be readily homologized (fig. 2). The palates agree remarkably in the small size of the interptery-

On the palate the interpterygoid vacuity became progressively wider (fig. 3). The pterygoid lost its connection with the basipterygoid process and higher labyrinthodonts depended entirely on the parasphenoid for its support. In frogs and certain primitive salamanders (some hynobiids, etc.) the pterygoid cartilage extends forward and fuses with the nasal capsule. The bony pterygoid which forms around it has much the form of the pterygoid of the Rachitomi but posteriorly it makes different contacts. The ectopterygoid is lost in all salamanders and frogs but still retained in a few caecilians. The palatine is variable in occurrence. Within a single genus of frogs some species may possess and others lack an ossified palatine. The most remarkable changes occur in the prevomer of modern forms. In salamanders the palatine undergoes a radical change at metamorphosis, part becoming lost and part apparently fusing with the prevomers. This combined prevomer and palatine tends to invade the parasphenoid region in the various families of salamanders, sending back long denticular processes on either side of the parasphenoid region (salamandrids) or ventral to it (plethodontids). In most plethodontids the posterior processes break off as one or two separate denticular areas overlying the parasphenoid as "parasphenoid teeth." A few frogs (brevipitids) have succeeded in similarly dividing the prevomers, but the posterior elements overlie the palatine, not the parasphenoid region. A few others have the prevomers fused into a single element (*Xenopus*). In all salamanders except certain primitive salamandrids and hynobiids and a few higher forms, the pterygoid fails to reach the maxilla, and in the Plethodontidae it never ossifies at all, although it may extend forward to the maxillae. It is the reduced pterygoid and maxilla which make the salamander palate seem so unlike that of the frogs, although they are both fundamentally alike and referable to the Rachitomi plan. If the palate of such a primitive salamandrid as *Tylotriton* is compared with that of a frog or of *Eryops*, the fundamental resemblance becomes obvious.

The most reduced part of the modern amphibian skull is the lower jaw. The Embolomeri inherited a complex mandible of ten pieces. In the Rachitomi and Stereospondyli there occurs a gradual reduction of the mandible in width, a loss or fusion of elements, until in primitive salamanders there was left only a dentary, a prearticular and articular and an angular. Coronoids are present in the larvae of most salamanders. The angular is fused with the prearticular in all members of this group above the Cryptobranchioidea. In caecilians a very early fusion of the jaw elements occurs in most genera, but the resulting element probably contains a coronoid as well as the dentary, articular and prearticular; for two rows of teeth are present in many forms. In the Salientia the reduction is carried to an extreme, for only the dentary and prearticular are recognizable. The articular ossifies in very few Salientia and is then fused to the prearticular. The anterior end of Meckel's cartilage ossifies as a pair of distinct elements in some Ranidae, Hylidae and Bufonidae.

While the changes in the skull and jaws discussed above proceeded regularly in the evolution of the Amphibia and may be classified as trends of evolution or orthogenetic changes without a primary adaptive significance, there were other modifications taking place which seem more definitely correlated with the environment. Perhaps the most important of these were those associated with the ear. The first tetrapods as represented by *Eogyrinus* possessed a stapes and very probably a tympanic membrane, but no fenestra ovalis. The sound waves were thus transmitted from the stapes through the otic capsule. This condition was scarcely different from that of fishes where no stapes was present. Another piscine character was the absence of a cranial wall between the labyrinth and the brain. The latter character was handed on to certain Rachitomi but later Amphibia walled off the auditory apparatus from the brain, leaving only a foramen for the auditory nerve. With the assumption of land life the fenestra ovalis was completed in the lateral wall of the otic capsule. The Salientia inherited this auditory apparatus in a slightly modified form. All Caudata have suffered a loss of the tympanum and middle ear. The stapes is connected in the larva with the quadrate, and sound waves are transmitted through the lower jaw resting on the sub-

stratum to the quadrate and thence via the stapes to the inner ear. In the metamorphosed individual the head is raised from the ground and the stapes is usually connected by a muscle with the shoulder girdle. Vibrations are thus apparently sent through the forelegs of the adult salamander to the ear.

The osteolepid ancestors of the Amphibia had five branchial arches, while the modern Amphibia have at most four. The latter possess, however, a pair of laryngeal cartilages which may or may not represent the fifth branchial arch. The gill arches in the adult salamander or frog are modified by reduction and fusion.

Vertebrae.—The major groups of the Amphibia are classified to a large extent on the form and composition of their vertebrae. To evolve the first tetrapod vertebrae from those of their fish ancestors did not require any radical alterations. The immediate ancestors of the Embolomeri are not known to have embolomeric vertebrae, but they probably had vertebrae which could be easily resolved into the embolomeric type. Most fishes and Amphibia have the vertebrae more or less ossified and the cartilaginous blocks of the embryonic vertebrae after certain unequal growths fused. The basidorsals almost invariably grow up and around the neural tube tending to enclose it as a neural arch. The basiventral may either grow up around the notochord or it may remain rudimentary, while the basidorsal grows down toward it. The interdorsal and interventral may fuse and ossify or remain separate, either ossifying or not. In the tail region of the fish *Amia* the interdorsals sometimes fuse with the interventrals but not with the basiventral. Thus, each neural arch may have two centra, an embolomeric condition. In the body region of the same fish interdorsals, interventrals and basiventrals may fuse as a single centrum.

Such a variability of vertebral composition becomes greatly restricted in the Amphibia. The first tetrapods retained the embolomeric or double centrum type of vertebrae for their entire column. The Rachitomi, being more cartilaginous, have the four pairs of embryonic blocks ossified, but separate, producing the rachitomorphic or "backbone-cut-into-pieces" type. In the most specialized labyrinthodonts a decided one-sided growth of the blocks has occurred, for the centrum is composed entirely of basiventral, the interdorsal and interventral either being greatly reduced or remaining cartilaginous.

The Lepospondylia and Phyllospondylia have sprung from either the Rachitomi or from a labyrinthodont stock slightly more specialized than the known Embolomeri. Their vertebrae are more embryonic than that of the Embolomeri in that the notochord is less restricted by the surrounding centrum. The vertebrae are, on the other hand, more specialized in that the interdorsal and interventral remain cartilaginous (*i.e.*, are not present in the fossils), the definitive centrum being formed by the basidorsal and basiventral, which may remain separate in some branchiosaurs but always fuse into a single ring in the microsaur. In both these orders the vertebral column seems to consist of a series of rings, one for each somite, the septum, as shown by the position of the rib being, therefore, between the successive vertebrae unless by a secondary shifting, such as occurs in modern Amphibia, the rib arises from the side of the vertebra. All Phyllospondylia have their ribs arising in this secondary position while most Lepospondylia retain the more primitive position.

Primitive salamanders and frogs (Ascaphidae) have vertebrae very similar to those of branchiosaurs, except that they are more ossified. Further, in the trunk region of the recent forms, the basiventrals remain very small, and the main part of the centrum is formed by the basidorsals. Interdorsals and ventrals remain cartilaginous in the primitive types of modern Amphibia and frequently, as in *Ascaphus*, no joints are formed between the successive vertebrae. In the higher forms, however, the intervertebral cartilage (interdorsal plus interventral fused) splits in such a way as to form a ball-like surface on the anterior (opisthocelus) or on the posterior end (procoelus) of the vertebrae. Usually in Salientia and frequently in Caudata the articular ball calcifies or ossifies. In a few frogs (*Megalophrys*, etc.) the ball may remain quite free of either the vertebrae before or the one behind it. This ball has been called a centrum by various authors.

As it contains almost all of the interdorsal and interventral tissue it is homologous to the centrum of reptiles and mammals, but not to that of the Phyllospondyls, Lepospondyls or Stereospondyli. In the Salientia the form of the vertebrae as determined by the manner of fusing of the intervertebral ball affords one of the primary characters of classification.

The Salientia are in various features of their skeleton more primitive than the Caudata, but the development of their vertebrae is far less diagrammatic. In the most extreme types, some terrestrial (Pelobatidae), others aquatic (Pipidae, Discoglossidae), the basidorsals and ventrals extend only a short distance towards each other before metamorphosis. At this time the notochord is greatly reduced and a much flattened vertebra results, formed, except for the articular ball, almost entirely by the basidorsal. The explanation of these coenogenic features may rest in the large notochord and very active tadpoles found in these forms. The developmental history if taken alone would throw very little light on the past history of these vertebrae.

Ribs.—The ribs of primitive Amphibians and reptiles articulate with all vertebrae, at least as far back as the middle of the tail. In phylogeny the sacral ribs become fused to the vertebrae first, then the caudals, next the lumbar, the cervical and finally the thoracic. In elongate salamanders the ribs have become reduced in number. *Siren* and *Amphiuma* have only the anterior thoracic vertebrae still retaining the ribs. In frogs the reductions have reached an extreme. Discoglossids retain three, liopelmids only two ribs in the adult. The pipids have two ossified ribs in the larva, but these fuse later to the diapophyses. The bits of cartilage on the ends of the diapophyses of the higher frogs have been considered homologues of the ribs. This is perhaps a matter of definition. No ossified ribs appear as distinct elements in the development of any Salientia above the Pipidae.

The ribs are long in the primitive labyrinthodonts and surround the body as a series of hoops. They never meet in the mid-line and never connect with the sternum. In some higher Rachitomi (*Cacops*) the ribs are short and directed outward. The microsaurs have long curved ribs, the branchiosaurs and modern Amphibia very short and rod-like ones. The ribs are shortest in the frogs and the long-bodied perennibranchs; longest in the primitive salamandrids. In *Tylotriton*, and its close relative *Triturus waltli*, the tips of the ribs may be long, pointed and actually protruding through the skin. This apparently serves as a special mode of protection, for when the animal is quickly seized the needle-like ribs may give a sharp prick.

The ventral side of the body of many Labyrinthodontia, Lepospondylia and Phyllospondylia was sheathed with a coat of closely set rods or plates. These apparently gave rise to the abdominal ribs of reptiles. In modern Amphibia only *Liopelma* has large myoseptal cartilages of apparently the same form as the abdominal ribs of lizards, but a few salamanders have splints of cartilage in a few of the myosepta which may possibly be similarly interpreted.

Pectoral Girdle.—The pectoral girdle of the first tetrapod was practically identical to that of the primitive bony fish except that a new dermal element, the interclavicle, had been added to its ventral surface in the mid-line. Four pairs of dermal elements were present in the first land vertebrates in addition to the interclavicle. These formed a half ring of bone on either side of the body directly behind the branchial arch region. The cartilage bones which form the bulk of the pectoral girdle of modern Amphibia were represented in these primitive forms merely as a simple buttress for the humerus on each side. Such a buttress may be called a scapula or a scapulo-coracoid, for it is only in the higher Amphibia that this ossifies from two centres.

Aquatic labyrinthodonts secondarily broadened their clavicles and interclavicles. A similar broadening of the ventral girdle elements is found in many modern Amphibia which are wholly aquatic. The dermal elements, however, continued to dwindle in the higher Amphibia. This seems to be directly correlated with a greater development of the leg and shoulder musculature brought into play by the increased use of the forelimbs.

The branchiosaurs possessed a pectoral girdle very similar to

that of the Rachitomi but more cartilaginous. The entire glenoid and coracoid regions remained unossified. A somewhat similar difference distinguishes the pectoral girdle of certain aquatic Caudata from that of their more terrestrial relatives.

The Salientia have retained the pectoral girdle of the more terrestrial Rachitomi in almost its entirety. The interclavicle has been lost and a new structure, the omosternum, had arisen by a forward elongation and usually a division of the coracoid cartilages. The broadened ventral ends of scapulo-coracoid bars have become fenestrated. The posterior rim ossifies as a separate centre, the coracoid, while the mesial and anterior part usually remains cartilaginous. The anterior rim is called the procoracoid, while the mesial part the coracoid cartilage. In spite of these different names the fundamental resemblance of the pectoral girdle of frog and labyrinthodont is obvious.

In higher Salientia many modifications of the pectoral girdle occur. In different families the coracoid cartilages may fuse in the mid-line producing a firmisternal type of girdle. In the Brevicipitidae procoracoid and clavicle may become lost entirely. Omosternum and sternum are subject to either ossification or loss. In the Ranidae and the Polypedatidae the former may become widely forked posteriorly. The sternum was possibly cartilaginous in the labyrinthodonts and branchiosaurs, although as it is never found fossil in these groups its presence has been denied. The sternum in the most primitive Salientia resembles greatly the abdominal ribs and may, in fact, have arisen from this series of elements.

The Caudata are specialized in the complete loss of the dermal elements. As if in compensation for this loss the coracoid cartilages are usually broadly dilated. The deltoid region has become extended into a long, so-called procoracoid in most forms, but the primitive genera of several families retain this in a less extended condition. The salamanders are thus primitive in that the scapulo-coracoid usually ossifies as a single piece, the ossification often extending far down into the coracoid region producing a structure very much as in *Eryops*; in *Siren* and *Pseudobranchius* the posterior ventral margin of the cartilage ossifies as a separate coracoid.

Pelvic Girdle.—The pelvic girdle of the first tetrapods has advanced beyond the conditions found in fishes in that a pubis, ischium and ilium are present meeting in the acetabulum in a triadial suture. The ilium, however, was not firmly attached to the sacral ribs.

The ilium soon gained a firmer support to the sacral ribs, and even within the Embolomeri the girdle underwent some modification. *Diplovertebron*, according to Watson, failed to ossify its pubis, and this condition has been handed down to most modern Amphibia. The terrestrial labyrinthodonts retained a more ossified girdle which was almost indistinguishable from that of the contemporary cotylosaur reptiles.

Modern Amphibia have inherited the same plate-like pelvis of the primitive labyrinthodonts. The obturator foramen so characteristic of modern reptiles is not present and the pubis is usually unossified, as in the branchiosaurs and higher labyrinthodonts. In a few Salientia the pubis region is either calcified or ossified, but it rarely forms a separate bone. The pubis cartilage is of variable extent in the different families of Caudata, it being more extensive in aquatic than in terrestrial forms. A part of the pubis is unossified in even the most terrestrial Amphibia.

Many salamanders exhibit at the anterior end of the pubis a Y-shaped cartilage called an epipubis or an ypsiloid apparatus; as shown by Whipple, this structure serves to assist in controlling the form of the lungs in those forms that use this structure as a hydrostatic organ. It seems to be a neomorph in the salamander group, although certain liopelmids and pipids have a cartilaginous plate immediately anterior to the pubis. The primitive *Ascapheus* has developed a pair of rod-like cartilages which lie over the ventral surface of the pubis and function in directing forward the "tail" or copulatory apparatus of the male.

Limbs.—The Amphibia arose from some generalized cross-opterygian. The skeletons of the paddles of only two of these primitive types of fishes are known. These fin bones are leg-like in that they consist of a proximal element or humerus subtending

two distal elements, a radius and ulna. The outer row of elements, however, are more numerous than the supporting elements in the hands or feet of tetrapods. Undoubtedly a series of fusions and losses must have occurred in the change from fin to limb. The modifications are confined to the distal segment of the appendage. The fundamental ground plan of single-proximal, double-medial and multiple-distal elements was already well established in the fish ancestors of the tetrapods.

The chief problem in the origin of the chiropterygium concerns the distal segment of the limb. How many fingers and toes were present in the first land vertebrates and how many carpal and tarsal elements formed their support? Watson has shown that *Diplovertebron* had five well-developed fingers and toes, as in the case of the oldest reptiles. He finds no evidence of a sixth or seventh digital ray, such as has been described in the rachitinous *Eryops*. This makes it highly probable that the prepollex and postminimus, if present at all, were cartilaginous, as in certain recent reptiles and mammals.

All Amphibia above the Embolomeri had only four digits in the hand, but many, to judge from their tracks, must have had a well-developed prepollex. Further, *Eryops* apparently had a stout prepollex, a rudiment of the fifth finger and a cartilaginous block representing a sixth. The prepollex was originally a supporting ray on the inner side of the hand. In modern Salientia it is almost universally present and often hypertrophied in the male to ensure a better grip in amplexus. In Caudata, even in forms which are not known to practise an amplexus, the prepollex is sometimes present and even bony. The modern Amphibia inherited a prepollex, four digits and a rudiment of a fifth digit in the hand.

In the foot of modern Amphibia there are five digits present, as in *Diplovertebron*, but also in most Salientia a prehallux, and in some primitive Caudata, both a cartilaginous prehallux and a postminimus. In burrowing Salientia the prehallux is greatly enlarged to form the core of a "spade." This gives the impression that the prehallux is a recent adaptive structure which has arisen in connection with the burrowing habit. Its wide occurrence in non-burrowing forms is, however, against such a hypothesis. It seems highly probable that the prehallux is a fundamental element and that the original tetrapod foot, like the hand, was seven rayed.

The oldest known carpus and tarsus are both from rachitinous types. In both there is found the maximum number of elements found in any amphibian. The proximal row consists of four elements. Distal to this proximal row of elements there is a series of three elements called medialia by Schmalhausen, because of their position. Immediately distal to the medialia are the carpalia, 1-5 in the hand, and tarsalia, 1-5 in the foot.

Numerous fusions or, perhaps better, failures of the blastema to differentiate distinct elements have occurred in the carpus and tarsus of modern forms. The Hynobiidae, Ambystomidae and Cryptobranchidae approach most closely to the primitive condition. Some specimens of *Ranodon*, according to Schmalhausen, differ in their tarsus from *Trematops* only in that tarsalia 1-2 are fused. Salamanders with a reduced number of digits have suffered the greatest number of fusions. The Salientia have also diverged considerably from the primitive type. In the carpus fusions have occurred in all three rows. The discoglossids and pelobatids exhibit fewer fusions than the higher families. The tarsus of the Salientia is peculiar in the great elongation of the tibiale and fibiale, and the loss or fusion of all the other elements save three or four of the tarsalia. This elongation of the proximal series gives the frog's hind leg the appearance of having three long segments instead of the usual two. Such a specialization is undoubtedly an adaptation to jumping, although various species living today have given up that habit.

CLASSIFICATION

1. Labyrinthodontia.—Amphibia with a roofed skull, a lower jaw consisting of at least eight bones on each side and vertebrae consisting of neural arches and intercentra in all forms, with pleurocentra in addition in most.

The Labyrinthodontia are divided into three suborders or

grades: Embolomeri, Rachitomi and Stereospondyli. The first is from the Lower Carboniferous to Permian, the second, from the Permian and Triassic, and the last, from the Triassic. The skeletal organization of these groups has been discussed above. A detailed classification has been given by Watson.

2. Phyllospondylia.—Small, very highly specialized Amphibia with a roofed skull, palate with very widely open interpterygoid vacuities, coracoid and pubis not ossified; ventral armour of small round scutes. *Branchiosauridae*. Carboniferous and Lower Permian.

3. Lepospondylia.—Small Amphibia with roofed skull and lepospondylous vertebrae. *Nectridia*, *Diplocaulidae*, *Aistopodidae*. Carboniferous and Permian.

4. Apoda.—Recent wormlike Amphibia without limbs and with a very short tail; male with an intromittent copulatory organ. Tropicopolitan, excepting Madagascar. Apparently evolved from the Lepospondylia, but fossil annectant forms lacking. Nineteen genera are recognized.

5. Caudata.—Salamanders (*q.v.*) are readily distinguished from other living Amphibia by their four limbs and tail. They are grouped into five suborders and eight families. The latter may be briefly characterized here.

(1). *Hynobiidae*.—A small group of Asiatic land salamanders distinguished from ambystonids, which they resemble externally, in having the angular free, premaxillary spines short not separating nasals and in practising external fertilization. There are five genera, but only *Hynobius* has a wide range.

(2). *Cryptobranchidae*.—Two genera of semi-larval salamanders of large size directly evolved from the hynobiids, and differing in retaining a few larval characters in the adult. *Cryptobranchus* (*q.v.*) of eastern United States is more larval than the Japanese-Chinese *Megalobatrachus*.

(3). *Ambystomidae*.—A family of common American salamanders distinguished from salamandrids by their short prevomers and amphicoelous vertebrae, and differing from hynobiids in their fused angulars, long premaxillary spines and internal fertilization. The family includes three American genera, of which only *Ambystoma* with eleven species is well known.

(4). *Salamandridae*.—A varied group of aquatic forms, such as the newts, and terrestrial species, such as *Salamandra*, with vomerine teeth extending back as a series on each side of the parasphenoid and with the vertebrae opisthocelous. The primitive salamandrids are large and rough-skinned, with a bony, frontosquamosal arch, high neural spines and long ribs. The more specialized forms show a reduction of these elements and also of the maxillaries, pterygoids and basihyals. This family includes the "newts" (*q.v.*) and the old world fire salamander and its relatives.

(5). *Amphiumidae*.—A family including only the American genus *Amphiuma*. The large "Congo eel" is a semi-larval type derived from the salamandrids. It has lungs, a bony pterygoid, a posterior process from each prevomer and premaxillary spines elongated to separate the nasals.

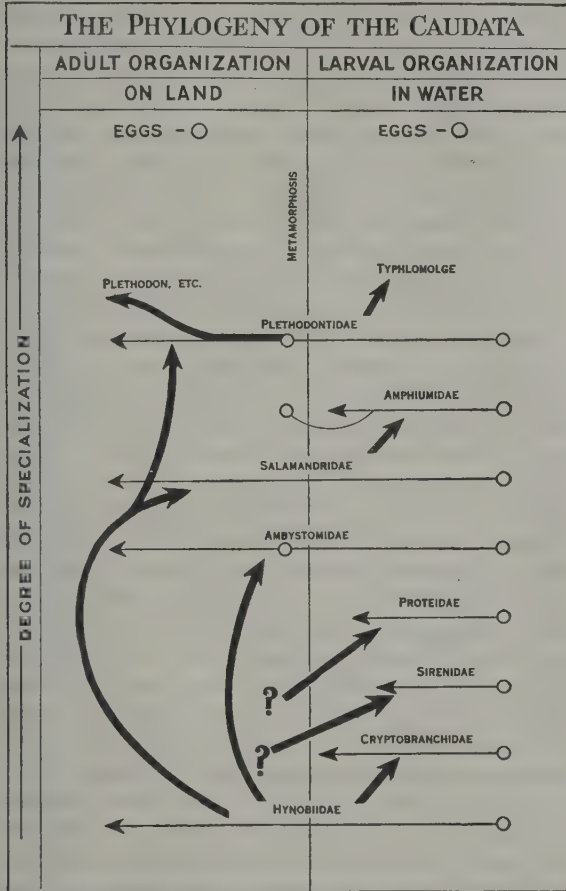
(6). *Plethodontidae*.—A large group of salamanders abundant in America and including both aquatic and terrestrial forms, with a pterygoid that remains cartilaginous throughout life and with vomerine teeth carried back by processes during ontogeny to form one or two dentigerous patches over the parasphenoid. All plethodontids are lungless and possess a nasolabial groove to assist in freeing the nostril from water.

(7). *Proteidae*.—A group of permanently larval salamanders of unknown ancestry including only the European *Proteus* (*q.v.*) and American *Necturus*. Lungs are present, but the ypsiloid apparatus is absent. The pubo-ischium has a distinctive form, being long and pointed anteriorly. *Proteus* is a blind and pigmentless cave form while *Necturus*, represented by two species, is an active stream or pond dweller.

(8). *Sirenidae*.—Long-bodied *Siren* and *Pseudobranchius* of southeastern United States form a group which agrees with the very young larvae of other families in possessing only the anterior appendages and in lacking many later ontogenetic developments of the skull. They differ when adult from the young

of other families in possessing reduced pterygoids, a separate ossification of the coracoid and a well-developed Jacobson's organ. Their relationships to the other families of Caudata is unknown.

6. **Salientia**.—The frogs and toads with their short, tailless bodies and long hind legs are distinguished from other living Amphibia. The order has been divided into four suborders, eleven



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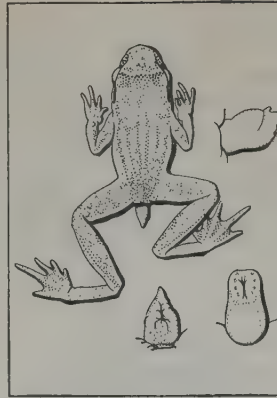
FIG. 4.—DIAGRAM SHOWS THAT LARGE AQUATIC SALAMANDERS KNOWN AS PERENNIBRANCHS ARE NOT NECESSARILY PRIMITIVE SPECIES BUT PERMANENT LARVAE WHICH HAVE FAILED TO METAMORPHOSE. SOME HAVE GONE FURTHER IN THE METAMORPHIC PROCESSES THAN OTHERS

families and many subfamilies, but only the families will be considered here.

(1). *Ascaphidae*.—Primitive frogs with amphicoelous vertebrae and two pairs of ribs; a family including only *Liopelma* of New Zealand and *Ascaphus* of northwestern United States. The latter is remarkable in possessing an extension of the cloaca in the male to form a "tail." This appendage is apparently used in copulation as fertilization is internal (fig. 5).

(2). *Discoglossidae*.—Primitive old world frogs having opisthocelous vertebrae, three pairs of ribs, sacral vertebra free with biconvex centrum. The family includes only two European, one Eurasian and one Philippine genus.

(3). *Pipidae*.—Aquatic Salientia which have lost the tongue and movable eyelids (except *Pseudhymenochirus* which retains a lower eyelid). Ribs are free in the larva, but ankylose to the diapophyses on metamorphosis. Various fusions occur in the vertebral column, the presacral vertebrae numbering five to seven. The sacrum is fused to the coccyx (rarely free with a single condyle). The pectoral girdle is partly or wholly firmisternal, the cartilages never broadly overlap as in the *Discoglossidae*. The family includes the Surinam toad (*q.v.*).



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FIG. 5.—MALE ASCAPHUS TRUEI (STEJNEGER), A PRIMITIVE FROG. SHOWING THE CLOACAL APPENDAGE OF THIS SEX. THE FIGURES ON THE RIGHT REPRESENT THE "TAIL" FULLY EXTENDED IN A BREEDING MALE

(4). *Pelobatidae*.—Salientia without ribs at any stage of development, sacral vertebrae procoelous, ankylosed to coccyx or if free with only a single articular condyle for the latter; presacral vertebrae eight, either uniformly procoelous or with free intervertebral discs (interdorsals). The *Pelobatidae* agree with *Bufonidae* in the arciferal pectoral girdle and dilated sacral diapophyses; they differ from them in their single coccygeal condyle and primitive musculature. The family includes the spade-foot toads and certain forest frogs of the Seychelles, southeastern Asia and the East Indies.

(5). *Palaeobatrachidae*.—Fossil frogs from the Jurassic, Oligocene and Miocene formations of Europe. They are procoelous, arciferal forms differing from the *Pelobatidae* in having a double condyle on the coccyx and in having the sacrum formed of two or three slightly dilated precoccygeal vertebrae. In limb proportions the *Palaeobatrachidae* approach the *Pipidae* and it is highly probable that the species were thoroughly aquatic.

(6). *Bufonidae*.—A dominant family of true toads (*q.v.*) and neotropical "frogs" having a uniformly procoelous vertebral column and a double condyle to the coccyx (rarely fused to sacrum). They are arciferal and resemble the *Pelobatidae* in many characters, but differ in musculature and coccygeal articulation. The toothed *Bufonidae* are frequently designated as *Leptodactylidae*. They are more primitive than the toothless genera, but as they have given rise to toothless *Bufonidae* in different parts of the world, it makes a more natural system to group both together as a single family.

(7). *Hylidae*.—Arciferal frogs with an intercalary cartilage or bone between the last two phalanges of each digit and usually with claw-shaped terminal phalanges. They are procoelous and usually with dilated sacral diapophyses. Most, but not all, are tree-frogs (*q.v.*) and a few, such as *Acris*, are semi-aquatic. There are 15 genera of hylids. All of these, save *Hyla* (including *Hylella* and *Nyctimystes*), are confined to the neotropical region.

(8). *Brachycephalidae*.—A large group of small neotropical toads recently shown to be closely allied to the *Bufonidae* and to have no relationship to the *Ranidae* or *Brevicipitidae* with which they were formerly confused; procoelous forms with the two halves of the pectoral girdle partly or wholly fused in the mid-line. This group, however, should perhaps have the *Dendrobatidae* and *Rhinodermatidae* split off as independent families.

(9). *Ranidae*.—Firmisternal frogs (*q.v.*) with cylindrical or slightly dilated sacral diapophyses, digits without intercalary cartilages, sacral vertebra convex anteriorly, the eighth vertebra biconcave and preceded by seven procoelous vertebrae. *Ranids* are primarily old world frogs, only one genus, *Rana*, reaching America. Africa seems to have been a centre of differentiation for the family, the greatest diversity of type occurring there.

(10). *Polypedatidae*.—*Ranids* with cylindrical sacral diapophyses and intercalary cartilages between the two last phalanges of each digit. The *Polypedatidae* are tropical tree-frogs of the old world.

(11). *Brevicipitidae*.—A group of toads closely related to the *Ranids* and differing chiefly in the more dilated sacral diapophyses. The more specialized forms have lost their teeth and all the ventral elements of the shoulder girdle save the coracoids. The family is cosmopolitan. *Brevicipitids* in the Asiatic, East Indian and Malagasy regions seem to have run through independently on series of structural changes, often parallel in the three regions.

GENERAL MORPHOLOGY

Integument.—The skin of modern Amphibia may be rough and dry or smooth and moist, but it is never covered with scales as in nearly all reptiles. Many caecilians, however, have rings of minute scales hidden in the transverse folds of their skin. Aquatic or fossorial Amphibia, which rely to a large extent on their skin for respiration, usually have a thinner and smoother integument than terrestrial forms, but many exceptions to this rule occur, particularly in the Pipidae and Bufonidae. The fossil labyrinthodonts, phyllospondyls and lepospondyls were frequently well armoured with scales, especially on the ventral surface where these scutes of varying shapes and sizes were arranged, for the most part, in orderly rows converging toward the mid-line. In a few salamandrids and many tropical Salientia a secondary deposit of bone forms in the deeper dermal tissues and may produce encrustations ankylous to the underlying bones. The bizarre casques of *Pternohyla*, *Triprion*, *Cerathyla*, etc., are of this character (fig. 6). Less conspicuous bony covers to the skull appear in the spade-foot toads and various hylids, particularly the marsupial frogs. Similar bony growths extend to the derm of the back in various Salientia and in rare instances (*Brachycephalus*) may be ankylous to the vertebrae. The epidermis covering warts or spines may be more or less cornified in modern Amphibia and in various Caudata (*Desmognathus*, *Necturus*, etc.) that on the digit tips is similarly modified. In a few hynobiids thick horny pads occur on the palms and soles, while in the larvae of others the epidermis of the digits is extended into pointed claws. Similar horny claws occur on the three inner toes of the African pipids and may have been found on all the digits of some extinct Amphibia, for in one of the most primitive labyrinthodonts the terminal phalanges have the form of curved claws.



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FIG. 6.—HORNED TREE-FROG (*CERATHYLA JOHNSONI*), AN AMPHIBIAN WHOSE BONY HEAD PRESUMABLY SERVES TO CLOSE THE HOLE OR CREVICE IN WHICH IT SITS. Secondary bony deposits in the form of plates, horns or pseudo-teeth are found on the skulls of many unrelated groups of Salientia.

The integument of modern Amphibia is further distinguished from that of reptiles in being highly glandular. There are two main types of glands: the granular and the mucus. The first may be broadly distributed over the dorsal surfaces or massed in folds or warts on the sides of the body. Its secretion is creamy, very irritating to mucus membranes and poisonous when taken internally. The mucus glands are more uniformly distributed over the body. They produce a slime less irritating to the nasal passages and conjunctiva but, nevertheless, toxic when injected into lower animals. Amphibia differ enormously in both the quantity and kind of integumentary secretion. Some species, such as the toads, secrete only when mistreated, while others, such as *Bombina* and particularly the American *Plethodon glutinosus*, produce a copious irritating or sticky secretion when handled. Closely related species may differ considerably in their secretions. Brazil and Vellard report that the South American *Ceratotophrys americana* has a virulent poison while the much larger and more brightly coloured *C. dorsata* possesses an innocuous skin secretion. Brightly coloured Amphibia are frequently not more poisonous than their dull coloured relatives, and some, such as the red-legged *Leptodactylus pentadactylus* may lack a poisonous secretion. Frequently the secretions are odorless, certain closely related forms of *Rana*, *Bufo* and *Hyla* being readily distinguished by their odour alone.

The skin of the larva differs from that of the adult in that the glands are unicellular and the epidermis consists of only two layers of cells. Larvae approaching metamorphosis and most perennibranchs have a thicker epidermis equipped with multicellular glands. The superficial layer of epidermis is periodically shed by the adults and usually in one piece. The first shedding of

the entire epidermis occurs normally at metamorphosis, but perennibranchs, such as *Cryptobranchus* shed their skin in one piece before they lose their external gills, and the larvae of some salamanders shed their skin in minute pieces.

Pigmentation.—The coloration of Amphibia is due in part to a diffuse pigment distributed throughout the integument, but chiefly to a number of cellular elements of which three main types may be recognized: first, white cells which owe their colour to a dense deposit of guanine (a substance allied to the urates); secondly, the yellow cells which contain droplets of oil; and thirdly, the dark brown or melanin filled cells. White cells are often clumped together in small areas under the epidermis producing the white flecks on the back of many salamanders or the white spots in some tree-frogs. Other guanine-filled cells lie closely associated with the yellow and brown cells directly under broad areas of the epidermis and give the characteristic ground colour of these regions. Green is a mixed colour due to the blue rays of light reflected from the small guanine or "turbid cells" mixing with the yellow tone in the overlying yellow cells to produce a green. The blue reflections of the turbid cells are swamped by the white reflections of the subjacent tissues when the melanophores or dark cells are contracted. Brown is produced by the complete enclosure of the turbid cells by the expanded melanophores. The latter expand to surround the turbid cells when stimulated by cold, moisture and rough surfaces, or by hormones produced by the pars intermedia of the pituitary gland. The colour tone of a frog or toad at any one time may be due to either stimulations received through the skin or eyes or to the physiological (emotional) state of the individual.

Organs of Nutrition, Respiration and Reproduction.—As these organs are only rarely used in defining natural groups of Amphibia they may be discussed here briefly. Amphibia are primarily carnivorous, only the larvae of the Salientia being more or less herbivorous in their diet. The intestine is therefore short, except in the tadpoles. The tongue is more developed in the primitive forms and may be rudimentary or absent in the aquatic species. The development shows that the salamander tongue arises out of two parts, of which the hinder is homologous to the tongue of fishes, while the anterior and lateral part is a glandular fold which has been added to the first part during evolution.

Although the Amphibia have not evolved from the Dipnoans, they show many similarities in their venous and arterial systems. The heart of salamanders shows various modifications according to the extent that the lungs are used in respiration. Many salamanders living near mountain streams have lost their lungs and respire entirely by their skins and well-vascularized throats. The entire family *Plethodontidae* is lungless. Many other salamanders use their lungs primarily as hydrostatic and not respiratory organs. Salamanders are mute or endowed with a very poor voice. Most Salientia have a larynx modified and equipped with vocal organs. Frogs call chiefly to attract mates in the spring.

Fertilization in the Amphibia may be external or internal. Most salamanders, except the *Hynobiidae* and *Cryptobranchidae*, are equipped with a spermatheca, a series of tubules in the roof of the cloaca where the sperm remain after copulation until the time of fertilization. In these salamanders the sperm mass is emitted by the males in the form of spermatophores, small tufts of sperm attached to a gelatinous base. Courtship in the salamanders is primarily directed towards exciting the female sufficiently to ensure her picking up the spermatophore with the cloacal lips. The sperm then make their way into the spermatheca by their own efforts. The Gymnophiona are equipped with a protrusible cloaca which is used as an intromittent organ. The male American liopelmid frog, *Ascapheus*, has a movable extension of the cloaca. In these forms fertilization is internal, as well as in certain little-known African frogs which have no special apparatus for transmitting sperm. The gonads are variously modified in different groups permitting a greater freedom of the seminal ducts from the kidneys. In *Bufo* a rudimentary ovary, Bidder's organ, is found in front of the testis and when the latter is removed it develops into a functional ovary. Sex reversal has also been recorded in both frogs and salamanders. (See Sex).

Life History.—Most Caudata and Salientia lay their eggs in the water, where they hatch into larvae or tadpoles destined to live a more or less extended period in this element before metamorphosing into terrestrial adults similar to their parents. The larval state seems to be an old inheritance of the Amphibia handed down from their crossopterygian fish ancestors. Even primitive Amphibia underwent a metamorphosis, as is proved by fossil remains of larval labyrinthodonts and branchiosaurs.

Metamorphosis represents a period of tremendous change in both the morphology and physiology of Amphibia. It is marked by such external changes in Caudata as the reduction of the external gills, the loss of the tail fin, the shedding of the larval skin, the formation of eyelids, etc. But fundamental changes in skull form and throat musculature take place. In Salientia metamorphosis is indicated by a freeing of the forelimbs by autolysis of local areas in the operculum, by radical changes in the shape and structure of the head and by absorption of the tail. One of the recent achievements of physiology has been the demonstration that the changes of metamorphosis are produced by the thyroid hormone, or at least this hormone working in conjunction with that of the anterior lobe of the hypophysis. A review of the physiology of development cannot be given here, but reference may be made to the summaries of Remy ("Les sécrétions internes et les métamorphoses," *Amer. Sci. Nat. Zool.* [10], vii), E. Uhlenhuth ("The Internal Secretions in Growth and Development of Amphibians," *Amer. Nat.*, 1921), and B. M. Allen ("Influence of the Hypophysis upon the Thyroid Gland in Amphibian Larvae," *Univ. Calif. Publ. Zool.*, xxi, 1927). (See ENDOCRINOLOGY: *Endocrinology in Animals.*)

Certain groups of salamanders, such as the Cryptobranchidae, Sirenidae and Proteidae, fail to metamorphose. This phenomenon appears as a variation in the life history of many of these creatures, particularly in those species passing their larval period in cold water. Neoteny in the latter case is due to the failure of the thyroid to function, but the causes of arrested development in the case of groups unknown as metamorphosed individuals is more complex. In considering the relations of the perennibranchs, it is important to compare their organization with that of the larvae of other groups, not with that of the adults. Neoteny is not a new development in the Amphibia. It is found even in the Permian *Dvinosaurus*.

Some salamanders and many tropical Salientia produce large yolked eggs which they usually lay on land, although a few retain them within the oviducts until the young are born, more or less fully developed. Only two frogs are viviparous, and both are rare East African species (*Nectophrynoides tornieri* and *N. vivipara*). The breeding habits of the Amphibia are often elaborate and one may trace within the group a gradual evolution in many of the instincts associated with courtship and egg laying.

The larvae of the Amphibia frequently exhibit specializations which are of phylogenetic or at least taxonomic importance. The larvae of the marsupial frog and its allies possess enormous bell-shaped gills. All brevicipitid tadpoles, except those of certain South African genera which probably had an independent origin, have the same toothless, protrusible buccal apparatus. Where the life history is very specialized, both larval modifications and breeding habits will tend to indicate the relationships of the forms. Thus, only *Prototipa* and *Pipa* carry their eggs in individual dermal chambers on the maternal parents' back; *Phyllobates* and *Dendrobates* are the only genera that transport to the streams their unspecialized tadpoles on the males' back; *Cryptotritrachus*, *Cerathyla*, *Gastrotheca* and *Amphignathodon*, the only ones that carry their eggs in a single mass on their backs (either exposed or enclosed in a dermal fold). The genera in each of these groups differed one from the other in matters of dentition and hence, according to earlier classifications, would not be considered closely related. But recently, when both anatomical and life history data were considered in further detail, it was recognized that each of these groups is in fact a natural one.

Geographical Distribution.—Distribution of the salamanders does not agree with that of the Salientia and the latter is unlike that of the caecilians, for each of these groups probably

spread from different centres, was affected by different barriers, and subjected to diverse conditions of travel. The present distribution of the Amphibia gives evidence of former union of the northern continents. Cryptobranchid salamanders are found only in eastern Asia and eastern North America. Proteid salamanders are found only in Europe and North America. One genus of plethodontids, *Hydromantes*, is found only in the two latter regions. One genus of salamandrids, *Triturus*, is holarctic, although a closely related form has apparently managed to work its way south of the Sahara. *Rana* and *Bufo* have closely related species in North America, Europe and Asia. The present distribution of the Amphibia is thought to necessitate an early Tertiary or pre-Tertiary connection between North and South America, for the bufonid toads have undergone an enormous adaptive radiation in the latter continent. The ranids and some brevicipitids of South America may have reached the continent after the present Panamanian connection was formed, but the occurrence of several endemic genera of the latter group would favour an early migration for this family as well. The present distribution of the Pelobatidae, Bufonidae, Ranidae, Polypedatidae and Brevicipitidae apparently demands a land bridge between Asia and Africa during part of the Tertiary and possibly a direct connection with the Seychelles. Pelobatids are not found in Africa, but in Asia, some of the East Indies, Europe and the Seychelles. The bufonid *Nectophryne* is found in the oriental region and the African rain forest. The African *Chiromantis* is closely allied to the oriental *Polypedates*. *Rana* must have been in Africa for some time, for it has split up into a number of endemic subgenera. Madagascar is frequently claimed to have derived its fauna directly from the oriental region. *Polypedates* is found in both regions. The Madagascan *Dyscophus* is closely allied to the Asiatic *Calluella*. But Madagascar lacks caecilians and Bufonidae, and its ranids and brevicipitids have undergone an extensive local specialization which would suggest long isolation. Further, it possesses *Hyperolius*, *Megalixalus* and *Rana* in common with Africa. If these recent and aggressive genera have gained access to Madagascar without the aid of a land bridge it is highly probable that brevicipitid and ranid stocks may have done the same at an earlier period when other genera formed the dominant African fauna.

It is frequently claimed that the present distribution of the Amphibia affords some of the best evidence of the existence of former land bridges in the southern hemisphere. Caecilians are tropicopolitan; pipid toads occur only in tropical Africa and South America. Hence, many zoogeographers would postulate a land bridge across the mid-Atlantic. There is good evidence that in the case of other primitive groups extensive migrations have occurred in the northern region without leaving any fossil remains. For example, one genus of liopelmid is found today in northwestern United States, the other in New Zealand, and consequently liopelmid must have occurred in the intervening area at one time. Salientia do not make good or frequent fossils, but the occurrence of toothed bufonids ("leptodactylids") in Australia, Africa and South America has led Hewitt to assume a radiation of toads from the south to Asia and the two latter continents along three theoretical land masses existing in Mesozoic times. Such speculations have little in their support and it is far simpler to assume that all families of Amphibia, except the neotropical Brachycephalidae, arose in one of the northern continents and migrated south along existing continental land masses.

Today ambystomids, sirenids and amphiumids are endemic to North America and may have originated there. The large family of Plethodontidae is found chiefly in that continent. Hynobiids are known only from Asia. Salamandrids have their headquarters in Europe, although Asia, North Africa and North America have received a few species. Discoglossids are palarctic, pelobatids mainly holarctic. Bufonids, hylids, ranids and brevicipitids have a world-wide range, but exhibit certain remarkable lacunae in their ranges. Thus, hylids are not found in the Ethiopian region (with a single possible exception) nor in most of southeastern Asia and the adjacent islands; ranids, except the modern genus *Rana*, are absent from South America and Australia. The latter also lacks brevicipitids, except in the northeast. Papua has an

amphibian fauna essentially like northeastern Australia. It possesses bufonids, hylids, ranids and brevicipitids, but no pelobatids. The bufonids have undergone an adaptive radiation in Australia, while the brevicipitids did the same in New Guinea.

Economic Value.—Toads are of great use to farmers as they are indiscriminate feeders on insect life. In cases of an insect plague toads feed on the dominant insect and tend to restore the balance of nature. Frogs and toads are used for food in many parts of the world, but successful frog farms are rare. Frogs require from two to five years to reach maturity, and large quantities of living insect food are needed during this period. Hence, in America almost the entire frog crop is obtained in the wild state.

Dried frogs and salamanders are used for medicinal purposes in various parts of the world, particularly in the orient. Their value as a cure is chiefly psychological. Probably the greatest use of Amphibia to humanity is their martyrdom to science. Frogs and salamanders, both in adult and young stages, have long been recognized as ideal laboratory animals. Some of our most fundamental discoveries in developmental mechanics (*See EXPERIMENTAL EMBRYOLOGY*), endocrinology (*q.v.*) and general physiology (*q.v.*) have been made with amphibian material.

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AMPHIBIAN PLANE: *see* AERONAUTICS and SEAPLANE.

AMPHIBOLE, an important group of rock-forming minerals very similar in chemical composition and general characters to the pyroxenes and, like them, falling into three series according to the system of crystallization (from the Gr. ἀμφίβολος, "ambiguous"). They differ from the pyroxenes, however, in having an angle between the prismatic cleavages of 56° instead of 87°; they are specifically lighter than the corresponding pyroxenes, and in their optical characters they are distinguished by a stronger pleochroism and by a smaller angle of extinction on the plane of symmetry. The amphiboles in their composition conform in general to the metasilicate formula $R''SiO_3$, and are usually classified as follows:—

ORTHORHOMBIC SERIES	
Anthophyllite	(Mg,Fe)SiO ₃
Gedrite	(Mg,Fe)SiO ₃ —Al ₂ O ₃
MONOCLINIC SERIES	
(a) Sesquioxide-free members	
Cummingtonite	(Mg,Fe)SiO ₃
Grünertite	FeSiO ₃
Tremolite	Ca,Mg ₂ (SiO ₃) ₄
Actinolite	Ca(Mg,Fe) ₃ (SiO ₃) ₄
(b) Sesquioxide-rich members	
Hornblende	Ca(Mg,Fe) ₃ (SiO ₃) ₄
with variable	(Mg,Fe)SiO ₃ -(Al,Fe) ₂ O ₃
and	Na,Al(SiO ₃) ₂

(c) Alkali amphiboles

Glaucophane	Na(Al,Fe)(SiO ₃) ₂ ·(Mg,Fe)SiO ₃
Crocidolite	NaFe ^{III} (SiO ₃) ₄
Arfvedsonite	Na ₂ Fe ^{IV} ₂ (SiO ₃) ₄
Riebeckite	2NaFe ^{III} (SiO ₃) ₂ FeSiO ₃

TRICLINIC SERIES

Aenigmatite Group

Aenigmatite	(Na,K,H) ₄ (Fe,Mg,Ca) ₅ (Fe,Al) ₂ (Si,Ti) ₁₂ O ₃₈
Cossyrite	H ₂ Na ₄ Fe ₁₅ Fe ^{III} ₂ (Si,Ti) ₂₂ O ₆₇
Rhoenite	(Ca,Nb ₂ K ₂)Mg ₄ Fe ^{IV} ₂ Fe ^{III} ₂ Al ₄ (Si,Ti) ₆ O ₃₀

Though, as already stated, there is a close similarity in composition between the amphiboles and pyroxenes, the former are the more complicated and their nature less understood. Most amphiboles contain some alkalis, fluorine and water of constitution and do not with few exceptions crystallize from dry melts. Rhombic amphibole of composition MgSiO₃ (kupferite) has been obtained as an unstable phase by rapid cooling of a MgSiO₃ melt. The natural rhombic amphiboles always contain water and usually some alkali. Gedrite may contain up to 22% Al₂O₃.

The cummingtonite-grünertite group of monoclinic amphiboles appears to form a solid solution series. The magnesian end member has been prepared by rapid cooling of a MgSiO₃ melt and also by subjecting kupferite in the presence of water to a temperature of 375°-475° C. Cummingtonite occurs together with anthophyllite in anthophyllite schists and in parallel intergrowth with the latter mineral or with gedrite in pneumatolytically metamorphosed sediments as in Finland and Cornwall. Grünertite occurs in association with garnet and fayalite in the rocks known as eulysites and is a prominent constituent of the altered iron-bearing rocks of the Lake Superior region.

A lime-magnesia amphibole of the composition CaMgSi₂O₆ has been prepared by rapid cooling of a melt of the composition 85% diopside 15% SiO₂, but in nature an amphibole of this composition is unknown. The sesquioxide-free amphiboles, tremolite and actinolite are most characteristic of metamorphosed calcareous sediments both thermal and dynamic, while in the metamorphosed igneous rocks—such as hornblende schists, the sesquioxide-rich hornblende is more common.

The hornblendes occurring as porphyritic crystals in some basalts, andesites and porphyrites, and known as basaltic hornblende are brown in thin slices and contain significant proportions of titanium. They are well-known from the basalts of Bilin and Schima (Czechoslovakia). They are distinguished by a very low optical extinction angle on the plane of symmetry. Hornblende is a common mineral of many types of igneous rocks as in granite, syenite and especially diorite; also in the crystalline schists.

The alkali amphiboles are distinguished by their very complicated composition and little is known of their constitution. They appear to form with hornblende a series of solid solutions which are represented by alkali amphiboles of intermediate composition. The alkali amphiboles may be subdivided broadly into two groups according to their composition, habit and mode of occurrence: an iron-poor light blue coloured group which are especially characteristic of the crystalline schists and an iron-rich dark blue coloured group which occur as prominent constituents of alkaline igneous rocks.

The first group is prominently represented by glaucophane and its alumina-rich relative gastaldite, while the second group is represented by the arfvedsonite-riebeckite series of amphiboles.

The arfvedsonite-riebeckite series occur in the alkaline igneous rocks such as nepheline syenite, tinguaita and phonolite. Riebeckite was first described from the granites of the island of Socotra.

To be classed here is the hastingsite of the nepheline syenites of Ontario. Crossite, an alkali amphibole in the crystalline schists of Berkeley, California, is distinguished by possessing an optic axial plane normal to the plane of symmetry. Barkevikite, related to arfvedsonite is a brown pleochroic amphibole originally described from Barkevik (Norway).

The three minerals of the aenigmatite group, viz., aenigmatite, cossyrite and rhoenite are usually classed as triclinic amphiboles, (C. E. T.)

AMPHIBOLITE, in petrology the name given to a gray, green or black, typically nonschistose rock consisting mainly of amphibole and a feldspar of the plagioclase group, the use of the term being restricted, however, to rocks of metamorphic origin. The term may be contrasted with hornblende schist, which is of identical composition but possesses a well-defined schistose structure as compared with the granoblastic unfoliated structure of the amphibolite. As is the case with most petrological terms the exact connotation is not very strictly defined, and some authors reserve the term hornblende schist for schistose rocks built up essentially of amphibole. As accessory constituents may be noted a red lime-magnesia-iron garnet, epidote, zoisite, green pyroxene, scapolite, biotite, etc.

The commonest amphibole is the aluminous monoclinic hornblende. Other varieties, however, occur, such as tremolite, actinolite, the soda amphibole glaucophane and, more rarely still, crossite. The magnesia-iron amphiboles of the cumingtonite-grünerite series, and the rhombic amphiboles anthophyllite and gedrite form essential constituents of certain amphibolites. The usual plagioclase feldspar is an andesine or labradorite; in this zoning and lamellar twinning are often less marked than in the felspars of igneous rocks.

The amphibolites are typical rocks of the metamorphic group and as such attain a large development in all regions of crystalline schists and gneisses as in the old preCambrian shields and in metamorphic areas of later date. They occur principally in stocks or bosses representing basic igneous intrusions, or as long, narrow strips intercolated among outcrops of other metamorphic rocks. Genetically they fall into two groups, the ortho-amphibolites, which are transmuted igneous rocks, and the para-amphibolites, the metamorphic representatives of sedimentary rocks. The former are much the more common, and of these the greater number are derived without significant change in bulk composition from gabbros and dolerites. Igneous rocks containing much augite pass under the conditions prevailing in regional metamorphism where shearing stress is dominant into rocks of this kind, the pyroxene being converted to amphibole often with separation of iron ores and sphene. From more alkaline basic rocks the soda amphibole, glaucophane, is produced.

Plagioclase feldspar is recrystallized with or without separation of some of the anorthite molecule as epidote or zoisite according to the grade of metamorphism imposed. The rock may thus be completely transformed into a granoblastic aggregate of new-formed minerals with entire loss of all igneous textures. Frequently, however, this transformation is only partial, and examination of a large number of specimens reveals a series of intermediate or transitional stages, proving conclusively the nature of the processes at work.

The sedimentary amphibolites or para-amphibolites, less common than those above described, are frequent in some districts, such as the northern Alps, southern highlands of Scotland, Green mountains, U.S.A. Many of them have been ash beds, and their conversion into hornblende schists follows exactly similar stages to those exemplified by basic crystalline igneous rocks. Others have been graywackes of varied composition with epidote, chlorite, feldspar, quartz, iron oxides, etc., and may have been mixed with volcanic materials, or may be partly derived from the disintegration of basic rocks. When they are most metamorphosed they are often very hard to distinguish from igneous hornblende schists; yet they rarely fail to reveal signs of bedding, pebbly structure, sedimentary banding and gradual transition into undoubtedly sedimentary types of gneiss and schist.

Impure dolomitic limestones yield on metamorphism para-amphibolites strikingly similar to some ortho-amphibolites. By mutual reaction of chlorite, kaolin, calcite and dolomite amphiboles and plagioclase felspars are produced. The original nature of these highly altered rocks, however, is frequently displayed in the rapid variation in mineral composition followed across the strike, corresponding to initial inhomogeneity of the original sediment. Amphibolites of this type are common in the Haliburton-Bancroft area of Ontario, where they occur, together with ortho-amphibolites, as enclosures in the Laurentian gneiss. (C. E. T.)

AMPHIBOLOGY or **AMPHIBOLY**, in logic, a verbal fallacy arising from ambiguity in the grammatical structure of a sentence (Aristotle, *Organon*, *Soph. El.*, ch. iv.). It occurs frequently in poetry, owing to the alteration for metrical reasons of the natural order of words; Jevons quotes as an example Shakespeare, *Henry VI*: "The duke yet lives that Henry shall depose." The success of ancient oracles was largely due to skill in amphibology.

AMPHICTYONY, an association of ancient Greek communities centering in a shrine (from the Greek ἀμφικτύονες, "dwellers around"). As the extant sources do not define the term, and as they apply it to but five or six associations, the majority of which are little known, modern scholars are in doubt as to the essential character of the institution, and hesitate therefore to extend the name beyond this limited list. The word itself indicates that the association primarily comprised neighbours, though the Delphic amphictyony came to include distant communities. Neighbouring communities chose the sanctuary of some deity at which to hold their periodical festival for worship and their fair for the interchange of goods. If the limited use of the word according to our sources is not purely accidental, at all events there were many Greek leagues, not expressly termed amphictyonies, which had the characteristics here stated. The Delian amphictyony reached the height of its splendour early in the 7th century B.C. The "Hymn to the Delian Apollo," composed about that time, celebrates the gathering of the Ionians at the shrine of their god on the island of Delos, to worship him with music, dancing and gymnastic contests. Peisistratus, taking possession of Delos, seems to have used the sanctuary as a means of extending his political influence. When, after the great war with Persia, the Aegean cities, under the leadership of Athens, united in a league (477 B.C.), they chose as its centre the temple of the Delian Apollo. How far the institutions of the Delian confederacy were based upon the amphictyonic organization cannot be determined.

The removal of the treasury to Athens in 454 B.C. deprived Delos of political importance. In 426 B.C. the Athenians instituted a great festival to be held under their presidency every four years (Thuc. iii, 104). At the end of the Peloponnesian War Athens was perished of Delos, but it appears to have regained control after the victory of Cnidus (394 B.C.). The affairs of the temple were managed by a board of five Athenian amphictyons, assisted by some Delian officials; and in the 4th century we again hear of a council in addition to the board. At this time the amphictyony is known to have embraced both the Athenians and the inhabitants of the Cyclades; but a strong Delian party bitterly opposed Athenian rule, which came to an end with the supremacy of Macedon. The dissolution of the amphictyony soon followed.

Far more famous is the Delphic amphictyony. It was originally composed of 12 tribes dwelling round Thermopylae—the Thesalians, Boeotians, Dorians, Ionians, Perrhaebians, Magnesians, Locrians, Oetaeans, Phthiotians, Malians, Phocians and Dolopians. The name of the council (*Pulaia*) and of one set of deputies (*pulagorai*), together with the importance of the temple of Demeter at Anthela, near Thermopylae, suggests that this shrine was the original centre of the association. How and when Delphi became the centre is uncertain. The council of the league included deputies of two different kinds—*pulagorai* and *hieomnemones*. The latter were 24 in number, two from each tribe. Originally made up of neighbours, the league in time admitted the Dorians of the Peloponnese and the Athenians (as Ionians) must have entered before the first Sacred War. Henceforth Athens monopolized one of the two Ionian votes, while the other passed in rotation among the remaining Ionic, perhaps only among the Euboeic, cities. In the same way Doris held one Dorian vote and the other passed in rotation among the Dorian cities of Peloponnese; and the east and west Locrians came to have one each. After the second Sacred War, Macedon took the place of the Phocians and the Delphians partially displaced the Perrhaebians and Dolopians.

In the following century the Aetolians gained such dominance in the amphictyony as to convert the council into an organ of their league. They were never formally admitted to membership,

but maintained their supremacy in the council by controlling the votes of their allies, who—called Aetolians in the inscriptions—were often in the majority. They made no material change in its composition, which, accordingly, after the dissolution of their league by the Romans is found to be nearly as it was after the second Sacred War. A few minor changes were introduced under the supremacy of the Roman republic; Augustus increased the number of votes to 30 and distributed them according to his pleasure. In the age of the Antonines the association was still in existence.

The *hieromnemes* of the Thessalians, who held the presidency, were elected, but the office was ordinarily, as at Athens, filled by lot. As a rule they were renewed annually. Each *hieromnemon* was accompanied by two *pulagorai*, elected semi-annually. On one occasion Athens is known to have sent three. The *hieromnemes* were formally superior, but being usually mediocrities, readily became the tools of the *pulagorai*, who were orators and statesmen. The latter are rightly given credit for the acts of the council; it was the *pulagorai* who set a price on the head of the traitor Ephialtes (Herod. vii, 213), and who, on the motion of Themistocles, rejected the proposition of Lacedaemon for the expulsion of the states which had sided with Persia. The *pulagorai* had a right to propose measures and to take part in the deliberations. The *hieromnemon*, however, cast the vote of his community, though in the record his two *pulagorai* were made equally responsible for it. The inference is that the vote was determined by a majority of the three deputies. The council decided all questions which fell within its competence. Matters of greater importance, as the levy of an extraordinary fine on a state or the declaration of a sacred war, it presented in the form of a resolution to an assembly, composed of the deputies, the amphictyonic priests, and any other citizens of the league who chanced to be present. This assembly was relatively unimportant, however, and is mentioned by only two authorities.

The amphictyons met both in the spring and in the autumn at Delphi and at Thermopylae. The meeting at Thermopylae followed that at Delphi. The primary function of the council was to administer the temporal affairs of the two shrines. The duty of the *hieromnemes* was to inspect periodically the sacred lands, to punish those who encroached, and to see that the tenants rendered their quota of produce; and the council held the states responsible for the performance of such duties by their deputies. Another task of the council was to supervise the treasury, to protect it from thieves, to increase the capital by investment and to control the expenditure. We find it contracting for the rebuilding of the Delphic temple after it had been destroyed by fire, adorning the interior with statues and pictures, inscribing the proverbs of the Seven Sages on the walls, bestowing crowns on benefactors of the god, preparing for the Pythian games, awarding the prizes and issuing coins. A law of great interest imposed an oath upon the members of the league not to destroy an amphictyonic city or to cut it off from running water in war or peace; but to wage war upon those who transgressed this ordinance, and to punish any others who sought to injure the god. In this regulation, which was intended to mitigate the usages of war among the members of the league, we have one of the origins of Greek interstate law. It was also unlawful to levy tolls on pilgrims to the shrines. Other regulations were made to secure peace at the time of the festival, and occasionally the council was called upon to arbitrate in a dispute; but no provision was made to compel arbitration.

For the enforcement of such laws it was necessary that the council should have judicial power. As jurors the deputies took an oath to decide according to law or, in cases not covered by law, according to their best judgment. The earliest known penalty inflicted was the destruction of Crisa for having levied tolls on pilgrims. This offense was the cause of the first Sacred War. The second and third Sacred Wars, fought in the 4th century B.C., were waged by the amphictyons against the Phocians and the Amphissaecans respectively for trespassing on the sacred lands. The council fined the Dolopians for piracy, and the Lacedaemonians for having occupied the citadel of Thebes in time of peace.

The judgments of the council were sometimes considered unfair, and were defied by the states affected. The Lacedaemonians refused to pay the fine above mentioned; the Athenians protested against the treatment of Amphissa, and were slow in accepting the decisions given under the influence of Macedon. The inability of the council to enforce its resolutions was chiefly due to its composition; the majority of the communities represented were even in combination no match for individual cities like Athens, Sparta or Thebes. As in the League of Nations (*q.v.*), the support of the "great powers" was necessary if more than moral influence was to be employed. But the moral influence was usually powerful.

In addition to these associations there was an amphictyony of Onchestus and an amphictyony of Argos of which Epidaurus and Aegina were members.

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AMPHILOCHUS (ām-fil'ō-kŭs), in Greek legend, a famous seer, son of Amphiarus and Eriphyle and brother of Alcmæon. According to some, he assisted in the murder of Eriphyle, which, according to others, was carried out by Alcmæon alone. He took part in the expedition of the Epigoni against Thebes and in the Trojan war. After the fall of Troy he founded, in conjunction with Mopsus, another famous seer, the oracle of Mallos in Cilicia. The two seers afterwards fought for its possession, and both were slain in the combat. Amphilocheus is also said to have been killed by Apollo (Strabo xiv, 675, 676). According to another story, he returned to Argos from Troy, but, being dissatisfied, left it for Acarnania, where he founded Amphilocheian Argos on the Ambracian gulf. He was worshipped at Orpopus, Athens and Sparta.

See Strabo xiv, pp. 675, 676; Thucydides ii, 68; Pausanias i, 34, iii, 15.

AMPHINEURA, group of marine invertebrate animals constituting a class of the Mollusca (*q.v.*), the majority with a shell of eight transverse plates. A much smaller number are devoid of a shell and have the general appearance of worms. Up to the present upwards of 120 genera of these animals have been described. They are all sedentary, slow-moving creatures usually of insignificant size, and are generally found in shallow water. Until recent years it was customary to regard the class as divisible into two orders, the shell-bearing Chitons or Polyplacophora and the worm-like Solenogastres or Aplousophora. The Chitons are divided into three suborders according to the structure of the shell, and the Solenogastres into two suborders, the Neomeniomorpha and Chaetodermomorpha. Some zoologists, however, regard the Solenogastres as more closely allied to certain groups of primitive worms (Platyhelminia, Archiannelida) than to the Mollusca. J. Thiele (1925) has accordingly removed them from the Mollusca, in which they were placed by Spengel and Ray Lankester. The name Amphineura, which was used to designate the Chitons and Solenogastres collectively, is therefore abandoned by Thiele and the older name Loricata has been revived for the Chitons, which are still treated by Thiele as a class of the Mollusca. In this article the Solenogastres are included in the Mollusca and the unity of the Amphineura is upheld; but the question of the relationships of the Solenogastres cannot be regarded as finally settled. (See below.)

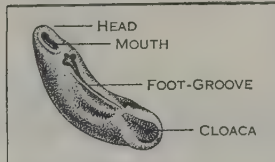
The Chitons are elongate, rather flattened animals, rarely exceeding a few inches in length. *Cryptochiton stelleri* attains a length of 8 in., and the smallest forms barely exceed half an inch when fully grown. The overlapping plates of the shell give them the appearance of wood lice, a comparison perhaps more accurate than that involved in the German name *Käferschnecken*, or "beetle-snails." The outer covering of the animal constitutes the "mantle" on the upper surface and sides. On the lower surface it forms the solid and muscular foot. (See MOLLUSCA.) The cells of the mantle secrete the eight calcareous plates of the shell. In most genera of Chitons the separate valves are articu-

lated together, though with enough freedom to enable the animal to roll up into a ball like a wood-louse. The plates are pierced by a number of branching canals through which nerves pass to end on the surface of the shell in peculiar sense organs known as "shell-eyes." In some forms the shell becomes covered by the mantle. This is well seen in the large *Cryptochiton stelleri* of the north-east Pacific. The mantle also secretes horny or calcified

of the foot, and the fact that there are no separate generative ducts. The gonad (ovary or testis) opens into the pericardium and the ova or spermatozoa are discharged by the kidneys. The gills are concentrated in a posterior cavity (cloaca). In *Neomenia* and its allies there is, on the under surface of the body, a groove which is interpreted as the line of junction between the two edges of the mantle which have grown round the sides. In the *Chaetodermatidae* this groove is absent, and the animal is entirely cylindrical.

The embryological development of the Solenogastres is still imperfectly known; but, as far as it has been studied, it is held to endorse the conclusion that these animals are more nearly allied to certain groups of worms than to the Mollusca.

As a class the Amphineura have a world-wide distribution; but, while some genera (e.g., *Lepidopleurus*) are found in nearly all seas, others have a more localized occurrence. The oldest fossil chitons are found in the Ordovician. Their evolutionary history has been uneventful, no very marked departure from the main type of shell-structure being recorded. The Solenogastres have not so far been recognized as fossils. Both the chitons and the Solenogastres are sluggish animals, creeping slowly about to



AFTER HANSEN, 1888

FIG. 2.—VENTRAL VIEW OF A SPECIMEN OF *NEOMENIA CARINATA*; NATURAL SIZE

no great distance. The chitons are found on or under rocks and stones. The chemical constitution of the rock is of small importance in determining the occurrence of these animals. They prefer a smooth surface and are usually found on rocks that weather to such a condition. Ashby found the greatest numbers on pure granite, "counting over 70 specimens of *Ischnoradsia* on a single rock no larger than a dinner plate." *Neomenia* and its allies live on corals and hydroids, while *Chaetoderma* prefers muddy and oozy bottoms. Some members of the class are found at very great depths, e.g., *Leptochiton benthus* in 2,300 fathoms ("Challenger"); but most of them live in shallow littoral waters. The chitons are mainly herbivorous and browse on the Algae that adhere to rocks. The members of the Neomeniidae which live on corals and hydroids feed on those organisms and are thus carnivorous. Free-living Neomeniomorpha such as *Proparamenia* are probably more aggressive and active in their feeding-habits. *Chaetoderma* and its allies feed on minute organisms such as Protozoa, etc.

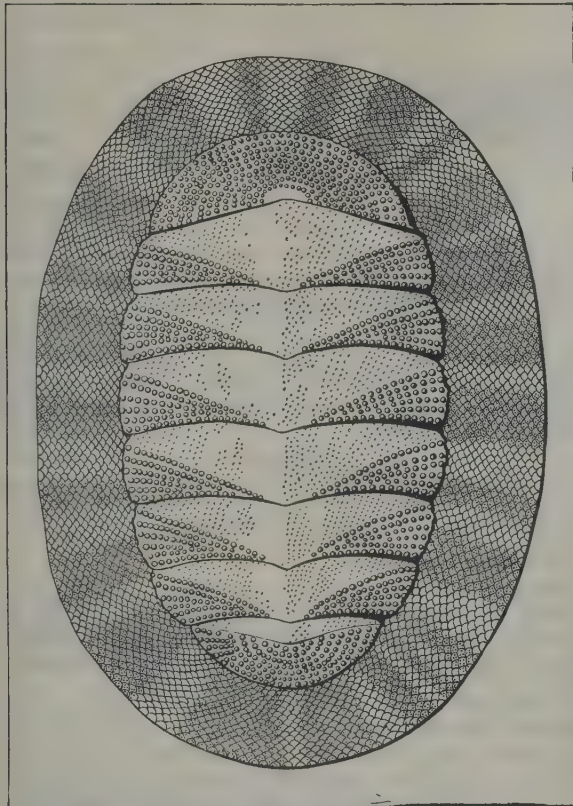
The lack of satisfactory evidence as to the development of the Solenogastres makes it difficult to assess their relationships. The structural peculiarities on which Thiele, Odhner and others have relied in removing these animals from the mollusc lead us to believe that their affinity with the chitons may not be so close as was formerly believed. But a critical test of their relationships can only be provided by a study of their development.

For the relationship of the Amphineura to the other groups of Mollusca, see MOLLUSCA.

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AMPHION and ZETHUS, in Greek mythology, the twin sons of Zeus by Antiope. When children, they were exposed on Mt. Cithaeron, but were found and brought up by a shepherd. Amphion became a great singer and musician, Zethus a hunter and herdsman. After punishing Lycus and Dirce for cruel treatment of Antiope (q.v.), they built and fortified Thebes, huge blocks of stone forming themselves into walls at the sound of Amphion's lyre. Amphion married Niobe, and killed himself after the loss of his wife and children (Ovid. *Metam.*, vi. 270).

AMPHIOXUS or LANCELET, a small, marine creature, neither fish nor worm, but something between the two, which is the simplest example of the Vertebrate type of structure. It was first discovered on the coast of Cornwall, and a preserved

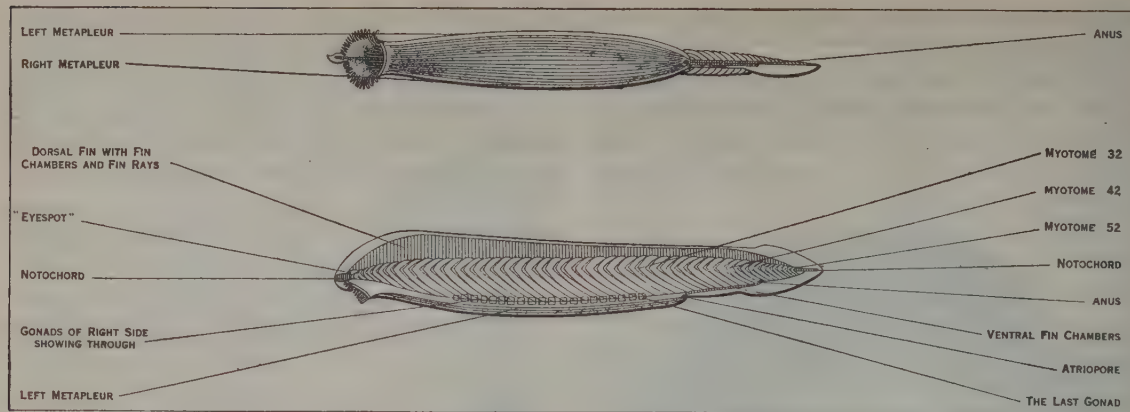


BY COURTESY OF THE LINNEAN SOCIETY OF SOUTH WALES

FIG. 1.—THE OVERLAPPING PLATES OF THE SHELL OF *CHITON* SP., ONE OF THE SHELL-BEARING AMPHINEURA

spicules. These are found at the edge of the mantle (girdle), where it projects beyond the shell. In *Tonicia* and other genera the spicules are so large and numerous that they give the animal a rough and shaggy appearance. The cavity of the mouth contains the radula (see MOLLUSCA) or rasping tongue. The alimentary canal extends in a straight line from the mouth to the anus, which is situated at the posterior end of the body. It receives the ducts of the mucous and salivary glands and of the liver. The heart occupies a position in the middle line at the posterior end. A single aorta leads the blood from the heart, and it is eventually collected for oxygenation into two large cavities (sinuses). From these it passes to the gills, which project from the adjacent body-wall into the cavity formed by the edge of the mantle, where it overhangs the sides. The gills vary in number from 4 to 80. There are two kidneys, one on each side of the body. Their external apertures are at the posterior end of the body, and at their inner end they open into the pericardium (the cavity surrounding the heart). The nervous system consists of four main nerve trunks joined by transverse commissures and, unlike the main nerve cords of Gastropoda and other molluscs, is largely without ganglia. The sexes are separate in the Chitons. The ovary and testis have no communication with the pericardium as they have in the Solenogastres. The ova and spermatozoa are passed to the exterior by a pair of gonoducts.

Regarded as molluscs, the Solenogastres are mainly characterized by the loss of the shell, the substantial reduction or loss



AFTER KIRKALDY IN "THE QUARTERLY JOURNAL OF MICROSCOPICAL SCIENCE," BY PERMISSION OF J. & A. CHURCHILL.

FIG. 1.—VIEWS FROM BELOW AND FROM THE LEFT SIDE OF THE ASYMMETRON CULTELLUS SHOWING THE SINGLE ROW OF GONADS (REALLY ON THE RIGHT SIDE) AND THE ASYMMETRICAL CONNECTION BETWEEN THE RIGHT METAPLEUR AND THE CAUDAL FIN. THE DRAWING IS SLIGHTLY ALTERED FROM KIRKALDY

specimen sent to Pallas, who was unacquainted with its lively movements, was described by him in 1774 as a slug, *Limax lanceolatus*. Couch rediscovered it in 1831, and his specimen was described and figured by Yarrell in 1836 under the title *Amphioxus lanceolatus* (Brit. Fishes, vol. ii.).

Characteristics.—The body of *Amphioxus* rarely exceeds 2½ in. in length. It is laterally compressed and tapered at each extremity. From end to end above the alimentary canal runs a solid, elastic rod, the notochord, which plays an important part in the animal's movements. On each side of it run powerful longitudinal muscles, which are divided up into chevron-like segments, the myotomes, like the muscle-flakes of a whiting. Above the notochord lies a nerve-cord, corresponding to the spinal cord of Vertebrates, and giving origin, like it, to alternate pairs of sensory and motor nerves, which, however, remain distinct, and do not unite to form complex structures like the spinal nerves, with their double roots, in Vertebrates. There is, moreover, no centralized brain in front, and no trace of paired olfactory, optic and auditory sense-organs and nerves. Jaws, teeth and other prehensile organs are lacking, as well as skull, vertebral cartilages and paired limbs or fins. The circular, contractile mouth lies at the back of a preoral depression, the buccal cavity, on the underside of the snout. This cavity is fringed behind and on each side by stiff processes or cirri, provided with a solid, jointed, internal skeleton. They are capable of spreading outwards, thus freely opening the buccal cavity, or of bending inwards, when they overlap the entrance with a protective grating. A circlet of true, sensitive tentacles lies just inside the circular mouth. The cheeks of the buccal cavity are beset inside with parallel ciliated ridges, which are offsets from a primary pair of dorso-lateral ridges, diverging behind around the mouth, and converging forwards to surround an asymmetrical cilio-glandular depression known as *Hatschek's pit*. The entire organ is known as the *wheel-organ*. Its ciliary action is directed backwards towards the mouth. The alimentary canal is described below.

Classification.—There has been a tendency to include *Amphioxus* within the Vertebrata as *Acrania*, but this procedure exaggerates the resemblances of *Amphioxus* to the Vertebrates, since in all the essentials of its life and organization, as distinct from superficial form, *Amphioxus* is much more intimately related to the Tunicata (*q.v.*), and constitutes with them a well-defined group, termed by Balfour Protochordata, the distinctive features of which lie in the feeding-mechanism described below. The differences between *Amphioxus* and the Tunicata are chiefly that *Amphioxus* retains its notochord and powers of locomotion throughout life, while in Tunicata these are mostly restricted to the larval stage, and the notochord itself is confined to the tail. *Balanoglossus* (*q.v.*), which in certain respects foreshadows *Amphioxus*, stands at a much lower plane of general organization,

and, with the Pterobranchia (*q.v.*), possesses mere rudiments of the characteristic notochord and neural canal. Thus the position of *Amphioxus* within the phylum Chordata is indicated by the following classification:

- | | |
|-------------------------------|--|
| | CHORDATA |
| I. Hemichordata | { 1. Pterobranchia, e.g., <i>Cephalodiscus</i> .
2. Enteropneusta, e.g., <i>Balanoglossus</i> . |
| II. Protochordata | { 1. Tunicata (= Urochorda).
2. Cephalochordata, e.g., <i>Amphioxus</i> . |
| III. Vertebrata (= Craniata). | |

There are good reasons for regarding these three sub-phyla as marking successive stages in the progressive evolution of the Chordata, although in its possession of protonephridial excretory organs *Amphioxus* retains an archaic larval character (*cf. Actinotrocha*) which has been lost by all other Chordata.

In the latest revision of the Cephalochordata (Franz, 1922) two genera only are recognized, *Branchiostoma* (= *Amphioxus*) and *Asymmetron* (*see below*). Which is primitive? Franz decides in favour of *Amphioxus*; but, if their relationship with Tunicates is borne in mind, the unpaired gonads, the small size (9–10 mm.) at sexual maturity, and the frequent presence of a caudal appendage in *Asymmetron* enable us to recognize in this form a possible stage of transition from a neotenic Ascidian towards *Amphioxus*, the unsegmented caudal appendage (which supports a well-marked caudal fin in the pelagic larva) being a vestige of the Ascidian larval tail. The relations of the metapleural ridges and ventral fin-fold are consistent with this view, since it is generally admitted that the continuity of these structures in *Asymmetron*, though one-sided, is more primitive than the discontinuity in *Amphioxus*. The species of *Asymmetron* fall into two groups according to the presence or absence of the caudal appendage, the second group corresponding with the genus *Heteropleuron* of Kirkaldy; but the variations of a vestigial organ furnish an insecure basis for a definite division of the genus.

I. ASYMMETRON, Andrews (Tattersall)—Gonads on right side only; left metapleur distinct, the right continuous with the ventral fin.

A—with a distinct caudal appendage. Species: *lucayanum* (62–71 myotomes), Bahamas, Zanzibar to Philippines; *macriscadatum* (58–66), Florida; *caudatum* (60–64), Louisiade archipelago; *orientale* (63–69), Maldives.

B—without a caudal appendage. Species: *cultellum* (50–56 my., notochord unusually prominent behind), E. Africa to Philippines and E. Australia; *cingalense* (61–64), Ceylon; *parvum* and *agassizii* (68–70), Maldives; *maldivense* (70–76), Maldives and Laccadives; *bassanum* (70–78), S.W. Australia; *hectori* (84–85), New Zealand.

2. AMPHIOXUS, Yarrell (= *Branchiostoma*, Costa). Gonads in paired series; right and left metapleura ending symmetrically

behind the atriopore; no caudal appendage. Species: *lanceolatus* (58–62 my.), European coasts; *caribaeus* (57–60), Atlantic coasts of America; *haeckelii* (59–61), Ceylon; *belcheri* (63–66), E. Africa to Japan and Queensland; *californiensis* (64–69), California; *indicus* (69–71) (snout elongated), Indian Ocean; *capensis* (74–76), S. Africa; *elongatus* (77–80), Pacific coast of S. America.

Habits.—*Amphioxus* burrows in loose sand, into which it dives with amazing rapidity. It projects its snout above the surface, and remains perfectly still unless disturbed, when it darts out of the sand, gyrates wildly about in zig-zag fashion for a few seconds, and then plunges head-first in again. Except for these brief moments of activity, its habits are as sedentary as those of a fixed Ascidian. *Asymmetron* has similar habits, but *A. lucayanum* appears to be actively pelagic at night.

Feeding Mechanism.—*Amphioxus* agrees with the Tunicata, and differs from all other Chordata, in certain characteristic modifications of the front part of the alimentary canal or pharynx for the collection of minute floating organisms (micro-plankton) as food. The canal itself in *Amphioxus* runs straight from mouth to anus, the latter being situated ventrally a short distance from the posterior extremity of the body, to the left of the ventral fin (in Tunicata also the anus is left-sided, but dorsal). The long, dilated pharynx is succeeded by a narrow gastro-intestinal region, provided in front with a hepatic caecum projecting forwards on the right side. There is no distinct stomach. The entire side-walls of the pharynx, and the body-wall investing it, are pierced by a paired series of close-set U-shaped or tongue-barred gill-slits, each of which extends obliquely backwards, and is divided up into smaller perforations, firstly by fusion of the apex of the tongue-bar with the ventral wall of the

pair of epibranchial flaps (the subatrial ridges). This fusion is incomplete behind, leaving an aperture, the atriopore, situated ventrally, midway between pharynx and anus. The metapleurae are a pair of ventro-lateral ridges on the outer surface of the atrial wall.

The narrow roof and floor of the pharynx are grooved longitudinally. The ventral groove or endostyle is beset with rows of gland-cells, and between them runs a median tract of cells bearing long flagella. Its lateral margins are finely ciliated, and diverge in front to encircle the pharynx inside the mouth as a pair of peripharyngeal bands. These bands bend backwards dorsally and merge into the ciliation of the upper or epipharyngeal groove, which leads into the oesophagus. It is in fact the food-groove, and the rest of the pharynx is a collecting apparatus to supply it.

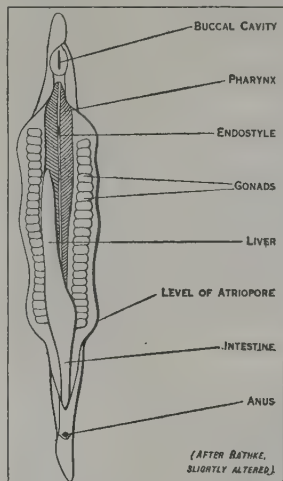
When *Amphioxus* is at rest, its mouth opens, and the cilia of its numerous gill-slits set up a current which flows steadily in through mouth and pharynx, and out through atrium and atriopore. At the same time the endostyle pours out a stream of mucilage, the greater part of which is flicked out of the groove right and left on to the side-walls of the pharynx, and is there swept upwards in the form of parallel longitudinal strings by the

action of cilia coating the internal surface of the gill-bars. In this way the fenestrated walls of the pharynx are traversed by a moving succession of slimy threads. Food-particles entering with the water are sooner or later entangled in the mucilage and rolled upwards into the epipharyngeal groove which concentrates them and conveys them as a continuous food-rope backwards into the digestive part of the canal.

The physiology of digestion is described by E. J. W. Barrington (1937).

Reproduction.—The sexes are separate. The gonads arise as pouches from the lower ends of the myotomes, and project into the atrium. At the breeding season the pouches burst, and the sexual elements pass through the atrium to the exterior, where fertilization takes place.

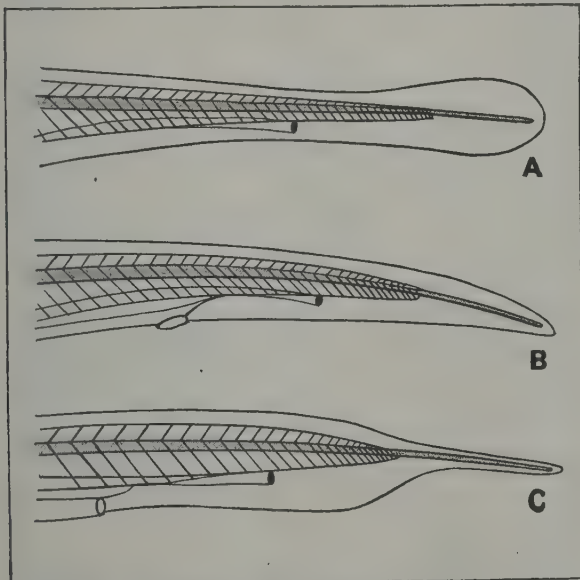
Development.—On account of its relative yolklessness, the fertilized egg of *Amphioxus* provides a typical example of total and regular segmentation, and of gastrulation by invagination. Notochord and neural canal (the latter enclosing the blastopore) are developed as in the lower Vertebrates. Paired mesoblastic somites arise as outgrowths, from the embryonic endoderm, and divide into the myotomes above and visceral elements below which unite to form the perivisceral coelom. A primitive tripartite arrangement of the coelom is recognizable, as in *Balanoglossus*, the myotomes and perivisceral elements being derivatives of the third primitive or trunk segment (MacBride). The first primitive segment is cut off from the blind extremity of the archenteron as a single vesicle, which divides into two, the right half expanding as the head-cavity, while the left, which acquires an opening to the exterior, becomes reduced to form Hatschek's pit. Its aperture is clearly homologous with the proboscis pore of *Balanoglossus* and the water-pore of Echinoderm larvae. It is surrounded in the larva by a peculiarly ciliated patch, known as the *preoral pit*, which subsequently develops into the wheel-organ of the adult. Goodrich has given good reasons for regarding this organ as equivalent to the anterior part, at any rate, of the Vertebrate hypophysis.



AFTER RATHKE, "BERWIRKUNGEN ÜBER DEN BANDES AMPHIOXUS"

FIG. 3.—AMPHIOXUS LANCEOLATUS LAID OPEN VENTRALLY

Exposing the organs which project into the atrial cavity (pharynx, intestine with liver, caecum directed forwards, row of gonads in each side-wall)



AFTER ANDREWS, "AN UNDESCRIBED ACRANIATE ASYMMETRON LUCAYANUM" IN "STUDIES FOR THE BIOLOGICAL LABORATORY OF JOHNS HOPKINS UNIVERSITY." BY PERMISSION OF THE JOHNS HOPKINS PRESS

FIG. 2.—DEVELOPMENT OF THE CAUDAL APPENDAGE OF ASYMMETRON LUCAYANUM BY ATROPHY OF THE PRIMITIVE CAUDAL FIN OF THE LARVA

A. Larva of 6 mm. with 22 gill-slits, no caecum and atrium unclosed ventrally

B. Immature specimen with 27 gill-slits, small caecum and closed atrium

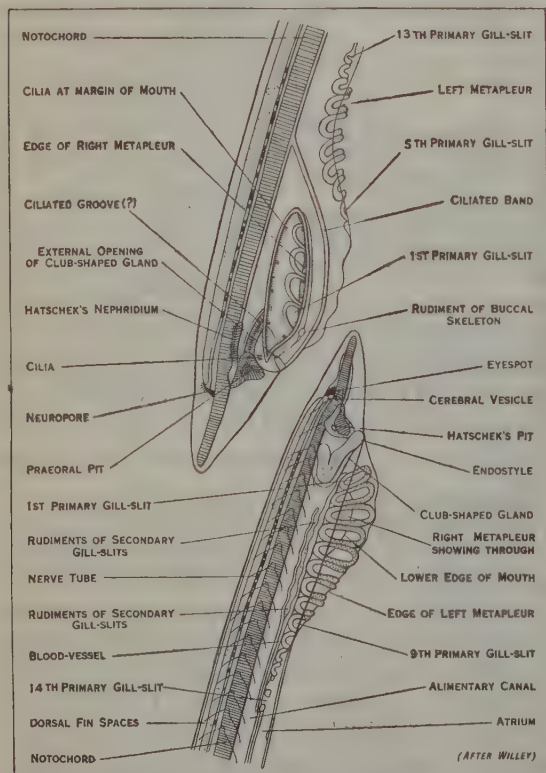
C. Mature adult of 14 mm. with 25 gonads

Note the incipient development in C of a secondary caudal fin in the postanal region of the myotomes representing normal "caudal fin" of *Amphioxus*

slit, and then by subdivision of the half-gill-slits into stigmata by outgrowth of synapiculae from the tongue-bars. The edges of all the perforations are strongly ciliated and lash outwards through the body-wall. To protect the fenestrated walls from injury, the whole pharyngeal region is sunk beneath the general level, and enclosed within a peribranchial chamber or atrium by downgrowth of the muscular body-wall and ventral fusion of a

Amphioxus hatches at about the eighth hour after fertilization as a ciliated embryo, with the neural folds, notochord and first few mesoblastic somites established, but without mouth or anus. The ciliated embryo elongates rapidly with the formation of additional somites, and at about the 36th hour passes into the first larval stage, characterized by perforation of the mouth, first gill-slit and anus. This stage is curiously asymmetrical, the mouth and single gill-slit being situated opposite one another to left and right. The mouth becomes enormously distended along the left side, while new gill-slits arise on the right side up to as many as 14. Subsequently (metamorphosis stage) the last six of these, as well as the first one, close up, and the remainder rotate below to their permanent position on the left side, while a new series arises above the first to replace it on the right. At the same time the mouth rotates forwards to a median position.

Various theories have been put forward to account for this temporary distortion. The present writer suggests that it is the consequence of a secondary reduction of yolk in the egg, accompanied by premature hatching, which has entailed the improvisation of a temporary feeding mechanism, the basis of which appears to be the enlargement and special ciliation of the mouth and an adaptation of the club-shaped gland for the supply of mucilage.



AFTER WILLEY

FIG. 4.—ANTERIOR REGION OF TWO PELAGIC LARVAE OF *A. LANCEOLATUS* Showing the large left-sided mouth with its ciliated margin and the opposite series of simple primary gill-slits

Of great interest are the origin of the endostyle as a V-shaped loop of the peripharyngeal band, thus recalling the adoral band of Echinoderm larvae, and the development immediately behind the endostyle, of the club-shaped gland, with two successive internal orifices on opposite sides of the endostyle, and a single external orifice below the left-sided mouth. Willey regarded this gland as a modified gill-cleft. The present writer identifies it with certain pharyngeal glands of Appendicularians, and interprets all of them as highly modified vestiges of the epicardium or budding-organ of Tunicata (*q.v.*).

Evolution.—If these views are correct, *Amphioxus* must have been derived from sessile ancestors of a primitive Ascidian stock, and its elongated form is the result of loss of fixation and retention of larval habits, modified by secondary adaptation to an arenicolous life. We have already seen that *Asymmetron* retains a caudal appendage which can be little else than a remnant of the Ascidian larval tail, and this accords with its possession of unpaired gonads as in Ascidians. The secondary symmetrization of the gonads in *Amphioxus* is paralleled in Ascidians themselves (Stolidobranchia). The main axis of Chordate evolution may thus be regarded as a line of sedentary plankton-feeding organisms, which began with an external apparatus of ciliated tentacles and food-grooves, and ended with an endopharyngeal mechanism of gill-slits and endostyle. From this Pterobranch-Ascidian line *Balanoglossus*, *Amphioxus* and the Appendicularians have been given off at different levels as successive paedomorphic offshoots. The line may be carried still farther back to the primitive stalked Echinoderms, to inheritance from which we must ascribe such features as the larval form of *Balanoglossus* (*Tornaria*), Hatschek's pit and the V-shaped endostyle of *Amphioxus*. Assuming that the ancestral Echinoderm handed on to its Hemichordate descendants a primitive type of Dipleurula larva, the Protochordate tadpole may readily have been derived from it by the substitution of muscular for ciliary means of progression. The adoral band may thus have been the forerunner of the endostyle, and the circumoral ciliated band, with its underlying nervous system, of the ciliated neural folds of Vertebrates, which at the outset have identical relations to mouth and blastopore.

That the vertebrate have shared the same ancestry as the Protochordata, is shown by the retention in vertebrate embryos of unequivocal remnants of the Protochordate feeding mechanism of endostyle and tongue-barred gill-slits, as shown by the details of development of the thyroid and thymus glands.

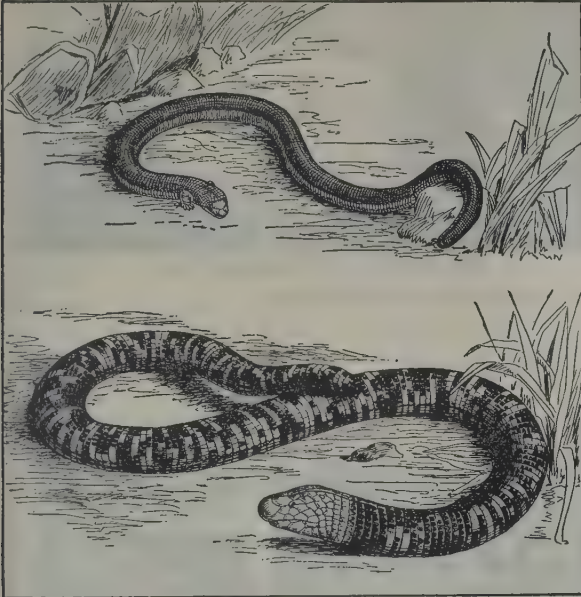
BIBLIOGRAPHY.—E. A. Andrews, "On *Asymmetron lucayanum*," *Stud. Biol. Lab. Johns Hopkins Univ.*, v. (1893); A. Willey, *Amphioxus and the Ancestry of the Vertebrates* (1894); J. W. Kirkaldy, "Genera and Species of Branchio-Stomidae," *Q.J.M.S.*, xxxvii. (1895); E. W. MacBride, "Formation of the Layers in *Amphioxus*, etc.," *Q.J.M.S.*, liv. (1900); E. S. Goodrich, "Excretory Organs of *Amphioxus*," *Q.J.M.S.*, liv. (1909); J. H. Orton, "Ciliary Mechanisms and Feeding in *Amphioxus*, etc.," *Jour. Mar. Biol. Ass.*, x. (1913); V. Franz, "Systemat. Acranier-Studien," *Zool. Anz.*, liv. (1922); W. Garstang, "Morphology of Tunicata and its bearings on the Phylogeny of the Chordata," *Quart. Jour. Micr. Sci.* (1928); V. Franz, *Zeit. f. d. Ges. Anat.* (1927); E. J. W. Barrington, "Digestive System of *Amphioxus*," *Phil. Trans. (B)* 228 (1937). (W. GA.)

AMPHIPOLIS (mod. YENI KEUI), ancient city of Macedonia, on the east bank of the River Strymon, where it emerges from Lake Cercinitis, about 3 mi. from the sea. Originally a Thracian town, known as 'Εννέα Ὀδοί ("Nine Roads"), it was colonized by Athenians with other Greeks under Hagnon in 437 B.C., previous attempts—in 497, 476 and 465—having been unsuccessful. It 424 B.C. it surrendered to the Spartan Brasidas without resistance, through the negligence of the historian Thucydides, who was with the fleet at Thasos. In 422 B.C. Cleon led an unsuccessful expedition to recover it; both he and Brasidas were slain. It was to have been restored to Athens by the peace of Nicias (421) but remained long independent. In 357 Philip of Macedon occupied it in spite of Athenian opposition. The importance of Amphipolis was due to its command of the bridge over the Strymon, and the route from northern Greece to the Hellespont; it was a depot for the gold and silver mines of the district, and for ship-timber. Under the early empire it became the headquarters of the Roman governor of Macedonia, though independent. Many inscriptions, coins, etc., have been found here, and traces of ancient fortifications and a Roman aqueduct are visible. (See S. Casson, *Macedonia, Thrace and Illyria* [1926] and Pauly-Wissowa, s.v.).

AMPHISBAENA, the vernacular name for a family of worm-shaped lizards, and likewise the generic name of the best known genus. The family is represented in Florida and Lower California, Mexico, Spain, North Africa and southwestern Asia, but most of its members are found in tropical America and Africa.

In these lizards the body is of nearly the same thickness throughout, the tail being very short. The various species range

from about six inches to two feet in length. The head (in which the eyes are beneath the scales of the head) is blunt like the tail, and it is this superficial resemblance between the head and tail



AFTER BREHM

TWO AMPHISBAENAS, THE TWO-HANDED BIPES OF MEXICO AND THE BLACK AND WHITE COMMON AMPHISBAENA OF SOUTH AMERICA

that leads the Brazilians to call it the snake with two heads and to the belief that it can move equally well backward and forward. The name *amphisbaena* was applied to a serpent in Greek mythology; it implies that the animal is able to crawl in either direction. The wormlike body-form is correlated with burrowing habits. *Amphisbaenas* feed on termites, ants and other small subterranean animals. Little is known about the breeding habits of these remarkable creatures.

The majority of forms of the family being wholly limbless, it is remarkable to find a genus (*Bipes*) in western Mexico and Lower California with short fore-limbs that appear to sprout from the neck like a small pair of hands. (See LIZARD.) (K. P. S.)

AMPHITHEATRE, a building, primarily for entertainments, in which the seats for the spectators surround the stage or arena. It is differentiated from the stadium (*q.v.*) by the fact that its shape approximates an ellipse. The amphitheatre was early developed in the Italian peninsula as the logical building for the local gladiatorial combats. The early amphitheatres were built of wood and were strictly temporary and it was only in the last century of the republic that permanent amphitheatres of stone were erected (Pompeii *c.* 80 B.C.). In Rome an amphitheatre with a stone enclosing wall and wooden seats was built in 29 B.C. by C. Statilius Taurus. But it is the earliest great Roman amphitheatre, the Flavian, or Colosseum, that has remained the outstanding and the largest example of the type. It was built by Vespasian and Titus upon the site of Nero's "Golden House." The Colosseum, as it now stands, was completed only after the great fire of 217 A.D., when the present upper story, until then of wood, was added. The dimensions of this amphitheatre are 615 by 510 ft. with an arena 281 by 177 feet. Its capacity is now estimated at about 50,000, the ancient Roman estimates, which varied from 80,000 to 100,000, being manifestly exaggerated. Other great examples of the ancient amphitheatre are: the Amphitheatre Castrense in Rome, built of brick, probably during the reign of Trajan; the amphitheatre at Pompeii already mentioned, 444 by 342 ft.; that at Capua, 557 by 458 ft.; that at Verona, 502 by 403 ft., probably of the time of Diocletian; that at Pozzuoli, 482 by 383 ft., particularly famous for the perfect preservation of its stage arrangements; and, outside of Italy, those at Nîmes and Arles in France;

Pola in Istria; and Thysdrus in Africa, all of these approximately the same size—between 400 and 500 ft. long and between 300 and 400 ft. wide. Besides these, fragmentary remains are found widely scattered throughout the Roman empire. In England, at 'Silchester in Hampshire, there is an example in which the seats were placed largely on banked up earth.

In the typical Roman amphitheatre the arena was usually raised above an elaborate structure containing cells for wild beasts, storage room, connecting passages and rooms for gladiators, all ingeniously arranged to connect by means of many trap doors with the arena above (see illustration of Pozzuoli). Around this arena, and separated from it by a high wall, arose the seats of the spectators. These were divided by passageways running around the amphitheatre into several sections (*maeniana*); the lowest, known as the podium, for state officials; the next reserved for the wealthy or the nobles; and those above for the rest of the populace. Each of these was divided into wedge shaped sections (*cunei*) by radial walks and from them many exits (*vomitoria*) led down to the passages below the seats and so to the street. Apparently seats were always reserved, as they are usually carefully numbered; and tickets of clay bearing the seat numbers have been found. The seats were supported on walls running radially to the exterior between which the exit stairs were most ingeniously arranged so that the enormous crowds were distributed evenly to the exit arches which surrounded the ground story. In addition, vaulted corridors ran elliptically around the outside, connecting the various radial elements; the arcaded exterior was, therefore, a necessary and logical expression of the construction.

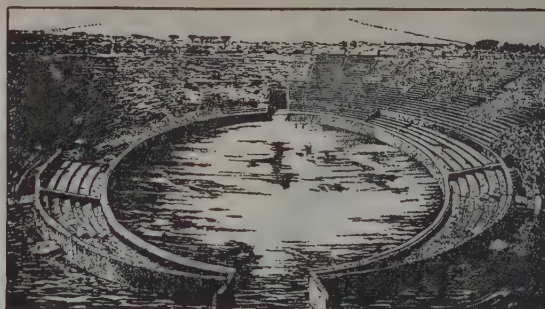
In modern usage the word amphitheatre is sometimes used for a theatre or concert hall whose seats surround the central area, as, for example, the Albert hall, London, and both the new and the old Madison Square Garden in New York. Modern open amphitheatres also exist, particularly in connection with the sports of the United States, for instance, Soldier field, Chicago (cap. about 200,000), Franklin field, Philadelphia (cap. 83,000), the Yale "bowl" at New Haven (cap. 80,000), the Baltimore "stadium" (cap. 78,000) and that at Los Angeles (cap. 75,000). The largest of all structures of this type, in England is at Wembley, near London, which accommodates 25,000 persons under cover, 10,000 at the ringside and 91,500 standing, or a total of 126,500. Other amphitheatres have been built or projected on the continent of Europe. (T. F. H.)

AMPHITRITE, in mythology of ancient Greece, a sea-goddess daughter of Nereus (or Oceanus) and wife of Poseidon. It was said that Poseidon saw her first dancing at Naxos among the other Nereids, and carried her off. She then fled from him over the sea, but was found by the dolphin of Poseidon, which was afterward set among the stars. In works of art she is represented either enthroned beside him or driving with him in a chariot drawn by sea-horses or other fabulous creatures of the deep, and attended by Tritons and Nereids.

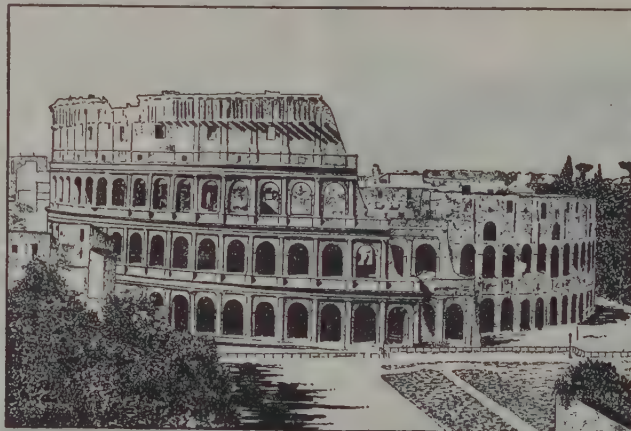
AMPHITRYON, in Greek mythology, son of Alcaeus, king of Tiryns. Having accidentally killed his uncle Electryon, king of Mycenae, he was driven out by another uncle, Sthenelus. He fled with Alcmena, Electryon's daughter, to Thebes, where he was cleansed from the guilt of blood by Creon, his maternal uncle, king of Thebes. Alcmena, who had been betrothed to Amphitryon by her father, refused to marry him until he had avenged the death of her brothers, all of whom except one had fallen in battle against the Taphians. Amphitryon accordingly took the field against the Taphians, accompanied by Creon, who had agreed to assist him on condition that he should slay the Teumessian fox which had been sent by Dionysus to ravage the country. The Taphians, however, remained invincible until Comaetho, the king's daughter, out of love for Amphitryon, cut off her father's golden hair, the possession of which rendered him immortal. Having defeated the enemy, Amphitryon put Comaetho to death and handed over the kingdom of the Taphians to Cephalus. On his return to Thebes he married Alcmena, who gave birth to twin sons, Iphicles being the son of Amphitryon, Hercules of Zeus, who had visited her during Amphitryon's absence.



INTERIOR OF THE AMPHITHEATRE AT POZZUOLI (PUTEOLI)



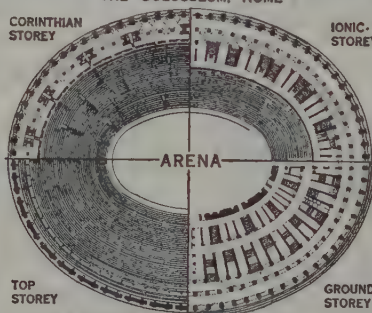
INTERIOR OF THE AMPHITHEATRE AT POMPEII

PART ELEVATION
COLOSSEUM

THE COLOSSEUM, ROME

SECTION
COLOSSEUM

ARENA AND AUDITORIUM, VERONA



1/4 PLANS, COLOSSEUM



LOWER, ARCHED CORRIDOR, COLOSSEUM



EXTERIOR OF THE AMPHITHEATRE AT NIMES (NEMAUSUS)

AMPHITHEATRES AT POZZUOLI AND POMPEII, FROM PHOTOS BY BROGI; PART ELEVATION, FROM D'ESPOUY, "FRAGMENTS D'ARCHITECTURE ANTIQUE" (MASSIN & CIE); COLOSSEUM SECTION, ARENA AND AUDITORIUM, AND 1/4 PLANS, BY PERMISSION FROM SIR BANISTER FLETCHER'S "HISTORY OF ARCHITECTURE ON THE COMPARATIVE METHOD," EIGHTH ED. (1928) BATSFORD; ARCHED CORRIDOR, FROM PISAN AND SALVAT, "HISTORY OF ART"; AMPHITHEATRE AT NIMES, FROM PHOTO BY NEURDEIN
THE AMPHITHEATRE AT POZZUOLI SHOWS THE TRAPDOORS IN THE ARENA FLOOR BY WHICH ANIMALS OR GLADIATORS COULD BE INSTANTLY INTRODUCED INTO ANY PART OF THE ARENA. THE LARGEST LEADS TO A CORRIDOR CONNECTED WITH ALL THE CELLS BELOW THE FLOOR. IN THE COLOSSEUM SECTION NOTE THE POSITION OF THE STAIRS BY WHICH THE SPECTATORS ENTERED AND LEFT. THE AMPHITHEATRE AT VERONA SHOWS THE MANY VOMITORIA OR EXITS

The modern use of *Amphitryon* in the sense of a generous host is derived from Molière's comedy on the subject, iii, 5.

See Apollodorus ii, 54-62; Herodotus v, 59; Pausanias viii, 14, ix, 10, 11, 17; Hesiod, *Shield*, 1-56; Pindar, *Pyth.*, ix, 81.

AMPHORA, usually an earthenware vessel used by the ancient Greeks and Romans and so named from having a handle on each side of the neck (Gr. *ἀμφι*, on both sides; *φέρειν*, to carry). Amphorae either rested on a foot, or ended in a point so that they had to be fixed in the ground. The amphora was a standard measure of capacity among both Greeks and Romans, the Attic containing nearly nine gallons, and the Roman about six.

AMPLIATIVE JUDGMENTS or PROPOSITIONS are those in which something is affirmed that is not included in the definition or connotation of the subject. When the predicate merely unfolds or analyzes the meaning of the subject; the proposition is called "explicative." (When the predicate is a *genus* or *differentia* of the subject, the proposition is explicative; if the predicate is a *proprium* or *accidens* the proposition is ampliative. (See **PREDICABLES**.) Instead of "ampliative" the terms "augmentative" and "synthetic" are also used; and the terms "analytic" and "verbal" are sometimes used instead of "explicative." (See **ANALYSIS and LOGIC**.)

AMPLIFICATION. In radio communication amplification may be considered as a magnification or enlargement of energy which takes place in an electrical circuit. It is a function by which the intensity of the electrical variations in the output circuit are increased without altering their wave forms. Amplification is essentially a relay action. In radio reception, the comparatively weak signal voltages impressed on a vacuum tube *amplifier* produce in the output circuit a correspondingly increased amount of power which is drawn from the "B" battery or other source of power in the plate circuit. The *amplification factor* is a number which expresses the magnitude of this effect.

AMPLIFICATION FACTOR OF A VACUUM TUBE, a quantity which is used to express the relative effects of the grid voltage and plate voltage in affecting the plate current of a vacuum tube. The amplification factor is the change in plate potential divided by the negative change in grid potential under the condition that the plate current remains unchanged. As most precisely used, the term refers to infinitesimal changes in the potentials as indicated in the defining equation. Amplification

factor $\mu = -\frac{de_p}{de_g}$, $i_p = \text{constant}$.

AMPLIFIERS. According to the committees on standards of the American Institute of Radio Engineers (1938), "an amplifier is a device whose output is an enlarged reproduction of the essential features of an input wave and which draws power therefrom from a source other than the input signal." The output signal may be proportional to the input signal, or input and output may be related in a quadratic, logarithmic, or other nonlinear fashion.

Amplifiers usually perform this function by making the input signal regulate the flow of energy from an external energy source to the output. For example, the locomotive engineer, by pushing an easily movable lever, controls the flow of energy from the boiler to the steam engine, which applies sufficient force to the driving wheels to move the locomotive. This control system is thus a type of amplifier although the name "amplifier" is not ordinarily applied to it. Similarly, the grid of a thermionic tube or valve (see **ELECTRON TUBE**) controls the flow of energy from the cathode to the anode, so that such a tube can be used as an amplifier.

When the signal of interest is very small, or involves rapid changes or high frequencies, thermionic tube amplifiers are used almost exclusively. If great magnifications of power are required, several stages of amplification in a train of thermionic tubes may be necessary. In this case, the complete assembly of tubes and associated circuits is referred to as an amplifier. A great number of thermionic tube amplifiers have been designed and have become standard for a variety of specific applications. Several different types of amplifiers are to be found in the home radio receiver contributing at various stages to the process of convert-

ing the extremely weak high frequency electrical signals picked up by the antenna to strong signals at audible frequencies. Amplifiers are necessary in radio transmitting stations to increase the energy received by a microphone to a level so high that receivers miles away will be supplied with detectable amounts of energy. Public address systems use amplifiers in raising the sound level of the human voice or of music to a level audible at a considerable distance. Amplifiers are widely used in long-distance telephone circuits to compensate for the power losses in the long transmission lines. Thermionic tube amplifiers are found in a multitude of other applications including television, hearing aids, medical and physical research, aeroplane and submarine detectors, and photoelectric and other control of machinery.

By 1945, thermionic tube amplifiers were available at power levels varying from a small fraction of a watt up to several hundreds of kilowatts. Amplifiers of the type used in the home radio receiver were capable of detecting and amplifying signals as low as 1,000,000th of a volt, and amplifiers had been built for slowly varying signals, which could detect and amplify signals of less than 1,000,000,000th of a volt. At very high frequencies of the order of thousands of megacycles, high-power amplifiers had not yet been achieved, but new types of thermionic tubes gave promise of important advances.

For many high-power applications, particularly in the control of heavy machinery, specially constructed rotating electrical machines such as the "amplidyne" can be used as amplifiers and have advantages of simplicity and high amplification. Frequently, electromechanical amplifiers of this type are used in conjunction with thermionic tube amplifiers.

Hydraulic amplifiers in which hydrostatic pressure is applied by opening or closing a valve are used in steering large aircraft, in swinging heavy turrets on ships, and in the control of turbines and other machinery.

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AMPLITUDE, the extreme range of a fluctuating quantity. In mathematics and physics the word is generally used in connection with periodic functions or motions and denotes the maximum difference or displacement from the mean value (sometimes called the semi-amplitude since the whole range is double). In navigation the amplitude of a heavenly body is the angular distance of the point at which it rises or sets from the east or west point.

AMPSANCTUS or AMSANCTUS (mod. *Sorgente Mefita*), a small lake in the territory of the Hirpini, 10 mi. S.E. of Aeclanum, close to the Via Appia. There are now two small pools which exhale carbonic acid gas and sulphuretted hydrogen. A temple of the goddess Mephitis had a cave with suffocating vapours, and the place was brought into connection with legends of the infernal regions.

AMPTHILL, ODO WILLIAM LEOPOLD RUSSELL, 1ST BARON (1829-1884), British diplomatist and ambassador, was born in Florence on Feb. 20, 1829, the son of Maj.-Gen. Lord George William Russell. His education, like that of his two brothers—Hastings, who became eventually 9th duke of Bedford, and Arthur, who sat for a generation in the house of commons as member for Tavistock—was carried on entirely at home, under the general direction of his mother, whose beauty was celebrated by Byron in *Beppo*. Lady William Russell was as strong-willed as she was beautiful, and certainly deserved to be described as she was by Disraeli, who said in conversation: "I think she is the most fortunate woman in England, for she has the three nicest sons." In March 1849 Odo was appointed by Lord Malmesbury attaché at Vienna. He was employed successively in the foreign office in London, in Paris, Constantinople and Florence. In 1858 he was sent to reside in Rome, where he remained for 12 years, till Aug. 1870. During all that period he was the real though unofficial representative of England at the Vatican, and his consummate tact enabled him to do more than an ordinary man could have done in

a stronger position. Although he sympathized with those who laboured to prevent the extreme partisans of papal infallibility from having everything their own way, yet he made it clear to his own government that all efforts were useless, and seems to have had no illusions as to the result of the debate. In 1868 Odo Russell married Lady Emily Theresa Villiers, the daughter of Lord Clarendon. In 1870 he was appointed assistant undersecretary at the foreign office, and in Nov. of that year was sent on a special mission to the headquarters of the German army, where he remained till 1871.

In 1870 Russia had taken advantage of the collapse of France and of her own cordial relations with Prussia to denounce the Black Sea clauses of the treaty of Paris of 1856. Russell, in an interview with Bismarck, pointed out that unless Russia withdrew from an attitude which involved the destruction of a treaty solemnly guaranteed by the powers, Great Britain would be forced to go to war "with or without allies." This strong attitude was effective, and the question was ultimately settled by the conference which met in London in 1871. Though the result was to score a distinct diplomatic success for the Liberal government, the bellicose method employed threatened to create trouble for the ministry in parliament. On Feb. 16, 1871, accordingly, Gladstone, in answer to a question, made an enigmatical statement on the subject which was interpreted as an attack on Russell. A little later in the same year, however, he was made ambassador at Berlin. Russell remained at Berlin, with only brief intervals of absence, from Oct. 16, 1871, until his death at Potsdam on Aug. 25, 1884. He was third plenipotentiary at the Berlin congress. He was raised to the peerage in 1881. At the conference about the Greek frontier, which followed the congress of Berlin, he was the only British representative. During all this long sojourn in the Prussian capital he did everything that he could to bring about close and friendly relations between Great Britain and Germany.

He was succeeded as 2nd baron by his son, ARTHUR OLIVER VILLIERS RUSSELL (1869-1936), who was private secretary to Chamberlain, 1895-97, and governor of Madras, 1899-1906. In 1904 he acted temporarily as viceroy of India. He served in France throughout World War I. The legitimacy of his grandson was impugned by the complex proceedings popularly known as the "Russell baby case," which, commenced in 1921, was ended in the infant's favour in 1924.

AMPTHILL, urban district, Bedfordshire, England, 44 mi. N.N.W. of London by the L.M.S.R. Pop. (1938) 2,350. It lies on the southern slope of a low range of hills, in a well-wooded district. The church of St. Andrew contains a monument to Richard Nicolls (1624-72), who received the submission of New Amsterdam (later New York) in 1664, and became its first English governor. In Ampthill park, celebrated for its ancient and majestic oaks, is a cross marking the site of Ampthill castle, residence of Catherine of Aragon while her divorce from Henry VIII was pending. Lacemaking is said to have been introduced by Catherine of Aragon, but is now practically extinct. Straw-plaiting for hatmaking survives to some extent, but the interests of the town are in the main purely agricultural. Area 2.9 sq.mi.

AMPULLA, a small narrow-necked, round-bodied vase for holding liquids, especially oil and perfumes. It was used in ancient times for toilet purposes and anointing corpses, being then buried with them. Gildas mentions *ampullae* as used by the Britons in his time, and St. Columba is said to have used an ampulla in crowning King Aidan. In the western church the name is still applied to the vessel containing the oil consecrated by the bishop for ritual uses. It occurs in the English coronation service in connection with the ancient ceremony of anointing by the archbishop of Canterbury, which is still observed. The ampulla of the regalia of England takes the form of an eagle. The ampulla known as *la sainte ampoule*, at Reims, from which the kings of France were anointed (supposed to have been brought from heaven by a dove for the coronation of Clovis), was destroyed at the Revolution. The word is used in biology for a certain portion of the anatomy of a plant or animal.

AMPUTATION means the removal of a part of the body, as of the breast. In a more restricted sense the term is applied to

the removal of a part or the whole of a limb. The conditions under which amputation becomes necessary are: (1) injury, (2) gangrene, (3) infection, (4) malignant tumour, (5) deformity, (6) pain. Experience in World War I taught surgeons that amputation is necessary much less often than was formerly supposed. Advances in reconstructive surgery have made it possible to rehabilitate badly damaged limbs without amputation, and modern methods of preventing and controlling infection have lessened the danger from this source. However, some injuries still demand amputation under certain conditions, notably avulsion of part of a limb, compound fractures, crushing and lacerating wounds and irreparable injury to the circulation of a limb. In the case of a definite gangrene it is usually a choice between a slowly advancing process, with the probability of an infection sooner or later, and amputation. In severe infections of a limb, especially if complicated by lesions of bone or joints, amputation may be a lifesaving measure. Malignant tumours often necessitate amputation; deformities and pain occasionally do so.

AMRAM (died 875), a famous *gaon* or head of the Jewish Academy of Sura (Persia) in the 9th century. He was author of many "Responsa," but his chief work was liturgical. He was the first to arrange a complete liturgy for the synagogue, and his prayer book (*Siddur Rab 'Amram*) was the foundation of most of the extant rites in use among the Jews. The *Siddur* was published in Warsaw in two parts (1865).

AMRAOTI, a town and district of India in Berar, Central Provinces and Berar. The district was reconstituted in 1905, when that of Ellichpur was incorporated with it. The town (pop. 61,971 in 1941) is the richest town of Berar, with the most numerous and substantial commercial population. It possesses a branch of the Bank of Bombay, with a famous cotton mart, as well as a large grain market, cotton presses, ginning factories and oil mills.

The district of Amraoti has an area of 4,715 sq.mi. In 1941 the population was 988,524. The district is an extensive plain, about 800 ft. above sea level, the general flatness being broken only by a small chain of hills running in a northwesterly direction between Amraoti and Chandor, with an average height from 400 to 500 ft. above the lowlands. The principal towns, besides Amraoti, are Karinja, Kolapur and Badnera.

'AMR IBN AL-AS, the Arab conqueror of Egypt, belonged to the tribe of the Quraish (Koreish). He had in his youth opposed Mohammed, but he returned to his allegiance and joined the fugitive prophet at Mecca.

'Amr was one of the three generals sent by Abu Bekr to invade Syria in 633, but the main direction of the Syrian campaigns lay with Khālid ibn al-Walid, who was sent to Syria when the imperial army advanced.

In 639 Omar sent him as head of an expedition to Egypt. With an army of only about 4,000 men he took Pelusium (Jan. 640) and, with the aid of a new army of 10,000 men sent by Omar, defeated the imperial troops at Heliopolis (July 640). He then reduced Babylon (near Cairo) and founded the city of Fostat there. By a treaty made with the patriarch Cyrus, Alexandria was surrendered (Sept. 17, 642). 'Amr became the first Mohammedan governor of Egypt, but Omar, who perhaps feared the strong personal influence exercised by 'Amr, sent 'Abdullah ibn Sa'd ibn Abi Sarh to supersede him in Upper Egypt. Othman, Omar's successor, extended 'Abdullah's rule to Lower Egypt. But in 645 'Amr was still in command of the forces which defeated a Greek expedition to Alexandria and retook the city (646). The statement that he burnt the great Alexandrian library has no basis except in the allegations of Abulfaraj (Bar-Hebraeus), who lived six centuries later. After the conquest of Alexandria 'Amr extended Mohammedan rule to Barca and even to Tripoli.

It was probably the desire to secure the governorship of Egypt for himself that ranged 'Amr on the side of Mu'āwiya in his war against Ali after the death of Othman. After the battle of Siffin (July 26-27, 657) when the dispute between Ali and Mu'āwiya was put to arbitration, 'Amr represented Mu'āwiya in the court held at Adhruh in 658 (see CALIPHATE and ALI). In 658 he reconquered Egypt in Mu'āwiya's interest and governed it till his death on Jan. 6, 664. In a pathetic speech to his children on his

deathbed, he bitterly lamented his youthful offense in opposing the prophet, although Mohammed had forgiven him and frequently affirmed that "there was no Mussulman more sincere and steadfast in the faith than 'Amr."

Sir W. Muir, *The Caliphate*, revised ed. (Edinburgh, 1924); E. Gibbon's *Decline and Fall of the Roman Empire*; Alfred J. Butler, *Arab Conquest of Egypt* (Oxford, 1902); L. Caetani, *Annali dell' Islam*, vol. iv, vii (Milan, 1911, 1914); also article EGYPT: *History*.

'AMR IBN KULTHUM, Arabian poet, author of one of the *Mo'allafât*. Little or nothing is known of his life save that he was a member of the tribe of Taghlib and that he is said to have died of excessive wine-drinking. Some stories of him are told in the *Book of Songs* by Bar-Hebraeus (*q.v.*), vol. ix. pp. 181-5.

AMRITSAR, a city and district of British India. The city, the wealthiest in the Punjab, had in 1941 a population of 391,010, mostly Moslem and Hindu. About 200 looms are engaged in the carpet-making industry; an entrepôt trade in piece goods and a large business in skins and hides are carried on. It is a trade centre for the trans-Himalayan routes. The two yearly fairs are the most widely attended in the province. The town attained a certain notoriety in 1919 when riots occurred as a result of general unrest. On April 13 it was held necessary to disperse an unlawful gathering in the Jallianwala Bagh, and as a result nearly 400 Indians were killed by gunfire, and a considerable number wounded. Amritsar city is chiefly notable as the centre of the Sikh religion and the site of the Golden Temple, the chief worshipping place of the Sikhs. Ramdas, the fourth *guru*, laid the foundations of the city upon a site granted by the emperor Akbar. He also excavated the holy tank from which the town derives its name of Amrita Saras, or Pool of Immortality. It is upon a small island in the middle of this tank that the Golden Temple is now situated. After many vicissitudes the city and surrounding district fell under the sway of Ranjit Singh at Lahore, and passed with the rest of the Punjab into the possession of the British after the second Sikh war. The Golden Temple is thus called on account of its copper dome, covered with gold foil. A Sikh college for university education was opened in the neighbourhood in 1897. Amritsar district is a nearly level plain, with a very slight slope from east to west. Numerous branches of the Upper Bari Doab canal intersect the district, affording ample means of irrigation. The North Western railway and Grand Trunk road, which runs parallel with it, afford the principal means of communication and traffic. The area of the district is 1,572 sq.mi.; pop. (1941) 1,413,876. It is the headquarters of the Sikh religion, containing (1931) 399,951 Sikhs as against 174,392 Hindus and 524,676 Mohammedans. The principal crops are wheat, pulse, maize, millet, with some cotton and sugar-cane. There are factories for ginning and pressing cotton.

AMROHA, a town of British India, in the Moradabad district of the United Provinces; noteworthy for the tomb of Sheikh Saddu, a Mohammedan saint. Pop. (1941) 55,957.

AMRUM or **AMROM**, a German island in the North sea, off the coast of Schleswig-Holstein, south of Sylt. Population 858. It is 6 mi. long and 3 mi. broad, with an area of 10½ sq.mi. and is reached from the mainland by a regular steamboat service to Wittdün; or at low water from Föhr. Amrum consists of a treeless sandy expanse, but a fringe of rich marshes affords good pasture-land. The principal place is Nebel, connected by a light railway with Wittdün. (See also FRISIAN ISLANDS.)

AMRU'-UL-QAIS or **IMRU'-UL QAIS**, **IBN HUJR**, Arabian poet of the 6th century, the author of one of the *Mo'allafât* (*q.v.*), was regarded by Mohammed and others as the most distinguished poet of pre-Islamic times. He was of the kingly family of Kinda, and his mother was of the tribe of Taghlib. While he was still young, his father was killed by the Bani Asad, and his life was devoted to the attempt to avenge his father's death. He wandered from tribe to tribe to gain assistance, but his attempts were always foiled by the persistent following of the messengers of Mundhir of Hira (Hira). By means of Harith of Ghassan he procured an introduction to the Byzantine Emperor Justinian. After a long stay in Constantinople he was named phylarch of Palestine, and received a body of troops from Justin II. With

these he started on his way to Arabia. It is said that he was charged before the emperor with the seduction of a princess, and that Justin sent him a poisoned cloak, which caused his death at Ancyra.

BIBLIOGRAPHY.—His poems are contained in W. Ahlwardt's *The Divans of the six ancient Arabic Poets* (London, 1870), and have been published separately in M'G. de Slane's *Le Divan d'Amro'ikais* (Paris, 1837); a German version with life and notes in F. Rückert's *Amrīkai's der Dichter und König* (Stuttgart, 1843). Many stories of his life are told in the *Kitāb ul-Aghāni*, vol. viii., p. 62-77.

AMSDORF, NICOLAUS VON (1483-1565), German Protestant reformer, was born on Dec. 3 1483, at Torgau, on the Elbe and died at Eisenach on May 14 1565. He was educated at Leipzig, and then at Wittenberg. Throughout his life he remained one of Luther's most determined and active supporters. He was with him at the Leipzig conference (1519), and the Diet of Worms (1521); and was in the secret of his Wartburg seclusion.

He assisted the first efforts of the Reformation at Magdeburg (1524), at Goslar (1531) and at Einbeck (1534); took an active part in the debates at Schmalkalden (1537), where he defended the use of the sacrament by the unbelieving; and (1539) spoke out strongly against the bigamy of the landgrave of Hesse. After the death of the count palatine bishop of Naumburg-Zeitz, he was installed there (Jan. 20 1542), though in opposition to the chapter, by the elector of Saxony and Luther. His position was a painful one, and he longed to get back to Magdeburg, but was persuaded by Luther to stay. After Luther's death (1546) he took part in founding Jena University (1548); opposed the "Augsburg Interim" (1548); and superintended the publication of the Jena edition of Luther's works. He urged the separation of the High Lutheran party from Melancthon (1557), got the Saxon dukes to oppose the Frankfort Recess (1558) and continued to fight for the purity of Lutheran doctrine. Many letters and other short productions of his pen are extant in manuscript, especially five thick volumes of *Amsdorfiana*, in the Weimar library. They are a valuable source for our knowledge of Luther. A small sect, which adopted his opinion on good works, which he held to be useless, was called after him.

BIBLIOGRAPHY.—Life, in Th. Pressel, *Leben u. ausgewählte Schrift. der Väter der luth. Kirche*, vol. viii. (published separately, Elberfeld, 1862, 8vo.); J. Meier in *Das Leben der Altväter der luth. Kirche*, vol. iii., ed. M. Meurer (1863); art. by G. Kawerau in Herzog-Hauck, *Realencyc. für prot. Theologie* (3rd ed., Leipzig, 1896).

AMSLER, SAMUEL (1791-1849), Swiss engraver, was born at Schinznach, in the canton of Aargau. He studied his art under Johan Heinrich Lips (1758-1817) and Karl Ernst Hess, at Munich, and from 1816 pursued it in Italy, and chiefly at Rome, till in 1829 he succeeded his former master Hess as professor of copper engraving in the Munich academy. He was a passionate admirer of Raphael and had great success in reproducing his works. Amsler's principal engravings are: "The Triumphal March of Alexander the Great" and a full-length "Christ," after the sculptures of Thorwaldsen and Dannecker; the "Entombment of Christ" and two "Madonnas" after Raphael; and the "Union between Religion and the Arts," after Overbeck, his last work, on which he spent six years.

AMSTERDAM, the chief city of Holland, in the province of North Holland, on the south side of the Y or IJ, an arm of the Zuider Zee, in 52° 22' N. and 4° 53' East. Pop. (1939) 793,526. It has communications by railway and canal in every direction; steam-tramways connect it with Edam, Purmerend, Alkmaar and Hilversum, and electric railways with Haarlem and the seaside resort of Zandvoort. Amsterdam, the "dam or dyke of the Amstel," is so called from the Amstel, the canalized river which passes through the city to the Y. Its beginnings centre around a small sea-fishing settlement. In the 13th century it was held in fee by the lords of Amstel of the bishops of Utrecht and in 1204 Giesebrecht II. built a castle here. A little later Giesebrecht III. constructed a dam to keep out the sea, and around the castle and dam the city grew. The first mention of the town is in 1275, in a charter of Floris IV., count of Holland, exempting it from certain taxes.

In 1296 the place passed out of the hands of the lords of Amstel, owing to the part taken by Giesebrecht IV. in the murder

of Count Floris V. Count John (d. 1304), with the approval of the bishop of Utrecht, bestowed the fief on his brother, Guy of Hainaut. Guy gave the town its first charter in 1300, with a bailiff (*schout*) and judicial assessors (*scabini* or *schoppen*), the overlord's supremacy being guarded, and an appeal lying from the *scabini*, in cases of disagreement, to Utrecht. In 1342 more extensive privileges were granted by Count William IV., including freedom from tolls by land and water in return for certain annual dues. In 1482 the town was surrounded with walls. During the religious troubles of the 16th century its prosperity increased owing to influx of refugees from Antwerp and Brabant. Amsterdam, influenced by its trading interests, did not join the other towns in revolt against Spain until 1578. In 1587 the earl of Leicester made an unsuccessful attempt to seize it. The great development of Amsterdam was due, however, to the treaty of Westphalia in 1648, by which its rival, Antwerp, was ruined, owing to the closing of the Scheldt. The city held out obstinately against the stadtholders, and in 1650 opened the dykes to prevent William II. seizing it. The same device was successful against Louis XIV. in 1672; and Amsterdam, now reconciled with the stadtholder, was one of the staunchest supporters of William III. against France. In 1787 Amsterdam was occupied by the Prussians, and in 1795 by the French under Pichegru. It was then made capital of the Batavian Republic and afterwards of the kingdom of Holland. In 1810 this was united with the French empire and Amsterdam was recognized officially as its third town, following Paris and Rome. The modern city has been built to a great extent over boggy ground and the foundations of the buildings were made secure by driving long piles into the firm clayey soil below. The city suffered only slight damage during the five-day German attack on the Netherlands in May 1940. On the landward side the city is surrounded by a fosse or canal and was at one time fortified; but the ramparts have been demolished and replaced by gardens and houses; one gateway, the Muiderpoort, still stands. Within the city are four canals (*grachten*) with their ends resting on the Y, extending in polygonal crescents nearly parallel to each other and to the outer canal. Lesser canals intersect the others radially, thus virtually dividing the city into a number of islands. The nucleus of the town lies within the innermost crescent canal and with the large square, the Dam, in the centre represents the area of Amsterdam about the middle of the 14th century. At one end of the enclosing canal is the Schreijerstoren (1482) or "Weepers' Tower," on the ancient harbour, the scene of former sorrowful leave-takings. Between this and the next crescent (Heeren Gracht) there sprang up, on the east, the foreign quarter where the large Jewish population is located and where Rembrandt lived (1640-1656) and Spinoza was born (1632). Beyond the Heeren Gracht lie the Keizers Gracht and the Prinsen Gracht respectively, and these three celebrated canals, with their tree-bordered quays and old-fashioned houses, form the principal thoroughfares of the city. West of the Prinsen Gracht lies the district called De Jordaan, a corruption of Le Jardin, for its streets are named after various flowers. It was formed by the settlement of French refugees after the revocation of the Edict of Nantes. The outermost crescent canal is called the Singel (girdle) and marks the boundary of the city at the end of the 17th century. The city's long connection with the sea produced its seamen, merchants and explorers. With the accumulation of mercantile wealth, coupled with a tradition of keenness of mind and action (enhanced by the arrival of refugees), the city became the home of artists, philosophers and religious leaders. Around the Dam are the Nieuwe Kerk and the palace. The palace, in classical style, was originally built as a town-hall in 1648-1655 by van Campen. After 1768 it was used as a royal residence. The exterior is beautifully decorated. The great hall is lined with white Italian marble, and in spite of its enormous dimensions the roof is unsupported by pillars. The Nieuwe Kerk (St. Catherine's) is a fine Gothic building dating from 1408. Internally it is remarkable for its remains of ancient stained glass, fine carvings and interesting monuments, including one to the famous Admiral de Ruyter (d. 1676). The new exchange (1901) lies between the Dam and the central station

(1889). The Oude Kerk (St. Nicolaas), so called (c. 1300), contains some beautiful stained glass of the 16th and 17th centuries, by Pieter Aertsen of Amsterdam (1508-1575) and others. One window contains the arms of the burgomasters of Amsterdam from 1578 to 1767. The North church was the last work of the architect Hendrik de Keyser (1565-1621) of Utrecht. The Roman Catholic church of St. Nicholas (1886) replaced a com-



VIEW ALONG THE CANAL IN AMSTERDAM. IN THE BACKGROUND, THE ROMAN CATHOLIC CHURCH OF ST. NICHOLAS, BUILT IN 1886

mon dwelling-house, now the Museum Amstelkring of ecclesiastical antiquities. Among the Jewish synagogues, the largest is that of the Portuguese Jews (1670). The St. Antonieswaag, built as a town gate (1488-1585), contains the city archives; and the Trippenhuis, the Royal Society of Science, Letters and Fine Arts. The Ryks, or State museum, is a finely situated building in the Dutch Renaissance style, erected in 1876-1885. It has a department of general antiquities and a large gallery of pictures of the Dutch and Flemish schools. Famous pictures in the Ryks museum are those from the Trippenhuis, the so-called "Night-watch" and the "Syndics of the Cloth Hall" by Rembrandt, and the "Banquet of the Civic Guard," by van der Helst. The Trippenhuis gallery consisted of the pictures brought from The Hague by Louis Bonaparte, king of Holland, and belonging to the collection of the Orange family dispersed during the Napoleonic period. The municipal museum contains a collection of furniture and paintings, including an outstanding collection of van Gogh. The Joseph Fodor museum (1860) contains modern French and Dutch pictures. The pictures collected by Burgomaster Jan Six (d. 1702) are (except the family Rembrandts) in the Ryks museum. The Willet Holthuysen museum (1895) has exhibits of furniture and porcelain.

Modern Amsterdam extends southward beyond the Singel. In the middle of this new region lies the Vondel park, named after the great national poet Joost van den Vondel (d. 1679), whose statue stands therein. The Willems park adjoining was added later. In the older part of the town the chief open space is the Zoological gardens in the north-east corner, set out by the *Natura Artis Magistra* Society in 1838, which are well known. There is attached a library and an ethnological and natural history museum. Nearby are the Botanical gardens. The public squares include the Sophiaplein, with the picturesque mint-tower; the Rembrandtplein, with a monument to the painter; the Thorbeckeplein, with monument, and the Leidscheplein, with the large theatre, rebuilt in 1890-04 after a fire. There are two universities, the Free university (1880), and the more ancient municipal university of Amsterdam, founded in 1632, but reconstructed in 1887. In addition to the numerous science laboratories the State university possesses a very fine library of about 100,000 volumes, including the Rosenthal collection of over 8,000 books on Jewish literature. The Society for Public Welfare (1785) promotes the education and improvement of all classes, and has branches all over Holland. Among other societies are the *Felix Meritis* (1776) and the *Arti et Amicitiae* (1839), whose art exhibi-

tions are of a high order. At the Concertgebouw, erected in 1888, the famous Concertgebouw orchestra gives its concerts. Amsterdam is the seat of a superior court and a court.

Harbour and Commerce.—The first attempt to overcome the evils wrought to trade by the slow formation of the Pampus sandbank, at the entrance to the Y from the Zuider Zee, was the construction of the North Holland canal to the Helder in 1825. The route was long and difficult, and in 1876 a larger and more direct canal was built across the isthmus to the North sea at IJmuiden.

The serious rivalry of Rotterdam, especially with regard to the transit trade, and the inadequacy of the Keulsche Vaart, which connected the city with the Rhine, led to the construction in 1892 of the Merwede canal to Gorinchem. Meanwhile, a complete transformation took place on the Y to suit the new requirements of the city's trade. The three islands built out into the river serve to carry the railway across the front of the city, and form a long series of quays. On either side are the large East and West docks (1825-34), and beyond these stretch the quays at which the ocean liners are berthed. On the west of the West dock is the timber dock, and east of the East dock is another series of islands joined together so as to form basins and quays, one of which is the State Marine dock (1790-95), with the arsenal and admiralty offices.

Opening out of one of the crescent canals which penetrate the city from the Y is the State Entrepôt dock (1900), the free harbour of Amsterdam, where the produce from Indonesia is stored. The trade with the East Indies increased enormously in the 20th century. On the north side of the Y are the dry docks and the petroleum dock.

The principal imports ordinarily are timber, coal, grain, ore, petroleum, tobacco, tea, coffee, cocoa, sugar, Peruvian bark and other drugs. Diamond cutting, long practised by the Jews, became one of the most characteristic industries of the city. Other industries include sugar refineries, soap, oil, glass, iron, dye and chemical works; distilleries, breweries, tanneries; tobacco and snuff factories; shipbuilding and the manufacture of machinery and stearine candles.

The Amsterdam exchange achieved considerable importance. The celebrated Bank of Amsterdam (1609) was dissolved in 1796 and the Bank of the Netherlands was established in 1814. The city suffered considerably during World War I from the loss of a great part of the former extensive financial business. The position continued bad until shipping on the Rhine increased after the German mark had been stabilized and conditions in the Ruhr had improved.

Buildings of the Schiphol aerodrome, one of the most important in Europe before World War II and the principal station for the K.L.M. air lines to the East Indies and all parts of Europe, were demolished by bombing attacks and by German parachute troops during the invasion of May 10-14, 1940.

See P. Scheltema, *Inventaris van het Amsterdamsche archief*, 3 vol. (1866-74); H. Brugmans and A. Loosjes, *Amsterdam in beeld* (1925). **AMSTERDAM**, the only city of Montgomery county, N.Y., U.S., on the north and south shores of the Mohawk river, about 31 mi. N.W. of Albany.

It is on the New York Central railroad, the state barge canal and the direct highway between New York and Buffalo; and is served also by the Fonda, Johnstown and Gloversville buses and (through south Amsterdam) by the West Shore railroad. Hills on both sides of the river command fine views of the Mohawk valley. The city has an area of 6.05 sq.mi. The population was 32,269 in 1950 by the federal census; 33,329 in 1940; and 33,524 in 1920.

Amsterdam manufactures rugs, carpets, brooms, pearl buttons, fabric gloves, underwear, sport jackets, ladies' dresses, leather gloves, boxboard, box machinery, paper boxes, looms, men's shirts, mattresses, trousers, piece goods (silk and rayon), baseballs, footballs and basketballs. Outbound freight amounts to more than 300,000 tons annually, and it is estimated that more than twice as much comes in. There is a breeding farm for race horses on the outskirts of the city.

Three miles away, on a trolley line, is Fort Johnson, built

by Sir William Johnson, the well-known American pioneer (see JOHNSON, SIR WILLIAM).

Amsterdam was settled about 1775 and was called Veedersburg until 1804, when its present name was adopted. It was incorporated as a village in 1830 and chartered as a city in 1885.

AMSTERDAM ISLAND, an uninhabited island in the Indian ocean, in 37° 47' S. and 77° 34' E., 60 mi. N. of St. Paul Island and approximately midway between the Cape of Good Hope and Tasmania. It is a nearly extinct volcano rising 2,760 ft. from the sea. Exposed to the westerly winds and enshrouded in mists, the island possesses a vegetation of mosses and lichens and is the haunt of innumerable sea birds. Fishing (cod and seal) is profitably carried on by fishermen from Réunion. It was discovered by Anthony van Diemen in 1633 and annexed by France in 1893.

In 1871, the British frigate "Megaera" was wrecked there and most of the 400 persons on board had to remain more than three months on the island.

The *Mémoires* of a Frenchman, Capt. François Péron (Paris, 1824), who was marooned three years on the island (1792-95), are of much interest.

See Schenck, *Vergleichende Darstellung der Pflanzengeographie der Subantarktischen Inseln*, 2 vol. (Jena, 1905).

AMUCK, RUNNING (or more properly АМОК), the native term for the homicidal mania which attacks Malays. A Malay will suddenly and apparently without reason rush into the street armed with a kris or other weapon, and slash and cut at everybody he meets till he is killed. These frenzies were formerly regarded as due to sudden insanity. It is now, however, certain that the typical *amok* is the result of circumstances, such as domestic jealousy or gambling losses, which render a Malay desperate and weary of his life. It is, in fact, the Malay equivalent of suicide.

Medically, the word implies a psychic state associated with periods of depression and a sort of homicidal mania. The word is widely used in a figurative sense.

Though so intimately associated with the Malay there is some ground for believing the word to have an Indian origin, and the act is certainly far from unknown in Indian history. Some notable cases have occurred among the Rajputs. Thus, in 1634, the eldest son of the raja of Jodhpur ran amuck at the court of Shah Jahan, failing in his attack on the emperor, but killing five of his officials.

During the 18th century, again, at Hyderabad (Sind) two envoys, sent by the Jodhpur chief in regard to a quarrel between the two states, stabbed the prince and 26 of his suite before they themselves fell.

In Malabar there were certain professional assassins known to old travellers as *Amouchi* or *Amuco*. The nearest modern equivalent to these words would seem to be the Malayalam *amarkhan*, "a warrior" (from *amar*, "fight"). The Malayalam term *chaver* applied to these ruffians meant literally those "who devote themselves to death."

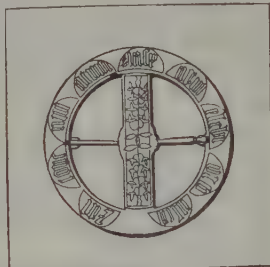
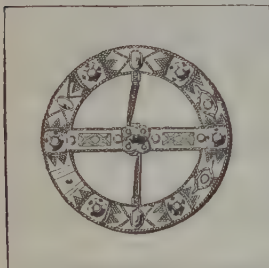
In Malabar there was a custom by which the zamorin or king of Calicut had to cut his throat in public when he had reigned 12 years. In the 17th century a variation in his fate was made. He had to take his seat, after a great feast lasting 12 days, at a national assembly, surrounded by his armed suite, and it was lawful for anyone to attack him, and if he succeeded in killing him the murderer himself became zamorin. In 1600, 30 would-be assassins were killed in their attempts.

These men are called *amar-khan*, and it has been suggested that their action was "running amuck" in the true Malay sense. Another proposed derivation for *amouchi* is Sanskrit *amokshya*, "that cannot be loosed," suggesting that the murderer was bound by a vow, an explanation more than once advanced for the Malay *amuck*; and *amokshya* in such a sense is unknown in Malayalam.

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AMUL or **AMOL**, a town of Iran, in the province of Mazanderan, 23 mi. S.W. of Barfurush (renamed Barbul). Pop. about 22,000. It is on both banks of the Heraz river, and is an important town between the Elburz mountains of the south and the low shoreland of the Caspian sea. Around the present site are ruins that tell of Amul's former greatness. They include the mausoleum of King Seyed Kavvam Ud-Din (d. 1379) and several other 14th-century mausolea. Rice and fruits are the chief products.

AMULET, a charm, generally, but not invariably, hung from the neck, to protect the wearer against witchcraft, sickness, acci-



BY COURTESY OF THE BRITISH MUSEUM

FRONT AND BACK VIEW OF THE 15TH-CENTURY GLENLYON BROOCH OF Scottish workmanship, this amulet formerly belonged to the Campbells of Glenlyon. It is about 5½ in. in diameter, of heavy silver-gilt, set in front with pearls which stand about an inch above the flat surface, alternating with crystals and amethysts. The back is inscribed with the names Caspar, Melchior and Balthazar, followed by "Consumatum" ("it is finished") the last words of Christ on the cross

dents, etc. (Late Lat. *amuletum*, origin unknown). Amulets have been of many different kinds, and formed of different substances—stones, metals and strips of parchment being the most common, with or without characters or legends engraved or written on them. Gems have often been employed and greatly prized, serving for ornaments as well as for charms. Certain herbs, too, and animal preparations have been used in the same way. In setting them apart to their use as amulets, great precautions have been taken that fitting times be selected, stellar and other magic influences propitious, and everything avoided that might be supposed to destroy or weaken the force of the charm. The belief in the prevalence of occult evil influences engenders trust in amulets and similar preservatives against them. There are references to, and apparently correctives of, these customs in the Mosaic injunctions to bind portions of the law upon the hand and as frontlets between the eyes, as well as write them upon the door-posts and the gates.

Amulets were much used by the ancient Egyptians, among the Greeks and Romans, and in the early Christian Church; hence the emphatic protests of Chrysostom, Augustine and others against them. *Talisman*, from the Arabic, is a word of similar use; but while talismans bring good luck or transmit qualities, amulets are preventive. A talisman, whose "virtues are still applied to for stopping blood and in cases of canine madness," gives name to one of Sir Walter Scott's novels.

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AMUN: see **AMON**.

AMUNDSEN, ROALD (1872–1928), Norwegian explorer, was born July 16 1872, in Borge, a country district near Sarpborg in south-eastern Norway. Educated at Christiania (now Oslo) he took his B.A. degree in 1890 and began to study medicine, but gave it up and went to sea in 1894. During the following nine years, Amundsen, with the tenacity of purpose which was one of his chief characteristics, prepared himself for his

future career as an explorer, and in 1903–06 he led an expedition consisting of himself and six companions through the North-west Passage, on board the "Gjøa," a little sloop of 47 tons, and succeeded in fixing the position of the magnetic North Pole.

His next expedition, on board the "Fram," originally intended as a North Polar expedition, by a dramatic surprise, became a South Polar expedition (1910–12), and was the first actually to reach the South Pole. After his return in 1913 he resumed his preparations for a North Polar expedition but was stopped by the outbreak of the World War. He remained inactive until 1918 when he left Norway on board the "Maud," a new vessel, with the aim of drifting from the North Siberian Islands across the Pole. Baffled in this undertaking owing to the fact that the Polar stream did not prove to be constant, he decided to force the Polar basin in an aeroplane.

On his fourth attempt he succeeded, using the semi-rigid dirigible "Norge," built in Italy. Starting with the American Ellsworth, from Spitsbergen, May 11 1926, he flew to the Pole, which he circled twice, thence across the unexplored Arctic basin to Point Barrow, Alaska, and finally landed, May 14, at Teller on Bering Sea. The total distance traversed was 2,700 m., the time occupied in the flight being only 71 hours (see **ARCTIC REGIONS**). When General Nobil's airship, "Italia," returning from the North Pole was wrecked on May 24, 1928, Amundsen chivalrously volunteered to go in search of him. He left Bergen for Spitsbergen in an aeroplane on June 17, and was not heard of again. See R. Amundsen, *My Life as an Explorer* (1927); B. Partridge, *Amundsen* (1929).

AMUR, the chief river of Eastern Asia north of the Hwang-ho and about 3,000 miles in length. It traverses from west to east a series of tilted earth-blocks which present a steep face to the south-east and a gentle back-slope to the north-west. The course of the river is, therefore, alternately towards the north-east, when it flows parallel to the north-east to south-west trending ridges and towards the south-east, when it cuts across them. It is formed by the confluence of the Shilka, rising in Transbaikalia, and the Argun, rising on the back-slope of the Great Khingan, one of these earth-blocks. It receives its most important tributaries, the Sungari and the Ussuri, from the similar back-slope of the earth-block overlooking the Sea of Japan. Both tributaries enter from the south. Since the late 17th century, when the Chinese came into contact with the extending power of Russia, the Amur has had considerable political significance. The Argun head-stream was taken as part of the boundary between the two empires at the Treaty of Nerchinsk (1689), and the present boundary between Manchuria and Siberia follows the line of the Argun, Amur and Ussuri, thus forming one of the longest river frontiers in the world. The river is highest in summer, the season of rains, and then the Sungari, draining North Manchuria, has a greater volume of water than the Amur itself. In winter the river is frozen over and navigation is confined to the six months from May to October. For boats drawing four feet of water, the Amur is then navigable for over 2,000 miles up to Stretensk and the Sungari up to Kirin. But the fact that its outlet lies so far to the north deprives the Amur of much of its value and, moreover, it has as a competitor the Chinese Eastern railway which is linked with more southerly ports at Vladivostok and in Manchoukuo.

AMURATH: see **MURAD IV.**

AMUR REGION, a part of the Khabarovsk area of the R.S.F.S.R. Area 82,548 sq.mi. Population 394,000 (urban 75,588). Its boundaries are, on the south, the Amur river, on the west and northwest Chita province, on the east and northeast the Amguno river, on the north Nizhne-Amursk province. It includes the broad fertile plain which stretches from the junction of the rivers Zeya and Amur at Blagoveshchensk to the Bureya or Little Khingan mountains 250 mi. below. The river



BY COURTESY OF THE BRITISH MUSEUM

RINGS WITH MAGICAL INSCRIPTIONS

The larger is of silver engraved with astrological characters. The smaller, of gold, has the form of a serpent with its tail in its mouth. It is inscribed ASLSV—Salus

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AN AZTEC PENDANT

Made of jasper and supposed to have magical powers in stanching blood

there is broad and slow flowing; at Blagoveshchensk, 1,200 mi. from its mouth, its elevation is less than 400 ft. The climate is milder than that of the Lena basin though it has severe winters, the principal drawback being that the maximum rainfall is in July and August, too late to be of the best service to crops, though oats, wheat, buckwheat, barley and potatoes are successfully grown. The average temperature at Blagoveshchensk is 17° F. in January and 70° F. in July. Above Blagoveshchensk the river valley is narrow and there is little land available for cultivation. The mountain slopes are thickly forested and yield furs and timber, while the valley of the Zeya is noted for its gold mines. There are also deposits of iron ore, coal, antimony and fluorspar. Horses, cattle, pigs, sheep and camels are reared. The Amur, Zeya and Bureya rivers furnish boat communication in summer and sledge in winter, but the province has developed markedly since the construction of the trans-Siberian railway through it, with its branch to Blagoveshchensk, which is an important trading and culture centre.

The region was known to the Russians in the 17th century and began to be settled by them in 1847. In 1858 China ceded to Russia the whole left bank of the Amur and the right below the Ussuri confluence and in 1860 the whole territory between the Ussuri and the Eastern sea.

AMYGDALIN (Gr. *ἀμυγδαλή*, "almond"), a glycoside $C_{20}H_{27}NO_{11}$, was isolated from bitter almonds by H. E. Robiquet and A. F. Boutron-Charlard in 1830, and subsequently investigated by Justus von Liebig and Friedrich Wöhler and others. It is extracted from almond cake by boiling alcohol; on evaporation of the solution and the addition of ether, amygdalin is precipitated as white minute crystals. It has been found to be a glycoside of formula $C_{20}H_{27}NO_{11}$, being a compound of the disaccharide gentiobiose, benzaldehyde and hydrocyanic (prussic) acid. It is decomposed by dilute sulphuric acid into benzaldehyde, *d*-glucose and hydrocyanic acid; and by concentrated hydrochloric acid into mandelic acid, *d*-glucose and ammonia. The enzyme maltase partially decomposes it, giving *d*-glucose and mandelic nitrile glucoside, $C_6H_5CH(CN)O.C_6H_{11}O_5$. Emulsin, on the other hand, decomposes it into benzaldehyde, prussic acid and two molecules of glucose; this enzyme occurs in the bitter almond, and consequently the seeds invariably contain free prussic acid and benzaldehyde. The glucose obtained in the foregoing reactions is formed by hydrolysis of the gentiobiose. (See GLUCOSIDES, NATURAL.)

AMYL ACETATE, the collective term applied to the acetic acid esters of any amyl alcohol or mixture of amyl alcohols. All of the amyl acetates are colourless, neutral, mobile liquids having pleasant fruitlike odours, hence the use of certain amyl acetates as essences in perfumery and cosmetics. Of the eight possible isomeric amyl acetates (empirical chemical formula $CH_3CO_2C_5H_{11}$), six are produced in commercial quantities.

The composition of commercial amyl acetate depends primarily upon the source of the amyl alcohols used in its manufacture. The principal sources of amyl alcohol are fusel oil (a by-product of alcoholic fermentation) and pentane hydrocarbons (see below).

Isoamyl alcohol constitutes 85% of the amyl alcohols present in fusel oil. The remainder is active amyl alcohol (2-methyl-butanol-1) with a trace of *n*-amyl alcohol. Consequently, amyl acetate prepared from these amyl alcohols is primarily isoamyl acetate. This is the amyl acetate used in perfumery and as a flavouring compound. Because of its excellent solvent properties (particularly for nitrocellulose), isoamyl acetate was principally used until 1943 as a solvent in the manufacture of high-grade lacquers, enamels, synthetic leather and celluloid products. Amyl acetate was formerly used in the manufacture of penicillin, but was replaced by *n*-butyl acetate.

After 1925 synthetic amyl alcohols were manufactured by the hydrolysis of chloropentanes, which in turn are derived from pentane hydrocarbons obtained from petroleum. This process produces five of the eight possible isomeric amyl alcohols in the following proportions: sec-butyl carbinol, 32%; *n*-amyl alcohol, 26%; pentanol-3, 18%; isoamyl alcohol, 16%; pentanol-2, 8%. Synthetic amyl acetates are prepared by (1) the action of acetic acid on these alcohols; (2) by the action of sodium acetate on the mixture of chloropentanes; or (3) by the action of acetic acid on amylene gases in the presence of sulphuric acid. Considerable amounts of *n*-amyl and isoamyl alcohols are also produced as by-products of the Fischer-Tropsch process (see ALCOHOL).

The amyl acetates are powerful solvents, and with the exception of the small amounts used by the perfume and pharmaceutical industries, their commercial importance depends upon this quality. Production of amyl acetates in the U.S. declined rapidly after the peak years of 1944 and 1945, from 15,589,000 lb. in the latter year to 3,865,000 lb. in 1950. Amyl acetate is also known as banana oil. (D. G. Z.; N. C. S.)

AMYL ALCOHOLS. There are eight of these alcohols theoretically possible. All are known, and the most important is isobutyl carbinol (or isoamyl alcohol), the chief constituent of fermentation amyl alcohol and consequently present in fusel oil

(*g.v.*). It can be extracted from fusel oil by shaking this with strong brine, discarding the brine layer and collecting the portion boiling between 125° and 140° C. By shaking this product with hot aqueous calcium hydroxide, separating the oily layer, drying it with calcium chloride and collecting the fraction boiling between 128° and 132° C., a further degree of purification may be effected. A mixture of amyl alcohols that is used as a solvent for pyroxylin lacquers is manufactured by the chlorination of pentanes from petroleum and subsequent hydrolysis of the resulting amyl chlorides.

Isoamyl alcohol is a colourless liquid of specific gravity 0.8248 (0° C.), boiling at 131.6° C., slightly soluble in water, easily soluble in alcohol, ether, chloroform and benzene. It possesses a characteristic strong smell and a sharp burning taste. It is oxidized by chromic acid mixture to isovalerylaldehyde, $(CH_3)_2CH.CH_2.CHO$, and then to isovaleric acid, $(CH_3)_2CH.CH_2.CO_2H$.

The eight amyl alcohols all have the general formula $C_5H_{11}OH$, the differences being caused by the different ways in which the carbon atoms are linked together and by the hydrogen and oxygen atoms. In normal amyl alcohol, there is a "straight chain" primary alcohol, $CH_3.CH_2.CH_2.CH_2.CH_2OH$, which can be regarded as derived from the hydrocarbon *n*-pentane (normal pentane) by replacement of one end hydrogen atom with the alcoholic (hydroxyl) group. Methyl-*n*-propyl carbinol,



and di-ethyl carbinol, $C_2H_5.CHOH.C_2H_5$, are two secondary amyl alcohols, also derivable from *n*-pentane. From the hydrocarbon $(CH_3)_2CH.CH_2.CH_3$ can be derived isobutyl carbinol or isoamyl alcohol, $(CH_3)_2CH.CH_2.CH_2OH$, methyl isopropyl carbinol, $(CH_3)_2CH.CHOH.CH_3$, dimethyl ethyl carbinol, $(CH_3)_2COH.C_2H_5$, and active amyl alcohol, $CH_3.C(CH_2OH)H.CH_2.CH_3$. And from the hydrocarbon $(CH_3)_4C$ can be derived tertiary butyl carbinol, $(CH_3)_3C.CH_2OH$. Three of these contain "asymmetric carbon atoms" (marked *) and can, therefore, exist each in two optically active forms and one optically inactive form (see STEREOCHEMISTRY); the amyl alcohols include four primary alcohols (containing the group $.CH_2OH$), three secondary alcohols (containing the group $:CHOH$) and one tertiary alcohol (containing the group $:COH$).

All the amyl alcohols can be obtained synthetically, isoamyl alcohol by the action of paraformaldehyde on isobutyl magnesium bromide, an example of Grignard's reaction. The synthesis of tertiary butyl carbinol proved the most difficult and was finally achieved in 1891 by L. Tissier, who reduced a mixture of trimethylacetic acid and trimethylacetyl chloride with sodium amalgam. It is a solid which melts at 48°–50° C. and boils at 112–113° C.

AMYL NITRITE (isoamyl nitrite), a liquid which finds application in medicine, since it dilates the blood vessels and gives quick relief from attacks of angina pectoris. It is used also to some extent in the preparation of diazonium and isonitroso compounds. It is prepared by passing nitrous fumes (from starch and concentrated nitric acid) into warm isoamyl alcohol; or by distilling a mixture of 26 parts of potassium nitrite in 15 parts of water with 30 parts of isoamyl alcohol in 30 parts of sulphuric acid. It is a yellow-coloured liquid of specific gravity 0.877, boiling at about 95°–96° C., of characteristic penetrating odour and having the composition $C_5H_{11}ONO$. It is insoluble in water, but dissolves readily in alcohol, ether, glacial acetic acid, chloroform or benzene. It is easily reduced by metal-acid combinations, with the formation of ammonia and isoamyl alcohol; and on hydrolysis with potassium hydroxide it forms potassium nitrite and isoamyl alcohol. When the liquid is dropped on fused potassium hydroxide, it forms potassium valerate. (F. L. A.)

AMYMONE, in ancient Greek legend, daughter of Danaüs. With her sisters, she had been sent to look for water, the district of Argos being then parched through the anger of Poseidon. Amymone, having thrown her spear at a stag, missed it, but hit a satyr asleep in the brake. The satyr pursued her, and she called for help from Poseidon, who appeared and for love of her beauty caused a spring to well up, which received her name.

Aeschylus wrote a satyric drama on the subject. By the god Amymone became the mother of Nauplius, the wrecker. Her meeting with Poseidon at the spring is frequently represented on ancient coins and gems.

See Apollodorus ii, 1, 4; Hyginus, *Fab.* 169; Propertius ii, 26.
AMYNTAS I, king of Macedonia (c. 540–498 B.C.), was a tributary vassal of Darius Hystaspes and the first Macedonian ruler to have dealings with other countries. He made an alliance with the Peisistratidae; and when Hippias was driven out of Athens, he offered him the territory of Anthemus on the Thermoic gulf, hoping to turn the Greek party feuds to his own advantage (Herodotus v, 17, 94; Justin vii, 2; Thucydides ii, 100; Pausanias ix, 40).

AMYNTAS II or **III**, king of Macedonia from 393 (or 389) to 369 B.C. He came to the throne after the ten years of confusion which followed the death of Archelaus and showed the same taste for Greek culture and its representatives. In 383 B.C. he was driven out by the Illyrians, but in the following year, with the aid of the Thessalians, he recovered his kingdom. He concluded a treaty with the Spartans, who helped him to reduce Olynthus (379 B.C.). He also entered into a league with Jason of Pherae, and cultivated the friendship of Athens. The youngest of his three sons was the famous Philip of Macedon.

See Diodorus xiv, 89, xv, 19, 60; Xenophon, *Hellenica*, v, 2; Justin vii, 4.

AMYOT, JACQUES (1513–1593), French writer, was born of poor parents at Melun on Oct. 30, 1513. He was educated at the University of Paris and then at Bourges, where he was made professor of Greek and Latin through the influence of Margaret of Valois. There he translated *Théagène et Chariclée* from Heliodorus (1547 f.), for which he was rewarded by Francis I with the abbey of Bellozane. He was thus enabled to go to Italy to study the Vatican text of Plutarch, on the translation of whose *Lives* (1559; 1565) he had been engaged for some time. On the way he turned aside on a mission to the Council of Trent. Returning home, he was appointed tutor to the sons of Henry II, by one of whom (Charles IX) he was afterward made grand almoner (1561) and by the other (Henry III) was appointed, in spite of his plebeian origin, commander of the order of the Holy Ghost. Pius I promoted him to the bishopric of Auxerre, and there he continued to live in comparative quiet, repairing his cathedral and perfecting his translations, for the rest of his days, though troubled toward the close by the insubordination and revolts of his clergy. He died on Feb. 6, 1593, bequeathing, it is said, 1,200 crowns to the hospital at Orléans for the 12 "deniers" he received there when "poor and naked" on his way to Paris. He translated seven books of Diodorus (1554), the *Daphnis et Chloe* of Longus (1559) and the *Opera Moralia* of Plutarch (1572). His lively and idiomatic version of Plutarch, *Vies des hommes illustres*, was translated into English by Sir Thomas North, and supplied William Shakespeare with materials for his Roman plays. The translation of Plutarch was his magnum opus. His other translations were subsidiary. The version of Diodorus he did not publish, although the manuscript had been discovered by himself. Amyot took great pains to find and interpret correctly the best authorities, but the interest of his books lies in the simplicity and purity of language which won the praise of Michel de Montaigne. His translation reads like an original work. The personal method of Plutarch appealed to a generation addicted to memoirs. Amyot's book, therefore, obtained an immense popularity and exercised great influence over successive generations of French writers.

There is a good edition of the works of Amyot from the firm of Didot (25 vol., 1818–21). See also Auguste de Blignyères, *Essai sur Amyot et les traducteurs français au xvii^e siècle* (1851).

AMYRAUT, MOISE (1596–1664), also known as *Amyraut*, French Protestant theologian and metaphysician, studied at Orléans, Poitiers and then at Saumur under the famous Scottish Protestant teacher John Cameron. He was made pastor of Saumur and professor of theology there. Amyraut and his colleagues, Louis Cappel and Josué de la Place, also Cameron's pupils, collaborated in the *Theses Salmurienses*, and in 1631 published his *Traité des religions*.

Amyraut was chosen by the national synod of 1631 to present to the king the complaint of the French Protestants against the revocation of the Edict of Nantes. His oration on that occasion is famous in the history of French Protestantism. Later he conferred with Cardinal Richelieu, but without success, on the possi-

bilities of reconciliation.

Amyraut held fast to Calvinism, but in his *Traité de la prédestination* he tried to mitigate its harsher features by his "universalism hypohtheticus"—that God predestines all men to happiness on condition of their having faith. For this doctrine he was thrice accused of heresy before the synod, but without success. His most important metaphysical work was *De l'élevation de la foi et de l'abaissement de la raison en la créance des mystères de la religion* (1641). But perhaps he is better remembered by his simpler works of devotion, which have remained fireside favourites of the French Protestant peasantry.

Moise Amyraut died Jan. 18, 1664.

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ANA, a town on the Euphrates, Iraq, in 34° 30' N. and 42° E., 192 mi. below Deir, and 119 above Hit. It has retained its name at least since the beginning of the 2nd millennium B.C., but the actual site seems to have changed slightly. The earlier writers describe it as being on an island, and even as late as the 16th century A.D. at least a part of the town was so situated. At that time, however, the greater part of the town already lay on the right bank of the Euphrates, to which it is confined today. The town is important as the end of the desert journey from Tadmor in the west, as a station controlling the Euphrates waterway and as a point of contact and trade with the desert to the southwest. In the early 17th century A.D. at one of its most flourishing periods, the emir of Ana seems to have controlled the desert as far west as Tadmor; it was then the most flourishing Arab town on the Euphrates but later it fell into decay, suffering inroads from the desert. It was formerly known for its wine, and, later on, for its palm groves; it is a region of great fertility.

The population of Ana is 15,000 (a rather uncertain estimate), most of whom are Sunni Arabs. It is a centre of considerable trade along the valley road, and for trade with the Bedouins. It is also an agricultural oasis, growing mainly cereals, fruit and dates, the latter of which are traded; and its exports also include butter and wool.

The modern motor route and aeroplane track to Damascus runs south of the old caravan route and leaves the Euphrates at Ramadi.

ANA, a Latin neuter plural termination appropriated to various collections of the observations and criticisms of eminent men, delivered in conversation and recorded by their friends, or discovered among their papers after their decease. Though the term ana is of comparatively modern origin, the introduction of this species of composition is not of recent date. It appears, from Barthelemy d'Herbelot's *Bibliothèque Orientale*, that from the earliest periods the eastern nations were in the habit of preserving the maxims of their sages. From them the practice passed to the Greeks and Romans. Plato and Xenophon treasured and recorded the sayings of their master Socrates; and Arrian, in the concluding books of his *Enchiridion*, now lost, collected the casual observations of Epictetus. The numerous apophthegms scattered in Plutarch, Diogenes Laertius and other writers show that it was customary in Greece to preserve the colloquially expressed ideas of illustrious men. It appears that Julius Caesar compiled a book of apophthegms, in which he related the *bons mots* of Cicero.

But though vestiges of ana may be traced in the classical ages, it is only in modern times that they have come to be regarded as constituting a distinct species of composition, comprising literary anecdotes, critical reflections and historical incidents, mingled with the detail of *bons mots* and ludicrous tales. The term ana seems to have been applied to such collections as far back as the beginning of the 15th century. Francesco Barbaro, in a letter to Poggio, says that the information and anecdotes which Poggio and Bartolommeo of Montepulciano had picked up during a literary excursion through Germany would be called *Ana*.

Poggio (q.v.) Bracciolini is the first eminent person of modern times whose jests and opinions have been transmitted to pos-

terity. During the pontificate of Martin V., Poggio and other members of the Roman chancery were in the habit of assembling in a common hall adjoining the Vatican, in order to converse freely on all subjects. The jests and stories which occurred in these unrestrained conversations were collected by Poggio and formed the chief materials of his *Facetiae*. This collection, which forms a principal part of the *Poggiana* printed at Amsterdam in 1720, is chiefly valuable as recording interesting anecdotes of eminent men of the 14th and 15th centuries. It also contains a number of quibbles or *jeux de mots*, and a still greater number of *facetiae*, idle and licentious stories.

Though Poggio was the first person whose remarks and *bons mots* were collected under the name of Ana, the *Scaligerana*, which contains the opinions of Joseph Scaliger, was the first work published under that appellation. There are two collections of Scaligerana—the *Prima* and *Secunda*. The first was compiled by a physician named François Vertunien, sieur de Lavau, who attended a family with whom Joseph Scaliger resided. It was published in 1669, under the title of *Prima Scaligerana, nusquam antehac edita*. The second work, known as *Secunda Scaligerana*, was collected by two brothers of the name of Vassan, students of the University of Leyden, of which Scaliger was one of the professors. Being particularly recommended to Scaliger, they were received in his house and enjoyed his conversation.

In imitation of the *Scaligerana*, a prodigious number of similar works appeared in France towards the end of the 17th and beginning of the 18th century. At first these collections were confined to what had fallen from eminent men in conversation; but they were afterwards made to embrace fragments found among their papers, and even passages extracted from their works and correspondence. Of those which merely record the conversations of eminent men, the best known and most valuable is the *Ménagiana*. Gilles Ménage was a person of good sense, of various and extensive information and of a most communicative disposition. A collection of his oral opinions was published in 1693, soon after his death.

The *Perroniana*, which exhibits the opinions of Cardinal du Perron, was compiled from his conversation by C. Dupuy, and published by Vossius in 1666. The *Thuana*, or observations of the president de Thou, have usually been published along with the *Perroniana*, but first appeared in 1669.

The *Valesiana* is a collection of the literary opinions of the historiographer Adrien de Valois, published by his son.

The *Fureteriana* (1666) contains the *bons mots* of Antoine Furetière, the Academician, the stories which he was in the habit of telling, and a number of anecdotes and remarks found in his papers after his decease.

The *Chevreana* (1697), so called from Urbain Chevreau, is more scholarly than most works of a similar description and probably more accurate, as it differs from the Ana proper, of which the works described above are instances, in having been published during the life of the author and revised by himself.

Parrhasiana (1699–1701) is the work of Jean le Clerc, a professor of Amsterdam, who bestowed this appellation on his miscellaneous productions with the view of discussing various topics of philosophy and politics with more freedom than he could have employed under his own name.

The *Huetiana* contains the detached thoughts and criticisms of P. D. Huet (1630–1722), bishop of Avranches, which he himself committed to writing when he was far advanced in life.

The *Casauboniana* presents us with the miscellaneous observations, chiefly philological, of the celebrated Isaac Casaubon.

Besides the above a great many works under the title of Ana appeared in France about the same period. Thus, the opinions and conversations of Charpentier, Colomesius and St. Evremont were recorded in the *Carpenteriana*, *Colomesiana* and *St. Evremontiana*; and those of Segrais in the *Segraisiana*—a collection formed by a person stationed behind the tapestry in a house where Segrais was accustomed to visit, of which Voltaire declared, “que de tous les Ana c’est celui qui mérite le plus d’être mis au rang des mensonges imprimés, et surtout des mensonges insipides.” The Ana, indeed, from the popularity which they now

enjoyed, were compiled in such numbers and with so little care that they became almost proverbial for inaccuracy.

Of the examples England has produced of this species of composition, perhaps the most interesting is the *Walpoliana*, a transcript of the literary conversation of Horace Walpole, earl of Orford. Most other works which in England have been published under the name of Ana, as *Baconiana*, *Atterburyana*, etc., are rather extracts from the writings and correspondence of eminent men than memorials of their conversation.

Of the productions which belong to the class, though they do not bear the name of Ana, the most celebrated are the *Colloquia Mensalia* of Luther and Selden’s *Table-Talk*. The former, which comprehends the conversation of Luther with his friends and coadjutors in the great work of the Reformation, was first published in 1566. The *Table-Talk* of Selden contains a more genuine and undisguised expression of the sentiments of that eminent man than we find in his more studied productions. It was published after his death by Richard Milward, his amanuensis, who affirms that for 20 years he enjoyed the opportunity of daily hearing his discourse, and made it his practice faithfully to commit to writing “the excellent things that usually fell from him.”

The most remarkable collection of Ana in the English language—and, indeed, in any language—is to be found in a work which does not correspond to the normal type either in the name or in form. In his *Life of Samuel Johnson, LL.D.*, Boswell relates that to his remark, *à propos* of French literature. “Their Ana are good,” Johnson replied, “A few of them are good; but we have one book of that kind better than any of them—Selden’s *Table-Talk*.” Boswell’s own work, however, is incomparably superior to all. Mrs. Thrale (who called her note-book “Thraliana”) gave the world a volume in the orthodox Ana style in her *Anecdotes of the late Samuel Johnson, LL.D.* A good modern collection of Ana is Mountstuart Grant Duff’s *Notes from a Diary* (1897–1905).

J. C. Wolf has given a history of the Ana in a preliminary discourse to his edition of the *Casauboniana*, published in 1710. In the *Répertoire de bibliographies spéciales, curieuses, et instructives*, by Peignot, there is a *Notice bibliographique* of these collections; but many of the books there enumerated consist of mere extracts from the writings of popular authors.

ANABAPTISTS, a name given by their enemies to various sects which denied the validity of infant baptism and for other reasons became prominent in Germany and elsewhere during the period of the Reformation. (Gr. ἀναβαπτίζω, rebaptize.) So used, the word is too well known to be discarded, though it describes these sects by one of the least important of their distinctive doctrines and practices. The Anabaptists of Germany are historically noteworthy, not because they insisted on rebaptism as a condition of admission to their community, but because the enthusiasm of the Reformation manifested itself in them in a form and manner altogether peculiar. Their views as to the true function of the church and its relation to the State, and the efforts which they made to realize these views, furnish a problem, partly theological, partly historical, of which a satisfactory solution is not easy. To one who looks merely at the extravagance and lawlessness which appear on the surface, fanaticism and madness, credulity and imposture may provide a sufficient explanation of the whole Anabaptist movement, but a deeper insight will find elements in it which are quite inconsistent with such a supposition.

Anabaptism, as a system, may be described as the Reformation doctrine carried to its extreme limit; the Anabaptists were the extreme left in the army of the Reformers. The hostility of the orthodox Reformers to them cannot conceal the fact that the most peculiar doctrines of the Anabaptists were to them only corollaries—illegitimately drawn, as the orthodox Reformers believed—from the fundamental principle common to both: the independence of the individual judgment, and the supreme importance of the subjective element, personal faith, in religion. The connection of this principle with their theory of the church and its relation to the State, their doctrine of the sacraments, and even their political risings, is evident.

The history of the Anabaptist movement in its outward development is brief but eventful. In 1521 their first rising took

place at Zwickau, under the leadership of Thomas Münzer, Lutheran pastor of that place. Compelled to leave Zwickau, Münzer visited Bohemia, resided two years at Allstedt in Thuringia, and in 1524 spent some time in Switzerland. During this period he proclaimed his revolutionary doctrines in religion and politics with growing vehemence, and, so far as the lower orders were concerned, with growing success. The crisis came in the so-called Peasants' War in south Germany in 1525. In its origin a revolt against feudal oppression, it became, under the leadership of Münzer, a war against all constituted authorities, and an attempt to establish by force his ideal Christian commonwealth, with absolute equality and the community of goods. The total defeat of the insurgents at Frankenhausen (May 15, 1525), followed as it was by the execution of Münzer and several other leaders, proved only a temporary check to the Anabaptist movement. Here and there throughout Germany, Switzerland and the Netherlands there were zealous propagandists, through whose teaching many were prepared to follow as soon as another leader should arise. A second and more determined attempt to establish a theocracy was made at Münster, in Westphalia (1532-35). Here the sect had gained considerable influence, through the adhesion of Rothmann, the Lutheran pastor, and several prominent citizens; and the leaders, Johann Matthyszoon or Matthiesen, a baker of Haarlem, and Johann Bockholdt, a tailor of Leyden, had little difficulty in obtaining possession of the town and deposing the magistrates. Vigorous preparations were at once made, not only to hold what had been gained, but to proceed from Münster, as a centre to the conquest of the world. The town being besieged by Francis of Waldeck, its expelled bishop (April 1534), Matthiesen, who was first in command, made a sally with only 30 followers, under the fanatical idea that he was a second Gideon, and was cut off with his entire band. Bockholdt, better known in history as John of Leyden, was now supreme. Giving himself out as the successor of David, he claimed royal honours and absolute power in the new "Zion." He justified the most arbitrary and extravagant measures by the authority of visions from heaven, as others have done in similar circumstances. With this pretended sanction he legalized polygamy, and himself took four wives, one of whom he beheaded with his own hand in the market-place in a fit of frenzy. As a natural consequence of such licence, Münster was for 12 months a scene of unbridled profligacy. After an obstinate resistance the town was taken by the besiegers on June 24, 1535, and in January 1536, Bockholdt and some of his more prominent followers, after being cruelly tortured, were executed in the market-place. The outbreak at Münster was the crisis of the Anabaptist movement. It never again had the opportunity of assuming political importance, the civil powers naturally adopting the most stringent measures to suppress an agitation whose avowed object was to suppress them. It is difficult to trace the subsequent history of the sect as a religious body. The fact that after the Münster insurrection the very name Anabaptist was proscribed in Europe, is a source of twofold confusion. The enforced adoption of new names makes it easy to lose the historical identity of many who really belonged to the Münster Anabaptists; but, on the other hand, has led to the classification of many with the Münster sect who had no connection with it. The latter mistake, it is to be noted, has been much more common than the former. The Mennonites, for example, have been identified with the earlier Anabaptists on the ground that they included among their number many of the fanatics of Münster. But the continuity of a sect is to be traced in its principles, and not in its adherents, and it must be remembered that Menno and his followers expressly repudiated the distinctive doctrines of the Münster Anabaptists. They have never aimed at any social or political revolution, and have been as remarkable for sobriety of conduct as the Münster sect was for its fanaticism (see MENNONITES). In English history frequent reference is made to the Anabaptists during the 16th and 17th centuries, but there is no evidence that any considerable number of native Englishmen ever adopted the principles of the Münster sect. Many of the followers of Münzer and Bockholdt seem to have fled from persecution in

Germany and the Netherlands to be subjected to a persecution scarcely less severe in England. The excesses of John of Leyden, the Brigham Young of that age, cast an unjust stigma on the Baptists, of whom the vast majority were good, quiet people who merely carried out in practice the early Christian ideals of which their persecutors prated. Broadly speaking, the various branches of the Anabaptist movement held the following doctrines in common. (1) They taught that Jesus did not take the flesh from his mother, but either brought his body from heaven or had one made for him by the Word. The Anabaptists were accused of denying the incarnation of Christ: they did, but not in the sense that he was not divine; they rather denied him to be human. (2) They condemned oaths, and also the reference of disputes between believers to law-courts. (3) The believer must not bear arms or offer forcible resistance to wrongdoers, nor wield the sword. No Christian has the *ius gladii*. (4) Civil government belongs to the world, is Caesar. The believer who belongs to God's kingdom must not fill any office, nor hold any rank under government, which is to be passively obeyed. (5) Sinners or unfaithful ones are to be excommunicated and excluded from the sacraments and from intercourse with believers unless they repent, according to Matt. xviii. 15 *seq.*, but no force is to be used towards them. Some sects calling themselves *Spirituales*, *Pneumatici* or *Perfecti* also held that the baptized, or regenerate man, cannot sin, a very ancient tenet: though the outward man sinned, the inward man sinned not.

One of the most notable features of the early Anabaptists is that they regarded any true religious reform as involving social amelioration. The Socialism of the 16th century was necessarily Christian and Anabaptist. Lutheranism was more attractive to grand-ducal patriots and well-to-do burghers than to the poor and oppressed and disinherited. The Lutherans and Zwinglians never converted the Anabaptists. Those who yielded to stress of persecution fell back into Roman Catholicism and went to swell the tide of the Catholic reaction.

See Beard, *The Reformation in its relation to Modern Thought and Knowledge* (Hibbert lectures, 1883); Lindsay, *History of the Reformation* (1907), vol. ii.; Hastings, *Encyclopaedia of Religion and Ethics*, art. "Anabaptism" with references given there; and the general church histories of the period.

ANABASIS, the title given by Xenophon (*q.v.*) to his narrative of the expedition of Cyrus the younger against his brother, Artaxerxes of Persia, 401 B.C., and adopted by Arrian for his history of the expedition of Alexander the Great (Gr. *ἀνάβασις*, a march up country).

ANABOLISM, the biological term for the building up in an organism of more complex from simpler substances, constructive metabolism. (See BIOLOGY; PHYSIOLOGY.)

ANACHARSIS (c. 600 B.C.), a Scythian philosopher, the son of a chief of a nomadic tribe of the Euxine shores and a Greek woman. He went on an embassy to Athens about 589 B.C. and became acquainted with Solon, and it is said that he was initiated into the Eleusinian mysteries. After he had spent several years at Athens, he travelled through different countries and returned home filled with the desire of teaching his countrymen the laws and the religion of the Greeks. According to Herodotus he was killed by his brother. His simple and forcible language originated the proverbial expression "Scythian Eloquence," but his epigrams are as unauthentic as the letters which are often attributed to him.

See Herodotus iv. 76; Lucian, *Scythia*; Cicero, *Tusc. Disp.* v. 32; Diog. Laert. i. 101.

ANACHRONISM, a neglect or falsification, whether wilful or unsigned, of chronological relation (Gr. *ἀνά*, back, and *χρόνος*, time). Its commonest use is in the ante-dating of events, circumstances, or customs; *i.e.*, in the introduction, especially in works of imagination that rest on a historical basis, of details borrowed from a later age. Anachronisms may originate through ignorance of the progress of the arts and sciences and the other ascertained facts of history; artists on the stage and on canvas, in story and in song in all ages and all countries have been inclined to assimilate their *dramatis personae* to their own nationality and time.

ANACOLUTHON, a defectively constructed sentence which does not run on as a continuous whole. When a writer or speaker is full of his subject, or is carried rapidly along by the passion of the moment, such inconsequents are very apt to occur. Of Niebuhr it is told that his oral lectures consisted almost entirely of anacoluthic constructions. To this kind of licence some languages, as Greek and English, readily lend themselves; while the grammatical rigidity of others, as Latin and French, admits of it but sparingly. The following is an example: "And he charged him to tell no man; *but go show thyself*," etc. (Luke v, 14). The anacoluthon, as might be expected, is found several times in the plays of Shakespeare; e.g.,

Keep your word, Phoebe, *that you'll marry me,*
Or else, refusing me, *to wed this shepherd.*

(*As You Like It*, Act v, 4.)

ANACONDA, a city of Montana, U.S.A., 26 mi. N.W. of Butte, on federal highway 10A at an elevation of 5,288 ft.; the county seat of Deer Lodge county. The population of Anaconda in 1950 was 11,221; in 1940 it was 11,004 by the federal census. The Butte, Anaconda and Pacific (electric) railway connects the city with Butte and with the Northern Pacific, the Great Northern, the Oregon Short Line and the Chicago, Milwaukee, St. Paul and Pacific railways. It is served also by Northwest and Western Air Lines. Anaconda is a product of the Anaconda Mining company, which in 1884 erected a plant on the north side of Warm Springs valley in order to treat locally the ore from its copper mines at Butte.

This site was selected because there was no adequate water supply nearer. The first plant merely smelted the ore into matter which was sent to Swansea or to Baltimore for further reduction. In 1892 a full installation of converters was provided, and thereafter only metallic copper was shipped from the district.

In 1902 a new plant was erected 1 mi. E. of the city, increasing the capacity of the works to 17,000 tons of ore daily. The works employed 3,500 men at mid-century, and used 80,000 h.p. from the water-power plants of the Montana Power company, and 10,000 more developed in steam engines on the spot. It is the largest nonferrous reduction plant in the world.

ANACONDA (*Eunectes murinus*), an aquatic boa, inhabiting the swamps and rivers of Brazil, northeastern Peru and the Guianas in South America. It is the largest of American snakes and rivals the reticulated python as the largest snake in the world. Exaggerated tales have been told by travellers of its size and swallowing capacity, but the largest known do not exceed 30 ft. in length. There is very great dread of this snake among the natives, though authenticated cases of its having attacked man are few. The general colour of the anaconda is olive-brown, with large oval black spots arranged in two alternating rows along the back, and with smaller white-eyed spots along the sides. The belly is whitish, spotted with black. The head is elongate, flat and very distinct from the neck. The nostrils are situated between three large shields. The anaconda feeds chiefly at night upon birds and other animals, which it kills by constriction. Good sized specimens of the alligatorlike caymans are regularly killed and eaten by the anaconda. In contrast to the boa constrictor, which rarely takes to the water, the anaconda spends most of its time there, lying entirely submerged, with only a small part of its head above the surface, waiting for any suitable prey. Only seldom does it establish itself in the branches of trees like the boa. It is ovoviviparous and the young are about 36 in. long when born.

A smaller species of anaconda, *Eunectes notatus*, inhabits Paraguay and the northern part of Argentina. Other species have been described from northern South America.

ANACONDA COPPER MINING COMPANY, a United States company, incorporated in 1895 to succeed the Anaconda Mining company; it has, through the acquisition of various mining and fabricating companies in the United States and elsewhere, developed into the world's premier company in the nonferrous metal industry. Directly, or through its subsidiary and associated companies, it controls the annual production of more than 1,000,000,000 lb. of copper, 500,000,000 lb. of zinc, 150,000,000 lb. of lead, and more than 5% of the world production of silver.

In addition to almost the entire ownership of the Butte (Montana) mining district, "the richest hill on earth," it has large investments in 15 other U.S. states, as well as in Canada, Mexico and Chile. It is also a large producer of lumber, coal, gold, arsenic, sulphuric acid, superphosphate, zinc oxide and white lead, and has a large custom smelting and refining business, with plants situated at Anaconda and Great Falls, Mont.; Tooele, Utah; Miami, Ariz.; East Chicago, Ind.; and Perth Amboy, N.J. Through its ownership of The American Brass company, and its equity in Anaconda Wire and Cable company, it is the world's largest user of copper and manufacturer of copper and brass products with plants located in California, Connecticut, Illinois, Indiana, Michigan, Montana, New York, Rhode Island and Toronto, Canada.

Among the principal subsidiary and associated companies of Anaconda Copper Mining Co. are: American Brass company and subsidiaries; Andes Copper Mining company; Arizona Oil company; Butte, Anaconda and Pacific Railway company; Butte Water company; Chile Copper company and subsidiary companies; Diamond Coal and Coke company; Greene Cananea Copper company; Inspiration Consolidated Copper company; International Smelting and Refining company; Mountain City Copper company; National Tunnel & Mines company; North Lily Mining company; Santiago Mining company; Tooele Valley Railway company; and Walker Mining company. In addition to the above, it owns participations in many other mining companies and enterprises.

In 1939 the outstanding capital stock was \$433,716,900, and the total assets, \$587,932,841.

The net income was \$20,236,552 and the surplus for the year, \$7,518,600.

The principal office of the company is at Anaconda, Montana, the executive offices being in New York city. (E. O. S.)

ANACORTES, a city and a port of entry in Skagit county, Wash., U.S.A., occupying the upper end of Fidalgo island, about 80 mi. N. of Seattle. It is connected with the mainland by the Great Northern railway and the San Juan extension of the Pacific highway; with Vancouver island and Victoria by automobile ferries running through the San Juan archipelago. It is a fine harbour and a port for deep water, coastwise and sound shipping. The population in 1950 was 6,916; in 1940 it was 5,875.

Anacortes has important fishing industries: salmon and tuna fish canneries, deep-sea codfish packing plants, and a fish fertilizer plant. It has large lumber mills, a plywood plant, a pulp mill, shingle mills and box factories. It is a distributing point for British Columbia logs of fir, cedar, spruce and hemlock. Strawberries for cold storage, green peas for canning, field and garden seeds of most varieties and the bulk of the cabbage seed raised in the world come from this vicinity. Deception Pass State park is four miles away, on the southwestern end of Fidalgo island. The city was incorporated in 1889.

ANACREON, Greek lyric poet, was born about 560 B.C., at Teos, an Ionian city on the coast of Asia Minor. Little is known of his life, except a few scattered notices, not in all cases certainly authentic. He may have shared the voluntary exile of the mass of his fellow-townsmen, who, when Cyrus the Great was besieging the Greek cities of Asia (545), sailed to Abdera in Thrace, where they founded a colony. Anacreon seems to have taken part in the fighting, in which, on his own admission, he did not distinguish himself, but, like Alcaeus and Horace, threw away his shield and fled. He is said to have acted as tutor to Polycrates of Samos; that he enjoyed the tyrant's confidence we learn on the authority of Herodotus (iii, 121), who represents the poet as sitting in the royal chamber when audience was given to the Persian herald. Anacreon wrote many complimentary odes upon his patron. Like his fellow-lyrist, Horace, who was one of his great admirers, and in many respects of a kindred spirit, Anacreon seems to have been made for the society of courts. On the death of Polycrates, Hipparchus, who was then in power at Athens and inherited the literary tastes of his father Peisistratus, sent a special embassy to fetch the popular poet to Athens in a galley of 50 oars. Here he became acquainted with the poet Simonides, and other members of the brilliant circle which had gathered round Hipparchus. When this

circle was broken up by the assassination of Hipparchus, Anacreon seems to have returned to his native town of Teos, where, according to a metrical epitaph ascribed to his friend Simonides, he died and was buried. According to others, before returning to Teos, he accompanied Simonides to the court of Echeocrates, a Thessalian dynast of the house of the Aleuadae. Lucian (Macrob. 26) mentions Anacreon as having completed 85 years. If an anecdote given by Pliny (*Nat. Hist.* vii. 7) is to be trusted, he was choked at last by a grape-stone, but the story has an air of mythical adaptation to the poet's habits. Anacreon was for a long time popular at Athens, where his statue was to be seen on the Acropolis, together with that of his friend Xanthippus, the father of Pericles. On several coins of Teos he is represented, holding a lyre in his hand. A marble statue found in 1835 in the Sabine district, and now in the Villa Borghese, is said to represent Anacreon.

Anacreon had a reputation as a composer of hymns, as well as of those bacchanalian and amatory lyrics which are commonly associated with his name. Two short hymns to Artemis and Dionysus, consisting of eight and 11 lines respectively, stand first amongst his few undisputed remains, as printed by recent editors; but pagan "hymns" and "Anacreontic" poetry are often not unlike. The tone of Anacreon's lyric effusions has probably led to an unjust estimate of the poet's character. The "triple worship" of the Muses, Wine, and Love, ascribed to him as his religion in an old Greek epigram (*Anthol.* iii. 25, 51), may have been as purely professional in the two last cases as in the first, and his private character on such points was probably neither much better nor worse than that of his contemporaries. Athenaeus remarks acutely that he seems at least to have been sober when he wrote; and he himself strongly repudiates, as Horace does, the brutal characteristics of intoxication as fit only for barbarians and Scythians (*Fr.* 64). Of the five books of lyrical pieces by Anacreon which Suidas and Athenaeus mention as extant in their time, we have now but the merest fragments, collected from the citations of later writers. Those graceful little poems (most of them first printed from the mss. by Henry Stephens in 1554), which long passed among the learned for the songs of Anacreon, and which are well known to many English readers in the translations of Cowley and Moore, are really of much later date, though possibly here and there genuine fragments of the poet are included. Modern critics, however, regard the entire collection as imitations belonging to different periods—the oldest probably to Alexandrian times, the most recent to the last days of paganism. They will always retain a certain popularity from their lightness and elegance, and some of them are fair copies of Anacreon's style. A strong argument against their genuineness lies in the fact that the peculiar forms of the Ionic Greek, in which Anacreon wrote, are not to be found in these reputed odes, while the fragments of his poems quoted by ancient writers are full of Ionicisms. Again, only one of the quotations from Anacreon in ancient writers is to be found in these poems, which further contain no references to contemporaries, whereas Strabo (xiv. p. 638) expressly states that Anacreon's poems included numerous allusions to Polycrates. The character of Love as a mischievous little boy is quite different from that given by Anacreon, who describes him as "striking with a mighty axe, like a smith."

The best edition of the genuine fragments of Anacreon, as well as of the Anacreontea, is by Bergk (*Poetae lyrici graeci*, 1882). He includes in an appendix a similar collection of imitations from the



AFTER A CAST IN THE METROPOLITAN MUSEUM OF ART
ANACREON

Anecdota graeca of P. Matrang (1850), which had their origin in the beginning of the middle ages and resemble the Christian anacreontics of Sophronius.

ANACREONTICS (from the name of the Greek poet Anacreon), the title given to short lyrical pieces, of an easy kind, dealing with love and wine. The English word appears to have been first used in 1656 by Abraham Cowley, who called a section of his poems "anacreontiques," because they were paraphrased out of the so-called writings of Anacreon into a familiar measure which was supposed to represent the metre of the Greek. Half a century later, when the form had been much cultivated, John Phillips (1631-1706) laid down the arbitrary rule that an anacreontic line "consists of seven syllables, without being tied to any certain law of quantity." In the 18th century, the antiquary William Oldys (1696-1761) was the author of a little piece which is the perfect type of an anacreontic: this begins:

Busy, curious, thirsty fly,
Drink with me, and drink as I;
Freely welcome to my cup,
Could'st thou sip and sip it up.
Make the most of life you may;
Life is short and wears away.

In 1800 Tom Moore published a collection of erotic anacreontics which are also typical in form; Moore speaks of the necessity of catching "the careless facility with which Anacreon appears to have trifled," as a reason why anacreontics are often tame and worthless. He dwells, moreover, on the absurdity of writing "pious anacreontics," a feat, however, which was performed by several of the Greek Christian poets, and in particular by Gregory of Nazianzus and John of Damascus. (E. G.)

ANADYOMENE, a common Greek epithet of Aphrodite (Venus), expressive of her having sprung from the foam of the sea (from the Greek *anaduomenē*, "rising"). In a famous picture by Apelles she was represented as having just emerged from the sea and in the act of wringing her tresses. This painting was executed for the temple of Asclepius at Cos, from which it was taken to Rome by Augustus in part payment of tribute, and set up in the temple of Caesar. In the time of Nero, owing to its dilapidated condition, it was replaced by a copy made by the painter Dorotheus.

ANADYR, (1) a gulf, and (2) a river, in the extreme north-east of the Kamchatka province of the Far Eastern Area of the Russian S.F.S. Republics. The gulf extends from Cape Chukchi on the north to Cape Navarin on the south, forming part of the Bering sea. The river rises in the Stanovoi mountains as the Ivashki or Ivachno, about 67° N. and 173° E., flows through the Chukchi country, at first south-west and then east, and enters the Gulf of Anadyr after a course of about 500m. The country through which it passes is thinly populated, barren and desolate. For nine months of the year the ground is covered with snow. Reindeer, upon which the inhabitants subsist, are numerous.

ANAEMIA. The circulating blood consists normally of about 45% solid material and 55% of liquid matter called plasma. The solid material is composed almost entirely of red blood cells. A reduction in the total mass of circulating red blood cells is called anaemia. The chief constituent of the red blood cell, and the material which gives it its colour, is the unusual chemical called haemoglobin. More strictly defined, anaemia is a condition in which there is a reduction either in haemoglobin concentration or in the red-blood-cell count or in both. In males the haemoglobin level varies from 14.5 g. to 16.0 g. per 100 c.c. of blood (85%-105%) and the red-cell count from 4,800,000 to 5,500,000 per cubic millimetre. In women the levels are usually lower—from 11.7 g. to 14.0 g. (75%-85%) of haemoglobin and from 4,000,000 to 4,500,000 red cells per cubic millimetre. Figures below the lower levels of normality may be considered as indicative of anaemia. Anaemia should not be considered as a disease; it is rather an indication (symptom) of some underlying disorder. Its presence calls for a thorough search for its cause. Since all anaemias have a cause, the earlier designations of "primary" and "secondary" anaemia have little value and are best discarded.

Causes.—The production centre for red-blood-cell formation is in the sequestered reaches of the marrow of the bones. It is

estimated that the marrow, if it were all put together, would have a greater volume than the largest organ of the body, the liver. The marrow "factories" require essential materials for the manufacture of haemoglobin and red cells. These materials are derived from the diet, digested by the stomach, absorbed by the intestinal tract and stored for future use by the liver. The products of the bone-marrow factories are gradually lost from the circulation by breakdown or seepage but are replaced by fresh cells. Anaemia may develop as the result of a disturbance in any one of these mechanisms. Thus, broadly speaking, anaemia is due to one of three chief causes: (1) a deficiency in the supply of materials (deficiency anaemias); (2) a disturbance in red-cell production (bone marrow); and (3) an excessive loss of the finished product, *i.e.*, the red cell from the circulation. This may be due either to haemorrhage or to increased red-blood-cell destruction.

In addition to this aetiological or causative method for classifying anaemia, one depending upon the red-cell size has considerable value. Anaemias in which the red cells are small (microcytic), normal in size (normocytic) and large (macrocytic) may be discriminated. If the red cells tend to be small and are deficient in haemoglobin, it is likely that an iron-deficiency state is present, whether caused by excessive bleeding or other mechanisms. If the red cells tend to be unusually large, there may be a lack of the liver-extract factor, etc. In each case presenting anaemia as one manifestation, an attempt should be made to work out the mechanisms responsible for the production of the anaemia; this is facilitated by study of the cell size and haemoglobin content.

Methods for Studying Anaemia.—The concentration of haemoglobin, which is the iron-containing, oxygen-carrying red pigment in the blood, is best determined by the photoelectric method, which uses the principle of the "electric eye." The paper (Tallqvist) method is grossly inaccurate. Actual counts of the red cells, white cells and other constituents of the blood are made and films of the blood prepared on glass slides or cover glasses are studied with the microscope after staining. The percentage volume of red cells (haematocrit) is useful for determining the average red-cell size. In severe or puzzling cases presenting anaemia, numerous auxiliary studies may be made. Examination of the bone marrow, which is usually made by aspirating a small amount of marrow from the sternum or breastbone, or from some other bone such as the crest of the ilium is often of great importance. Studies of the faecal matter for microscopic blood, and for the products of blood destruction, gastric analysis or study of the stomach juices, X-rays of the stomach, bowels, chest and bones, various blood chemical studies, metabolism tests, etc., are at times required. To work out the cause of a given case of anaemia is often a difficult problem taxing all the facilities of the modern diagnostic laboratory and hospital.

The Deficiency Anaemias.—In this great group of conditions, the marrow factories are fundamentally sound although disorganized through a lack of materials. The deficiency state may be brought about by a single causative factor, or the additive effects of a number of factors may be required. Thus, the diet may be inadequate with respect to blood-building substances; *i.e.*, those rich in iron such as meat, liver, eggs, milk, brown cereals, rye bread, or shellfish, or in certain proteins such as meat, liver and eggs, or in certain vitamins such as those foods rich in the B vitamins (*i.e.*, meat, liver, eggs, milk, brown cereals, rye bread, unpolished rice or unrefined flour). Or the principal disturbance may be in the stomach, where a greatly diminished quantity of hydrochloric acid or of a certain protein-splitting enzyme ("intrinsic factor") is present. If the diet is adequate, yet the stomach does not digest it, the "goodness" of the diet fails to reach the proper production centre. The same holds true for the intestines, which absorb the materials of stomach digestion. If there is chronic diarrhoea, the foodstuffs are lost to the outside world before being absorbed. In some cases, the liver is grossly damaged, and this immediately diminishes the reserve storage factor which is so important. Numerous pregnancies take a toll in that the developing foetus must get its materials for blood formation from the mother; and, like a parasite, it sometimes takes more than

the mother can safely afford to lose. Cases of anaemia resulting from a single disturbance such as an inadequate diet are less common than those caused by a combination of disturbances; thus, an inadequate diet because of poverty, bowel disturbances and numerous pregnancies are often found together. In the tropics, such multiple factors as an inadequate meat diet, chronic diarrhoea, parasites and the like are often present.

Chronic Iron-Deficiency Anaemia (Chronic Hypochromic Anaemia, Secondary Anaemia).—In babies this is called nutritional anaemia; in adolescent girls, chlorosis; in adult women, "primary" or "idiopathic hypochromic" anaemia. Various causative factors are operative: an inadequate diet with respect to iron-containing foods; numerous infectious diseases in youngsters; a lack of hydrochloric acid in the stomach in cases of chlorosis and hypochromic anaemia; multiple pregnancies; chronic diarrhoea; an unusual degree of menstrual bleeding. Women tend to develop this condition more often than men, chiefly because they lose appreciable quantities of blood with the menstrual cycle.

In this condition, red-blood-cell production in the bone marrow continues at a fairly rapid rate, but the developing red cells contain smaller quantities of iron and haemoglobin than they should, and as a result the blood haemoglobin is low and the red cells in the blood small and low in colour content. Because of a deficiency in iron in the tissues, the skin becomes sallow and wrinkled and the tongue shiny; the hair loses its lustre and becomes gray; the fingernails become flattened and brittle. This condition in adolescent girls is called chlorosis, a common condition at the turn of the 20th century. Beginning about 1910 or thereabouts relatively few cases were seen. In adults showing this type of anaemia, a careful search should be instituted for chronic blood loss, particularly from the gastrointestinal tract; this requires examination of the bowel movements. Most cases respond quickly to the administration of adequate quantities of various types of iron salts such as ferrous sulphate. Liver extract has no added effect. Vitamins are of value only if there is an associated deficiency in such materials.

Chronic Liver-Extract Deficiency (Pernicious Anaemia).—In this condition, which usually occurs in blue-eyed, fair-haired people and is far more common in Scandinavians and Irish than in Italians and Negroes, the stomach juice is usually the central feature in the development of the reduced blood formation. The diet may be good (often, however, it is reduced); but the stomach juice is lacking in an enzyme, discovered by William B. Castle, which facilitates the absorption of protein meat foods. Lacking this absorption, the marrow receives insufficient quantities of a substance which helps to make the red cells grow; and as a result a peculiar (megaloblastic) marrow develops, which produces small quantities of large red cells.

A deficiency of liver-extract substance also leads to the development of early graying of the hair, redness and smoothness of the tongue and, most important of all, to various disturbances of the spinal cord, including a form of crippling paralysis known as "combined system disease." In severe, long-standing cases, the patient becomes very pale and has a yellowish cast to the skin. Tongue and bowel disturbances are common. The red-cell count may reach extraordinarily low values of 500,000 or so, although in some cases, particularly with nerve disease, the red count may be as high as 3,500,000. The red cells are distinguished by their unusually large size (macrocytes). Until 1926 the condition was almost always fatal. Acting on the work of George H. Whipple, who had found that liver was unusually effective in certain types of dog anaemia, George Richards Minot and associates tried liver in a series of cases of pernicious anaemia and achieved dramatic cures. The dying came quickly back to life, the red counts rose rapidly from 1,000,000 to 5,000,000 per cubic millimetre. An extract of liver was soon prepared by Edwin H. Cohn of Harvard Medical school and, later, extracts for injection purposes were manufactured.

Since the cause of the deficiency (*i.e.*, the defective stomach juice) continues, it is necessary to administer liver extract indefinitely, and preferably by injection. If this is discontinued, the anaemia returns and, what is more, crippling of the nervous

system may develop and become permanent. In 1945-46, the medical world was startled by the news that a few milligrams of a chemical called folic acid when taken by mouth was as effective as liver extract in the treatment of the disease. Two years later, scientists working both in the United States and Great Britain almost simultaneously described vitamin B₁₂. In incredibly small amounts of millionths of a gram (or thousandths of a milligram) the substance was effective in inducing a beneficial response in pernicious anaemia. This was probably the most active chemical introduced into medical practice. Vitamin B₁₂, like folic acid, is a universal growth factor, being required by bacteria, hen's eggs, chickens, and various animals as well as man. Pernicious anaemia may therefore be linked up with numerous animal and bacterial diseases as a form of a more universal growth problem. The exact relationships between folic acid and vitamin B₁₂ were still obscure at mid-20th century, but B₁₂ appeared to be the long-sought-for active principle of liver extract.

Anaemias Related to Pernicious Anaemia.—A number of conditions differing in slight degree but fundamentally related to pernicious anaemia are known. These include sprue, pernicious anaemia of pregnancy, tropical macrocytic anaemia, and megaloblastic anaemia of infancy.

Sprue is a condition ordinarily seen in the tropics and is most prevalent in Puerto Rico, China and Indonesia. It is probably due to a combination of such circumstances as long-continued dietary inadequacy, particularly with respect to meat, and chronic intestinal irritation. There develops a marked impairment of intestinal absorption. Chief symptoms are a burning sensation of the tongue and severe diarrhoea, with loose, bulky stools. A varying degree of anaemia is present. Because the intestines function poorly, numerous important materials fail to be absorbed and there develops a lack of calcium, protein and of various vitamins. Treatment with all these substances must be given. Folic acid is particularly effective in this condition.

Tropical macrocytic anaemia is very closely related to sprue and responds quickly to the administration of folic acid.

Most women develop a certain degree of anaemia during pregnancy; this is usually hypochromic (iron deficient) in type. Occasionally, the anaemia is severe or pernicious and responds slowly to medications including liver extract. Transfusions are at times required. Folic acid is much more effective than liver extract or vitamin B₁₂.

Vitamin B-Deficiency Anaemias.—Deficiency of the B-complex vitamin results in a variety of conditions, such as pellagra and beri-beri. Although these conditions are seen among the impoverished and are particularly prevalent in tropical climates, they not infrequently occur with persistent and chronic alcoholism. A varying degree of anaemia is present, usually responding to the administration of the specific deficient substance concerned or to a complex of all the B vitamins.

Anaemias of Bone-Marrow Disturbance.—Since the bone marrow is the production centre for red-blood-cell formation, any severe and widespread disorder of that tissue will result in anaemia. There is usually an associated low white-cell count and a low platelet count. Many types of bone-marrow disturbances are present. These in general are due to: (1) lack of growth, (2) a disturbance in normal growth due to the presence of foreign tissue such as leukaemia or tumours, and (3) an unusual effect of the spleen.

Aplastic Anaemia.—In this condition the bone marrow stops producing cells or produces them in greatly diminished numbers. Usually, this is due to the harmful effects of such chemicals as benzol and benzol-containing drugs, arsenic and various arsenicals and X-rays, radioactive substances, gamma-rays from atomic bombs, etc. In some cases the disorder is congenital and in others arises for no known cause. The marrow, which is normally red, becomes fatty and yellow. Anaemia develops and bleeding occurs because of lack of platelets. Treatment with liver extract, iron, etc., is ineffectual. Transfusions of blood are helpful in replacing missing blood, but often these are of only temporary benefit. In occasional cases removal of the spleen is of value.

"Myelophthisic" Anaemia.—The bone marrow is destroyed by the overgrowth in that tissue of large numbers of wildly growing leukemic cells or of tumour cells or of an overgrowth of connective tissue cells. In these cases, the spleen often becomes very large. Treatment is unsatisfactory.

Splenic Anaemia.—In some cases (see *Haemolytic Anaemia*, below) the spleen, especially when it is enlarged, becomes unusually active either in destroying red cells or in preventing them from leaving the marrow in proper numbers. As a result, anaemia develops. Removal of the spleen may result in cure.

Anaemias of Excessive Loss of Red Blood Cells.—Normally a certain number of mature red cells is lost from the circulation daily. The life span of a red cell is approximately 120 days. Gradually the cell wears out and forms a yellow pigment called bilirubin, the colouring matter of the bile. Some of the red cells are lost by seepage into

various tissues or through minute bleeding, as from the mouth or intestines, or in women by way of the menstrual cycle. Two types of blood loss may thus be discriminated, one from haemorrhage (loss of intact red cells), the other from increased blood destruction of haemolysis.

Haemorrhagic Anaemias.—The sudden loss of a large quantity of blood may be disastrous. The quick use of transfusions is often lifesaving. The loss of small quantities of blood by repeated bleeding from the nose, the womb, the gastrointestinal tract, or from haemorrhoids results in a varying degree of anaemia, of which the outstanding feature is a low haemoglobin content in the blood. Many cases of haemorrhagic anaemia, in which the loss of blood is slight but continuous, go about unrecognized. Although the anaemia is discovered, treatment with liver extract, iron or other substances is often given, when chief emphasis should be placed on finding the cause of the anaemia. Examination of the stools for "occult" blood may be very important.

Haemolytic Anaemias are those in which there is an excessive destruction of red blood cells. These are due to various causes, some of them obvious, some quite obscure. Hereditary or familial cases, cases which are due to various causes (acquired) and cases with haemoglobinuria ("blackwater") are discriminated.

Hereditary types include three main types: spherocytic (familial haemolytic jaundice); target-oval-cell type or Mediterranean anaemia; target-sickle-cell type or sickle-cell anaemia.

The spherocytic type is the best known. It is inherited by means of a Mendelian dominant mechanism and through either parent. The central feature is the presence in the blood of large numbers of small, very thick "fragile" red cells. An enlarged spleen and slight jaundice are present, and gallstones commonly develop. Although removal of the spleen is curative, the hereditary tendency can still be passed on to the next generation. If the spleen is not removed, the patient is subject to the development of a "haemolytic crisis" during which the red count may suddenly drop 1,000,000 to 3,000,000 within 24 hrs. Removal of the spleen is compatible with a long life span. The common statement that an individual without a spleen can live no longer than seven years is completely fallacious.

The target-oval-cell type, or Mediterranean anaemia, occurs in people of Mediterranean origin or ancestry, more particularly in Italians, Greeks and Syrians, and to some extent in Portuguese. The severest forms were first described by Thomas B. Cooley, and mild forms were discriminated by Maxwell M. Wintrobe and William Dameshek, all of the United States. The central feature of the blood is the presence of numerous red cells which look like "bull's-eyes" or targets. These are unusually thin, and therefore have a decreased red-cell fragility. Severe forms of the disease are fatal, but individuals with mild forms may live a normal life span. The milder cases are often unrecognized. Mild cases are carriers, most of their children developing the same condition. The mating of two carriers may result in the birth of children having the severe form of the disease (Dameshek, Valentine and Neel). Various forms of treatment including the use of liver extract, iron and splenectomy (removal of the spleen) are without effect.

The sickle-cell anaemia occurs almost exclusively in Negroes although occasional typical cases occur in purebred Italians and Portuguese. About 7% of all Negroes have the "sickle-cell trait," which is an inherited characteristic. This is demonstrated by exposing the fresh red cells to an environment which is low in oxygen; if the sickling trait is present, the red cells develop crescent or sickle shapes within a matter of hours. Normal red cells or red cells from various types of anaemia fail to show this trait. Individuals with the trait (*heterozygous* form) have been found by Pauling and others to have a mixture in their red cells of normal haemoglobin with an abnormal or sickle cell haemoglobin. Neel showed that if two individuals with the sickle cell trait married and begot children, some (25%) of the children would have the severe sickle cell anaemia, in which the haemoglobin is 80% to 100% abnormal (*homozygous* form). In the latter condition, there is severe anaemia, usually accompanied by pains in various extremities, and attacks of fever, lung disturbances, abdominal pain, paralysis and numerous other complications. The red cells are very thin and many target cells are present. Sickle cells are found, even without exposing the blood to an environment low in oxygen. These cases are very serious and have a poor outlook for a useful life. Treatment with iron, liver extract or splenectomy is without effect.

In many cases of haemolytic anaemia, a hereditary factor is completely lacking; these are called "acquired." Rapidly developing (acute), slowly developing (chronic) and intermediate types are discriminated. Various drugs and chemicals, various bacteria and their products, various immune bodies (haemolysins and agglutinins), various diseases such as leukaemia and tumours of white cells, and even such physical factors as burns and extreme cold may induce increased blood destruction in certain individuals. Most cases are due to the development by the body of an "auto-immune" mechanism resulting in injury and ultimate rapid destruction of the individual's own red blood cells. The rapid destruction of blood leads to anaemia, an increased amount of bile pigment in the blood, enlargement of the spleen and an increase in bone-marrow activity. In acute or rapidly developing cases, the individual's life may be quickly placed in jeopardy. Under such circumstances, transfusions are urgently required, and the matter of combating the fundamental disturbance discussed. Removal of the spleen was at one time accepted, and in fact the only form of therapy other

than transfusion. Many cases fail to respond, however, to this operation. In 1950 and 1951, the remarkable effects of ACTH and cortisone in controlling this condition in most cases were reported.

A special form of haemolytic anaemia, seen in the newborn, is called erythroblastosis foetalis. The mechanisms for the development of this serious condition came to light in 1941-44, chiefly through the researches of Philip Levine, Karl Landsteiner and Alexander Wiener. Landsteiner and Wiener discovered that 85% of all white humans had in their red cells a certain factor called the Rh factor; 15% did not possess it (*i.e.*, were Rh negative). By the law of averages women who were Rh negative usually mated with men who were Rh positive. The babies born of this union were usually Rh positive. During pregnancy, the developing child might immunize the mother to the Rh factor with resultant development of an antistubstance called anti-Rh agglutinin. Levine showed that this antistubstance circulating in the mother's blood might enter the foetal circulation and cause the foetus' red cells to clump together with resulting severe anaemia and jaundice. The recognition of the Rh factor and its importance in this profound anaemia of the newborn was an important development, chiefly because to be forewarned is to be forearmed. Pregnant women should be tested for Rh factor and, if found negative, the husband should be tested. If the husband is Rh positive, the child is usually Rh positive and should be carefully watched for anaemia and jaundice. Whereas the condition was previously almost universally fatal, appropriate transfusions are often curative. An unfortunate situation is that once a woman has borne an erythroblastic infant, she is likely to bear others.

The passage of "blackwater" (urine containing haemoglobin) occurs in a number of conditions including malaria ("blackwater fever"). Some cases show blackwater during exposure to cold—paroxysmal cold haemoglobinuria; others pass haemoglobin at night—nocturnal type; and still others during long walks or runs—march type. The haemoglobinurias are in many respects among the most mysterious conditions seen in medical practice.

Treatment of Anaemia.—Since anaemia is a symptom, fundamental treatment should be directed at its cause, if this can be determined. Thus, if the anaemia is caused by bleeding from the bowel, and this is caused by cancer or an ulcer, the offending lesion must be removed. In other cases, the fundamental cause, such as an abnormally functioning stomach or bowel, cannot be altered and the patient must be treated with the substance which has become deficient; *i.e.*, liver extract, folic acid, iron or the vitamin B complex. Liver extract is of no value when given to individuals with an iron deficiency, and conversely iron does no good when the deficiency is one of liver extract. Transfusions are used to replace blood which has been quickly lost by haemorrhage or increased blood breakdown and are often administered as a temporary expedient to individuals who have a serious bone-marrow disturbance. Splenectomy (removal of the spleen) is performed in certain forms of haemolytic anaemia, and in some other conditions in which the spleen is enlarged. The hormones ACTH and cortisone are of great value in the treatment of acquired haemolytic anaemia.

Pseudo ("Tallqvist") Anaemia.—Many women complain of lack of vitality and endurance and often appear pallid and listless. Upon examination, nothing abnormal is found, but the haemoglobin reading is somewhat low, particularly by the inaccurate Tallqvist paper scale method. The diagnosis of anaemia is then made and the patient is treated with series of injections of liver extract. Usually the patient feels much improved but when the injections are discontinued, she feels "low" again. These cases are in reality examples of nervous disability or neurasthenia. Women having this condition lack energy and are often considered as chronic invalids. Despite this they usually outlive many more robust and energetic types.

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ANAESTHESIA AND ANAESTHETICS. Anaesthesia is a word used in medicine to indicate a state of local or general insensibility to external impressions. Anaesthesia may be a symptom of certain diseases of the brain or spinal cord. Anaesthetic is the adjectival form of the word and is also used as a noun to indicate an agent capable of producing the state of anaesthesia. Oliver Wendell Holmes is credited with suggesting these words after William T. G. Morton first demonstrated publicly the use of ether to produce insensibility to pain during surgical operations on Oct. 16, 1846. Before that time there had been, from the beginning of history, a search for means of relieving pain. With the discovery of oxygen and nitrous oxide by Joseph Priestley in 1772, there was continued study of these and other agents which led to the eventual discovery of anaesthesia for surgical purposes. Humphry Davy described the anaesthetic properties of nitrous oxide in 1800 and suggested its use during surgical operations. His suggestion was not developed. Henry Hill Hickman showed that partial asphyxiation and carbon-dioxide inhalation would produce unconsciousness and relief of pain. He published his findings in 1824 without arousing interest. Michael Faraday inhaled ether and reported its effect. On March 30, 1842, Crawford W. Long of Athens, Ga., used ether to produce surgical anaesthesia. He did not publicize his discovery. Horace Wells, in Dec. 1844, had nitrous oxide administered to himself for extraction of a tooth. A public demonstration by him of its use for a surgical operation ended in a fiasco. Later demonstrations proved successful.

Anaesthesiology is a word that is used to designate special study of the preparation of patients and their care during and after the administration of an anaesthetic. The anaesthesiologist, in addition to the administration of general anaesthetics, interests himself in the administration of local anaesthetics for surgical, diagnostic and therapeutic purposes. He also may perform blood transfusions, administer other fluids and stimulants parenterally, use resuscitative measures and administer gases for therapeutic purposes. The scope of the duties of the anaesthesiologist is rapidly increasing and may give rise to the question as to how much he will be able to broaden his activities and still retain the status of specialist. Specialization in the field of anaesthesiology and organizations of anaesthesiologists developed rapidly after 1940. Wartime need for specially trained persons and recognition of their usefulness have given added impetus to the advancement of anaesthesiology. In the United States a degree of M.S. (anaesthesia) was first awarded in 1936. In England a diploma in anaesthetics (D.A.) has been awarded since 1935 jointly by the Royal College of Surgeons of England and the Royal College of Physicians of London to candidates who successfully pass an examination and pay a statutory fee.

Agents and Methods.—Inhalation anaesthesia is a type of anaesthesia produced by gaseous or volatile agents. Nitrous oxide, which first was used in 1844 for anaesthetic purposes, has continued to be used extensively with an increasing awareness of the anaesthetist of the need for precaution against suboxygenation and the subsequent danger of cerebral damage which may accompany its administration. Because it is a weak anaesthetic agent, its greatest usefulness is in combination with other anaesthetic agents.

Diethyl ether holds a dominant place among the inhalation anaesthetics. Many new ethers have been prepared and used experimentally. Among these are cyclopropyl methyl, cyclopropyl ethyl, *n*-methyl propyl, ethyl-*n*-propyl, propenyl ethyl,

propethylene, cyprome, cypreth, cyprethylene and cyclopropyl vinyl ether. Some of these have been given clinical trial. Divinyl ether (vinethene, divinyl oxide) is more powerful than diethyl ether. Its usefulness is limited by the occasional ill effects which may result from prolonged administration.

Chloroform, which first was introduced by James Y. Simpson in 1847, is more potent and more toxic than ether. Its use as an anaesthetic has decreased with increased knowledge of its dangers.

Trichlorethylene (trilene) appears to be less toxic to the heart than chloroform but it does not always produce complete muscular relaxation. When trichlorethylene is administered in a closed circuit, toxic oxidation products caused by the interaction of trichlorethylene and soda lime may produce palsy of the trigeminal nerve and of other cranial nerves. The drug also may break down into toxic products under the influence of heat, such as heat from an electric cautery.

Ethylene, an explosive gas, was introduced in 1923. It is more potent than nitrous oxide and more oxygen may be used with it.

Ethyl chloride has a limited usefulness as an inhalation anaesthetic. It is similar to chloroform in its toxicity. Ethyl chloride is used for freezing of superficial tissues by applying it as a spray.

Cyclopropane, a potent, explosive gas, was first used clinically in 1934. A large amount of oxygen may be used with it. Muscular relaxation is produced by the gas. The question of its action on the heart has been debated. The usefulness of this agent has been enhanced by the introduction of curare.

Curare (*d*-tubocurarine, intoxostin), which first was used in connection with anaesthetics in 1942, is not an anaesthetic but is used in conjunction with anaesthetics to increase muscular relaxation. It may be administered intravenously or intramuscularly. Respiratory depression or arrest occurs from an overdose of curare or from too rapid administration of this drug. Artificial respiration and neostigmine and the quickly effective anticholinergic Tensilon are the antidotes for curare. Other drugs which have a curarelike action have been studied. Some of these are salts of erythroidine, quinine ethochloride, nicotine, thiamine, magnesium, quinine and quinine derivatives. Other agents used for relaxation are Flaxedil and Synchronine.

⁶ The intratracheal method of administering inhalation anaesthetics has increased the safety and adaptability of these agents. Constant improvement and modifications of anaesthesia equipment have contributed to the wider application of special anaesthetic techniques. Soda lime is used to absorb the carbon dioxide from anaesthetic mixtures. It effects a reduction in the amount of anaesthetic agent necessary to maintain anaesthesia. The explosion hazard in anaesthesia has been studied and safety measures have been recommended and accepted. The Horton intercoulper was devised for the purpose of reducing the probability of explosions resulting from static spark.

Rectal anaesthesia is the method by which unconsciousness is produced by introducing the agent into the rectum. Ether, the barbiturates and tribromethyl alcohol in amylene hydrate (avertin) are the drugs that have been used most often in this method. Tribromethyl alcohol in amylene hydrate has been used for release of a ureteral stricture around a stone by direct injection of the agent into the ureter. It was used by the intravenous route to produce anaesthesia in World War II.

Hypnotism has been revived and has found a limited usefulness in obstetrics and in prisoner-of-war camps in the absence of adequate anaesthetic agents.

Intravenous anaesthesia, the method by which the anaesthetic agent is introduced directly into the blood stream, has been used extensively and proved most valuable for anaesthesia in warfare. The barbiturates have recently been employed satisfactorily. After a long search for a suitable agent, thiopental sodium (pentothal sodium) probably has been used more than any other barbiturate. Sural gives results comparable to pentothal. Alcohol, injected intravenously, has been used for relief of postoperative pain. Procaine hydrochloride, administered intravenously, has been used to relieve many forms of pain and sometimes for operative anaesthesia. Vascular spasm as well as pruritus has been re-

lieved by this method of administering procaine hydrochloride.

It has been found that anaesthetics such as pentothal sodium may be administered by injecting the solution into the bone marrow (intraosseous anaesthesia).

Local anaesthesia is the method by which insensibility is produced by a locally active agent such as procaine hydrochloride. Many agents have been used, the safest being procaine hydrochloride. Metycaine, nupercaine and pontocaine also have been used. When the local anaesthetic agent is injected so that it blocks the nerve supply, the method is known as "block" or "conduction" anaesthesia. Special types of blocks, such as caudal, sacral, brachial plexus and spinal blocks, have been developed. A modification of caudal anaesthesia is the continuous method in which a needle or catheter is left within the caudal canal and repeated injections of the local anaesthetic are made to produce continuous anaesthesia. This method has been used chiefly in obstetrics.

Spinal anaesthesia is a special form of block anaesthesia in which the local anaesthetic agent is deposited in the spinal fluid. The single-injection method has been modified by the continuous method. Here the needle or a catheter is left in position and intermittent injections are given to sustain a continuing insensibility. By this method, smaller, safer doses of the drug may be given in each injection and the value of the method is increased because the limited time element of the single-dose method is overcome. Penicillin has been added to local anaesthetic solutions in an attempt to increase the safety of the injection, especially in infected areas. Studies have shown that procaine hydrochloride did not interfere with penicillin activity.

Refrigeration (cryo-anaesthesia) is a form of local anaesthesia. By applying ice to an extremity or to a skin area, insensibility to pain of amputation has been produced. Skin grafts have been removed painlessly and amputation of an extremity, especially in cases of diabetes, has been done with greatly decreased operative risk. Cold has been found to be of value in the treatment and prevention of shock and in the retardation of infection.

Related Agents include the sulfonamide drugs which have been studied in relation to anaesthetics. Procaine hydrochloride was found to have an antisulfonamide action. Acetylation of the amino group of *p*-aminobenzoic acid leads to a 10,000-fold decrease in its antisulfonamide activity. Other studies of the sulfonamide drugs in relation to anaesthetics showed that in patients who have had sulfonamide therapy the inhalation anaesthetics were the most controllable. Sulfonamide drugs in large doses were found to affect the toxicity of pentothal sodium in rats. In actual use, no demonstrable ill effects were noted in patients heavily medicated with sulfonamides and anaesthetized with pentothal sodium, and no synergism between the two drugs was seen. Sulfonamides were found not to increase the operative risk of animals in shock; in some instances, the effects of sulfonamides seemed to be beneficial.

Vitamins in relation to anaesthesia as well as the vitamin state in the preanaesthetic and postanaesthetic periods have been investigated. Vitamin C deficiency was found to increase the anaesthetic induction time and recovery time. Vitamin B₂ has been found to be necessary for adequate functioning of the cell respiratory mechanism.

Shock which exists before the administration of anaesthetics as well as that which may develop during operation has been studied extensively. Supportive measures have been used successfully in the prevention and treatment of shock. Blood transfusion, plasma transfusion and the so-called plasma substitutes, or plasma volume expanders, dextran, periston and gelatin, have decreased the incidence of operative shock.

Gas therapy is often under the supervision of the anaesthetist. Postanaesthetic administration of oxygen, carbon dioxide and oxygen or helium has proved valuable in preventing postanaesthetic complications. Helium, oxygen and carbon dioxide are used in conjunction with anaesthetics as well as in gas therapy.

Bronchoscopy has recently become of interest to anaesthetists. Diagnostic, preoperative, operative and postoperative tracheo-bronchial aspiration has reduced the incidence of serious pulmonary

complications.

Postanaesthesia observation rooms have been set aside in some institutions to facilitate the immediate postanaesthetic care of the patient under the direction of the anaesthetist. Resuscitation is often done by the anaesthetist because of his familiarity with the circulatory and respiratory physiology. Research in physiology as related to anaesthesiology also added much factual data.

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ANAGNIA (mod. Anagni); pop. (1936), town 6,590, commune 12,396; an ancient town of the Hernici, on a hill (1,558 ft.) above the valley of Trerus and Via Labicana, Italy. Its position in a fertile district soon gave it importance, and it became the seat of the assembly of the Hernican towns. In the war of 306 B.C. it lost its independence. It was besieged by the Saracens in 877, but in the 11th century was a place of considerable importance, the Conti and Caetani being the chief families; Pope Boniface VIII., a member of the latter, was there made prisoner in 1303. The ancient city walls, built of rectangular blocks of porous limestone, still stand, much restored in places. Within the city the only ancient remains are some massive substruction walls on the hillside. The cathedral, constructed in 1074 at the summit of the hill, is externally plain; it has a fine Gothic interior.

ANAGRAM, the result of transposing the letters of a word or words in such a manner as to produce other words that possess meaning (Gr. *ἀνὰ* back, and *γράφειν*, to write). The construction of anagrams is an amusement of great antiquity, its invention being ascribed without authority to the Jews, probably because the later Hebrew writers, particularly the Kabbalists, were fond of it, asserting that "secret mysteries are woven in the numbers of letters." Anagrams were known to the Greeks and also to the Romans, although the known Latin examples of words of more than one syllable are nearly all imperfect. They were popular throughout Europe during the middle ages and later, particularly in France, where a certain Thomas Billon was appointed "anagrammatist to the king" by Louis XIII. Dryden disdainfully called the pastime the "torturing of one poor word ten thousand ways," but many men and women of note have found amusement in it. A well-known anagram is the change of *Ave Maria, gratia plena, Dominus tecum* into *Virgo serena, pia, munda et immaculata*. Among others are the transposition of "Horatio Nelson" into "Honor est a Nilo"; and of "Florence Nightingale" into "Flit on, cheering angel." The pseudonyms adopted by authors are often transposed forms, more or less exact, of their names; the most remarkable pseudonym of this class is the name "Voltaire," which the celebrated philosopher assumed instead of his family name, "François Marie Arouet," and which is generally allowed to be an anagram of "Arouet, L.J.," that is, Arouet the younger. Some of the astronomers of the 17th century embodied their discoveries in anagrams with the design apparently of avoiding the risk that, while they were engaged in further verification, the credit of what they had found out might be claimed by others. Another species of anagram, called "palindrome," is a word or sentence which may be read backwards as well as forwards, letter by letter, while preserving the same meaning; for example, the word "tenet."

ANAHEIM, a city of Orange county, California, U.S., 25 mi. S.E. of Los Angeles. It is served by the Santa Fe, the Southern Pacific and the Union Pacific railways, and by a network of highways. The population was 14,556 in 1950; 11,031 in 1940.

It lies in a fertile plain, irrigated by the Santa Ana river, which produces oranges, lemons, avocados, walnuts and vegetables. Industrial products are canned and processed citrus juices, pectin, stock feed, paint, industrial alcohol, juice extractors, furniture, hosiery, resin, clothing and plastics. Natural gas is used for fuel.

It is the spring training home of major and Pacific coast ball

clubs.

Anaheim was the first of the settlements due to co-operative enterprise in southern California. In 1857, 50 Germans organized an association in San Francisco, bought 1,165 ac. of arid land, and prepared it for occupancy. The tract was then divided into 20-ac. shares, which were distributed among the members by lot, with bonuses and rebates to equalize differences in value. This ended the co-operative aspect of the venture, except that the irrigating canal remained common property. The town was incorporated in 1870, and received a city charter in 1888. It has a city-council form of government.

ANÁHUAC, a historical-geographical district of Mexico with imprecise boundaries. In Nahuatl (Aztec), the term signifies "country by the waters" and thus may refer either to the sea or various lakes. Traces of the name in southern Utah, the United States, and the gulf coast of Mexico led to theories that an ancient Indian empire extended to those parts, but modern archaeological investigations tended to dispel them. The name Anáhuac was also synonymous with that part of the Spanish colonial vice-regency of New Spain which became the independent area of Mexico in 1821. The term also refers to the plateau region of Mexico between the maritime Sierras and extended to the Isthmus of Tehuantepec. Usually and more properly, Anáhuac designates the important plateau valley of Mexico, between 18° 40' and 20° 30' N. lat., an area about 200 mi. long by 75 mi. wide, in which Mexico City is located. Its altitude averages about 7,500 ft. and its mean temperature around 62° F. (Hb. C.)

ANAKRUSIS, from the Greek, meaning literally "up beat," has been defined in poetry as, "a syllable at the beginning of a verse before the just rhythm"; otherwise, an introductory weak accent preceding a strong one. In music the term is similarly applied to the notes on the weak beats of the bar, more especially to that on the last beat, preceding the strong one on the first beat of the following bar, and often constituting an apparently incomplete bar when occurring at the beginning of a composition.

ANALCIME, a common mineral of the zeolite group. It crystallizes in the cubic system, the common form being the icositetrahedron (211), either alone or in combination with the cube (100). The crystals are often perfectly colourless and transparent with a brilliant glassy lustre, but some are opaque and white or pinkish-white. The hardness is 5 to 5½, and the specific gravity 2.25. Chemically, analcime is a hydrated sodium and aluminium silicate, NaAlSi₃O₈·H₂O. Before the blowpipe the mineral readily fuses with intumescence to a colourless glass. It is decomposed by acids with separation of gelatinous silica. Analcime usually occurs, associated with other zeolitic minerals, lining amygdaloidal cavities in basic volcanic rocks such as basalt and melaphyre. The Tertiary basalts of the north of Ireland frequently contain cavities lined with small brilliant crystals of analcime. Larger crystals of the same kind are found in the basalt of the Cyclopean islands, Sicily. Large opaque crystals of the pinkish-white colour are found in cavities in melaphyre at the Seisser Alpe in southern Tirol.

ANALGESIA is the name given to the loss of the sensation of pain, and is the result of an interruption of the nervous pathway between skin and brain. Different forms of sensation from one area of skin, such as touch, temperature, and pain, travel to the spinal cord by different nerve fibres in the same nerve bundle. Hence any injury or disease affecting such a nerve would abolish all forms of sensation in the area supplied by it. However, when the sensory nerves reach the spinal cord their fibres separate and pursue different courses on their way upward to the brain. Thus it is possible for certain forms of sensation to be lost, while others are preserved, in diseases which affect only certain areas in the spinal cord. Since the sensations of pain and temperature travel the same path, they are usually lost together. Diseases of the cord which may cause analgesia without loss of the sensation of touch are tabes dorsalis, syringomyelia and tumours of the cord. Analgesia may also be a manifestation of hysteria. The term is used for types of pain relief induced by the giving of various drugs. The term is used extensively in obstetric practice. (See ANAESTHESIA AND ANAESTHETICS; OBSTETRICS.)

ANALOGY. Originally the general term analogy appears to have been used in the sense of "proportion," and so confined to quantitative relationships. Thus, for instance, the relation between 3 and 4 would be described as analogous to that between 9 and 12; or, more generally, the relation between x and y would be described as analogous to that between nx and ny . Analogy in this sense could obviously serve as a basis for reliable inferences. In the solution of equations of many kinds it is usually possible to determine (that is, to infer) the value of an unknown quantity when its relation to a known quantity is given. Hence the early vogue of the expression "inference (or reasoning) from analogy." In mathematics, however, the term analogy has been displaced by the term proportion, except in the expression "Napier's Analogies" still used in spherical geometry.

Side by side with this quantitative application of the term analogy we find, already in Aristotle, a qualitative use of it. In its quantitative sense of "proportion," analogy designated similarity or identity of quantitative relationship between two pairs of terms; in its qualitative use the term analogy indicates similarity in any kind of (nonquantitative) relationship between two sets of terms. In this wider sense the term is very common, and the thought which it expresses is applied very extensively, especially in popular modes of thought and of expression. This is evident from the frequent use of metaphor, which is but one example of analogy. For instance, the metaphorical use of the term "sweet" in the phrase "a sweet melody" is an abridgment of the analogy that "this melody affects the ear in the same pleasing way as sweet things affect the palate." Similarly the expression "Mother Country" implies the analogy that "the relation of a country to its colonies is like that of a mother to her children." Another familiar group of analogies may be seen in the way in which people infect new terms (or terms which are new to them) on the model of the known inflections of other terms—e.g., "looped" is to "loop" as "looked" is to "look." Or, again, the names of certain organs of animals are often based on analogies—the so-called "wings" of butterflies are structurally very different from the wings of birds, but their function in relation to the butterfly (viz., in enabling it to fly) is essentially like that of the wings of birds, and so these otherwise different organs of butterflies and of birds are called "analogous organs." Similarly, new inventions are frequently given names based on analogy—"airships," e.g., are machines which do in the air what ships do in the water, etc.

As appears already from the case of metaphors, from the case of "analogous organs" in biology, and analogous constructions in grammar, the similarity of relationships between pairs or sets of terms is apt to appear as a similarity between the terms or things themselves. And so the term "analogy" has come to be extended to similarities generally, excepting that close similarity which exists between members of the same recognized class of objects in respect of those qualities which are regarded as characteristic of that class. Thus, e.g., one would not think of potatoes as being "analogous" to one another—they are too much like one another for that. Similarly with apples. But, as is evident from their French and German names, potatoes are regarded as "analogous" to apples.

The Psychology of Analogy.—Psychologically or educationally the importance of analogy lies in the fact that it is a very common form of apperception (*q.v.*), a way of assimilating new and strange objects to older and more familiar ones—a way of profiting from past experience for the proper apprehension and treatment of new situations. Any new thing or occurrence is apt to appear familiar, and so to become acceptable, as soon as it can be linked up in some way with the general store of our already acquired ideas and beliefs. The only safeguard against the evils of so-called "reasoning from analogy," or "analogical argument," is a correct insight into the real nature and function of analogy considered from a logical point of view.

The Logic of Analogy.—As was pointed out above quantitative analogy is a basis of valid inferences. Qualitative analogy (the only type with which we are now concerned) is also frequently made the ground of inference. In fact some thinkers regard analogical reasoning as one of the fundamental types of inference

together with deductive and inductive inference. Some, on the other hand, regard it as a species of deductive inference, and others as a variety of inductive inference. But at all events analogy is commonly accepted as a legitimate ground of inference when due care is taken. Now it is true that, as a matter of fact, people commonly do draw inferences from analogy. The real question, however, is whether such inferences can be regarded as conclusive or cogent. In other words, can reasoning from analogy ever be regarded as more than tentative, as equivalent to proof? This question must be answered in the negative for the following reasons. Reasoning from analogy usually assumes the following form: A certain phenomenon or a certain class of phenomena, say S , resembles a certain other phenomenon or class of phenomena, say Z , in some assignable respect, say M . Now Z is known to be P as well as M . It is accordingly inferred that S which resembles Z in respect of M also resembles it in respect of P ; in other words, S is P . Now, strictly speaking, this conclusion could only be justified if it could be shown that M and P are connected by some law, either directly or indirectly. For unless M and P are so connected, the presence of M , in S or in anything else, may be entirely irrelevant to the question of the presence of P . That is why it is usually insisted that analogies or similarities must be weighed, not merely counted. For instance, the fact that light and sound resemble each other in respect of being transmitted through considerable distances is in itself no evidence that they also resemble each other in respect of having the same medium, or in respect of polarization, or even in respect of an undulatory form of transmission. If there is any connection between transmissibility and any of these other phenomena, it must be established independently. Now the question whether there is any connection between M and P , and if so, what it is, can only be decided by the usual methods of induction, not by mere analogy. The analogy may suggest hypotheses for inductive investigation; but it cannot prove anything. Analogy, in brief, is probably the most fruitful source of suggestions, of hypotheses, that is, of tentative inferences, but it is not a type of proof at all. If an analogical inference is proved at all it is proved by inductive methods; if it is not proved or verified by inductive methods, it is not proved at all, and remains a mere suggestion, which may indeed be true, but is not yet established. In so far as an analogical suggestion proves fruitful it results in the inductive establishment of a connection between M and P , and so leads to the deductive application of this law of their connection to cases like S , etc. In other words, the analogy may eventually lead to both inductive and deductive proofs; but the analogy itself is neither inductive nor deductive, nor is it a proof at all; it is only an auxiliary to all these.

Of the value of analogy as an auxiliary to inductive investigation there can be no reasonable doubt. The history of science affords abundant evidence of this. A few illustrations may be adduced here. Descartes' perception of the analogy between algebraic and geometrical relationships has led to many important discoveries in modern mathematics. The observation of Jupiter and the Medicean satellites or moons led by analogy to the suggestion of the modern conception of the solar system. Newton's perception of the analogy between a falling apple and the moon led to the establishment of celestial gravitation. But analogy as such never goes beyond helpful suggestion—the actual results must be borne out by scientific methods. That is why in the more advanced sciences analogy plays a relatively unimportant part. The finished results are supported by inductive evidence; the analogies by which they may have been first suggested are no part of the evidence, and are of interest only as incidents in the mental history of the discoverer, in the history of the builder rather than in the structure of the building. On the other hand, in the less developed sciences analogy may play a prominent role. Much of so-called biological sociology consists in the exploitation of analogies between the structures and functions of animals and those of societies. The reason for the conspicuous part played by analogy in the less developed sciences, or stages of a science, is this: The first problem to be attacked in the history of a science is that of classification—the most helpful (intellectual) grouping of the phenomena to be investigated. Now some phenomena are

obviously similar or obviously different (though not always really so). Others are not so, and it may require a keen eye for analogies to bring together things that really belong together but not obviously. In this way analogy may be an early stage in the recognition of a new and somewhat complex class of facts. The history of terms like "boycott" or "Hobson's choice" furnishes popular illustrations of this process. Franklin's study of lightning, and his careful enumeration of the analogies between lightning and electricity, may serve as a scientific illustration of the help that may be rendered by analogy in the classificatory stage, as well as in the later stages, of a science. It should be noted, however, that Franklin did not stop at the analogies between lightning and electricity, but proceeded to test the suggestion experimentally by means of his famous kite. In comparatively simple cases the transition from analogy to a new class concept is easy. After considering a few cases analogous to that of Captain Boycott, or to that of Hobson, one may readily get at the idea of social ostracism, or of apparent without real choice, respectively. But in more complex instances there is the danger that some important feature may be overlooked in the general description or definition of the type as such. Hence probably the legal tendency to cite cases and follow precedents rather than formulate general laws or principles—flexible analogies being regarded as safer than rigid formulae in certain types of legal and similar problems.

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ANALYSIS, in general, the resolution of a whole into its component elements; opposed to synthesis, the combining of separate elements or minor wholes into an inclusive unity. Both analysis and synthesis may be either purely mental or physical. The analysis and synthesis carried out in psychology, for instance, are purely mental. But even in physics, chemistry, etc., where these processes can also be carried out physically, the mental analysis or synthesis generally precedes the physical in all well-planned experiments.

In grammar, analysis is the breaking up of a sentence into subject, predicate, object, etc. (an exercise introduced into English schools by J. D. Morell about 1852); so the analysis of a book or a lecture is a synopsis of the main points. The chief technical uses of the word, which retains practically the same meaning in all the sciences, are in (1) philosophy, (2) mathematics, (3) chemistry.

(1.) Logical analysis is the process of examining into the connotation of a concept or idea, and separating the attributes from the whole and each other. It, therefore, does not increase knowledge, but merely clarifies and tests it. In this sense Kant distinguished an analysis from a synthetic judgment, as one in which the predicate is involved in the essence of the subject. Such judgments are also known as verbal, as opposed to real or ampliative judgments. The processes of synthesis and analysis though formally contradictory are practically supplementary; thus to analyse the connotation is to synthesize the denotation of a term, and vice versa; the process of knowledge involves the two methods, analysis being the corrective of synthetic empiricism. In a wider sense the whole of formal logic is precisely the analysis of the laws of thought. Analytical psychology is distinguished from genetic and empirical psychology inasmuch as it proceeds by the method of introspective investigation of mental phenomena instead of by physiological or psycho-physical experiment. For the relation between analysis and synthesis on the one hand, and deduction and induction on the other, see INDUCTION.

(2.) In Greek mathematics the method of proving a proposition by resolving it into simpler statements already proved or else assumed as axiomatic. Pappus (c. 275), in his *Synagoge or Collection* (Bk. vii, "On the Treasury of Analysis"), gives the best extant Greek definition: "Analysis, then, takes that which is sought as if it were admitted and passes from it through its various consequences to something that is admitted as the result of synthesis." The process was probably used by the early Pythagoreans in the 5th century B.C., and was taught in Plato's

school. Pappus speaks of it further as "a method which Plato, as they say, communicated to Leodamas, and by which the latter, too, is said to have discovered many things in geometry."

In the Renaissance period it came to be considered as the method of solving problems by means of equations, as in analytic geometry (*q.v.*). At present the word is used in a much more general way, being considered as including the theory of functions of real variables, infinite series, the differential and integral calculus, definite and multiple integrals, the calculus of variations, the theory of functions of complex variables, algebraic functions, elliptic and modular functions, special functions (Eulerian, Legendre's, Bessel's, hypergeometric, etc.), metrical and projective properties of quadric surfaces, algebraic curves and surfaces, algebraic configurations in general and infinitesimal and differential geometry. These topics are treated in various special articles, including CALCULUS, DIFFERENTIAL AND INTEGRAL; CURVE; DIFFERENTIAL GEOMETRY (METRIC); DIFFERENTIAL GEOMETRY (PROJECTIVE); FUNCTION.

(3.) In chemistry the word analysis was introduced by Robert Boyle to denote the determination of the composition of substances. (See CHEMISTRY: Analytical.)

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ANALYSIS SITUS (POSITION ANALYSIS): see TOPOLOGY.

ANALYST, in modern times, a person who is professionally skilled in chemical analysis. He may be called upon in the discharge of his professional duties to analyse a very wide range of substances and report thereon with regard to their composition or their purity. Apart from private practitioners, analysts are employed by manufacturers, their duty being to exercise a constant watch over the processes of manufacture, to test the purity of raw materials used, and of the final product, and generally to engage in research work connected with the industry concerned. The services of analysts are constantly required in judicial enquiries, sometimes in purely criminal cases, sometimes in civil proceedings. In the case of criminal proceedings, the services of the local public analyst are usually employed, but in certain instances the official analyst of the British Home Office may be engaged. At the Government Laboratory, Clement's Inn Passage, London, W.C., a large staff of analysts examine foods, spirits, tobacco, etc., for import or excise duties and for other purposes. Under the Fertilisers and Feeding Stuffs Act, 1927, agricultural analysts are appointed by every county council, whose duty is the analysis of fertilisers and feeding stuffs.

A British public analyst is an analyst appointed by a local authority for the purposes of the administration of the Sale of Food and Drugs and closely allied Acts. He must be possessed of definite qualifications and be a competent authority on the microscopy and chemical analysis of all articles of food and drink. He must also have studied pharmacology and therapeutics.

The Society of Public Analysts was founded in 1874, and membership is open to any practising analytical chemist.

United States.—In the United States there are, in addition to numerous laboratories dealing exclusively with the control of plant operations, many consulting laboratories whose work is largely on analytical problems. Many of these laboratories deal in specialties, as foodstuffs, clinical, pathological and forensic analysis, fuel and water, and iron and steel. A large share of the consulting work of university laboratories deals with analytical problems. The organization of the U.S. department of agriculture in 1862 (which from 1889 was represented in the president's cabinet) included a chemist. This branch developed through the Bureau of Chemistry (1900) into the Bureau of Food, Drug and Insecticide Investigation (1927), which is charged with the enforcement of the Food and Drugs Act (1906). A number of branch laboratories assist in this work. Other analytical work on foods, drugs, fertilizers, soils, etc., is fostered by the Bureau of Chemistry and Soils. The official methods of analysis are those of the Association of Official Agricultural Chemists, with the exception of official drugs, the methods for the analysis of which are found in

the U.S. Pharmacopoeia. Supplementing the Bureau of Food, Drug and Insecticide investigation are the analytical laboratories and consulting chemists sponsored by the food commissioners of the several States under authority of their dairy, food and drug legislation. Most of this legislation is modelled after the Federal Food and Drugs Act. Agricultural analysis began in the agricultural experiment stations, organized in conjunction with the land grant colleges which were fostered by the Morrill Act of 1862. The experiment stations were provided for further by the Hatch Act of 1887. Other analytical laboratories of full or semi-public standing are those of the customs service, public health service, and the geological survey and State and municipal boards of health. Associations dealing largely with problems of analytical chemistry include the Association of Official Agricultural Chemists, the American Society for Testing Materials, the Association of Cotton-oil Chemists, the American Association of Cereal Chemists and the American Leather Chemists' Association. The majority of associations of this type publish their own journals and proceedings. Among societies of broader scope in which analytical procedures are given prominent attention are the American Chemical Society, the American Society of Biological Chemists, the American Public Health Association and the American Pharmaceutical Association.

ANALYTIC, of or pertaining to analysis; the method of separating a whole into its parts, the opposite of synthetic. For analytic *chemistry*, analytic *language*, etc., see the articles under the noun-headings. The title of *Analytics* was given by Aristotle to his treatises on logic.

ANALYTIC GEOMETRY. When Descartes first came upon the idea of co-ordinates, a link was made between the sciences of geometry and analysis. Now the connection has grown so close that the results of either can be passed over to the other by definite laws of interpretation. In what follows, a few leading ideas are set out in terms of plane geometry, most of which can be extended to three or more dimensions.

CARTESIAN CO-ORDINATES

Co-ordinates (*q.v.*) are numbers measuring certain geometrical quantities and used to fix the position of a point, *e.g.*, latitude and longitude fix a place on a map. It is possible to build up a geometry, which is not analytical, on the ideas of order and in-

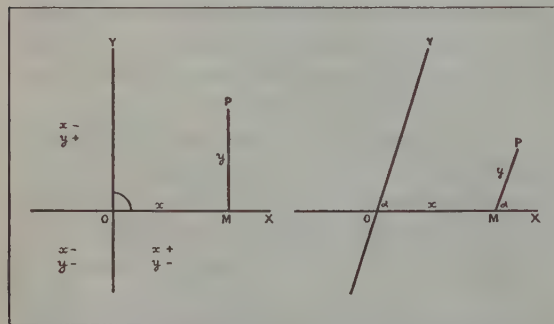


FIG. 1.—CARTESIAN CO-ORDINATES, RECTANGULAR AND OBLIQUE

cidence alone, without introducing measurement; but in analytic geometry we assume that we can measure such things as lengths and angles, and compare two different things of the same kind by measuring them in terms of a common unit. The value of a co-ordinate may depend on the choice of units; or it may be independent of them if it is defined as a ratio of two quantities of the same kind.

The simplest plane co-ordinates are *rectangular cartesian*. Through a fixed point (*origin*) *O*, we take two lines (*axes*) *OX*, *OY* in fixed directions at right angles to each other. (In *oblique cartesian co-ordinates*, the axes are not rectangular, but inclined at a given angle α ; the conditions of a problem often make this an advantage.) We reach any point *P* of the plane by going from *O* a certain distance $x = OM$ along *OX*, and then another distance

$y = MP$ parallel to *OY*. The pair of numbers (x , y) are the co-ordinates of *P*. If x and y are positive, this procedure leads only to points in the first quadrant of the plane, bounded by the half-lines *OX*, *OY*. Points in the other three quadrants are reached by taking one or both of the steps *OM*, *MP* in the opposite direction; to these reversed steps we assign negative co-ordinates. A zero co-ordinate belongs to a point on one or other axis, and the co-ordinates of the origin are (0 , 0). Every point of the plane has a unique pair of real numbers as co-ordinates, and every pair of real numbers are the co-ordinates of a unique point.

Thus the point *P*, and its pair of co-ordinates (x , y) are equivalent data. Any length, or other geometrical quantity, that is fixed when the point *P* and the axes *XOY* are given, is fixed when x , y are given; thus, $OP^2 = x^2 + y^2$, and $\tan POM = y/x$. (If, instead of x , y , we are given $r = OP = \sqrt{x^2 + y^2}$ and $\theta = \angle POM = \tan^{-1} y/x$, then, since $x = r \cos \theta$, $y = r \sin \theta$, both x and y are determined; thus r , θ , are data equivalent to x , y , and can serve just as well in determining *P*; they are called its *polar co-ordinates*.)

With any system of co-ordinates, the formula for the distance d between two given points P_1 , P_2 is of great importance. Let the co-ordinates of P_1 , P_2 have the suffixes 1, 2. Then, with rectangular cartesian co-ordinates,

$$d^2 = (x_2 - x_1)^2 + (y_2 - y_1)^2;$$

oblique cartesian co-ordinates,

$$d^2 = (x_2 - x_1)^2 + (y_2 - y_1)^2 + 2(x_2 - x_1)(y_2 - y_1) \cos \alpha;$$

polar co-ordinates,

$$d^2 = r_1^2 + r_2^2 - 2r_1 r_2 \cos (\theta_2 - \theta_1).$$

The simplest analytic geometry of all is of one dimension; *e.g.*, when we deal with only one line and the points on it. Any point *P* can be specified by its distance $x = OP$, measured from a fixed origin *O* in terms of a fixed unit, which can be shown by marking the point *A* at unit distance from *O*, so that $OA = 1$. Then x is the one co-ordinate of *P*.

By far the most important assumption is that of a single point with the co-ordinate ∞ , at an infinite distance from *O*. This is required, for example, as the homologue of *O* in ordinary inversion, in which the point whose co-ordinate is x corresponds to the point whose co-ordinate is $1/x$.

Equations.—If we interpret the variables as the co-ordinates of a variable point *P*, an equation in x , y is a statement of the position of *P*. For example, the equation $x^2 + y^2 = a^2$ tells us that *P* is at a distance a from *O*, that is, *P* is some point on the circle centre *O*, radius a . This does not fix *P*, for one equation does not determine both x and y , but it relates x and y , and it limits *P* to lie on the curve. The equation holds between the co-ordinates of any point on the circle, and of no other point; it is called the *equation of the curve*.

Any geometrical property of the circle is a statement about *P*, true if, and only if, *P* lies on the circle; it has a corresponding equation in x , y which follows from the equation $x^2 + y^2 = a^2$. Suppose we want to prove that, if *OX* meets the circle in *A*, *A'*, then $PM^2 = A'M \cdot MA$. The expression of this desired result in terms of the co-ordinates is $y^2 = (a+x)(a-x)$, which is a simple algebraic deduction from $x^2 + y^2 = a^2$. Thus, in general, any equation in x , y represents a curve, whose properties, when expressed in terms of the co-ordinates of a general point lying on it, are precisely the analytical consequences of this equation.

Since there is, as a general rule, a very much more certain and obvious way of verifying an analytical deduction than of devising a geometrical proof, the translation into equations introduces *method* and helps to turn geometry from an art into a science. One reason is that an algebraic expression has the property of *form*, which is more easily recognized than its geometrical equivalent. By the help of the conventions of the notation, the

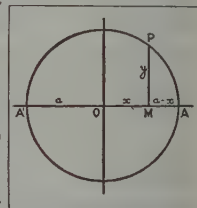


FIG. 2.—RECTANGLE OF SEGMENTS IN A CIRCLE

expression is analyzed, almost at first sight, into the components of its structure: variables and constants, terms, factors and indices.

The application of analysis to geometry saves effort by showing the direct way to success for soluble problems, and no less by showing certain others to be insoluble; it enables us to prove a negative. A particular figure may suggest wrongly that a certain property is true in general. In such a case, it is often quite hard to prove by pure geometry that the surmise does not always hold good. But when equations are written down expressing all the properties, both those given by hypothesis and those guessed from the figure, we can find out whether the second set can be deduced from the first or not. If they can, we may return more hopefully, and usually with some definite clue, to the search for a pure proof; if they are not deducible, we cease to waste our time on the matter. The classic example is the squaring of the circle by an Euclidean construction. For centuries, geometers were convinced that only a little more skill or luck was wanted for success, and no one was then in a position to assert that every conceivable attempt must fail. By the aid of analysis, that assertion is now proved. For this kind of special theorem, the analytical method is one of verification rather than discovery.

It is sheer folly to keep the two methods apart. There are occasions for using either alone, but we gain most power by using algebraic and analytical ideas and notations alongside, keeping ever present the relation between them, and the interpretation of each in terms of the others. "Every equation has its little meaning" is a better motto than "shut your eyes and write down the equations." For example, analytic geometry could hardly get going at all without relying on the theorem of Pythagoras, as was done tacitly earlier in this article in writing down $OP^2 = x^2 + y^2$.

Algebraic Curves.—The most important elementary property of cartesian co-ordinates is that an equation of the first degree in x, y represents a line, and conversely every line has an equation of the first degree. Thus:—

$y = \text{constant}$ is a line parallel to OX ,
 $x = \text{constant}$ is a line parallel to OY ,
 $ax + by = 0$ is a line through O ,
 $ax + by + c = 0$ is a line parallel to the last, but does not pass through O if $c \neq 0$,
 $x/a + y/b = 1$ is the line cutting off lengths a, b from the axes,

$y - b = m(x - a)$ is the line through the point A whose co-ordinates are (a, b) , making with OX the angle whose tangent is m . For different values of m , this can represent any one of the set of lines through A . The co-ordinates of the point of intersection of two given lines satisfy both their equations. Two independent linear equations in x, y always have one and only one solution, provided we admit infinite values; e.g., with the pair $ax + by = 0$, $ax + by + c = 0$. The corresponding geometrical convention is that two parallel lines intersect in one point at infinity.

A quadratic equation represents a *conic* (see CONIC SECTION), the simplest being the circle $x^2 + y^2 = a^2$. It illustrates the unity of mathematics that the same curves should be the first to present themselves naturally along the two lines of approach. The co-ordinates of the intersection of a line and conic satisfy a linear and a quadratic equation; their determination depends on the solution of the eliminant, a quadratic equation in one variable. Now a line may meet a conic in two different real points, or touch it at one point or pass clear of it. The conditions are the same as that the corresponding quadratic equation may have real and distinct, or equal or imaginary roots. It is therefore convenient to speak of the intersections of the line and conic as always two in number, being real or coincident or imaginary.

If the equation of a curve in cartesian co-ordinates is algebraic and not transcendental, its degree, in the co-ordinates jointly, is called the *degree of the curve*. The co-ordinates of the intersections of a curve of degree n and any line depend on an elimi-

nant of degree n ; there are n such intersections, real or imaginary, finite or coinciding with the one point at infinity on the line. The fundamental theorem about such curves is that two algebraic curves of degrees n_1, n_2 have $n_1 n_2$ points of intersection; as we have just seen in the case when one is a line, $n_2 = 1$. Thus two conics meet in four points.

A common application of co-ordinates in subjects such as engineering or statistics is to show the variation of two connected quantities by means of a graph. This is not really analytic geometry, but rather its converse; not the use of analysis to increase our geometrical knowledge, but the use of geometry to illustrate some analytical knowledge. We can draw a graph whenever we can calculate one co-ordinate directly in terms of the other, and its equation has the form $y = f(x)$.

OTHER TYPES OF CO-ORDINATES

A co-ordinate need not be a distance. In one dimension, a point P of a line can also be specified, for example, by choosing two points of reference A, B , and determining P by the co-ordinate $\lambda = AP/PB$, which is a ratio of lengths, not a length itself. Points within the segment AB have positive co-ordinates, 1 being that of the midpoint, the points beyond A and beyond B have negative co-ordinates of absolute values < 1 and > 1 respectively, and the co-ordinates of A, B and the point at infinity are $0, \infty$ and -1 . Again, we can choose three points of reference A, B, C , and define P by the value of the cross ratio

$$\xi = \frac{AP}{PB} / \frac{AC}{CB},$$

which is of advantage in dealing with projections.

In plane problems not concerned with actual measurements, the most useful co-ordinates are *areal*. Instead of two independent co-ordinates, each point has three, connected by a simple identity. We refer to a fixed triangle ABC , and the co-ordinates of P are ratios of areas of triangles and are independent of the units of length and area:

$$x = PBC/ABC, \quad y = PCA/ABC, \quad z = PAB/ABC,$$

with the sign convention that x is positive or negative according as A and P are on the same side or opposite sides of BC . Wherever P lies, we have identically

$$x + y + z = (PBC + PCA + PAB)/ABC \equiv 1.$$

The three co-ordinates are equivalent to two independent quantities only, which we could take to be x and y , but it is more convenient to leave them an unspecified pair of the ratios $x:y:z$, for the following reason. Since we may write $x+y+z$ for 1 , we can alter the dimension, in x, y, z jointly, of any term without altering its value. We thus arrange that every equation is homogeneous in the three variables; then it alters none of the work if we replace x, y, z by three other quantities having the same ratios, say, ax, ay, az , and these can be taken to be the co-ordinates of P , instead of x, y, z . The sum of these new co-ordinates is a instead of 1 , but this does not matter, since we need not use the identity again; the two independent ratios are the same as before. To this extent, the areal co-ordinates of a point are not unique, but each set of co-ordinates always determines a unique point.

The expression for distance in this co-ordinate system is complicated, involving the sides and angles of the triangle of reference, but it is still true that the equation of a line is of the first degree and conversely. If this is to hold without exception, the particular linear equation $x+y+z=0$, which contradicts the fundamental identity for the co-ordinates of a finite point, must be interpreted as a line altogether at infinity, the locus of the points at infinity on each of the other lines of the plane. There are other systems of homogeneous co-ordinates, in which also linear equations represent lines, the line at infinity having a less simple form; for example, *trilinear co-ordinates*, which are the perpendicular distances of P from the sides of the triangle of reference.

The cartesian co-ordinates (a, b) of a point P can be regarded as specifying the two lines $x=a$ and $y=b$, intersecting at P ,

selected from the two families of lines parallel to the axes OY , OX respectively. We have a more general type of co-ordinate, replacing these two families of lines by other curves; e.g., two families of concentric circles, with fixed centres A_1 , A_2 and varying radii. Then if P is given, it determines the values (ρ_1, ρ_2) of the radii for which the two circles, one from each family, intersect at P . These are *bipolar co-ordinates*. If ρ_1, ρ_2 are given, P

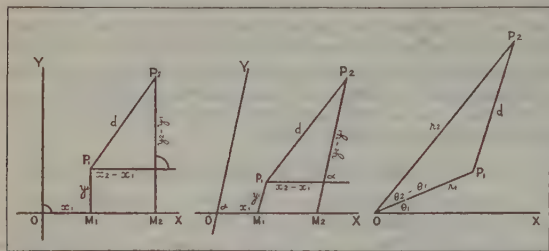


FIG. 3.—DISTANCE BETWEEN TWO POINTS IN RECTANGULAR, OBLIQUE, AND POLAR CO-ORDINATES

is not uniquely determined, for the two circles through P have another real intersection, the reflection of P in the line A_1A_2 . In some connections, for example, if we are interested in one-half only of the plane, this is no bar to their use.

In each of these systems, all the co-ordinates are elements of the same kind. This is not essential; of the two polar co-ordinates, one is a length and one an angle. In other systems, the interpretation of a co-ordinate by itself is less simple than that of some combination. For example, one of the circles, which determine P in the bipolar system, has a cartesian equation of the form $x^2 + y^2 + 2ax + 2by = \lambda$, where a, b are constants depending on the fixed centre, and λ is a parameter which can serve instead of ρ_1 as a co-ordinate of P , since it determines the circle equally well. Here λ itself is the negative square of the tangent from the cartesian origin to the circle through P ; whereas the combination $\sqrt{a^2 + b^2 + \lambda}$ is the radius ρ_1 .

TRANSFORMATIONS

A co-ordinate is always measured with respect to a fixed origin or base or *frame of reference* of some sort. The analytical method gains by choosing the frame so as to simplify the treatment of the problem in hand, and in particular to take advantage of any symmetry. If there is one fixed point outstanding among the data, we may take this as cartesian origin. If there is a pair of equal importance, we may put the origin midway between them, and take the axis of x to join them, so that their co-ordinates are $(a, 0)$, $(-a, 0)$. If the problem is descriptive and involves a triangle, areal co-ordinates are indicated, and so on. For example, the property of the existence of the centre of gravity of a triangle, where the medians concur, becomes the mere statement that there exists a point whose areal co-ordinates are $(1, 1, 1)$.

We often need to change the frame of reference in the middle of a piece of work, and to express, in terms of the new system, any result already obtained in terms of the old co-ordinates. We must find expressions to substitute for each of the old co-ordinates separately, that involve the new co-ordinates and the constants determining the new frame of reference in relation to the old, but that do not involve the other one of the old co-ordinates. Thus the change from cartesian to polar co-ordinates, with the same origin and axis, is effected by $x = r \cos \theta$, $y = r \sin \theta$; and the change back again by $r = \sqrt{x^2 + y^2}$, $\theta = \tan^{-1} y/x$.

If we change from one rectangular frame of axes XOY to another $X'O'Y'$, we must know the co-ordinates $OA = a$, $AO' = b$ of the new origin O' referred to the old axes, and also the angle ϕ of the $O'X'$ and OX . Then if P is any point, and (x, y) , (x', y') its two pairs of co-ordinates, we find:

$$x = a + x' \cos \phi - y' \sin \phi, \quad y = b + x' \sin \phi + y' \cos \phi;$$

and if, at a later point in the work, we wish to translate results involving x', y' into terms of the old co-ordinates we must use

$$x' = (x - a) \cos \phi + (y - b) \sin \phi, \\ y' = -(x - a) \sin \phi + (y - b) \cos \phi,$$

so as to eliminate the new co-ordinates.

If x', y' are point co-ordinates in a plane, π' , and we make a substitution of the form

$$x' = f_1(x, y), \quad y' = f_2(x, y), \quad (1)$$

and interpret x, y as point co-ordinates in another plane π , then to any point P of π there corresponds the particular point P' of π' , homologue of P , whose co-ordinates are given by (1). If P moves and describes a curve k , then P' also moves and describes a curve k' , which corresponds to k , and whose properties can be deduced from those in the other plane. If P' is a given point of π' , there corresponds to it all the group of points whose co-ordinates satisfy (1), when in these equations we regard x', y' as known and x, y as unknown. If P' lies on k' , in general only one of the group lies on k . Thus the two curves are transformed into one another so that each point of either corresponds to one and only one of the other. In particular, if (1) are such that they can be solved in the same form $x = f_1'(x', y')$, $y = f_2'(x', y')$, then there is a 1, 1 correspondence between all the points of the two planes, and not only between the points of the two curves.

The degree of a 1, 1 plane transformation is that of the curve in either plane which corresponds to a line in the other. If the two planes are identical, we have a transformation of the plane into itself. The simplest examples are translation, rotation, similarity and their combinations, which are all linear transformations, and inversion, which is quadratic. The last transforms P into the point P' of OP such that $OP \cdot OP' = \text{constant}$; it can be expressed by

$$x' = \frac{a^2 x}{x^2 + y^2}, \quad y' = \frac{a^2 y}{x^2 + y^2},$$

and the reverse equations have the same form. Two different maps of the same region of the earth's surface are 1, 1 transformations of it and of each other. For example, one may show the whole world as a rectangle, and the other may show it as a pair of circles. The shapes of Australia are quite different; but each spot within one map corresponds to one and only one within the other. This is not true of points on the boundaries, which are exceptional. (See CONFORMAL REPRESENTATION.)

So far we have considered co-ordinates of points only; but any variable geometrical object can have co-ordinates, for example, the lines or circles of the plane. If x, y are the cartesian co-ordinates of a point P , the equation of any line l can be taken in standard form $\alpha x + \beta y = 1$, where α, β are the reciprocals of the intercepts which l makes on the axes. For different values of α, β , we can identify l with any given line: thus α, β may be taken as the *line co-ordinates* of l . If x, y are constants and α, β variable, the equation expresses that the variable line l passes through the fixed point P , and is the equation of the point in line co-ordinates. Just as any equation in point co-ordinates defines a continuous set of points lying on a locus, which is a line if the equation is of degree 1, so an equation in line co-ordinates defines a continuous set of lines all touching a curve, called an *envelope* from this point of view, which is a point if the equation is of degree 1. For this reason, line co-ordinates are often called *tangential co-ordinates*. In general, the degree of the envelope is the number of tangents, real or imaginary, which can be drawn to the curve from any given point. This number is called the *class* of the curve, and is equal to the degree n if $n = 1$ or 2, but for $n \geq 3$, the two are not generally the same.

Any piece of analysis, which has a geometrical meaning when a pair of variables are taken to be the co-ordinates of a point, has another meaning when the same variables are taken instead to be the co-ordinates of a line; and all such geometrical theorems occur in pairs, *dual* to each other. Corresponding to any plane figure built up from points and the lines joining them, there is, a dual figure, built up in the same way from lines and their points of intersection. For any statement about the one, there is a statement about the other, exactly the same except that points

and lines are replaced by lines and points; and the analytical proofs are the same, except for the definitions of the symbols. The perpendicular distance of the line l from O is p where $1/p^2 = \alpha^2 + \beta^2$; the line equation $\alpha^2 + \beta^2 = 1$ is satisfied by any line at unit distance from O and the envelope represented by this equation is the circle of unit radius centre O . The same equation

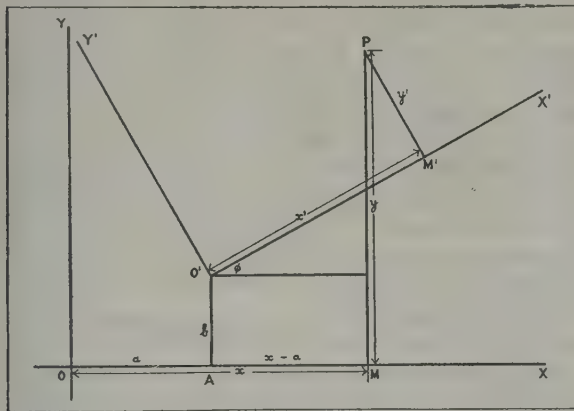


FIG. 4.—CHART SHOWING THE CHANGE OF RECTANGULAR AXES

in point co-ordinates represents the same circle, which is a self-dual figure.

THREE OR MORE DIMENSIONS

In three dimensions, a point requires three co-ordinates; a single equation between them represents a surface. For a curve, two equations at least are necessary; since each by itself gives a surface, the points whose co-ordinates satisfy both equations are those lying on both surfaces, and the curve represented is their complete intersection. If this total intersection breaks up into distinct curves, to represent one curve k apart from the other, we use the equation of another surface which passes through k but not through the other curve. There may or may not exist two surfaces whose total intersection is k ; if not, k cannot be represented by less than three equations. Thus the intersection of two quadrics can consist of a line and a twisted cubic curve. We can represent the line alone by the equations of two planes passing through it, for these have no other common curve; but to express the cubic we use the equation of a third quadric through it, meeting the first two in different lines.

In space, the general bilinear equation in two sets of three variables $\alpha x + \beta y + \gamma z = 1$, according to the way we interpret it, represents either a point or a plane, and these elements are dual to each other. A line may be regarded either as the intersection of two planes or as the join of two points, and, in either point or plane co-ordinates, can be represented by two linear equations. The whole set of lines in space is a fourfold infinity, and a line requires four independent or five homogeneous co-ordinates. It is more symmetrical and convenient to use a set of six homogeneous co-ordinates, which are connected by one quadratic identity, and whose ratios involve four independent quantities. If the line is defined as the intersection of two planes whose point equations are

$$\begin{aligned} a_1x + a_2y + a_3z + a_4 &= 0, \\ b_1x + b_2y + b_3z + b_4 &= 0, \end{aligned}$$

the co-ordinates of the line are the six quantities $p_{23}, p_{31}, p_{12}, p_{14}, p_{24}, p_{34}$, where $p_{ab} \equiv a_ab_b - a_bb_a$, connected by the identity:—

$$p_{23}p_{14} + p_{31}p_{24} + p_{12}p_{34} = 0.$$

As far as the algebra is concerned, there is no essential difference, except in complexity, between three dimensions and any higher number. Most people's imagination can deal with line, plane and space, and stops short there; but analytic geometry is more than imagination. With proper extensions, the ideas and language suitable to the lower dimensions, and partly supplied by everyday life, can be carried on. We agree to call a set of n numbers the co-ordinates of a point in a space of n dimensions, the series of sets satisfying one linear equation a *hyperplane*, and so on. This

may seem to be geometry in name only; but properties of lower space suggest valid and interesting extensions in higher space, that retain their geometrical tinge, and, conversely, many results in ordinary space have been suggested, or their mutual relations illuminated, by work in higher dimensions, which, to a specialist imagination, is as geometrical as the lower ranges are to everybody. Moreover, though it is not easy to imagine a fourfold infinity of points, we are familiar with the higher orders of infinity in other objects, for example, all the lines of ordinary space, or all the conics in a plane. Thus the six homogeneous co-ordinates p_{ab} of a line in three dimensions may be interpreted as homogeneous co-ordinates of a point in space of five dimensions, lying on the quadric in that space whose equation is given by the quadratic identity satisfied by the p 's.

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(H. P. Hu.; X.)

ANALYTIC JUDGMENT: see ANALYSIS.

ANALYTIC MECHANICS: see MECHANICS.

ANAMALAI HILLS (ANAIMALAI), a range of mountains in southern India, in the Coimbatore district of Madras, between $10^\circ 13'$ and $10^\circ 31' N.$, and between $76^\circ 52'$ and $77^\circ 23' E.$, forming a portion of the Western Ghats, south of the Palghat pass. They consist of a forest-clad and grassy tableland, with summits rising about 8,000 ft.; Anaimudi peak (8,850 ft.) is the highest in southern India. Their formation is metamorphic gneiss, veined with felspar and quartz, and interspersed with reddish porphyrite. The lower slopes yield teak and other timber.

ANAMORPHOSIS (än'a-môr'fô-sis) [Gr.], a deformation or distortion of appearance in drawing, the representation of an object as seen; for instance, as altered by reflection in a mirror; in botany, e.g., in the case of fungi or lichens, an abnormal change giving the appearance of a different species.

'ANAN BEN DAVID, a Persian Jew of the 8th century, and founder within Judaism of the sect of Qaraites (Karaites) which set itself in opposition to the rabbinic tradition. 'Anan ben David was an unsuccessful candidate for the dignity of Exilarch, and thus his opposition to the rabbanite Jews was political as well as theological. His secession occurred at a moment when the time was ripe for a reaction against rabbinism, and 'Anan became the rallying point for many opponents of tradition. (See QARAITES.)

ANANDA, one of the principal disciples of the Buddha (q.v.), known as the beloved disciple of the Buddhist story. According to the commentaries he was the son of Amitodana, an uncle of the Buddha, entered the order in the second year of the Buddha's ministry, and in the 25th year was appointed his permanent attendant. He attained enlightenment just before the first council, of which he was a member, and at which he repeated the *Suttapitaka*. From canonical passages we learn that he persuaded the Buddha to allow women to become nuns, and he is represented as being interlocutor in many discourses and the actual author of several. A collection of verses is ascribed to him in *Thera-gāthā*, 1,018 ff. In the time of Fa Hien (4th century A.D.) his relics were worshipped at Vesālī, and special devotion was shown by the nuns owing to his having obtained their admission to the order. (E. J. T.)

ANANIAS, the Greek form of Hananiah or Ananiah, a not uncommon name in the Bible. Best known are (1) A member of the first Christian community who, with his wife Sapphira, was punished by Peter with sudden death for falsehood (Acts v. 1-10; cf. Josh. vii.). (2) A disciple at Damascus in the story of the conversion and baptism of Paul (Acts ix. 10-17, xxii. 12-16). (3) Son of Nedeaios (Jos. Ant. xx. 5. 2), a high priest who presided during the trial of Paul at Jerusalem (Acts xxiii. 2, xxiv. 1-5). He was high priest A.D. 47-59, and being accused of acts of violence was sent to Rome for trial (A.D. 52), but was acquitted by the

emperor Claudius. As a friend of the Romans he was murdered by the people at the beginning of the Jewish war of revolt.

ANANKE (Ἀνάγκη), Necessity or Fate personified. She is fairly prominent in posthomerian literature and theological speculation, particularly Orphic, but is definitely known to emerge into cult only at Corinth, where she was worshipped with *Bia* (Might, Force), see Pausanias, ii, 4, 6; there are one or two faint and dubious traces of her cult elsewhere. In literature, she is associated with *Adrasteia*, the *Moirai*, and similar deities. In Italy she does not appear to have been worshipped at all; the famous description of *Necessitas* (Ananke) in Horace, *Carm.* i, 35, 17, which makes her attendant on Tyche, is purely literary.

See Roscher's *Lexikon*, arts. Ananke, Necessitas.

ANANTAPUR, a town and district of India, in the Madras presidency. The town has a station on the Madras railway, 62 mi. S.E. from Bellary. Pop. (1941) 21,482. The district of Anantapur was constituted in 1882 out of the unwieldy district of Bellary. It has an area of 6,734 sq.mi., and the north and centre form a high plateau, generally undulating, with large granite rocks or low hill ranges rising here and there above its surface. The south is more hilly, the plateau there rising to 2,600 ft. above the sea. There is a remarkable fortress rock at Gooty, and a similar but larger rock at Penukonda, over 3,000 ft. above the sea. Gooty fortress was a stronghold of the Maharrattas, but was taken from them by Hyder Ali. In 1789 it was ceded by Tippoo Sahib to the nizam, and in 1800 the nizam ceded the district of Anantapur with others to the British in payment for a subsidiary British force. The population in 1941 was 1,171,419. The principal crops are millet, rice, other food grains, pulse, oil seeds and cotton. There are factories for pressing cotton. Two railways traverse the district.

ANAPA, a port on the Black sea, north of Novorossisk, in the North Caucasian area of the R.S.F.S.R., 44° 58' N. 37° 18' E. It was formerly the scene of struggles between the Turks and Russians, until it became Russian in 1829. The fortifications were dismantled by the Russians during the Crimean War (1855). Pop. (1935) 13,180. The district has an experimental station for the encouragement of vinegrowing and wine manufacture. Anapa is on the site of the ancient Gorgippa.

See M. I. Rostovtsev, *Iranians and Greeks in S. Russia*, with a bibl. (Oxford, 1922).

ANAPAEST, a metrical foot consisting of three syllables, the first two short and the third long (from Gr. *anapaistos*, beaten upwards). An anapaestic verse is one which contains only or mostly anapaests. In Greek tragedy, a passage in this metre denotes a marching movement of the chorus or an actor.

ANAPHRODISIACS are agents used to allay sexual desire. In general mild sedatives may accomplish this effect, such as bromides or luminal. Avoidance of a diet rich in meats and spices, and especially of intoxicating beverages, is important. Epsom salts in the usual purgative doses may be of service. Failing benefit by such means the advice of a psychiatrist may be helpful.

ANAPHYLAXIS is a state of exaggerated susceptibility to a foreign protein occurring in animals or man, initiated by a primary (sensitizing) injection of the foreign protein and becoming manifest following a secondary (shocking, assailing, intoxicating) injection of the same protein. Charles Richet, who introduced the term in 1893, found that the second injection of eel serum into an animal produced serious (often fatal) reactions which were not produced by the first injection and used the term to signify a state which was the antithesis of prophylaxis, a state of protection or immunity commonly produced by the injection of bacterial toxins. Anaphylaxis has been produced in many species of animals. It has been studied most thoroughly in guinea pigs, dogs and rabbits, and the anaphylactic reaction or anaphylactic shock produced by the second injection of a foreign protein in guinea pigs is referred to as the Theobald Smith phenomenon.

The Anaphylactic Reaction.—The anaphylactic reaction is characteristic for the species of animal in which it occurs and is not determined by the foreign protein employed to produce it. If, for example, a guinea pig be injected intravenously, subcutaneously or intraperitoneally with an appropriate amount of horse serum, egg albumin or other protein substance, it gradually

becomes sensitized to the protein injected, so that, after a suitable interval (called incubation period) of 10 to 14 days, the reinjection of this protein produces anaphylactic shock. Within a period of a few minutes after reinjection the animal sneezes, scratches its nose, becomes restless, usually discharges urine and faeces and has great difficulty in breathing. The latter may increase until the animal dies from asphyxia as the result of inability, in spite of violent effort, to effectively ventilate its lungs. The difficulty in respiration is caused by an intense spastic contraction of the bronchioles. In the dog the prominent phenomena are vomiting, defecation, marked fall in blood pressure, collapse and incoagulability of the blood. In the rabbit the prominent phenomena are alternate and fleeting hyperaemia and pallor of the ears, discharge of urine and faeces, weakness, cardiac irregularities and collapse. Many minor phenomena, e.g., decrease in the number of circulating white blood cells and increase in the formation of lymph, also occur in these animals. If an animal survives, it is for a short time (one to two days) refractory to a subsequent injection of the foreign protein and is said to be antianaphylactic as the result of the desensitization produced.

Anaphylactic phenomena occur in various isolated tissues derived from sensitized animals; e.g., the isolated uterus or a small portion of the intestine from guinea pigs, when suspended in an oxygenated and warm saline bath, contracts markedly when minute amounts of the foreign protein are added to the bath. This reaction, referred to as the Schultz-Dale test, is so delicate and specific that fractions of a milligram of foreign protein can be detected in this manner.

Localized anaphylactic phenomena are seen in some animals. When the specific foreign protein is injected subcutaneously or intracutaneously into a sensitized rabbit, there may result within the ensuing 48 hr., swelling, induration and gangrenous slough at the site of the injection. This local reaction was first described by Maurice Arthus and is referred to as the phenomenon of Arthus.

Relation to Immune Processes.—The anaphylactic reaction can be produced by substances which, when injected, lead to the production of antibodies, and which for this reason are called antigens or anaphylactogens. The antibodies concerned with the anaphylactic reaction are called precipitins. The association of antibodies with the anaphylactic reaction is most clearly shown by the demonstration of passive transfer of anaphylactic sensitivity. Although an incubation period of several weeks is usually required for an animal to become actively sensitized following the injection of an antigen, it may become passively sensitized within a few hours by the injection of blood serum from another animal which has been actively sensitized. Since the ability of such a serum to convey passive sensitization is correlated with its content of precipitin antibodies, the latter are considered to be the anaphylactic antibodies.

(See also ALLERGY; IMMUNITY.)

The Mechanism of Production.—The means by which the anaphylactic reaction is produced are not thoroughly understood and there are, therefore, numerous theories which attempt to explain the reaction. One of the earliest theories postulated the anaphylactic antibodies to be enzymes which had the capacity to digest the foreign protein (upon its second administration), thereby liberating toxic degradation products called anaphylotoxins. This theory is no longer considered valid, primarily because it has been shown that the anaphylactic reaction can be produced by the reinjection of quantities of the antigen so minute as to preclude the formation of toxic fractions of requisite potency.

A later theory (postulated first by Henry H. Dale in 1929) holds that the anaphylactic phenomena are produced by means of anaphylotoxins which have been liberated from the tissues of the sensitized animal in some unknown manner as the result of the interaction between antigen and antibodies. There is evidence for the liberation of histamine (which can account for such phenomena as smooth muscle contraction, capillary dilatation and fall of blood pressure) and heparin (which can account for the incoagulability of the blood) in some animals, but all of the phenomena of anaphylaxis are not accounted for by the agents

thus far identified as released in the reaction. Drugs which have a definite antidotal action against histamine (e.g., benadryl, pyribenzamine, neo-antergan) have some prophylactic action against anaphylactic reactions in animals.

Anaphylactic Phenomena in Man.—Typical anaphylactic shock has been seen in man in a few instances. It has occurred following the injection of therapeutic sera used in the treatment of diphtheria, scarlet fever, etc. It is characterized by symptoms of apprehension, difficulty in breathing, fall in blood pressure and collapse. Occasionally, convulsions have been described. Despite the infrequency with which reactions occur, it is customary to test an individual for sensitivity (for methods see ALLERGY) before administering large amounts of serum.

In addition, therapeutic sera are treated in various ways to reduce the chance of anaphylactic reactions, and it is a wise precaution to have epinephrine available for prompt injection, should untoward symptoms appear.

Serum sickness, which occurs more frequently in man following the injection of sera than does acute anaphylaxis, is characterized by the appearance of urticaria, fever, joint pains and enlarged lymph nodes about seven or eight days after the administration of the serum.

The exact relationship of serum sickness to anaphylaxis is not known, but it is usually regarded as an anaphylactic reaction, subacute in type and delayed in onset.

Some students consider the manifestations of allergy to be anaphylactic phenomena, but with respect to this there is considerable disagreement. There are both similarities and differences and the exact relationship between them has not been established.

Detailed discussions of anaphylaxis will be found in the standard textbooks on immunology, pathology and allergy.

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ANARCHISM, the name given to a principle or theory of life and conduct under which society is conceived without government (from Gr. *an-* and *archē*, without authority)—harmony in such a society being obtained, not by submission to law, or by obedience to any authority, but by free agreements concluded between the various groups, territorial and professional, freely constituted for the sake of production and consumption, as also for the satisfaction of the infinite variety of needs and aspirations of a civilized being. In a society developed on these lines, the voluntary associations which already now begin to cover all the fields of human activity would take a still greater extension so as to substitute themselves for the State in all its functions. They would represent an interwoven network, composed of an infinite variety of groups and federations of all sizes and degrees, local, regional, national and international—temporary or more or less permanent—for all possible purposes: production, consumption and exchange, communications, sanitary arrangements, education, mutual protection, defence of the territory, and so on; and, on the other side, for the satisfaction of an ever-increasing number of scientific, artistic, literary and sociable needs. Moreover, such a society would represent nothing immutable. On the contrary—as is seen in organic life at large—harmony would (it is contended) result from an ever-changing adjustment and readjustment of equilibrium between the multitude of forces and influences, and this adjustment would be the easier to obtain as none of the forces would enjoy a special protection from the State.

If, it is contended, society were organized on these principles, man would not be limited in the free exercise of his powers in productive work by a capitalist monopoly, maintained by the State; nor would he be limited in the exercise of his will by a fear of punishment, or by obedience towards individuals or metaphysical entities, which both lead to depression of initiative and servility of mind. He would be guided in his actions by his own understanding, which necessarily would bear the impression of a free action and reaction between his own self and the ethical

conceptions of his surroundings. Man would thus be enabled to obtain the full development of all his faculties, intellectual, artistic and moral, without being hampered by overwork for the monopolists, or by the servility and inertia of mind of the great number. He would thus be able to reach full *individualization*, which is not possible either under the present system of *individualism*, or under any system of State Socialism in the so-called *Volkstaat* (popular State).

The Anarchist writers consider, moreover, that their conception is not a Utopia, constructed on the a priori method, after a few desiderata have been taken as postulates. It is derived, they maintain, from an *analysis of tendencies* that are at work already, even though State Socialism may find a temporary favour with the reformers. The progress of modern technics, which wonderfully simplifies the production of all the necessities of life; the growing spirit of independence, and the rapid spread of free initiative and free understanding in all branches of activity—including those which formerly were considered as the proper attribution of Church and State—are steadily reinforcing the no-government tendency.

Anarchists and the State.—As to economical conceptions, the Anarchists, in common with all Socialists, of whom they constitute the left wing, maintain that the now prevailing system of private ownership in land, and our capitalist production for the sake of profits, represent a monopoly which runs against both the principles of justice and the dictates of utility. They are the main obstacle which prevents the successes of modern technics from being brought into the service of all, so as to produce general well-being. The Anarchists consider the wage-system and capitalist production altogether as an obstacle to progress. But they point out also that the State was, and continues to be, the chief instrument for permitting the few to monopolize the land, and the capitalists to appropriate for themselves a quite disproportionate share of the yearly accumulated surplus of production. Consequently, while combating the present monopolization of land, and capitalism altogether, the anarchists combat with the same energy the State, as the main support of that system, not this or that special form, but the State altogether, whether it be a monarchy or even a republic governed by means of the *referendum*.

The State organization, having always been, both in ancient and modern history (Macedonian empire, Roman empire, modern European States grown up on the ruins of the autonomous cities), the instrument for establishing monopolies in favour of the ruling minorities, cannot be made to work for the destruction of these monopolies. The Anarchists consider, therefore, that to hand over to the State all the main sources of economical life—the land, the mines, the railways, banking, insurance, and so on—as also the management of all the main branches of industry, in addition to all the functions already accumulated in its hands (education, State-supported religions, defence of the territory, etc.), would mean to create a new instrument of tyranny. State capitalism would only increase the powers of bureaucracy and capitalism. True progress lies in the direction of decentralization, both *territorial* and *functional*, in the development of the spirit of local and personal initiative, and of free federation from the simple to the compound, in lieu of the present hierarchy from the centre to the periphery.

In common with most Socialists, the Anarchists recognize that, like all evolution in nature, the slow evolution of society is followed from time to time by periods of accelerated evolution which are called revolutions; and they think that the era of revolutions is not yet closed. Periods of rapid changes will follow the periods of slow evolution, and these periods must be taken advantage of—not for increasing and widening the powers of the State, but for reducing them, through the organization in every township or commune of the local groups of producers and consumers, as also the regional, and eventually the international, federations of these groups.

In virtue of the above principles the anarchists refuse to be party to the present State organization and to support it by infusing fresh blood into it. They do not seek to constitute, and

invite the working men not to constitute, political parties in the parliaments. Accordingly, since the foundation of the first International Working Men's Association in 1864, they have endeavoured to promote their ideas directly amongst the labour organizations and to induce those unions to a direct struggle against capital, distrusting parliamentary legislation.

Historical Development of Anarchism.—The conception of society just sketched, and the tendency which is its dynamic expression, have always existed in mankind, in opposition to the governing hierarchic conception and tendency—now the one and now the other taking the upper hand at different periods of history. To the former tendency we owe the evolution, by the masses themselves, of those institutions—the clan, the village community, the guild, the free mediaeval city—by means of which the masses resisted the encroachments of the conquerors and the power-seeking minorities. The same tendency asserted itself with great energy in the great religious movements of mediaeval times, especially in the early movements of the reform and its forerunners. At the same time it evidently found its expression in the writings of some thinkers, since the times of Lao-tsze, although, owing to its non-scholastic and popular origin, it obviously found less sympathy among the scholars than the opposed tendency.

As has been pointed out by Prof. Adler in his *Geschichte des Sozialismus und Kommunismus*, Aristippus (b. c. 430 B.C.), one of the founders of the Cyrenaic school, already taught that the wise must not give up their liberty to the State, and in reply to a question by Socrates he said that he did not desire to belong either to the governing or the governed class. Such an attitude, however, seems to have been dictated merely by an Epicurean attitude towards the life of the masses.

The best exponent of Anarchist philosophy in ancient Greece was Zeno (342–267 or 270 B.C.), from Crete, the founder of the Stoic philosophy, who distinctly opposed his conception of a free community without government to the State Utopia of Plato. He repudiated the omnipotence of the State, its intervention and regimentation, and proclaimed the sovereignty of the moral law of the individual—remarking already that, while the necessary instinct of self-preservation leads man to egotism, nature has supplied a corrective to it by providing man with another instinct—that of sociability. When men are reasonable enough to follow their natural instincts, they will unite across the frontiers and constitute the *Cosmos*. They will have no need of law-courts or police, will have no temples and no public worship, and use no money—free gifts taking the place of the exchanges. Unfortunately, the writings of Zeno have not reached us and are only known through fragmentary quotations. However, the fact that his very wording is similar to the wording now in use, shows how deeply is laid the tendency of human nature of which he was the mouthpiece.

In mediaeval times we find the same views on the State expressed by the illustrious bishop of Alba, Marco Girolamo Vida, in his first dialogue *De dignitate reipublicae* (Ferd. Cavalli, in *Mem. dell' Istituto Veneto*, xiii.; Dr. E. Nys, *Researches in the History of Economics*). But it is especially in several early Christian movements, beginning with the 9th century in Armenia, and in the preachings of the early Hussites, particularly Chojceki, and the early Anabaptists, especially Hans Denk (cf. Keller, *Ein Apostel der Wiedertäufer*), that one finds the same ideas forcibly expressed—special stress being laid of course on their moral aspects.

Rabelais and Fénelon, in their Utopias, have also expressed similar ideas, and they were also current in the 18th century amongst the French Encyclopaedists, as may be concluded from separate expressions occasionally met with in the writings of Rousseau, from Diderot's *Preface to the Voyage of Bougainville*, and so on. However, in all probability, such ideas could not be developed then, owing to the rigorous censorship of the Roman Catholic Church.

These ideas found their expression later during the great French Revolution. While the Jacobins did all in their power to centralize everything in the hands of the Government, it appears now, from recently published documents, that the masses of the people,

in their municipalities and "sections," accomplished a considerable constructive work. They appropriated for themselves the election of the judges, the organization of supplies and equipment for the army, as also for the large cities work for the unemployed, the management of charities, and so on. They even tried to establish a direct correspondence between the 36,000 communes of France through the intermediary of a special board, outside the National Assembly (cf. Sigismund Lacroix, *Actes de la commune de Paris*).

It was W. Godwin, in his *Enquiry concerning Political Justice* (2 vols., 1793), who was first to formulate the political and economical conceptions of anarchism, even though he did not give that name to the ideas developed in his remarkable work. Laws, he wrote, are not a product of the wisdom of our ancestors: they are the product of their passions, their timidity, their jealousies and their ambition. The remedy they offer is worse than the evils they pretend to cure. If and only if all laws and courts were abolished, and the decisions in the arising contests were left to reasonable men chosen for that purpose, real justice would gradually be evolved. As to the State, Godwin frankly claimed its abolition. A society, he wrote, can perfectly well exist without any government: only the communities should be small and perfectly autonomous. Speaking of property, he stated that the rights of every one "to every substance capable of contributing to the benefit of a human being" must be regulated by justice alone: the substance must go "to him who most wants it." His conclusion was communism. Godwin, however, had not the courage to maintain his opinions. He entirely rewrote later on his chapter on property and mitigated his Communist views in the second edition of *Political Justice* (8vo., 1796).

Proudhon Names Anarchy.—Proudhon was the first to use, in 1840 (*Qu'est-ce que la propriété?* first memoir), the name of anarchy with application to the no-government state of society. The name of "anarchists" had been freely applied during the French Revolution by the Girondists to those revolutionaries who did not consider that the task of the Revolution was accomplished with the overthrow of Louis XVI., and insisted upon a series of economical measures being taken (the abolition of feudal rights without redemption, the return to the village communities of the communal lands enclosed since 1669, the limitation of landed property to 120 acres, progressive income-tax, the national organization of exchanges on a just value basis, which already received a beginning of practical realization, and so on).

Now Proudhon advocated a society without government, and used the word anarchy to describe it. Proudhon repudiated, as is known, all schemes of Communism, according to which mankind would be driven into communistic monasteries or barracks, as also all the schemes of State or State-aided Socialism which were advocated by Louis Blanc and the collectivists. When he proclaimed in his first memoir on property that "Property is theft," he meant only property in its present, Roman law sense of "right of use and abuse"; in property rights, on the other hand, understood in the limited sense of *possession*, he saw the best protection against the encroachments of the State. At the same time he did not want violently to dispossess the present owners of land, dwelling-houses, mines, factories, and so on. He preferred to attain the same end by rendering capital incapable of earning interest; and this he proposed to obtain by means of a national bank, based on the mutual confidence of all those who are engaged in production, who would agree to exchange among themselves their products at cost-value, by means of labour cheques representing the hours of labour required to produce every given commodity. Under such a system, which Proudhon described as "Mutuellisme," all the exchanges of services would be strictly equivalent. Besides, such a bank would be enabled to lend money without interest, levying only something like 1%, or even less, for covering the cost of administration. Every one being thus enabled to borrow the money that would be required to buy a house, nobody would agree to pay any more a yearly rent for the use of it. A general "social liquidation" would thus be rendered easy, without violent expropriation. The same applied to mines, railways, factories, and so on.

In a society of this type the State would be useless. The chief relations between citizens would be based on free agreement and regulated by mere account keeping. The contests might be settled by arbitration. A penetrating criticism of the State and all possible forms of government, and a deep insight into all economic problems, were well-known characteristics of Proudhon's work.

It is worth noticing that French mutualism had its precursor in England, in William Thompson, who began by mutualism before he became a Communist, and in his followers John Gray (*A Lecture on Human Happiness*, 1825; *The Social System*, 1831) and J. F. Bray (*Labour's Wrongs and Labour's Remedy*, 1839). It had also its precursor in America. Josiah Warren, who was born in 1798 (cf. W. Bailie, *Josiah Warren, the First American Anarchist*, Boston, 1900), and belonged to Owen's "New Harmony," considered that the failure of this enterprise was chiefly due to the suppression of individuality and the lack of initiative and responsibility. These defects, he taught, were inherent to every scheme based upon authority and the community of goods. He advocated, therefore, complete individual liberty. In 1827 he opened in Cincinnati a little country store which was the first "Equity Store," and which the people called "Time Store," because it was based on labour being exchanged hour for hour in all sorts of produce. "Cost—the limit of price," and consequently "no interest," was the motto of his store, and later on of his "Equity Village," near New York, which was still in existence in 1865. Keith's "House of Equity" at Boston, founded in 1855, is also worthy of notice.

While the economical, and especially the mutual-banking, ideas of Proudhon found supporters and even a practical application in the United States, his political conception of anarchy found but little echo in France, where the Christian Socialism of Lamennais and the Fourierists, and the State Socialism of Louis Blanc and the followers of Saint-Simon, were dominating. These ideas found, however, some temporary support among the left-wing Hegelians in Germany, Moses Hess in 1843, and Karl Grün in 1845, who advocated anarchism. Besides, the authoritarian Communism of Wilhelm Weitling having given origin to opposition amongst the Swiss working men, Wilhelm Marr gave expression to it in the '40s.

On the other side, individualist anarchism found, also in Germany, its fullest expression in Max Stirner (Kaspar Schmidt), whose remarkable works (*Der Einzige und sein Eigentum* and articles contributed to the *Rheinische Zeitung*) remained quite overlooked until they were brought into prominence by John Henry Mackay.

Prof. V. Basch, in a very able introduction to his interesting book, *L'Individualisme anarchiste: Max Stirner* (1904), has shown how the development of the German philosophy from Kant to Hegel, and "the absolute" of Schelling and the *Geist* of Hegel, necessarily provoked, when the anti-Hegelian revolt began, the preaching of the same "absolute" in the camp of the rebels. This was done by Stirner, who advocated, not only a complete revolt against the State and against the servitude which authoritarian Communism would impose upon men, but also the full liberation of the individual from all social and moral bonds—the rehabilitation of the "I," the supremacy of the individual, complete "a-moralism" and the "association of the egotists." The final conclusion of that sort of individual anarchism has been indicated by Prof. Basch. It maintains that the aim of all superior civilization is, not to permit all members of the community to develop in a normal way, but to permit certain better endowed individuals "fully to develop," even at the cost of the happiness and the very existence of the mass of mankind. It is thus a return towards the most common individualism, advocated by all the would-be superior minorities, to which indeed man owes in his history precisely the State and the rest, which these individualists combat. Their individualism goes so far as to end in a negation of their own starting-point, to say nothing of the impossibility for the individual to attain a really full development in the conditions of oppression of the masses by the "beautiful aristocracies." His development would remain unilateral. This is why

this direction of thought, notwithstanding its undoubtedly correct and useful advocacy of the full development of each individuality, finds a hearing only in limited artistic and literary circles.

Anarchism in the International Working Men's Association.—A general depression in the propaganda of all factions of Socialism followed, as is known, after the defeat of the uprising of the Paris working men in June 1848 and the fall of the republic. All the Socialist press was gagged during the reaction period, which lasted fully 20 years. Nevertheless, even anarchist thought began to make some progress, namely in the writings of Bellegarrique (*Coeurderoy*) and especially Joseph Déjacque (*Les Lazaréennes, L'Humanisphère*, an anarchist-Communist Utopia, lately discovered and reprinted). The Socialist movement revived only after 1864, when some French working men, all "mutualists," meeting in London during the Universal Exhibition with English followers of Robert Owen, founded the International Working Men's Association. This association developed very rapidly and adopted a policy of direct economical struggle against capitalism, without interfering in the political parliamentary agitation, and this policy was followed until 1871. However, after the Franco-German War, when the International Association was prohibited in France after the uprising of the Commune, the German working men who had received manhood suffrage for elections to the newly constituted imperial parliament, insisted upon modifying the tactics of the International, and began to build up a Social-Democratic political party. This soon led to a division in the Working Men's Association, and the Latin federations, Spanish, Italian, Belgian and Jurassic (France could not be represented), constituted among themselves a federal union which broke entirely with the Marxist general council of the International. Within these federations developed now what may be described as *modern anarchism*. After the names of "federalists" and "anti-authoritarians" had been used for some time by these federations the name of "anarchists," which their adversaries insisted upon applying to them prevailed, and finally it was reindicated.

Bakunin (*q.v.*) soon became the leading spirit among these Latin federations for the development of the principles of anarchism, which he did in a number of writings, pamphlets and letters. He demanded the complete abolition of the State, which—he wrote—is a product of religion, belongs to a lower state of civilization, represents the negation of liberty, and spoils even that which it undertakes to do for the sake of general well-being. The State was an historically necessary evil, but its complete extinction will be, sooner or later, equally necessary. Repudiating all legislation, even when issuing from universal suffrage, Bakunin claimed for each nation, each region and each commune, full autonomy, so long as it is not a menace to its neighbours, and full independence for the individual, adding that one becomes really free only when, and in proportion as, all others are free. Free federations of the communes would constitute free nations.

As to his economical conceptions, Bakunin described himself, in common with his federalist comrades of the International (Cesar De Paepe, James Guillaume, Schwitzguébel), a "collectivist anarchist"—not in the sense of Vidal and Pecqueur in the '40s, or of their modern Social-Democratic followers, but to express a state of things in which all necessities for production are owned in common by the Labour groups and the free communes, while the ways of retribution of Labour, Communist or otherwise, would be settled by each group for itself. Social revolution, the near approach of which was foretold at that time by all Socialists, would be the means of bringing into life the new conditions.

Anarchism and Violence.—The Jurassic, the Spanish, and the Italian federation and sections of the International Working Men's Association, as also the French, the German and the American anarchist groups, were for the next years the chief centres of anarchist thought and propaganda. They refrained from any participation in parliamentary politics, and always kept in close contact with the Labour organizations. However, in the second half of the '80s and the early '90s of the 19th century, when the influence of the anarchists began to be felt in strikes, in May-

day demonstrations, where they promoted the idea of a general strike for an eight-hour day, and in the anti-militarist propaganda in the army, violent prosecutions were directed against them, especially in the Latin countries (including physical torture in the Barcelona castle) and the United States (the execution of four Chicago anarchists in 1887). Against these prosecutions the anarchists retaliated by acts of violence which in their turn were followed by more executions from above, and new acts of revenge from below. This created in the general public the impression that violence is the substance of anarchism, a view repudiated by its supporters, who hold that in reality violence is resorted to by all parties in proportion as their open action is obstructed by repression, and exceptional laws render them outlaws. (Cf., *Anarchism and Outrage*, by C. M. Wilson, and *Report of the Spanish Atrocities Committee*, in "Freedom Pamphlets"; *A Concise History of the Great Trial of the Chicago Anarchists*, by Dyer Lum (N.Y., 1886); *The Chicago Martyrs: Speeches*, etc.)¹

Anarchism continued to develop, partly in the direction of Proudhonian "Mutuellisme," but chiefly as Communist-anarchism, to which a third direction, Christian-anarchism, was added by Leo Tolstoi, and a fourth, which might be ascribed as literary-anarchism, began amongst some prominent modern writers.

The ideas of Proudhon, especially as regards mutual banking, corresponding with those of Josiah Warren, found a considerable following in the United States, creating quite a school, of which the main writers are Stephen Pearl Andrews, William Grene, Lysander Spooner (who began to write in 1850, and whose unfinished work, *Natural Law*, was full of promise) and several others, whose names will be found in Dr. Nettlau's *Bibliographie de l'anarchie*.

¹It is important to remember that the term "anarchist" is inevitably rather loosely used in public in connection with the authors of a certain class of murderous outrages, and that the same looseness of definition often applies to the professions of "anarchism" made by such persons. As stated above, a philosophic anarchist would repudiate the connection. And the general public view, which regards anarchist doctrines indiscriminately, is to that extent a confusion of terms. But the following résumé of the chief modern so-called "anarchist" incidents is appended for convenience in stating the facts under the heading where a reader would expect to find them.

Between 1882 and 1886 in France, Prince Kropotkin, Louise Michel and others were imprisoned. In England, Most, one of the German anarchist leaders, founded *Die Freiheit*, and, for defending in it the assassination of Alexander II. at St. Petersburg, was sentenced to 18 months' imprisonment with hard labour. After this he moved to the United States, and re-established his paper there in New York, in May 1886. During this period there were several anarchist congresses in the United States. In one at Albany, in 1878, the revolutionary element, led by Justus Schwab, broke away from the others; at Allegheny city, in 1879, again there was a rupture between the peaceful and the revolutionary sections. *The Voice of the People* at St. Louis, the *Arbeiter Zeitung* at Chicago, and the *Anarchist* at Boston, were the organs of the revolutionary element. In 1883, at Pittsburgh, a congress of 28 delegates, representing 22 towns, drew up an address to the working men of America. The programme it proposed was as follows:—

First, Destruction of the existing class rule by all means; i.e., energetic, relentless, revolutionary and international action.

Secondly, Establishment of a free society, based upon co-operative organization of production.

Thirdly, Free exchange of equivalent products by and between the productive organizations, without commerce and profit-mongery.

Fourthly, Organization of education on a secular, scientific and equal basis for both sexes.

Fifthly, Equal rights for all, without distinction of sex or race.

Sixthly, Regulation of all public affairs by free contracts between the autonomous (independent) communes and associations, resting on a federalistic basis.

This, together with an appeal to the working men to organize, was published in Chicago, Nov. 1883, by a local committee of four, representing French, Bohemian, German and English sections, the head of the last being August Spies, who was hanged in 1887 for participation in the Haymarket affair in Chicago, May 4, 1886. This affair was the culmination of a series of encounters between the Chicago working men and the police, which had covered several years. The meeting of May 4 was called by Spies and others to protest against the action of the police, by whom several working men had been killed in collisions growing out of the efforts to introduce the eight-hour day. The mayor of the city attended the meeting, but, finding it peaceful, went home. The meeting was subsequently entered by the police and commanded to disperse. A bomb was thrown, several policemen being killed and a number wounded. For this crime eight men were tried in one panel and condemned, seven—Spies, Parsons, Engel, Fischer, Fielden, Schwab

A prominent position among the individualist anarchists in America has been occupied by Benjamin R. Tucker. His journal *Liberty* was started in 1881 and his conceptions are a combination of those of Proudhon with those of Herbert Spencer. Starting from the statement that anarchists are egotists, strictly speaking, and that every group of individuals, be it a secret league of a few persons, or the Congress of the United States, has the right to oppress all mankind, provided it has the power to do so, that equal liberty for all and absolute equality ought to be the law, and "mind every one your own business" is the unique moral law of anarchism, Tucker goes on to prove that a general and thorough application of these principles would be beneficial and would offer no danger, because the powers of every individual would be limited by the exercise of the equal rights of all others. He further indicated (following H. Spencer) the difference which exists between the encroachment on somebody's rights and resistance to such an encroachment, between domination and defence; the former being equally condemnable, whether it be encroachment of a criminal upon an individual, or the encroachment of one upon all others, or of all others upon one; while resistance to encroachment is defensible and necessary. For their self-defence, both the citizen and the group have the right to any violence including capital punishment. Violence is also justified for enforcing the duty of keeping an agreement. Tucker thus follows Spencer, and, like him, opens (in the present writer's opinion) the way for reconstituting under the heading of "defence" all the functions of the State. His criticism of the present State is very searching, and his defence of the rights of the individual very powerful. As regards his economical views B. R. Tucker follows Proudhon.

and Ling—to death, and one—Neebe—to imprisonment for 15 years. The sentences on Fielden and Schwab were commuted by Governor Oglesby to imprisonment for life, on the recommendation of the presiding judge and the prosecuting attorney. Ling committed suicide in gaol, and Spies, Parsons, Engel and Fischer were hanged, Nov. 11, 1887. On June 26, 1893, an unconditional pardon was granted the survivors, Fielden, Schwab and Neebe, by Governor Altgeld. The reasons for the pardon were stated by the governor to be that, on an examination of the records he found that the jury had not been drawn in the usual manner, but by a special bailiff, who made his own selection and had summoned a "prejudiced jury"; that the "State had never discovered who it was that threw the bomb which killed the policemen, and the evidence does not show any connection whatever between the defendants and the man who did throw it." . . . or that this man "ever heard or read a word coming from the defendants, and consequently fails to show that he acted on any advice given by them." Judge Gary, the judge at the trial, published a defence of its procedure in the *Century Magazine*, vol. xxiii., p. 803.

A number of outbreaks in later years were attributed to the propaganda of reform by revolution, like those in Spain and France in 1892, in which Ravachol was a prominent figure. In 1893 a bomb was exploded in the French Chamber of Deputies by Vaillant. The spirit of these men is well illustrated by the reply which Vaillant made to the judge who reproached him for endangering the lives of innocent men and women: "There can be no innocent bourgeois." In 1894 there was an explosion in a Parisian café, and another in a theatre at Barcelona. For the latter outrage six men were executed. President Carnot of the French Republic was assassinated by an Italian at Lyons in the same year. The Empress Elizabeth of Austria was assassinated in Sept. 1898. These events, all associated by the public with "anarchism," led to the passage by the United States Congress of a law, in 1894, to keep out foreign anarchists, and to deport any who might be found in the country, and also to the assemblage of an international conference in Rome, in 1898, to agree upon some plan for dealing with these revolutionists. It was proposed that their offences should no longer be classed as political, but as common-law crimes, and be made subject to extradition. The suppression of the revolutionary press and the international co-operation of the police were also suggested. The results of the conference were not, however, published; and the question of how to deal with the campaign against society fell for a while into abeyance. The attempt made by the youth Spido on the (then) prince of Wales at Brussels in 1900 recalled attention to the subject. The acquittal of Spido, and the failure of the Belgian Government to see that justice was done in an affair of such international importance, excited considerable feeling in England, and was the occasion of a strongly-worded note from the British to the Belgian Government. The murder of King Humbert of Italy in July 1900 renewed the outcry against Italian anarchists. Even greater horror and indignation were excited by the assassination of President McKinley by Czolgosz on Sept. 6, 1901, at Buffalo, U.S.A. and by an attempt made to blow up the young king and queen of Spain on their wedding-day in 1906.

(Ed. E.B.)

The individualist anarchism of the American Proudhonians finds, however, but little sympathy amongst the working masses. Those who profess it—they are chiefly "intellectuals"—soon realize that the *individualization* they so highly praise is not attainable by individual efforts, and either abandon the ranks of the anarchists, and are driven into the liberal individualism of the classical economists, or they retire into a sort of Epicurean a-moralism, or super-man-theory, similar to that of Stirner and Nietzsche. The great bulk of the anarchist working men prefer the anarchist-Communist ideas which have gradually evolved out of the anarchist collectivism of the International Working Men's Association. To this direction belong—to name only the better known exponents of anarchism—Elisée Reclus, Jean Grave, Sébastien Faure, Emile Pouget in France; Enrico Malatesta and Covelli in Italy; R. Mella, A. Lorenzo, and the mostly unknown authors of many excellent manifestos in Spain; John Most amongst the Germans; Spies, Parsons and their followers in the United States, and so on; while Domela Nieuwenhuis occupied an intermediate position in Holland. The chief anarchist papers which have been published since 1880 also belong to that direction; while a number of anarchists of this direction have joined the so-called syndicalist movement—the French name for the non-political Labour movement, devoted to direct struggle with capitalism, which has lately become so prominent in Europe.

Scientific Anarchist-Communism.—As one of the anarchist-Communist direction, Peter Kropotkin for many years endeavoured to develop the following ideas: to show the intimate, logical connection which exists between the modern philosophy of natural sciences and anarchism; to put anarchism on a scientific basis by the study of the tendencies that are apparent now in society and may indicate its further evolution; and to work out the basis of anarchist ethics. As regards the substance of anarchism itself, it was Kropotkin's aim to prove that Communism—at least partial—has more chances of being established than collectivism, especially in communes taking the lead, and that free, or anarchist-Communism is the only form of Communism that has any chance of being accepted in civilized societies; Communism and anarchy are therefore two terms of evolution which complete each other, the one rendering the other possible and acceptable. He has tried, moreover, to indicate how, during a revolutionary period, a large city—if its inhabitants have accepted the idea—could organize itself on the lines of free Communism; the city guaranteeing to every inhabitant dwelling, food and clothing to an extent corresponding to the comfort now available to the middle classes only, in exchange for a half-day's or a five-hours' work; and how all those things which would be considered as luxuries might be obtained by every one if he joins for the other half of the day all sorts of free associations pursuing all possible aims—educational, literary, scientific, artistic, sports and so on. In order to prove the first of these assertions he has analysed the possibilities of agriculture and industrial work, both being combined with brain work. And in order to elucidate the main factors of human evolution he has analysed the part played in history by the popular constructive agencies of mutual aid and the historical rôle of the State.

Without naming himself an anarchist, Leo Tolstoi, like his predecessors in the popular religious movements of the 15th and 16th centuries, Chojecki, Denk and many others, took the anarchist position as regards the State and property rights, deducing his conclusions from the general spirit of the teachings of the Christ and from the necessary dictates of reason. With all the might of his talent he made (especially in *The Kingdom of God in Yourself*) a powerful criticism of the church, the State and law altogether, and especially of the present property laws. He describes the State as the domination of the wicked ones, supported by brutal force. Robbers, he says, are far less dangerous than a well-organized Government. He makes a searching criticism of the prejudices which are current now concerning the benefits conferred upon men by the church, the State and the existing distribution of property, and from the teachings of the Christ he deduces the rule of non-resistance and the absolute condemnation of all wars. His religious arguments are, however, so

well combined with arguments borrowed from a dispassionate observation of the present evils, that the anarchist portions of his works appeal to the religious and the non-religious reader alike.

It would be impossible to represent here, in a short sketch, the penetration, on the one hand, of anarchist ideas into modern literature, and the influence, on the other hand, which the libertarian ideas of the best contemporary writers have exercised upon the development of anarchism. One ought to consult the ten big volumes of the *Supplément littéraire* to the paper *La révolte* and later the *Temps nouveaux*, which contain reproductions from the works of hundreds of modern authors expressing anarchist ideas, in order to realize how closely anarchism is connected with all the intellectual movement of our own times. J. S. Mill's *Liberty*, Spencer's *Individual versus The State*, Marc Guyau's *Morality without Obligation or Sanction*, and Fouillée's *La morale, l'art et le religion*, the works of Multatuli (E. Douwes Dekker), Richard Wagner's *Art and Revolution*, the works of Nietzsche, Emerson, W. Lloyd Garrison, Thoreau, Alexander Herzen, Edward Carpenter and so on; and in the domain of fiction, the dramas of Ibsen, the poetry of Walt Whitman, Tolstoi's *War and Peace*, Zola's *Paris* and *Le travail*, the works of Merezhkovski and an infinity of works of less known authors,—are full of ideas which show how closely anarchism is interwoven with the work that is going on in modern thought in the same direction of enfranchisement of man from the bonds of the State as well as from those of capitalism. (P. A. K.)

Anarchism Since Kropotkin's Death.—Peter Kropotkin, the author of the foregoing section of this article, died in 1921, at the age of 79. The son of a distinguished Russian family, he renounced the life of the soldier and courtier which opened to him to devote himself to the natural sciences. But the reading of Proudhon turned his mind to social questions, and he became an anarchist of the Proudhonian school. To the propagation of these ideas he devoted the last 60 years of his life; and after the death of Bakunin he was probably the best known anarchist of the last two generations. Imprisoned in both Russia and Switzerland for his activities, he ultimately settled in London, where he was the centre of a distinguished circle of liberal-minded writers and Russian exiles. He wrote prolifically, some of his works, especially *Memoirs of a Revolutionist* (1901), *Mutual Aid* (1904) and *The Conquest of Bread* (1906) exercising considerable influence; while his *History of the French Revolution* is one of the best analyses of its subject written from the angle of extreme hostility to the State. In 1917, the revolution of March permitted him to return to Russia, where he lived until his death. It cannot be said that his last years were happy. He had never sympathized with the Marxist system; and his own passion for anarchist federalism found no comfort in the rigorous and authoritarian centralization of which the Bolsheviks were the sponsors. He was, however, honoured by the new régime as a great figure in the history of Russian revolutionary effort; and his house has been turned into a museum of social history.

It cannot be said, indeed, that anarchism has been other than a declining movement in recent years. It still has its groups of enthusiasts, especially in the Latin countries. Attention was drawn to it in 1909 by the execution, in the face of all the evidence, of the Spanish anarchist Francisco Ferrer, who had mainly been concerned with educational reform movements and was, on all the evidence, a man of the highest nobility of character. A wave of excitement in America in 1919 led to the deportation of certain well-known anarchists to Russia. Among these were Alexander Berkman and Emma Goldman, both of whom were well-known for their propaganda work. They found the new régime intolerable by reason of its sternly authoritarian character, and the constant imprisonment of their anarchist colleagues led them to leave Russia in disgust. Both published angry denunciations of the new system, of which *My Disillusionment in Russia* (1925), by Emma Goldman, is an interesting picture of the reaction of the Bolshevik State upon a mind strongly wedded to freedom. America again became the centre of attention in the civilized world in the summer of 1927 when, after a delay of seven years, two Italian anarchists, Sacco and Vanzetti, were executed

for supposed participation in a crime of violence (see F. Frankfurter, *The Sacco-Vanzetti Case*, 1927). As with Ferrer, 20 years before, the public opinion of the world felt that the execution had taken place less upon the evidence than for the crime of holding extreme opinions.

While anarchism in its classic form has made little headway in recent years, it can, however, claim that its central doctrines have not been without considerable influence. In the form of Proudhonian federalism it has created something like a revival of federalism in France: and the traces of this revival are to be found in the most diverse quarters. Its most usual thesis has been the danger of the centralized state to individual liberty, and under the name of Proudhon, a movement for decentralization has assumed considerable proportions. (See Charles-Brun, *Le Régionalisme* [1911]; *Cahiers du Cercle Proudhon* [1913]; and the prefaces to the complete edition of Proudhon [1927]).

Another neo-anarchist current of opinion in France derives from Stirner and is ably represented by H. L. Follin, M. L. Lefort and E. Armand.

(See especially the latter's *Initiation individualiste-anarchiste* [1923] and, generally, G. Pirou, *Les Doctrines Economiques en France depuis 1870* [1925]).

In England there has been no important anarchist thinker for many years. But, as in France, the reaction against the sovereign state had led to the growth of a political pluralism in which the influence of anarchist theories is apparent. (See, for instance, Bertrand Russell, *Roads to Freedom* [3rd ed., 1920]; H. J. Laski, *A Grammar of Politics* [1925]. G. D. H. Cole, *Social Theory* [2nd ed., 1921]). Anarchist groups, of course, remain but there is no evidence to suggest that they are at all largely influential.

(H. J. L.)

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ANASTASIUS, the name of four popes. ANASTASIUS I, pope from 399 to 401. He it was who condemned the writings of Origen shortly after their translation into Latin.

ANASTASIUS II, pope from 496 to 498. He lived in the time of the schism of Acacius of Constantinople. He showed some tendency towards conciliation, and thus brought upon himself the lively reproaches of the author of the *Liber pontificalis*. On the strength of this tradition, Dante has placed this pope in hell.

ANASTASIUS III, pope from 911 to 913, was a Roman by birth. Practically nothing is recorded of him, except that he took an active part in determining the ecclesiastical divisions of Germany, his pontificate falling in the period when Rome was, in the power of the Roman nobles.

ANASTASIUS IV was pope from 1153 to 1154. He was a Roman named Conrad, son of Benedictus, and at the time of his election, on July 9, 1153, was cardinal bishop of Sabina. He had taken part in the double election of 1130, had been one of the most determined opponents of Anacletus II and when Innocent II fled to France had been left behind as his vicar in Italy. During his short pontificate, however, he played the part of peacemaker; he came to terms with the emperor Frederick I in the vexed question of the appointment to the see of Magdeburg and closed the long quarrel, which had raged through four pontificates, about the appointment of William Fitzherbert (d. 1154)—commonly known as St. William of York—to the see of York, by sending him the pallium in spite of the continued opposition of the powerful Cistercian order. Anastasius died Dec. 3, 1154, and was succeeded by Cardinal Nicholas of Albano (Nicholas Breakspear) as Adrian IV.

ANASTASIUS I (c. 430-518), Roman emperor, was born at Dyrhachium not later than A.D. 430. At the time of the death of Zeno (491), Anastasius, a palace official (*silentarius*), bore a very high character, and was raised to the throne of the Roman empire of the East, through the choice of Ariadne, Zeno's widow, who married him shortly after his accession. His reign, though afterwards disturbed by foreign and intestine wars and religious distractions, commenced auspiciously. He gained popular favour by a judicious remission of taxation, and displayed great vigour and energy in administering the affairs of the empire. The principal wars in which Anastasius was engaged were those known as the Isaurian and the Persian wars. The former (492-496) was stirred up by the supporters of Longinus, the brother of Zeno. The victory of Cotyaeum in 493 "broke the back" of the revolt, but a guerilla warfare continued in the Isaurian mountains for some years longer. In the war with Persia (502-505), Theodosiopolis and Amida were captured by the enemy, but the Persian provinces also suffered severely and the Romans recovered Amida. Both adversaries were exhausted when peace was made (506) on the basis of *status quo*.

In 507 Anastasius built the strong fortress of Daras to hold Nisibis in check. The Balkan provinces were devastated by invasions of Slavs and Bulgarians; to protect Constantinople and its vicinity against them he built the "Anastasian Wall" in 512, extending from the Propontis to the Euxine. The emperor was a convinced Monophysite, but his ecclesiastical policy was moder-

ate; he endeavoured to maintain the principle of the *Henotikon* of Zeno and the peace of the church. It was the uncompromising attitude of the orthodox extremists, and the rebellious demonstrations of the Byzantine populace, that drove him in 512 to abandon this policy and adopt a monophysitic program of religious unity in the east at the cost of Rome's hostility. His consequent unpopularity in the European provinces was utilized by an ambitious man, named Vitalian, to organize a dangerous rebellion, in which he was assisted by a horde of "Huns" (514-515); the rebellion was finally suppressed by a naval victory won by the general Marinus. The financial policy of Anastasius was so prudent and economical that it gained him a reputation for avarice and contributed to his unpopularity. He died July 9, 518.

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ANASTASIUS II (d. 721), Roman emperor in the East, whose original name was Artemius, was raised to the throne of Constantinople in A.D. 713, on the deposition of Philippicus, whom he had served in the capacity of secretary. Anastasius sent an army under Leo the Isaurian, afterwards emperor, to defend Syria against the Saracens; adopted wise and resolute measures for the defense of his capital; attempted to reorganize the discipline of the army; and equipped and despatched to Rhodes a formidable naval force. The troops of the Opsician province, resenting the emperor's strict measures, mutinied, slew the admiral, and proclaimed Theodosius emperor. After a six months' siege, Constantinople was taken by Theodosius; and Anastasius, who had fled to Nicaea, was compelled to submit to the new emperor and, retiring to Thessalonica, became a monk (716). In 721 he headed a revolt against Leo, who had succeeded Theodosius; but the enterprise failed and Anastasius, falling into Leo's hands, was put to death by his orders.

ANASTIGMAT, or anastigmatic lens, a photographic lens free from astigmatism (*q.v.*), and which is capable of forming a large sharp image in which a relatively great quantity of light is concentrated. (See **PHOTOGRAPHY: Apparatus**.)

ANASTOMOSIS, the intercommunication between two vessels or nerves; a word used in medicine chiefly of blood vessels and other tubes in anatomy for the communication between arteries and veins containing fluid. The term is also used in operative surgery to signify the reuniting of several hollow viscera or vessels or for the making of artificial openings for the treatment of various conditions. (See **SURGERY**.) (F. L. A.)

ANATASE, one of the three mineral forms of titanium dioxide. It is always found as small, isolated and sharply developed crystals, and like rutile, a more commonly occurring modification of titanium dioxide, it crystallizes in the tetragonal system; but, although the degree of symmetry is the same for both, there is no relation between the interfacial angles of the two minerals, except, of course, in the prism-zone of 45° and 90°. There are also important differences between the physical characters of anatase and rutile; the former is not quite so hard ($H.=5\frac{1}{2}$ -6) or dense (sp. gr.=3.9); it is optically negative, rutile being positive.

Two types or habits of anatase crystals may be distinguished. The commoner occurs as simple acute double pyramids with an indigo-blue to black colour and steely lustre. Crystals of this kind are abundant at Le Bourg d'Oisans in Dauphiné, where they are associated with rock-crystal, feldspar and axinite in crevices in granite and mica-schist. Similar crystals, but of microscopic size, are widely distributed in sedimentary rocks, such as sandstones, clays and slates, from which they may be separated by washing away the lighter constituents of the powdered rock. Crystals of the second type have numerous pyramidal faces developed, and they are usually flatter or sometimes prismatic in habit; the colour is honey-yellow to brown. Such crystals occur attached to the walls of crevices in the gneisses of the Alps, the Binnenthal, Switzerland, being a well-known locality. Another common name for this mineral is octahedrite.

ANATHEMA, any curse, but especially one uttered by the Church for flagrant offenses against faith or morals, and accompanied by exclusion from the community. Such exclusion was early practised in Judaism (*cf.* Ezra x 8) and was developed into a formidable legal instrument by the rabbis (*cf.* "Ban" and "Anathema" in the *Jewish Encyclopedia*). References to the Jewish practice are found in the New Testament (*cf.* John ix 22, xii 42, xvi 2) and similar customs were early adopted by the church (*cf.* 2 Thess. iii 14; I Cor. v 5). I Cor. xii 3, xvi 22; Gal. i 8, 9 are probably no more than private curses, and Rom. ix 3 is simply a curse invoked by St. Paul against himself.

Instances of anathema in formulae of condemnation issued by councils are frequent, beginning with the 4th century, *e.g.*, a synod at Elvira (c. 300) issued an anathema against those who posted anti-Christian satires in churches and the Council of Nicaea (325) anathematized Arianism. The formula, which later became regular and official, appears in the canons of a council at Gangra (340?), "If any one (says such and such or behaves so and so), let him be anathema." A distinction between excommunication and anathema was drawn as early as the 6th century, and Pope John VIII (878) defined "excommunication" as isolation from fellow Christians and "anathema" as separation from the body of Christ, *i.e.*, the Church. The Gratian Decree interprets this definition as implying exclusion from the sacraments. In spite of occasional uncertainty in usage, "anathema" has generally been reserved as a term for the gravest censure pronounced by the Church. In the *Codex iuris canonici* (Rome, 1917), canon 2,257, it differs from excommunication only in the peculiarly solemn form in which it is pronounced.

The ecclesiastical legislation in canons 2,258-2,267 gives an excellent picture of the far-reaching effects of excommunication in Catholic society, even at the present day. Excommunicated persons are there divided into two classes, *vitandi* who have been publicly and by name denounced by the Apostolic see, and *tolerati* upon whom this sentence has not yet fallen. The society of *vitandi*, even in secular pursuits, is to be avoided except in special circumstances. Excommunicated persons may hear sermons but may not attend mass, and, although a *toleratus* attending mass need not be expelled from the church unless he attempt to take an active part in the service, a *vitandus* should be ejected or the service abandoned, if this can be managed without too great inconvenience. After formal condemnation no excommunicated person may receive sacraments or sacramentalia, or be buried in a Church cemetery, and he may not benefit by the indulgences, suffragia or public prayers of the Church, though private prayers and even masses may be offered on his behalf. In the case of *vitandi*, however, masses may only be said for their conversion. An excommunicated person ordinarily has no right to administer sacraments or sacramentalia, but may do so in the absence of clergy in good standing. Requests for sacraments and sacramentalia, however, should be made by the faithful to *vitandi* only in cases of extreme danger (*in solo mortis periculo*). No excommunicated person may take part in ecclesiastical transactions or procedure, except to appeal from the sentence of excommunication passed upon him, and should enjoy no ecclesiastical benefit or preferments. Jurisdictional acts (*tam fori externi quam fori interni*) performed by excommunicated persons are, with few exceptions, invalid. For offenses by which anathema may be incurred, *cf.* canons 2,314 *seq.* and D. M. Prümmer O. Pr., *Manuale iuris Ecclesiastici* (Friburg in Bregau, 1933), pp. 658 *seq.*

The ritual of anathema, now seldom used, is described in the *Pontificale Romanum* (ed. H. Dessain, Malines, 1934, pp. 815 *seq.*). It is performed at the high altar, or in some other public place, by a bishop and 12 priests, all vested and carrying lighted tapers. The bishop recites a solemn formula describing the state of the condemned and the authority by which his excommunication is pronounced. It concludes, "*et (eum) a societate omnium Christianorum separamus, et a liminibus sanctae Matris Ecclesiae in coelo, et in terra excludimus, et excommunicatum, et anathematizatum esse decernimus, et damnatum cum diabolo, et angelis eius, et omnibus reprobis in ignem aeternum indicamus; donec a diaboli laqueis resipiscat, et ad emendationem, et poenitentiam*

redeat, et Ecclesiae Dei, quam laesit, satisfaciatur; tradentes eum satanae in interitum carnis, ut spiritus eius saluus fiat in die iudicii." At this point all cry, "*Fiat, fiat, fiat,*" and dash their lighted candles to the ground. (R. P. C.; X.)

ANATOLI, JACOB (c. 1104-1256), Hebrew translator from the Arabic. He was invited to Naples by Frederick II., and, in association with Michael Scot, made Arabic learning accessible to Western readers. Among his most important services were translations of works by Averroes.

ANATOLIA (Gr. *ἀνατολή*, sunrise, *i.e.*, eastern land), ancient geography, the country east of the Aegean, *i.e.*, Asia Minor. It is now used by the Turks in the form *Anadolu* as the equivalent of the western part of Asia Minor (*q.v.*).

ANATOMY, literally dissection or cutting asunder, a term always used to denote the study of the structure of living things, animal or vegetable. Animal anatomy may include the study of the structure of different animals (*comparative anatomy* or *animal morphology*), or it may be limited to one animal only (*special anatomy*). From a utilitarian point of view the study of Man is the most important division of special anatomy, and this *human anatomy* may be approached from different points of view. From that of the medical man it consists of a knowledge of the exact form, position, size and relationship of the various structures of the human body in health (*descriptive* or *topographical human anatomy*). From the morphological point of view, human anatomy has for its object the discovery of the causes which have brought about the existing structure of Man, and needs a knowledge of the allied sciences of embryology or ontogeny, phylogeny and histology. Pathological or morbid anatomy is the study of diseased organs, while sections of normal anatomy, applied to various purposes, receive special names such as medical, surgical, gynaecological, artistic and superficial anatomy. The comparison of the anatomy of different races of mankind is part of the science of physical anthropology or anthropological anatomy.

In the present edition of this work the subject of anatomy is treated systematically rather than topographically. Each anatomical article contains first a description of the structures of an organ or system (such as nerves, arteries, heart, etc.), as it is found in Man; and this is followed by an account of the development or embryology and comparative anatomy or morphology, as far as vertebrate animals are concerned.

The following separate anatomical articles will be found under their own headings:—

Alimentary canal.	Nerve.
Arteries.	Nervous system.
Brain.	Olfactory system.
Coelom and serous membranes.	Pancreas.
Connective tissues.	Pharynx.
Diaphragm.	Placenta.
Ductless glands.	Reproductive system.
Ear.	Respiratory system.
Epithelium, Endothelium and glands.	Scalp.
Eye.	Skeleton.
Heart.	Skin and Exoskeleton.
Joints and Ligaments.	Skull.
Liver.	Spinal cord.
Lymphatic system.	Teeth.
Mammary gland.	Tongue.
Mouth and salivary glands.	Urinary system.
Muscular system.	Vascular system.
	Veins.

From the year 1910 onwards the government authorities have not only supervised the administration of the law, but also helped the schools to obtain an adequate supply of unclaimed bodies for their needs. The immediate result has been an extension of sources of supply so as to improve considerably the state of affairs which prevailed previously in Great Britain.

NOMENCLATURE

There is still much confusion in the nomenclature of anatomy. This has arisen from an attempt to revise and improve the

terminology which had previously been in common use. At present either the original or the new "Basle" terminology or a combination of both is employed, a manifest disadvantage. The most important recent advance has been the application of X-rays in the study of macroscopic anatomy, particularly of the living body—an advance which has proved of immense importance in the practice of medicine and surgery. Great improvements have been made in apparatus and technique and particularly in use of materials opaque to the rays for injections.

Osteology.—Advances in connection with the skeleton have been largely concerned with its development, and new views have been expressed as regards the origin, growth and fate of osteoblasts and osteoclasts. Important contributions have been made dealing with the human clavicle, ribs and bones of the face, with sexual differences in the human skull and sexual and racial characters of the human ilium and with the morphology of mammalian teeth and sternum.

Muscular System.—The investigations of Prof. Kulchitsky upon the innervation of muscle fibres, the suggestions of Prof. Hunter that muscle fibres are of two kinds with separate nerve supplies from the central and autonomic systems, and the actual designing of surgical measures for amelioration of muscle spasm based upon these ideas have not yet been sufficiently confirmed.

Nervous System.—C. W. Ariens Kappers has demonstrated that control is exercised upon the grouping of brain cells by forces, probably of a bio-electric character, emanating from the nerve tracts with which these are functionally associated. Attention has been given to the comparison of particular areas of the central nervous system in a series of vertebrates with a view to elucidating the evolutionary significance of these areas in man.

Organs of Sense.—Investigations have been carried out by Karl Pearson, E. Nettleship and C. H. Usher on the subject of albinism in man, showing that eyes, hair and skin may alone show perfect albinism, and that perfect albinism in eyes may be accompanied by imperfect or wholly absent albinism in hair. Other recent publications of importance concern the eye and the ear.

Vascular System.—Recent additions to the knowledge of the vascular system have been chiefly in relation to function, to the blood supply of the valves, the muscular architecture and the development of the human heart, and to the arterial supply of the pons, medulla, and fore-brain, and the development and comparative anatomy of the arteries of the extremities.

Digestive System.—Particular attention has been paid to the teeth, the shape and size of the tonsils at different ages, the minute structure of the oesophagus in mammalia, the form and immediate relations of the abdominal viscera with special reference to their peritoneal attachments, their blood and nerve supply and lymphatic connections.

Respiratory System.—Papers have been written upon the human and comparative anatomy and development of this system with special reference to the lobes of the lungs and the nerve supply of the larynx. Knowledge has been acquired, by means of X-rays, regarding the position of the diaphragm and thoracic viscera.

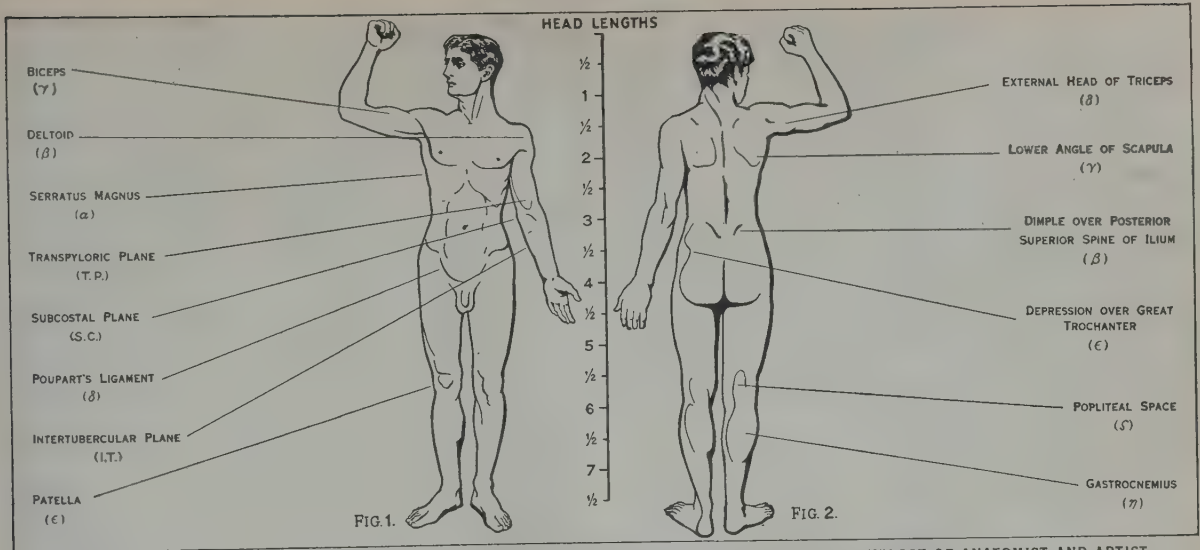
Genito-Urinary System.—Valuable additions have been made to our knowledge of the appearance of the urethra, bladder and ureter by the cystoscope, and of the kidney by radiography.

See Piersol, *Human anatomy* (6th ed. 1918); Testut, *Traité d'anatomie humaine* (7th ed. 1921-23); Cunningham, *Textbook of anatomy* (5th ed. 1922); Gray, *Anatomy descriptive and applied* (23rd ed. 1926). (F. G. P.; R. W. R.)

SUPERFICIAL AND ARTISTIC

The objects of the study of superficial anatomy are to show, first, the form and proportions of the human body and, second, the surface landmarks which correspond to deeper structures hidden from view. This study blends imperceptibly with others, such as physical anthropology, physiognomy, phrenology and palmistry, but whereas these deal chiefly with variations, superficial anatomy is concerned with the type.

With regard to the proportions of the body the artist and anatomist approach the subject from slightly different points of



A STUDY OF THE HUMAN BODY ACCORDING TO MEASUREMENTS SUGGESTED IN 1890 TO SERVE THE PURPOSE OF ANATOMIST AND ARTIST
 Superficial anatomy has a two-fold object: to show the proportions of the human body and to mark the features on the surface which correspond to internal structures. To serve both these purposes the body is divided into $7\frac{1}{2}$ head lengths. Four of these are above the fork and $3\frac{1}{2}$ below. Two heads are allowed for the greatest width of shoulders; $1\frac{1}{2}$ for greatest width of hips, one for narrowest part of waist, and $\frac{3}{4}$ for breadth of head on a level with the eyes

view. The former, by a process of artistic selection, seeks the ideal and adopts the proportions which give the most pleasing effect, while the latter desires to know only the mean of a large series of measurements.

The scheme which Dr. Paul Richer suggested (*Anatomie artistique*, Paris, 1890), and Professor Arthur Thomson approves (*Anatomy for Art Students*, 1896), is to divide the whole body into head-lengths, of which seven and a half make up the stature. Four of these are above the fork and three and a half below (see figs. 1 and 2). Of the four above, one forms the head and face, the second reaches from the chin to the level of the nipples, the third from the nipples to the navel, and the fourth from there to the fork. By dividing these into half-heads other points can be determined; for instance the middle of the first head-length corresponds to the eyes, the middle of the second to the shoulder, of the fourth to the top of the hip-joint, and of the fifth to the knee-joint.

The elbow-joint, when the arms are by the side, is a little above the lower limit of the third head-length, while the wrist is opposite the very centre of the stature, three head-lengths and three-quarters from the crown or the soles. The tips of the fingers reach a little below the middle of the fifth head-length. (In fig. 1 the fingers are bent.) By making the stature eight head-lengths instead of seven and a half the artistic effect is increased, as it is also by slightly lengthening the legs in proportion to the body. Approximate average breadth measurements are two heads for the greatest width of the shoulders, one and a half for the greatest width of the hips, one for the narrowest part of the waist, and three-quarters for the breadth of the head on a level with the eyes.

The relation of superficial landmarks to deep structures cannot be treated here in full detail, but the chief points may be indicated. Certain parts of the head may easily be felt through the skin. If the finger is run along the upper margin of the orbit, the notch for the supraorbital nerve may usually be felt at the junction of the inner and middle thirds. At the outer end of the margin is its junction with the malar bone, and this easily felt point is known as the external angular process. The junction of the frontal and nasal bones at the root of the nose is the nasion, while at the back of the skull the external occipital protuberance or inion is felt and marks the position of the torcular Herophili, where the venous sinuses meet. The zygoma may be felt running back from the malar bone to just in front of the ear, and two fingers' breadth above the middle of it marks the pterion, a very

important point in the localization of intracranial structures. It corresponds to the anterior branch of the middle meningeal artery, to the Sylvian point where the three limbs of the fissure of Sylvius diverge, to the middle cerebral artery, the central lobe of the brain or island of Reil, and the anterior part of the corpus striatum. The fissure of Sylvius can be marked out by drawing a line from the external angular process back through the Sylvian point to the lower part of the parietal eminence. The position of the sulcus of Rolando is important because of the numerous cortical centres which lie close to it. It may be mapped out by taking the superior Rolandic point, $\frac{1}{2}$ in. behind the bisecting of a line drawn from the nasion to the inion over the vault of the skull, and joining that to the inferior Rolandic point, which is just above the line of the fissure of Sylvius and 1 in. behind the Sylvian point. The external parieto-occipital fissure, which forms the boundary between the parietal and occipital lobes of the brain, is situated practically at the lambda, which is a hand's breadth ($2\frac{3}{4}$ in.) above the inion. The lateral sinus can be mapped out by joining the inion to the asterion, a point two-thirds of the distance from the lambda to the tip of the mastoid process; thence the sinus curves downward and forward toward the tip of the mastoid process. A point 1 in. horizontally backward from the top of the external auditory meatus will always strike it.

The Face.—On the front of the face a line drawn down from the supraorbital notch between the bicuspid teeth to the side of the chin will cut the exit of the second division of the fifth nerve from the infraorbital foramen, a quarter of an inch below the infraorbital margin, and also the exit of the third division of the fifth at the mental foramen, midway between the upper and lower margins of the body of the jaw. The angle of the mouth at rest usually corresponds to the interval between the bicuspid teeth. The skin of the eyelids is very thin, and is separated from the subjacent fibrous tarsal plates by the orbicularis palpebrarum muscle. On everting the lids the delicate conjunctival membrane is seen, and between this and the tarsal plates lie the meibomian glands, which can be faintly seen as yellowish streaks. From the free edges of the eyelids come the eyelashes, between which many large sweat-glands open, and when one of these is inflamed it causes a "stye." Internally the two eyelids form a little recess called the internal canthus, occupied by a small red eminence, the caruncula lachrymalis, just external to which a small vertical fold of conjunctiva may often be seen, called the plica semilunaris, representing the third eyelid of birds and many mammals. By gently drawing down the lower eyelid the lower punctum may

be seen close to the caruncula; it is the pinhole opening into the lower of the two canaliculi which carry away the tears to the lachrymal sac and duct. On the side of the face the facial artery may be felt pulsating about an inch in front of the angle of the jaw; it runs a tortuous course to near the angle of the mouth, the angle of the nose and the inner angle of the eye; in the greater part of its course its vein lies some distance behind it. The parotid gland lies between the ramus of the jaw and the mastoid process; anteriorly it overlaps the masseter to form the socia parotidis, and just below this its duct, the duct of Stensen, runs forward to pierce the buccinator and open into the mouth opposite the second upper molar tooth. The line of this duct may be marked out by joining the lower margin of the tragus to a point midway between the lower limit of the nose and the mouth. The facial or seventh nerve emerges from the skull at the stylo-mastoid foramen just in front of the root of the mastoid process; in the parotid gland it forms a network called the *pes anserinus*, after which it divides into six branches which radiate over the face to supply the muscles of expression.

The Neck.—In the middle line below the chin can be felt the body of the hyoid bone, just below which is the prominence of the thyroid cartilage called "Adam's apple," better marked in men than in women. Still lower the cricoid cartilage is easily felt, while between this and the suprasternal notch the trachea and isthmus of the thyroid gland may be made out. At the side the outline of the sterno-mastoid muscle is the most striking mark; it divides the anterior triangle of the neck from the posterior. The upper part of the former contains the submaxillary gland, which lies just below the posterior half of the body of the jaw. The line of the common and the external carotid arteries may be marked by joining the sterno-clavicular articulation to the angle of the jaw. The eleventh or spinal accessory nerve corresponds to a line drawn from a point midway between the angle of the jaw and the mastoid process to the middle of the posterior border of the sterno-mastoid muscle and thence across the posterior triangle to the deep surface of the trapezius. The external jugular vein can usually be seen through the skin; it runs in a line drawn from the angle of the jaw to the middle of the clavicle, and close to it are some small lymphatic glands. The anterior jugular vein is smaller, and runs down about half an inch from the middle line of the neck. The clavicle or collar-bone forms the lower limit of the neck, and laterally the outward slope of the neck to the shoulder is caused by the trapezius muscle.

The Chest.—It is important to realize that the shape of the chest does not correspond to that of the bony thorax which encloses the heart and lungs; all the breadth of the shoulders is due to the shoulder girdle, and contains the axilla and the head of the humerus. In the middle line the suprasternal notch is seen above, while about three fingers' breadth below it a transverse ridge can be felt, which is known as Ludovic's angle and marks the junction between the manubrium and gladiolus of the sternum. Level with this line the second ribs join the sternum, and when these are found the lower ribs may be easily counted in a moderately thin subject. At the lower part of the sternum, where the seventh or last true ribs join it, the ensiform cartilage begins, and over this there is often a depression popularly known as the pit of the stomach. The nipple in the male is situated in front of the fourth rib or a little below; vertically it lies a little external to a line drawn down from the middle of the clavicle; in the female it is not so constant. A little below it the lower limit of the great pectoral muscle is seen running upward and outward to the axilla; in the female this is obscured by the breast, which extends from the second to the sixth rib vertically and from the edge of the sternum to the mid-axillary line laterally. The female nipple is surrounded for half an inch by a more or less pigmented disc, the areola. The apex of a normal heart is in the fifth left intercostal space, three and a half inches from the mid-line.

The Abdomen.—In the mid-line a slight furrow extends from the ensiform cartilage above to the symphysis pubis below; this marks the *linea alba* in the abdominal wall, and about its

middle point is the umbilicus or navel. On each side of it the broad recti muscles can be seen in muscular people. The outline of these muscles is interrupted by three or more transverse depressions indicating the *lineae transversae* in the recti; there is usually one about the ensiform cartilage, one at the umbilicus, and one between; sometimes a fourth is present below the umbilicus. The upper lateral limit of the abdomen is the subcostal margin formed by the cartilages of the false ribs (8, 9, 10) joining one another; the lower lateral limit is the anterior part of the crest of the ilium and Poupart's ligament running from the anterior superior spine of the ilium to the spine of the pubis (see fig. 1, δ); these lower limits are marked by definite grooves. Just above the pubic spine is the external abdominal ring, an opening in the muscular wall of the abdomen for the spermatic cord to emerge in the male. The most modern method of marking out the abdominal contents is to draw three horizontal and two vertical lines; the highest of the former is the transpyloric line of C. Addison (fig. 1, T.P.), which is situated half-way between the suprasternal notch and the top of the symphysis pubis; it often cuts the pyloric opening of the stomach an inch to the right of the mid-line. The hilum of each kidney is a little below it, while its left end approximately touches the lower limit of the spleen. It corresponds to the first lumbar vertebra behind. The second line is the subcostal (fig. 1, S.C.), drawn from the lowest point of the subcostal arch (tenth rib); it corresponds to the upper part of the third lumbar vertebra, and is an inch or so above the umbilicus; it indicates roughly the transverse colon, the lower ends of the kidneys, and the upper limit of the transverse (3rd) part of the duodenum. The third line is called the intertubercular (fig. 1, I.T.), and runs across between the two rough tubercles, which can be felt on the outer lip of the crest of the ilium about two and a half inches from the anterior superior spine. This line corresponds to the body of the fifth lumbar vertebra, and passes through or just above the ileo-caecal valve where the small intestine joins the large. The two vertical or mid-Poupart lines are drawn from the point midway between the anterior superior spine and the pubic symphysis on each side vertically upward to the costal margin. The right one is the most valuable, as the ileo-caecal valve is situated where it cuts the intertubercular line, while the orifice of the vermiform appendix is an inch lower down. At its upper part it meets the transpyloric line at the lower margin of the ribs, usually the ninth, and here the gall-bladder is situated. The left mid-Poupart line corresponds in its upper three-quarters to the inner edge of the descending colon. The right subcostal margin corresponds to the lower limit of the liver, while the right nipple is about half an inch above the upper limit of this viscus.

The Back.—There is a well-marked furrow stretching down the middle line of the back from the external occipital protuberance to the cleft of the buttocks. In this the spinous processes of the vertebrae can be felt, especially if the model bend forward. The cervical spines are difficult to feel, except the seventh and sometimes the second, and although the former is called the vertebra prominens, its spine is less easily felt than is that of the first thoracic. In practice it is not very easy to identify any one spine with certainty: one method is to start from the prominent first thoracic and to count down; another is to join the lower angles of the two scapulae (fig. 2, γ) when the arms are hanging down, and to take the spine through which the line passes as the seventh.

The spinal furrow is caused by the prominence of the erector spinae muscles on each side; these become less well marked as they run upward. The outlines of the scapulae can be well seen; they cover the ribs from the second to the seventh inclusive. The scapular spine is quite subcutaneous, and can be followed upward and outward from the level of the third thoracic spine to the acromion, and so to the outer end of the clavicle. On the lower margin of the acromion is a little tubercle known as the metacromial process or acromial angle, which is very useful for taking measurements from. The tip of the twelfth rib may usually be felt about two inches above the middle of the iliac crest but this rib is very variable in length. The highest point

of the iliac crest corresponds to the fourth lumbar spine, while the posterior superior iliac spine is on a level with the second sacral vertebra. This posterior superior spine is not easily felt, owing to the ligaments attached to it, but there is usually a little dimple in the skin over it (fig. 2, β). By drawing horizontal lines through the 1st, 3rd and 5th lumbar spines, the transpyloric, subcostal and intertubercular lines or planes may be reproduced behind and the same viscera localized.

The Arm.—Running downward and outward from the inner half of the clavicle, where that bone is convex forward, is the clavicular part of the pectoralis major, while from the outer third of the bone, where it is concave forward, is the clavicular part of the deltoid; between these two muscles is an elongated triangular gap with its base at the clavicle, and here the skin is somewhat depressed, while the cephalic vein sinks between the two muscles to join the axillary vein. The tip of the coracoid process is situated just under cover of the inner edge of the deltoid, one inch below the junction between the outer and middle thirds of the clavicle. The deltoid muscle (fig. 1, β) forms the prominence of the shoulder, and its convex outline is due to the presence of the head of the humerus deep to it; when this is dislocated the shoulder becomes flattened. The pectoralis major forms the anterior fold of the axilla or armpit, the posterior being formed by the latissimus dorsi and teres major muscles. The skin of the floor of this space is covered with hair in the adult, and contains many large sweat-glands. The axillary vessels and brachial plexus of nerves lie in the outer wall, while on the inner wall are the serrations of the serratus magnus muscle, the outlines of some of which are seen on the side of the thorax, through the skin, when the arm is raised (fig. 1, α). Below the edge of the pectoralis major, the swelling of the biceps (fig. 1, γ) begins to be visible, and this can easily be traced into its tendon of insertion, which reaches below the level of the elbow-joint. On each side of the biceps is the external and internal bicipital furrow, in the latter of which the brachial artery may be felt and compressed. The median nerve is here in close relation to the artery. At the bend of the elbow the two condyles of the humerus may be felt; the inner one projects beneath the skin, but the outer one is obscured by the rounded outline of the brachio-radialis muscle. The superficial veins at the bend of the elbow are very conspicuous; they vary a good deal, but the typical arrangement is an M, of which the radial and ulnar veins form the uprights, while the outer oblique bar is the median cephalic and the inner oblique the median basilic vein. At the divergence of these two the median vein comes up from the front of the forearm, while the two vertical limbs are continued up the arm as the cephalic and basilic, the former on the outer side, the latter on the inner. On the back of the arm the three heads of the triceps are distinguishable, the external forming a marked oblique swelling when the forearm is forcibly extended and internally rotated (fig. 2, δ). In the upper part of the front of the forearm the antecubital fossa or triangle is seen; its outer boundary is the brachio-radialis, its inner the pronator radii teres, and where these two join below is the apex. In this space are three vertical structures—externally the tendon of the biceps, just internal to this the brachial artery, and still more internally the median nerve. Coming from the inner side of the biceps tendon the semi-lunar fascia may be felt; it passes deep to the median basilic vein and superficial to the brachial artery, and in former days was a valuable protection to the artery when unskilful operators were bleeding from the median basilic vein. About the middle of the forearm the fleshy parts of the superficial flexor muscles cease, and only the tendons remain, so that the limb narrows rapidly. In front of the wrist there is a superficial plexus of veins, while deeper down two tendons can usually be made to start up if the wrist be forcibly flexed; the outer of these is the flexor carpi radialis, which is the physician's guide to the radial artery where the pulse is felt. If the finger is slipped to the outer side of this tendon, the artery, which here is very superficial, can be felt beating. The inner of the two tendons is the palmaris longus, though it is not always present. On cutting down between these two the median nerve is reached.

The wrist-joint may be marked out by feeling the styloid process of the radius on the outer side, and the styloid process of the ulna on the inner side behind, and joining these two by a line convex upward. The superficial appearance of the palm of the hand is described in the article on PALMISTRY; with regard to anatomical landmarks the superficial palmar arterial arch is situated in the line of the abducted thumb, while the deep arch is an inch nearer the wrist. The digital nerves correspond to lines drawn from the clefts of the fingers toward the wrist. On the back of the forearm the olecranon process of the ulna is quite subcutaneous, and during extension of the elbow is in a line with the two condyles, while between it and the inner condyle lies the ulnar nerve, here known popularly as the "funny-bone." From the olecranon process the finger may be run down the posterior border of the ulna, which is subcutaneous as far as the styloid process at the lower end. When the thumb is extended, two tendons stand out very prominently; the outer of these is the tendon of the extensor brevis, the inner of the extensor longus pollicis. Situated deeply in the space is the radial artery, covered by the radial vein. On the dorsum of the hand there is a plexus of veins, and deep to these the tendons of the extensor longus digitorum stand out when the wrist and fingers are extended.

The Leg.—Just below Poupart's ligament (fig. 1, δ), a triangular depression with its apex downward may be seen in muscular subjects; it corresponds to Scarpa's triangle, and its inner border is the tendon of the adductor longus, which is easily felt if the model forcibly adducts the thigh. In this triangle the superficial inguinal glands may be made out. The head of the femur lies just below the centre of Poupart's ligament. The sartorius muscle forms the outer boundary of the triangle, and may be traced from the anterior superior spine obliquely downward and inward, across the front of the thigh, to the inner side of the knee. The two vasti muscles are well marked, the internal being the lower and forming with the sartorius the rounded bulging above the inner side of the knee. The internal saphenous vein runs superficially up the inner side of the thigh from behind the internal condyle of the femur to the saphenous opening in the deep fascia, the top of which is an inch horizontally outward from the spine of the pubis. On the other side of the thigh a groove runs down which corresponds to the ilio-tibial band, a thickening of the fascia lata or deep fascia; the lower end of this leads to the head of the fibula. On the front of the thigh, below the sartorius, the rectus muscle makes a prominence which leads down to the patella, the outlines of which bone are very evident (fig. 1, ϵ). The only part of the femur besides the great trochanter which is superficial is the lower end, and this forms the two condyles for articulation with the tibia. If the posterior part of the inner condyle be joined to the mid-point between the anterior superior spine and the symphysis pubis, when the thigh is externally rotated, the line will correspond in its upper two-thirds to that of the common and superficial femoral arteries, the former occupying the upper inch and a half. The common femoral vein lies just internal to its artery, while the anterior crural nerve is a quarter of an inch external to the latter. The rounded mass of the buttock is formed by the gluteus maximus muscle covered by fat; the lower horizontal boundary is called the fold of the nates, and does not correspond exactly to the lower edge of the muscle. At the side of the buttock is a depression (fig. 2, ϵ) where the great trochanter of the femur can be felt; a line, named after Nelaton, drawn from the anterior superior spine to the tuberosity of the ischium, passes through the top of this. On the back of the thigh the hamstrings form a distinct swelling; below the middle these separate to enclose the diamond-shaped popliteal space (fig. 2, ζ), the outer hamstrings or biceps being specially evident, while, on the inner side, the tendons of the semi-tendinosus and semi-membranosus can be distinguished.

On the front of the leg, below the knee, the ligamentum patellae is evident, leading down from the patella (fig. 1, ϵ) to the tubercle of the tibia. From this point downward the anterior border of the tibia or shin is subcutaneous, as is also the internal surface

of the tibia. External to the shin is the fleshy mass made by the tibialis anticus and extensor longus digitorum muscles. At the inner side of the ankle the internal malleolus is subcutaneous, while on the outer side the tip of the external malleolus is rather lower and farther back. Both this malleolus and the lower quarter of the shaft of the fibula are subcutaneous, and this area, if traced upward, is continuous with a furrow on the outer side of the leg which separates the anterior tibial from the peroneal groups of muscles, and eventually leads to the subcutaneous head of the fibula. At the back of the leg the two heads of the gastrocnemius form the calf, the inner one (fig. 2, η) being larger than the outer. Between the two, in the mid-line of the calf, the external saphenous vein and nerve lie, while lower down they pass behind the external malleolus to the outer side of the foot. The internal saphenous vein and nerve lie just behind the internal border of the tibia, and below pass in front of the internal malleolus. At the level of the ankle-joint the tibialis posticus and flexor longus digitorum tendons lie just behind the internal malleolus, while the peroneus longus and brevis are behind the external. Running down to the heel is the tendo Achillis with the plantaris on its inner side. On the dorsum of the foot the musculo-cutaneous nerve may be seen through the skin in thin people when the toes are depressed; it runs from the anterior peroneal furrow, already described, to all the toes, except the cleft between the two inner ones. There is also a venous arch to be seen, the two extremities of which pass respectively into the external and internal saphenous veins. The long axis of the great toe, even in races unaccustomed to boots, runs forward and outward, away from the mid-line between the two feet, so that perfectly straight inner sides to boots are not really anatomical. The second toe in classical statues is often longer than the first, but this is seldom seen in Englishmen. On the outer side of the sole the skin is often in contact with the ground all along, but on the inner side the arch is more marked, and, except in flat-footed people, there is an area in which the sole does not touch the ground at all.

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RADIOGRAPHY

The Skull.—An instructive radiogram of the skull is obtained by placing the tube generating the rays on one side of the head and by laying the photographic plate flat against the other. Fig. 1 on plate shows a lateral view of the head resting upon the upper part of the spinal column. A good view is obtained of the extent of the cavity which contains the brain. The orbital and nasal chambers with their accessory air sinuses (antrum of Highmore and sphenoidal air sinus) are well seen. Particularly there is noticeable, immediately behind the sphenoidal sinus, the saddle-shaped sella turcica for the lodgment of the pituitary gland.

Shoulder.—A front view of the shoulder and neighbouring part of the chest when the arm hangs by the side of the body, discloses the relative position of the bones of that region. The ribs pursue an obliquely downward course and their movements in life are well seen.

The clavicle passes outwards and slightly upwards toward the acromion process of the scapula, with it to form a bony arch overhanging the shoulder joint and thus helping to prevent upward displacement of the humerus at that joint. The body of the scapula rests on the ribs thickening at its axillary border and upper and outer angle where it expands to form the glenoid fossa for reception of the head of the humerus. The coracoid process which is swung by fibrous tissue to the clavicle in the recent state is very evident.

The ball and socket character of the shoulder-joint is so arranged as to allow of extensive movement of the arm at the joint, the socket (glenoid cavity) being small as compared with the large articulating surface of the ball. The upper extremity of the

humerus with its articular surface and tuberosities are well seen.

Elbow.—A good picture of this region is obtained by taking a radiograph from its inner side with the elbow-joint slightly bent and the forearm in such a position that the palm of the hand is directed toward the median plane of the body. The lower end of the humerus shows the internal condyle with a ridge running upward and a groove behind for the passage of the ulnar nerve from the arm into the forearm. The upper end of the ulna shows the deep concavity by which it articulates with the pulley-shaped surface of the humerus and its helmet-shaped upward extension (olecranon process) for the attachment of the triceps muscle. The head of the radius supported upon its conical neck articulates with the humerus above and the ulna at the side. The whole picture emphasizes the hinge-like character of the elbow-joint and the pivot character of the joint between the bones of the forearm at the elbow.

Wrist and Hand.—Fig. 5 on plate shows the lower part of the forearm and hand viewed from the palmar aspect. The radius and ulna, the carpal, metacarpal and phalangeal bones form distinct shadows. The outline of the wrist-joint shows that the hand is supported mainly by the expanded lower end of the radius, the head of the ulna being separated from the carpus by an interval which in the recent state is filled up by a fibrocartilaginous pad.

The outlines of all the eight bones of the carpus can clearly be made out forming a group consisting of two rows of bones with an S-shaped joint between them. The os magnum is the largest bone of the group and lies with its long axis in line with the middle finger, the semi-lunar and the radius. Its rounded head fits into a cup formed by the scaphoid and semi-lunar; its body is flanked by the trapezoid and unciform, and its base supports the third and to a lesser degree the second and fourth metacarpal bones. The pisiform is rather indefinitely seen immediately below the ulna and in front of the cuneiform. The trapezium partially hides the trapezoid.

The four inner metacarpal bones lie close to one another, while the first or that of the thumb is separated from the second by a wide interval. A small sesamoid bone is seen lying upon the inside of its head.

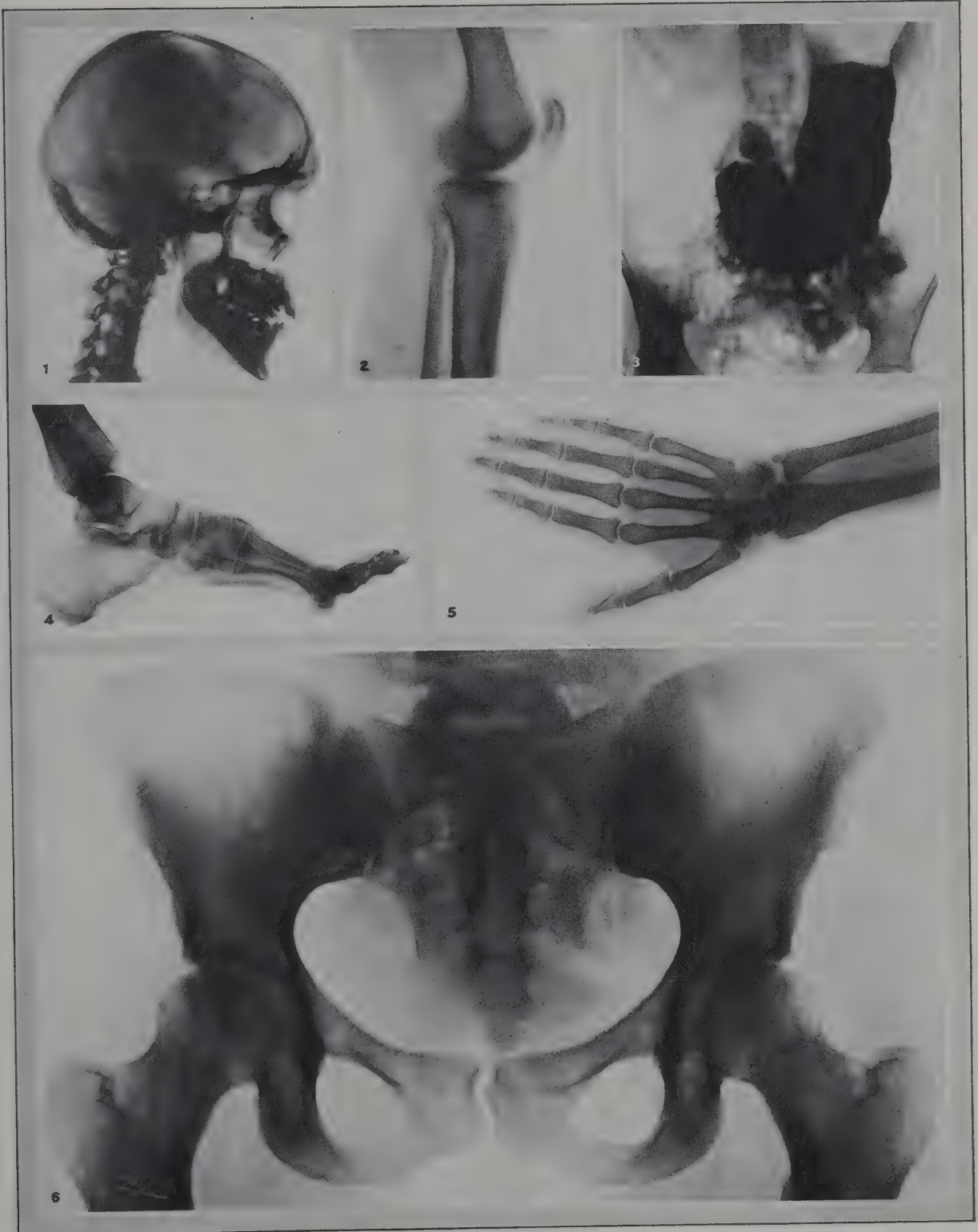
The phalanges of the fingers and thumb are shown very distinctly, and the ball and socket character of the metacarpophalangeal and the hinge-like nature of the inter-phalangeal joints are also manifest.

Pelvis and Hip-joint.—The architecture of the bony framework of the pelvis which transmits the weight of the trunk and upper extremities allowing at the same time room for viscera is well seen in fig. 6 on plate.

The relation of the wedge-shaped sacrum with its coccygeal appendage to the rest of the body girdle is apparent. The sacrum is seen to be interlocked between the ilia of the innominate bones, so as to form with them an arch transmitting the superincumbent weight either to the lower extremity in the erect position or to the ischial tuberosity in the sitting position. The tendency towards the spreading of the arch is prevented by the front portions of the pelvic girdle acting as tie beams, and there are three "buffers" which break shocks, one at the symphysis pubis in the middle of the front part of the girdle, and the other two at joints between the sacrum and ilia. The foramina for the exit of nerves from the spinal cord to supply the lower extremities and soft parts of pelvis are apparent. The general character of the female as compared with the male pelvis is well exemplified in fig. 6; e.g., the widely spreading ilia, the great width of cavity below the ilia and the wide sub-pubic angle.

To get a good radiogram of the region of the hip-joint is a somewhat difficult matter. One taken from the front shows the thigh occupying its position in the erect posture, revealing the socket or acetabulum, the head of the femur with its pit for the round ligament, the oblique neck, and the upper part of the shaft with the great and small trochanters. The arrangement of the cancellous bone tissue is such as to bear the superincumbent weight in the best possible way.

Knee.—A good general idea of the region is obtained by taking



BY COURTESY OF DR. LEVACK, DR. SPRIGGS, AND DR. SALMOND

PARTS OF THE HUMAN ANATOMY PHOTOGRAPHED BY RADIOGRAPHY

1. Lateral view of the head of a living person
2. Radiogram showing a side view of the knee
3. Normal stomach after ingestion of a barium meal
4. The bone structure of the ankle and foot
5. Radiogram showing the thumb as opposable to the rest of the hand
6. The bone structure of the pelvis and hip-joint

a radiogram from the side (fig. 2 on plate). It shows the lower part of the femur with its condyles, upper part of the tibia with its spine, tuberosities and tubercle, and the upper part of the fibula with its head.

There is seen to be but little interlocking between the femur, tibia and patella, which enter into the formation of the knee-joint. The tibia articulates by a relatively small surface with the relatively large articular surface of the femur, the joint so formed being an example of a hinge joint with the pin of the hinge a movable one. The spine of the tibia is seen projecting upward between the condyles of the femur acting like the flange of a wheel and so helping to prevent lateral displacement of the tibia from the femur at the joint. The knee-cap, to which are attached the great extensor muscles of the leg, moves upward and downward on the femur only. The fibula is seen articulating with the tibia, the joint surface being oblique in direction in order to break shocks between the two bones.

Ankle and Foot.—In fig. 4 on plate a view of the skeleton of the lower part of the leg and of the foot is given from the inside. The tibia and fibula of the leg, and the tarsal and metatarsal and some of the phalangeal bones are shown.

The tibia articulates with the astragalus at the ankle joint, and on close inspection the relative positions of the malleoli of both the tibia and fibula to the astragalus can be made out, the bones of the leg and the astragalus forming a hinge joint. The tip of the outer malleolus formed by the fibula reaches to a lower level than the tip of the inner malleolus, which belongs to the tibia.

The antero-posterior and to a less extent the transverse arch of the foot are shown, the pillars of the former consisting of the great tuberosity of the os calcis behind and of the heads of the metatarsal bones in front. The astragalus forms the keystone of the arch, and transmits the weight of the body from the tibia to the astragalus and os calcis behind, and to the scaphoid, cuboid, cuneiform and metatarsal bones in front. The spicules of the cancellous tissue in these bones are arranged so as to bear the weight of the body transmitted through them. The so-called tunnel of the tarsus and the mediotarsal joint across the foot between the astragalus and os calcis behind and the scaphoid and cuboid in front are very apparent, showing at the same time that the articulation between the os calcis and cuboid forms a separate joint. The front of the middle cuneiform is indicated by a narrow vertical shadow situated a little behind the shadow indicating the anterior border of the internal cuneiform.

The radiogram illustrates vividly the essential difference between the hand and the foot, in that the big toe is seen to be closely applied to the second toe and not opposable to the rest of the foot as the thumb is to the rest of the hand.

Ossification.—Ossification begins in each bone of the skeleton at one or more spots called "primary centres of ossification." Each appears before birth and by their spreading they form the main part of the bone. After birth "secondary centres of ossification" begin to show themselves independently of the main mass, form what are known as "epiphyses" and join it at various periods after birth to make the adult bone. Radiography, when applied to the living body, affords information as to the forms, times of first appearance and times of junction of the epiphyses with the main parts of bones to which they belong. It has shown that there is very great variability in the times, appearance and fusion of epiphyses in different individuals.

Thorax and its Contents.—Apart from revealing the skeleton of the thorax, radiography permits inspection of the position and contour of the heart and great vessels, the lungs and mediastinum.

Abdomen and its Contents.—Subsequent to the introduction of matter opaque to X-rays such as barium or bismuth salts into certain organs, radiography has played an important part in elucidating the anatomy of the alimentary canal and urinary tract.

Fig. 3 on plate shows a normal stomach and first part of the duodenum immediately after the ingestion of a barium meal. The clear area at the upper part indicates the air-containing portion of the cavity in the neighbourhood of the entrance of the oesophagus.

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ANATOMY IN DRAWING: see DRAWING, ANATOMICAL. See also the articles on various applications of anatomical drawing, as ILLUSTRATION, PEN DRAWING, PORTRAIT PAINTING, and the articles SCULPTURE and SCULPTURE TECHNIQUE.

ANATOMY OF PLANTS: see the section *Anatomy of Plants* under PLANTS and PLANT SCIENCE. See further the separate articles on ROOT and SEED and various sections under the articles FLOWER; LEAF; STEM.

ANATTO: see ANNATTO.

ANAU, site of an abandoned settlement 20m. E.S.E. from Ashkhabad in the Turkmenistan S.S.R. There are indications of four different cultures, the two earlier from a *kurgan* (mound) about a mile west of the ruins and $\frac{1}{2}$ mile south of the Trans-caspian railway and the two later from a *kurgan* about 1 mile further south.

The earliest inhabitants were grain cultivators and had hand-made pottery geometrically decorated. Pumpelly, calculating from loess deposits, dated the cultures 8,000-6,000 B.C., but 3,900-3,300 B.C. seems more probable.

See R. Pumpelly, *Explorations in Turkestan*, 1908; H. Frankfort, *Studies in Early Pottery of the Near East*, pt. i. 1924, pt. ii. 1927; Peake and Fleure, *Corridors of Time, III. "Peasants and Potters,"* 1927.

ANAXAGORAS, Greek philosopher, born probably about 500 B.C. (Apollodorus *ap. Diog. Laert.* ii. 7) at Clazomenae in Asia Minor. He went to Athens, which was rapidly becoming the headquarters of Greek culture (c. 464-462 B.C.). There he is said to have remained for 30 years. Pericles learned to love and admire him and the poet Euripides derived from him an enthusiasm for science and humanity. Some authorities assert that even Socrates was among his disciples. His influence was due partly to his astronomical and mathematical eminence, but still more to the ascetic dignity of his nature and his superiority to ordinary weaknesses.

It was he who brought philosophy and the spirit of scientific inquiry from Ionia to Athens. His observations of the celestial bodies led him to form new theories of the universal order, and brought him into collision with the popular faith. He attempted to give a scientific account of eclipses, meteors, rainbows and the sun, which he described as a mass of blazing metal, larger than the Peloponnesus; the heavenly bodies, he said, were masses of stone torn from the earth and ignited by rapid rotation. The polytheism of the time could not tolerate such explanation, and the enemies of Pericles used the superstitions of their countrymen as a means of attacking him in the person of his friend.

Anaxagoras was arrested on a charge of contravening the established dogmas of religion (some say the charge was one of Medism) and it required all the eloquence of Pericles to secure his acquittal. Even so he was forced to retire from Athens to Lampsacus (434-433 B.C.), where he died about 428 B.C. Anaxagoras holds that all things have existed in a sort of way from the beginning. But originally they existed in infinitesimally small fragments of themselves, endless in number and inextricably combined throughout the universe.

All things existed in this mass, but in an indistinguishable form. There were the seeds (*σπέρματα*) of corn and flesh and gold in the mixture; but these parts, of like nature with their wholes (the *ὁμοιομερῆ* of Aristotle), had to be eliminated from the complex mass before they could receive a definite name and character.

The existing species of things having thus been transferred, with all their specialities, to the prehistoric stage, they were multiplied endlessly in number by reducing their size through continued subdivision; at the same time each thing is so connected with every other that the keenest analysis can never completely sever them. The work of arrangement, the segregation of like from unlike and the summation of the *δυσουμενῇ* ("simple substances") into totals of the same name, was the work of Mind or Reason. This peculiar thing called Mind (*νοῦς*) was no less illimitable than the chaotic mass, but, unlike the Intelligence of Heraclitus (*q.v.*), it stood pure and independent (*μόνος ἐφ' ἑωυτοῦ*), a thing of finer texture, and everywhere the same.

This agent, possessed of all knowledge and power, is especially seen ruling in all the forms of life. Its first appearance, and the only manifestation of it which Anaxagoras describes, is Motion. It originated a rotatory movement in the mass which, arising at one point, gradually extended till it gave distinctness to the aggregates of like parts. But even after it has done its best, the original intermixture is not wholly overcome. No one thing in the world is ever abruptly separated from the rest. The name given to it signifies merely that in that congeries of fragments the particular "seed" is preponderant. Every *a* of this present universe is only *a* by a majority, and is also in lesser number *b, c, d*. It is noteworthy that Aristotle accuses Anaxagoras of failing to differentiate between *νοῦς* and *Ψυχή* while Socrates (Plato, *Phaedo*, 98 B) objects that his *νοῦς* is merely a *deus ex machina* to which he refuses to attribute design and knowledge.

Anaxagoras gave some account of the process from original chaos to present arrangements. First came the division into cold mist and warm ether. With increasing cold, the former gave rise to water, earth and stones. The seeds of life in the air were carried down with the rains and produced vegetation. Animals, including man, sprang from the warm and moist clay. We seem to see things coming into being and passing from it; but reflection tells us that decay and growth only mean a new aggregation (*σύνκρισις*) and disruption (*διάκρισις*). Thus Anaxagoras distinguished the senses, and preferred the conclusions of reflection. Accordingly, he maintained that there must be blackness as well as whiteness in snow; how otherwise could it be turned into dark water?

With Anaxagoras speculation passed from the colonies of Greece to settle at Athens. His theory of minute constituents and mechanical processes paved the way for the atomic theory. On the other hand the conception of reason in the world passed from him to Aristotle, to whom it seemed the dawn of sober thought after a night of disordered dreams. From Aristotle it descended to his commentators, and under the influence of Averroes became the engrossing topic of speculation.

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On the date of the trial of Anaxagoras see Burnet, *Early Greek Philosophy*, ch. vi. (1908); A. E. Taylor, *Classical Quarterly*, xi. 1917.

ANAXIMANDER, the second of the physical philosophers of Ionia, was a citizen of Miletus and a companion or pupil of Thales. The computations of Apollodorus have fixed his birth in 611, and his death shortly after 547 B.C. He taught the obliquity of the ecliptic, is said to have introduced into Greece the gnomon (for determining the solstices) and the sundial, and to have made the first map. But his reputation is due mainly to his work on nature. From the few fragments which remain we learn that the first principle was a boundless mass (*ἄπειρον*), eternal and indestructible, from which all beings came, by the separating out of

opposites, and to which they will return. From this primal body there sprang a central fiery mass enclosing the rings of sun, moon and stars, with the earth in the middle, cylindrical in shape, and held in place "because of its equal distance from everything." Living creatures arose from moisture evaporating in the sun. Man was supposed by Anaximander to have sprung from some other species of animals, probably aquatic, "for had he been originally as he is now he would never have survived."

See *Histories of the Ionian School* by Ritten, Mallet; Schleiermacher, "Dissert. sur la philosophie d'Anaximandre," in the *Mémoires de l'acad. des sciences de Berlin* (1815); J. Burnet, *Early Greek Philosophy* (1892); A. W. Benn, *Greek Philosophers* (1883, foll.); A. Fairbanks, *First Philosophers of Greece* (1898); Ritter and Preller, *Historia Phil.* 88 17–22; Mullach, *Fragmenta Phil. Graec.* i. 237–240; Burnet, *Early Greek Philosophy* (1908), ch. i. § 2; Diels, *Fragmente der Vorsokratiker*, vol. i. (1912); and *IONIAN SCHOOL OF PHILOSOPHY*.

ANAXIMENES, of Lampsacus (c. 380–320 B.C.), Greek rhetorician and historian, was a favourite of Alexander the Great, whom he accompanied in his Persian campaigns. He wrote histories of Greece and of Philip, and an epic on Alexander (fragments in Müller, *Scriptores Rerum Alexandri Magni*). As a rhetorician, he was a determined opponent of Isocrates and his school. The *Rhetorica ad Alexandrum*, usually included among the works of Aristotle, is now generally admitted to be by Anaximenes, although some consider it a much later production (edition by Spengel, 1847).

See P. Wendland, *Anax. von Lampsakos* (1905); see also *RHETORIC*.

ANAXIMENES, of Miletus, Greek philosopher in the latter half of the 6th century, said to have been the "associate of Anaximander." He held that air is the primary substance; it expands with heat or contracts with cold, and by these changes of density is the source of all that exists. The earth is a flat disc floating in air, with the heavenly bodies rotating round it.

See Schmidt, *Dissertation de Anaximenes psychologia* (Jena, 1860); Ritter and Preller, *Historia Phil.* 88 23–27; A. Fairbanks, *First Philosophers of Greece* (1898); Mullach, *Fragmenta Phil. Graec.* i. 241–243; J. Burnet, *Early Greek Philosophy*, ch. i. § 3 (1920); also *IONIAN SCHOOL OF PHILOSOPHY*.

ANAZARBUS, an ancient Cilician city, situated in the Aleian plain about 10 m. W. of the main stream of the Pyramus (Jihun) and near its tributary, the Sempas Su. A lofty isolated ridge formed its acropolis. Under the early Roman empire the place was known as *Caesarea*, and was the metropolis of Cilicia Secunda. Rebuilt by the emperor Justin after an earthquake, it became *Justinopolis* (A.D. 525); but the old native name persisted, and when Thoros I., king of Lesser Armenia, made it his capital early in the 12th century, it was known as Anazarva. Its great natural strength and situation not far from the mouth of the Sis pass, and near the great road which debouched from the Cilician gates, made Anazarbus play a considerable part in the struggles between the Byzantine empire and the early Muslim invaders. It had been rebuilt by Harun al-Rashid in A.D. 796, refortified at great expense by Saif addaula, the Hamdanid (10th century), and Saiked, and ruined by the crusaders.

The present wall of the lower city is of late construction, probably Armenian. It encloses a mass of ruins conspicuous in which are a fine triumphal arch, the colonnades of two streets, a gymnasium, etc. A stadium and a theatre lie outside.

ANBAR, originally Peroz Shapur or Perisopora, a ruined town on the Euphrates in lat. 33° 30' N., long. 43° 50' E., below modern Ramadi (*q.v.*) and 40–50 mi. from Baghdad. The town lies just south of the Sakhlawiye canal, the most northerly of the canals which link with the Tigris. Refounded c. A.D. 350 by the Persian emperor Shapur II, it was destroyed by the Roman emperor Julian. Rebuilt, it became a noted Christian and Jewish centre and the seat of the Jewish academy of Pumbeditha. It was capital of the Abbasid caliphs until the founding of Baghdad. By the 10th century it was falling into ruins, but 3,000 Jews were still there in the 12th century.

ANCAEUS, in Greek legend, son of Zeus or Poseidon, king of the Leleges of Samos. In the Argonautic expedition, after the death of Tiphys, helmsman of the "Argo," he took his place. It is said that, while planting a vineyard, he was told by a soothsayer that he would never drink of its wine. As soon as the

grapes were ripe, he squeezed the juice into a cup, and raising it to his lips, mocked the seer, who retorted with the words, Πολλά μεταξύ πέλει κύλικος καὶ χεῖλεος ἄκροῦ ("there is many a slip between the cup and the lip"). At that moment it was announced that a wild boar was ravaging the land. Ancaeus set down the cup, leaving the wine untasted, hurried out and was killed by the boar.

ANCASH, a department of central Peru, between the Pacific and the valley of the Marañon, with the department of La Libertad on the north and that of Lima on the south; area 14,701 sq.mi.; pop. (1950) 540,845. Lying partly on the arid coast and partly in the high cordilleras, Ancash has a variety of climates and products. Two lofty chains parallel with the coast, the Cordillera Blanca on the east and the Cordillera Negra on the west, include many high peaks, among them Huascarán, highest in Peru. They hem in the wide, fertile valley of the Santa or Huarás, the largest coast stream. This river is unique among those of Peru in that it rises east of the continental divide, flows from south to north through a longitudinal valley, cuts the western cordillera in a narrow gorge, and empties into the Pacific. The valley's climate is generally mild, with moderate rainfall. From south to north the principal crops are barley, potatoes, wheat and maize. Cattle and sheep are also raised.

On the eastern slopes of the Cordillera Blanca streams flow into the Marañón, while from the western slopes of the Cordillera Negra they cross the desert to the Pacific. In their valleys sugarcane, cotton, rice and tropical fruits are grown.

Ancash's highly mineralized mountains are still only partially exploited. Nevertheless, Ancash ranks second in Peru in antimony and third in magnesium production. There are important deposits of silver and lead, placer gold, copper and tungsten. The most important coal zone in Peru (containing an estimated 150,000,000 tons) extends along the Santa and Chuquicara rivers.

The capital, Huarás (*q.v.*), and most of the larger towns of the interior are located along the Santa. There are three ports, Chimbote (the most important), Casma, and Samanco. A road from Casma over a 14,000-ft. pass through the Cordillera Negra provides the principal means of access to Huarás. The Pan-American highway along the coast, completed in 1942, improved transportation facilities but those of the interior remained inadequate. Many interesting and archaeologically important pre-Columbian remains exist in both coastal and mountain areas. (L. W. BE.)

ANCELOT, JACQUES ARSENE FRANÇOIS POLYCARPE (1794-1854), French dramatist and *littérateur*, was born at Havre, Feb. 9 1794, and died in Paris Sept. 7 1854. His best-known plays were *Louis IX.* (1819), *Le Maire du palais* (1825) and *Maria Padilla* (1838).

ANCESTOR WORSHIP. In savage and barbarian belief, as in civilized sentiment, death does not make a person cease to belong to his social unit (family, clan, tribe, village, nation). Hence, since the living and the dead of any given community are as much one as any other two classes thereof—for instance, the older and the younger men—we might expect to find the dead treated much as are the older living members of the community, especially the dead who died at a ripe age, or at least after bearing or begetting offspring. For those who die immature are often treated as of less account, or as in some way different, while a common confusion of thought leads to conceiving all persons who died a long time ago as old. Now the aged are regarded in three different ways: (a) with contempt, owing to their physical weakness; hence they are not infrequently killed as *bouches inutiles*; (b) with fear, owing to their supposed magical powers; (c) with respect, as repositories of the traditional wisdom of their people, and often as more or less definite rulers; *e.g.*, the elders of an Australian tribe. We find the dead regarded more or less in all these ways by various peoples, but the matter is complicated by the following considerations: (1) All dead, as such, are terrible, because death is contagious, and where one person has died (especially by violence) more deaths are apt to follow. (2) The dead cannot fend for themselves, cannot hunt or look for vegetable food, etc., but as they are beloved or venerated members of the community they should be provided with necessities, as a sick

brother or a wise but feeble old medicine-man, tribal counsellor, or witch might be. (3) The dead or some of the dead (*e.g.*, chiefs or sorcerers) become more powerful than ever by reason of their death; they are now spirits able to help or harm, and should therefore be propitiated. This often blends with (1). (4) The dead, or some of them, return and are re-born into the community. (5) The older dead, if not quite forgotten, tend to become vague, idealized figures, often passing into gods.

Mere neglect of the dead, as of no account, is very rare; awe or fear, with or without affection as for kinsmen or fathers and mothers, is the prevailing attitude. The ideas given under (2) lead rather to tendence of the dead (offerings of food, etc., at their graves, soul feasts, destruction of all or some of the dead man's property to be of use to him in the other world) than to actual worship. All the ideas numbered (1), (3), and (5) may and do lead to worship of one sort or another; (4) is somewhat more complicated in its results.

Clearly, if the dead can be re-born (*see* METEMPSYCHOSIS), it is desirable to make sure that only the "good" dead shall thus re-enter the community. For persons unlucky, inefficient, scorners of law and justice, the survivors have no use whatever and do not want them back. Moreover, of the good dead, *i.e.*, those powerful, magically or materially efficient, observers of custom, some are so important that they will not condescend to become babies. Hence we get, among other things, a difference in funeral ceremonies; ordinary decent people are buried in one way, great chiefs in another; criminals, women dead in childbirth, men killed by wild beasts, etc., perhaps in a third (*see* DEAD, DISPOSAL OF THE). So far, no worship is necessarily implied, but we get prayers addressed to those of the dead who are expected to return. For instance, the Edo imagine that their normal dead will go to their heaven, *elimi*, stay there for a time, during which they can send blessings to the survivors, and finally return. "My father," one of their prayers runs, "tell Osa (God) to give you things when you come back." This touches ancestor worship, at least at one point; for a time the dead man is a worshipful ghost whose favours may be sought; he can also confer a last favour by providing well for his own life on earth before he returns (*Journ. Roy. Anth. Inst.*, 1920, p. 380 ff.). But it is not yet complete and typical.

Another practice very like ancestor worship at first sight is the worship of what may be called the life-stream. The object of this cult is not any man, living or dead, but the power which enables the community to continue in existence by natural increase—a power which may be embodied for the time being in the head of the family or clan and worshipped by him and his dependents. The Roman *genius* (*q.v.*) in its earliest form is an example of this.

TYPES OF ANCESTOR WORSHIP

But ancestor worship pure and simple is directed towards ancestors possessing venerable powers of one sort or another, coupled with either a kindly interest in their descendants or at least the ability to do them harm if they neglect them. It may be of several kinds, according to the beliefs of the people practising it.

Communal Worship.—(1.) The dead may be worshipped *en masse* by the family, clan, or other community to which they belong; *i.e.*, of which, while alive, they were really or supposedly members. The best known instances of this come from ancient Italy. The cult of the *manes* (*q.v.*) at Rome was not a worship of any individuals; that of the *di parentis* or *parentum* was the cult or tendence of all the dead of a particular line. This fits the belief in the *genius* quite logically. The really worshipful thing, the life-force, is gone from the dead man and there is little or nothing left to give him individuality or importance. For the most part, the cult consisted in the provision of food, either solemnly given to the ghosts, as at the Lemuralia, etc., or in the form of a communal banquet, in which presumably the ghosts had their share. But that these ghosts were not without power, at least collectively, is shown to some extent by the story that once, when the rites of the *parentalia* in February were neglected, the result was a plague which lasted until they were restored (*cf.* [1], above; Ovid. *Fast.*, ii. 545-554), but more decisively (for

such tales may be the result of Ovid's or another's imagination) by the dates of the festivals, in early spring and early summer, just when the ghosts who live in the ground can help or harm the crops, and by the inclusion of the *di manes* in the formula of *devotio* (Livy, viii. 9, 6), from which it appears that they were strong at least to curse.

Individual Worship.—(II.) On the whole, however, the worship of individual ancestors is more common. This may, after a fashion, be combined with (I.), for a large number, or even the entire series of ancestors, so far as they are remembered, may receive collective cult. This is often the case in Africa. For instance, at the *adae* or ceremony of worship of ancestral spirits carried out by a queen-mother among the Ashanti, Capt. Rattray heard of seven stools, each belonging to one of the dead queen-mothers, having each an offering placed upon it (Rattray, *Ashanti*, p. 104). But these same people have many prayers in which the ancestral spirits (*samanfo*) are addressed collectively. Such things, however, are to be expected among a people believing in more than one supernatural being of any kind, for it is not always thought necessary to address each object of cult in a separate prayer or ceremony.

Grades of Ancestors.—(III.) For the reason given in (3) above, not all ancestors are equally worshipful. It is plain that since a commoner was of little importance in life he is not a very powerful ghost; consequently, while such minor spirits are tended only by their immediate relatives, or perhaps not at all, the ghosts of great men are singled out for much more elaborate cult by the whole community. Thus the spirit of a Samoan chief is "supposed to be nearer than the spirits of common people," and is consulted "on all important occasions" (Rev. G. Brown, *Melanesians and Polynesians*, p. 209). His magical power, of course, was far greater than that of a commoner in his lifetime; but the ghosts even of commoners count for something; they "are consulted also" by their own descendants (*ibid.*). This is much the same idea as that underlying Greek hero-cult. But it is not merely prominence, even magical prominence, in life which brings about promotion after death to the rank of a worshipful ancestor. Seniority also has much to do with it; we often find that the founder of a family continues to be worshipped by that family throughout an indefinite number of generations; this worship is, of course, not affected by the circumstance that the founder in question never had any real existence. It is to be found at all manner of stages in culture, from the reverence paid by Australian blacks of to-day to their mythical *alcheringa* (see ARUNTA), to the practice of the civilized Greeks, who not only described themselves as "sons or descendants of such a one" (e.g., Iamida, descended from the legendary seer, Iamus, son of Apollo) but also definitely worshipped their founder, honouring him above all the intervening ancestors. On the other hand, the older ghosts may be forgotten in time—the number of generations in a pedigree that can be remembered, while often considerable, is not without limits—and in that case the once worshipful ancestor fades vaguely into the mass of ghosts or disappears altogether, unless he becomes a god. A ghost who has shown himself formidable, or a person whose death was in some way strange, may quite well enjoy high rank among the venerated ancestors, even if he has been of little account in life. Again, the ancestor most worshipped may be the last person of importance to die: "their father whom they knew is the head by whom they begin and end in their prayer, for they know him best," says one of Callaway's Zulu witnesses (*Religious System of the Amazulu*, p. 144). It by no means always follows that the character of the ghost, venerated or not, will be identical with that of the living person: "perhaps he, too, who was good becomes bad when he is dead; and he who was bad, when he is dead, is good and becomes a good Itongo" (*ibid.*, p. 151).

Ancestors as Gods.—(IV.) Finally, some one ancestor may so combine in his own person all the worshipful qualities a good ancestral ghost should have, or show such pre-eminence in some one quality, that he is no longer treated as a ghost, however venerable, but receives the full honours due to a god. Among many peoples it is a matter of considerable doubt, both to themselves,

when they give any thought to the matter, and to European investigators, whether they have any gods; i.e., any beings supernatural and non-human from the start, or only more or less worshipful ghosts adored by a greater or smaller portion of the community. This confusion is illustrated by the classical case of Asclepius, who was worshipped in many parts of Greece as a god, but is also several times spoken of as a hero; i.e., a worshipful ghost, with a clan, the *Asclepiadae*, called after him. It was an artificial clan, a guild of physicians; but this makes no difference. It is quite possible that a real man, renowned in his lifetime for his medical skill, lies behind the cult and myth of the god (see L. R. Farnell, *Greek Hero-Cults*, p. 234 ff.). Practically any work on the Pacific cultures will give instances of the same confusion.

If we ask why ancestors are worshipped, apart from the desire to propitiate them and prevent them doing harm because they are neglected and angry, the answer varies almost indefinitely. Ghosts are often thought of as living in or just outside the house; thus the Zulu *amatongo* frequently enter houses in the form of snakes (Callaway, *op. cit.*, p. 126 ff.). A Greek house had frequently a house-hero (*ἥρως οἰκουρὸς*), originally no doubt the spirit of some ancestor, whose influence, if he was properly looked after by the inhabitants, was good. In particular, he might intervene to beget a much desired child on the housewife, taking the form of her husband for the purpose (see *Herodotus*, vi. 69; the hero Astrabacus, one of the ancient royal house, comes from his shrine in the form of King Ariston of Sparta and becomes by the latter's wife the father of Demaratos). Offspring is indeed a boon regularly expected from ancestors, who, even if they are not supposed themselves to return and be re-incarnated, naturally are interested in the continuance of the line which tends or worships them. For a like reason they are expected to protect it in various ways, averting illness, giving warning and advice in dreams, and so forth. Again, as ghosts often are supposed to live in the ground, the ancestors are commonly worshipped in hopes of getting good crops. Thus in Malabar, at the feast of Vishnu, (the beginning of the agricultural year) the celebrant prays: "May the gods on high, and the deceased ancestors, bless the seed. . . . May they also vouchsafe us a good crop." (C. Karunakara Menon in E. Thurston's *Omens and Superstitions of Southern India*, p. 291). As they are thus associated with gods, they are often called upon to intercede with gods (see Sir J. G. Frazer, *Worship of Nature*, vol. i, p. 159); for they often live in the sky or some other abode of the deity or deities. But the above are only typical examples; there is almost nothing which an ancestral spirit may not be called upon to grant or to avert. Their relation to the gods is usually indeed that of inferior to superior; but they are commonly supposed to enjoy a larger share of divine favour than the dwellers on earth, if only because they live closer to the deities and so can act as "friends at court" for their worshippers. Usually, however, their ritual differs in kind as well as in degree from that of great gods, regularly preserving something of the methods supposed to be efficacious for securing the repose of a ghost.

DIFFUSION OF ANCESTOR WORSHIP

The custom is found among peoples very widely distributed, and in all grades of culture. It is not, however, so nearly universal as either the fear of ghosts or the cult of supernatural beings of some kind. Thus, the ancestors of totemic tribes are themselves totems; but it can hardly be said that the totem is worshipped; i.e., made the object of prayer and other forms of cult. It is not a god, but rather a respected kinsman. The totemic ceremonies of North America, for instance, consist largely in mimetic dances in which the celebrants are assimilated to the totem, rather than in performances intended to please it, or as requests to it to send some blessing. Totemism may here and there develop into worship, but can hardly be said to be worship (see TOTEMISM and Sir J. G. Frazer, *Totemism and Exogamy*, ii. p. 18). Again, merely to care for the totem of the dead ancestors is not necessarily to worship them; the Roman *parentalia* were quite as much tendance as worship proper. But examples of true ancestor-worship are very numerous, when all deductions have been made. Instances

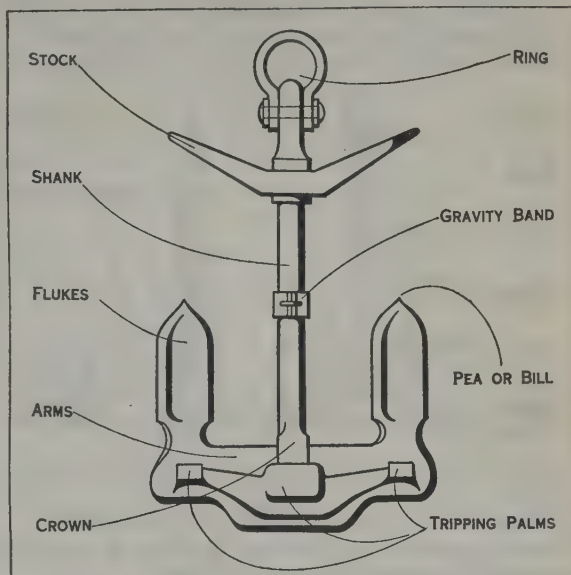
have been quoted from Africa, Asia and the Pacific islands, in all three of which it flourishes. Of civilized races, the Greeks, Romans and Vedic Indians all had it in a more or less developed form, and it has been claimed as a common Indo-Germanic heritage. This is possible but not certain. Of existing cultured peoples, the Chinese and Japanese are the best-known examples (see CONFUCIUS; TAOISM). Where it has completely disappeared the reason is normally the adoption of a monotheistic religion, as Christianity, Judaism, or Islam; hence it is no longer found in Europe. It is not necessarily inconsistent with the existence of a very high form of religious or ethical belief, such for example as Confucianism.

BIBLIOGRAPHY.—No complete modern work dealing specifically with this subject exists. For the civilized races, see the literature of the articles GREEK RELIGION; ROMAN RELIGION, etc. Standard older works are Sir H. Maine, *Ancient Law*; Fustel de Coulanges, *La cité antique*. For uncivilized peoples, besides the works quoted in the text, see especially Ploss-Renz, *Das Kind*, chap. xlviii. (Leipzig, 1912); J. G. Frazer, *The Belief in Immortality* (1913-1924); L. Lévy-Bruhl, *La Mentalité primitive* (1922). (H. J. R.)

ANCHISES, in Greek legend, son of Capys and Themis, grandson (according to Hyginus, son) of Assaracus, of the junior branch of the royal family of Troy, king of Dardanus on Mt. Ida. Here Aphrodite met him and, enamoured of his beauty, bore him Aeneas. For revealing the name of the child's mother, he was killed or struck blind by lightning (Hyginus, *Fab.*, 94). In more recent legend, adopted by Virgil in the *Aeneid*, he was conveyed out of Troy on the shoulders of his son Aeneas (q.v.) and died in Sicily.

ANCHOR. The most ancient anchors consisted of large stones, baskets full of stones, sacks filled with sand, or logs of wood loaded with lead. Of this kind were the anchors of the ancient Greeks; they held the vessel merely by their weight and by the friction along the bottom. When iron was introduced for the construction of anchors, an improvement was made by form-

miralty pattern anchor, which is still used for light work and in boats, is shown in fig. 1. The parts of the anchor are known as: the shank, the ring, the stock, the crown, the arms, the flukes, the pea or bill, and the gravity band. It will be noted that, by removing the keep pin, the anchor can be "unstocked" for stow-



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FIG. 2.—FRONT VIEW OF MARTIN'S CLOSE STOWING ANCHOR

ing. The anchor must be "stocked" before letting go, to ensure that one of the flukes takes the ground.

Later came the self-canting and close-stowing Martin anchor, which, passing through successive improvements, became the improved Martin anchor (fig. 2).

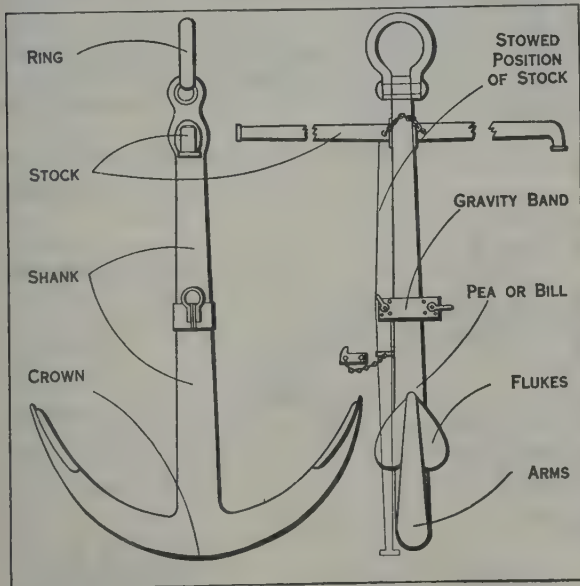
In this pattern the arms are in one plane and can turn through an angle of about 40° either side of the stock. Projections on the

arms known as tripping palms (K) cause the arms to rotate, if the anchor is dragged along the bottom, when the flukes will catch in the ground. It is superior to the Admiralty pattern because both flukes are holding the ship instead of only one. It is also much easier to stow.

To stow a stocked anchor on the anchor-bed it is hove up close to the forefoot, and by means of a ground chain (secured to a balancing or gravity band on the anchor), which is joined to a catting chain rove through a cat davit, the anchor is hove up horizontally and placed on its bed, where it is secured by chains passing over a rod fitted with a lever for "letting go."

Stockless anchors have now replaced the older pattern almost entirely for bow, sheet, and sometimes stern anchors. The latest type of this anchor is shown in fig. 3.

In 1903 they were adopted generally for the British Navy, after extensive anchor trials begun in 1885. Their advantages are: handiness combined with a saving of time and labour; absence of davits, anchor-beds and other gear, with a resulting reduction in

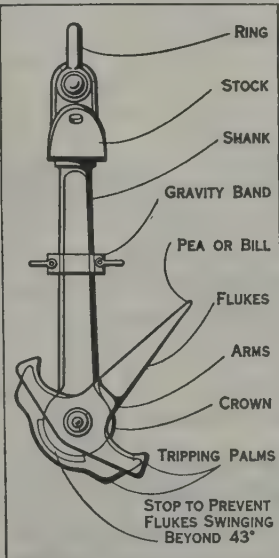


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FIG. 1.—FRONT AND SIDE VIEW OF AN ADMIRALTY PATTERN ANCHOR

ing them with teeth or "flukes" to fasten themselves to the bottom.

Until the beginning of the 19th century anchors were of imperfect manufacture, the means of effecting good and efficient welding being absent and the iron poor, whilst the arms, being straight, generally parted at the crown when weighing from good holding-ground. A clerk in the Plymouth yard, named Pering, in the early part of that century (1813) introduced curved arms; and after 1852 the Admiralty anchor, under the direction of the Board, was supplied to H.M. ships. The present form of Ad-



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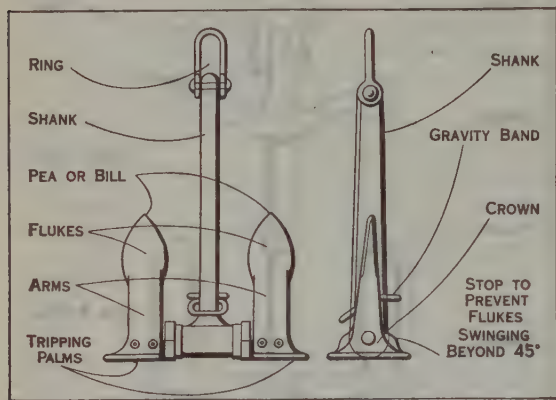
FIG. 2B.—SIDE VIEW OF MARTIN'S CLOSE STOWING ANCHOR

weight; and a clear forecastle for "right ahead" gun fire or for working ship.

These more than make up for the disadvantage that bigger, and therefore heavier, hawse-pipes are required.

Fig. 4 shows how a stockless anchor stows in a modern warship.

Fig. 5 shows the general arrangement of the anchors and cables on the forecastle of a modern battleship. (See also CABLE.)



FROM THE "MANUAL OF SEAMANSHIP," BY PERMISSION OF THE CONTROLLER OF H.M. STATIONARY OFFICE

FIG. 3.—FRONT AND SIDE ELEVATION OF A STOCKLESS ANCHOR

The word "anchor" is derived from the Greek *ἄγκυρα* which Vossius considers is from *δγκη*, a crook or hook.

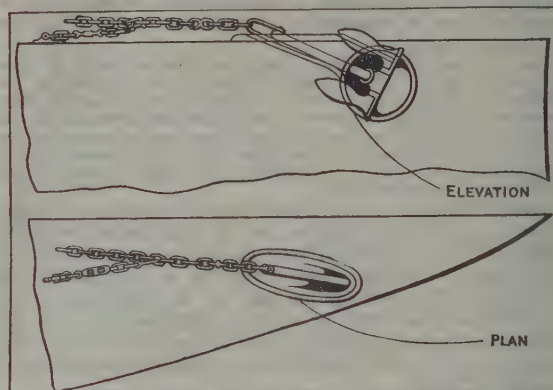
BIBLIOGRAPHY.—*Admiralty Manual of Seamanship*, vol. i (H.M. Stationary Office); *Lloyd's Register of British and Foreign Shipping*. (E. A.)

ANCHOVY (*Engraulis encrasicolus*), a fish of the herring family distinguished by its deeply cleft mouth, the angle of the gape being behind the eyes. The pointed snout extends beyond the lower jaw.

The fish resembles a sprat in having a forked tail and a single dorsal fin, but the body is round and slender. The maximum

in autumn, returning in the following spring. The shallow and landlocked waters of the Zuider Zee become raised to a higher temperature in summer than any part of the sea about the British coasts, and anchovies are able to spawn in these waters.

Spawning takes place in June and July. The eggs are buoyant and transparent but peculiar in having an elongated, sausage-like shape. They resemble those of the sprat and pilchard in having a segmented yolk and no oil globule. The larva hatches two or three days after fertilization and is very minute and

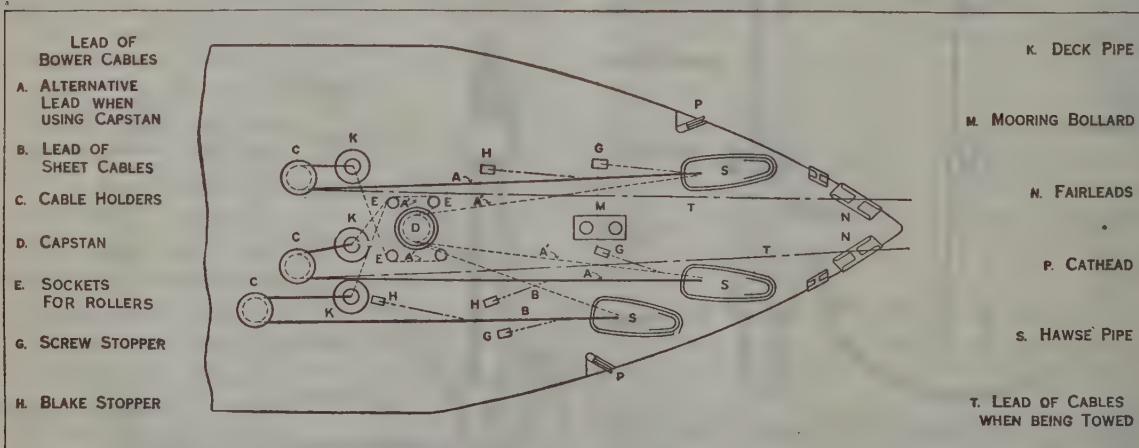


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FIG. 4.—METHOD OF STOWING THE STOCKLESS ANCHOR ON SHIPBOARD

transparent. The so-called "Norwegian anchovies" imported into England in little wooden kegs are sprats pickled in brine with bayleaves and pepper.

ANCHOVY EGGS, a savoury dish. To make it, beat three eggs slightly and stir them over a fire, together with $\frac{3}{4}$ oz. of butter, a tablespoonful of milk, $\frac{1}{2}$ -teaspoonful of anchovy essence, pepper, salt, capers or other seasoning. When the mixture thickens, pour it on hot buttered toast and decorate it with capers and anchovies laid crosswise.



FROM THE "MANUAL OF SEAMANSHIP," BY PERMISSION OF THE CONTROLLER OF H.M. STATIONARY OFFICE

FIG. 5.—DIAGRAM OF THE FORECASTLE OF A MODERN BATTLESHIP, SHOWING DISPOSITION OF ANCHORS

length is $8\frac{1}{2}$ in. Anchovies are abundant in the Mediterranean, and are regularly caught on the coasts of Sicily, Italy, France and Spain. The range of the species also extends along the Atlantic coast of Europe to south Norway.

In summer it enters the Zuider Zee in such numbers as to give rise to a regular and valuable fishery. It is also taken in the estuary of the Scheldt. The anchovies found at the western end of the English channel in November and December are probably those which annually migrate from the Zuider Zee to the Atlantic

ANCHOVY PEAR (*Grias cauliflora*), the common name for a tall slender tree cultivated in the West Indies and belonging to the family Lecythidaceae. The russet-brown fruit, which is about 3 in. long, is eaten pickled.

ANCHOVY TOAST, a pleasant savoury dish, best made as follows: Chop coarsely six boned anchovies, fry in butter with a finely chopped small onion and the yolk of an egg. Add, if desired, chopped parsley and cayenne pepper. When the mixture thickens, pour on hot buttered toast.

ANCIEN RÉGIME, THE, a French phrase commonly used to denote the social and political system established in France under the old monarchy and overthrown by the revolution of 1789. (See FRANCE; History.)

ANCIEN or **ANTIENT**, old or in olden times. "Ancient history" is distinguished from mediæval and modern, generally as meaning before the fall of the Western Roman empire. "The Ancient of days" is a Biblical phrase for God. In the London Inns of Court the senior barristers used to be called "ancients." From the 16th to the 18th century the word was also used, by confusion with "ensign," i.e., standard-bearer, for that military title. (See also ANCIENT LIGHTS; DEMESNE.)

ANCIENT LIGHTS, a phrase in English law for a negative easement (*q.v.*) consisting in the right to prevent the owner or occupier of an adjoining tenement from building or placing on his own land anything which has the effect of illegally obstructing or obscuring the light of the dominant tenement. At common law a person who opens a window in his house has a natural right to receive the flow of light that passes through it. But his neighbour is not debarred thereby from building on his own land even though the effect of his action is to obstruct the flow of light thus obtained. Where, however, a window has been opened for so long a time as to constitute immemorial usage in law, the light becomes an "ancient light," which the law protects from disturbance. The Prescription Act, 1832, created a statutory prescription for light. It provided (s. 3) that "when the access and use of light to and for" (any building) "shall have been actually enjoyed therewith for the full period of 20 years without interruption, the right thereto shall be deemed absolute and indefeasible, any local usage or custom to the contrary notwithstanding, unless it shall appear that the same was enjoyed by some consent or agreement, expressly made or given for that purpose by deed or writing." Since under the statute an "interruption" in order to prevent the right accruing must be one of at least a year, the period of prescription is really only 19 years. But the right given by the statute is inchoate, unless and until the dominant owner's claim is decided by the court, and the period of prescription must be the years immediately preceding the action raising the question. But in the meantime, however long the enjoyment may have been, the dominant owner's right is just the same, and the origin of his right is just the same as if the act had never been passed. These principles were laid down in 1904 by the House of Lords in the leading case of *Colls v. Home and Colonial Stores, Ltd.* (1904, A. C. 179). There has been much difference of judicial opinion as to what constitutes an actionable interference with "ancient lights." On the one hand, the test has been prescribed that if an angle of 45°—uninterrupted sky light—was left, the easement was not interfered with, and, while this is not a rule of law, it is a good rough working criterion. However, it has now been decided by the House of Lords in *Colls v. Home and Colonial Stores* (*supra*) that there must be a privation of light substantial enough to render the occupation of the house or building uncomfortable according to the ordinary notions of mankind and (in the case of business premises) to prevent the plaintiff from carrying on his business as beneficially as before. See also *Kine v. Jolly* (1905, 1 Ch. 480). The ordinary remedy for a disturbance of "ancient lights" is an injunction. Under the act commonly called Lord Cairns' Act, 1858, however, the court has power to grant damages in lieu of an injunction even before any damage has been done to the premises of the plaintiff (*Leeds Industrial Co-operative Society, Ltd. v. Slack*, 1924, A.C. 851). This jurisdiction is exercised only when the possible damage is certain to be small. (See EASEMENT.)

There is, in Scots law, no special doctrine as to "ancient lights." The servitude of light in Scotland is simply the Roman servitude *non officiendi luminibus vel prospectui*. (See EASEMENT and ROMAN LAW.) The same observation applies to the Code Civil and other European codes based on it. The doctrine as to ancient lights does not prevail generally in the United States. In a considerable number of the more important British dominions the acquisition of a prescriptive right to light and air has been abolished.

ANCILLARY (Lat. *ancilla*, a handmaid), an adjective meaning "subordinate to" or "merely helping," as opposed to "essential." Thackeray and some other writers have also employed it rather affectedly in its primary meaning of "pertaining to a maid-servant."

ANCILLON, CHARLES (1659–1715), one of a distinguished family of French Protestants, was born on July 28 1659, at Metz. His father, David Ancillon (1617–1692), was obliged to leave France on the revocation of the Edict of Nantes, and became pastor of the French Protestant community in Berlin. Charles Ancillon studied law at Marburg, Geneva and Paris, where he was called to the bar. In 1699 he succeeded Pufendorf as historiographer to the elector, and the same year replaced his uncle Joseph Ancillon as judge of all the French refugees in Brandenburg. He died on July 5 1715. Ancillon's chief claim to remembrance is the work that he did for education in Prussia, and the share he took, in co-operation with Leibnitz, in founding the Academy of Berlin. Of his works the only one still of value is the *Histoire de l'établissement des Français réfugiés dans les états de Brandebourg* (1690).

ANCILLON, JOHANN PETER FRIEDRICH (1766–1837), Prussian historian and statesman, great-grandson of Charles Ancillon, was born at Berlin, April 30 1766. He studied theology at Geneva, and after finishing his course was appointed minister to the French community at Berlin. Ancillon wrote a *Tableau des révolutions du système politique de l'Europe depuis le XV^e siècle* (1803; new ed. 1824), which gained him the eulogium of the Institute of France, and admission to the Academy of Berlin. It was the first attempt to recognize psychological factors in historical movements, but otherwise its importance was exaggerated. In 1808 he was appointed tutor to the royal princes, in 1809 councillor of state in the department of religion, and in 1810 tutor of the Crown Prince (afterwards Frederick William IV.), on whose sensitive and dreamy nature he was to exercise a powerful but far from wholesome influence. In Oct. 1814, when his pupil came of age, Ancillon was included by Prince Hardenberg in the ministry, with a view to utilizing his supposed gifts as a philosophical historian in the preparation of the projected Prussian Constitution. But the practical difficulty of the constitutional problem gave the "court parson"—as Gneisenau had contemptuously called him—excuse enough for a change of front which, incidentally, would please his exalted patrons. He became the soul of the reactionary movement at the Berlin court, and the faithful henchman of Metternich in the general politics of Germany and of Europe.

In 1818 Ancillon became director of the political section of the ministry for foreign affairs under Count Bernstorff, and in the spring of 1832, on Bernstorff's retirement, succeeded him as head of the ministry. Ancillon had convinced himself that the rigid class distinctions of the Prussian system were the philosophically ideal basis of the State, and that representation "by estates" was the only sound constitutional principle; his last and indeed only act of importance as minister was his collaboration with Metternich in the Vienna Final Act of June 12 1834, the object of which was to rivet this system upon Germany forever. He died on April 19 1837, the last of his family. His historical importance lies neither in his writings nor in his political activity, but in his personal influence at the Prussian court, and especially in its lasting effect on the character of Frederick William IV.

See C. A. L. P. Varnhagen von Ense, *Blätter aus der preussischen Geschichte* (Leipzig, 1868–69); *ib. Tagebücher*, vol. i. (Leipzig, 1861); H. O. Treitschke, *Deutsche Geschichte* (Leipzig, 1879–94), and essay on Ancillon in *Preussische Jahrbücher* for April 1872; *Allgemeine Deutsche Biographie*, s.v. (Leipzig, 1875).

ANCÓN, a small village and bathing resort on the coast of Peru, 22 mi. N. of Lima by rail. The bay is formed by two projecting headlands and is one of the best on the coast. It has a sloping beach of fine sand and first became a popular bathing place in mid-19th century, although the country behind it is arid and absolutely barren. At some time previous to the discovery of America, Ancón had a large aboriginal population. Traces of terraces on the southern headland can still be seen,

and the sand-covered hills and slopes overlooking the bay contain extensive burial-grounds which were first systematically explored in 1875 by W. Reiss and A. Stübel (see Reiss and Stübel's *The Necropolis of Ancón in Peru*), and at mid-20th century were being explored under government direction. In modern times Ancón was the scene of several important historical events. Its anchorage was used by Lord Cochrane in 1820 during his attacks on Callao; it was the landing place of an invading Chilean army in 1838; was bombarded by the Chileans in 1880; and in 1883 it was the meeting place of the Chilean and Peruvian commissioners who drew up the treaty of Ancón, which ended the war between Chile and Peru.

ANCON, the anatomical name for "elbow" (from the Gr. *ἀγκών*); "ancones" in architecture are the projecting bosses left on stone blocks or on drums of columns, to allow of their being either hoisted aloft or rubbed backwards and forwards to obtain a fine joint; the term was also given to the trusses or console brackets on each side of the doorway of a Greek or Roman building. A particular sort of sheep, with short crooked forelegs, is called "ancon" sheep.

ANCONA, ALESSANDRO (1835–1914), Italian man of letters, was born at Pisa on Feb. 20 1835 and died at Florence on Nov. 8 1914. He acted as intermediary between Cavour and the Tuscan Liberals in 1855, and represented Tuscany in the Società Nazionale. In 1861 he was appointed professor of Italian literature at Pisa, and was made a senator in 1904.

His chief works are: *Opera di Tommaso Campanella* (Turin, 1854); *Sacre Rappresentazioni dei secoli XIV., XV., e XVI.* (Florence, 1872); *Origini del Teatro in Italia* (Florence, 1877); *La Poesia popolare italiana* (Livorno, 1878), besides several volumes of literary essays, editions of the works of Dante and other early Italian writers, etc.

ANCONA, the Marches, Italy, an episcopal see and capital of the province of Ancona, on the north-east coast of Italy, 185 mi. N.E. of Rome by rail and 132 mi. direct, and 127 mi. S.E. of Bologna. Pop. (1936) 57,100 (town), 89,198 (commune). The town stands on and between the steep slopes of the two extremities of the promontory of Monte Conero, Monte Astagno to the south, occupied by the citadel, and Monte Guasco to the north, on which the cathedral stands (300ft.). The latter, dedicated to S. Ciriaco, is said to occupy the site of a temple of Venus, mentioned by Catullus and Juvenal as the tutelary deity of the place and 14 columns in the interior are attributed to it. It was consecrated in 1128 and completed in 1189. It is fine Romanesque in grey stone, in the form of a Greek cross, with a dodecagonal dome over the centre. The façade has a Gothic portal. The interior, with a crypt in each transept, preserves its original character. In the dilapidated episcopal palace Pope Pius II. died in 1464. S. Maria della Pizza has an elaborate arcaded façade (1210). The Palazzo del Comune (twice restored) with lofty arched substructures at the back, was the work of Margaritone d'Arezzo (1270). Fine late Gothic buildings include churches of S. Francesco and S. Agostino, the Palazzo Benincasa, and the Loggia dei Mercanti, all by Giorgio Orsini, usually called da Sebenico and the prefecture, which has Renaissance additions. The portal of S. Maria della Misericordia is ornate early Renaissance. There is an important archaeological museum.

To the east of the town is the harbour, now an oval basin of 990 by 880 yards, which, though small, is the finest harbour on the northwest coast of the Adriatic, and one of the best in Italy; improvements have been made. It was originally protected only by the promontory on the north from the elbow-like shape of which (Gr. *ἀγκών*) the ancient town, founded by Syracusan refugees about 390 B.C., took the name which it still holds. Greek merchants established a purple factory here (Sil. Ital. viii. 438). Even in Roman times it kept its own coinage and continued the use of the Greek language. When it became a Roman colony is doubtful. It was occupied as a naval station in the Illyrian War of 178 B.C. Caesar took possession of it immediately after crossing the Rubicon. Its harbour was of considerable importance in imperial times as the nearest to Dalmatia, and was enlarged by Trajan, who constructed the north quay. It was his starting point for his second expedition to Moesia and Dacia in A.D. 105. At the beginning of it stands the marble triumphal arch, erected in his honour in A.D. 115. Pope Clement II. prolonged the quay, and an inferior imita-

tion of Trajan's arch was set up; he also erected a lazaretto at the south end of the harbour, now a tobacco warehouse, Vanvitelli being the architect-in-chief. The southern quay was built in 1880, and the harbour is now protected by forts on the heights. Steamers run regularly to Zara and Fiume and also to Gravosa. There is a large sugar refinery and a shipbuilding yard. In 1926 the port dealt with 605,562 tons of merchandise, and 4,568 ships of tonnage 1,912,774, carrying 31,073 passengers. In the following 15 years the trade of the city steadily declined.

Ancona was attacked by Goths, Lombards and Saracens, but recovered its importance. It was one of the cities of the Pentapolis under the exarchate of Ravenna, the other four being Fano, Pesaro, Senigallia and Rimini, and eventually became a semi-independent republic under papal protection until Gonzaga took possession for Clement VII. in 1532. From 1797 onwards, when the French took it, it frequently appears in history as an important fortress, until Lamoricière capitulated here on Sept. 29, 1860, eleven days after his defeat at Castelfidardo. It suffered some damage from bombardment by the Austrian fleet on May 24, 1915.

ANCONA, a variety of domestic fowl, very similar to the Leghorn. The Ancona originated in Port Ancona, Italy, and was imported into England about the middle of the 19th century, and thence to America. It lays a white-shelled egg, and is a non-broody breed. There are two varieties, the Single Comb and the Rose Comb Ancona which, apart from the type of comb, are identical in every respect. The general plumage colour is lustrous black above with certain of the feathers tipped with a V-shaped white tip and slate below. (See POULTRY AND POULTRY FARMING.)

ANCREN RIWLE, a Middle English prose treatise written for a small community of three religious women and their servants. It is generally supposed to date from the first quarter of the 13th century, but E. Kölbing is inclined to place the Corpus Christi ms. about the middle of the 12th century. There are extant eight English mss. of the work (two fragmentary), four in Latin and one in French. One Latin ms., *Regula Anachoritarum sive de vita solitaria* (Magdalen college, Oxford, No. 67, fol. 50) has a prefatory note:—*Hic incipit prohemium venerabilis patris magistri Simonis de Gandavo, episcopi Sarum, in librum de vita solitaria, quem scripsit sororibus suis anachoritis apud Tarente*. But Bishop Simon of Ghent, who died in 1315, could not have written the book, though he may have been responsible for the Latin recension. It has been tentatively attributed to Richard Poor, bishop successively of Chichester, Salisbury and Durham; but the claim rests on slight foundation.

What was the original language of the *Ancren Riwle*? Morton held that it was English, but his view was challenged by E. E. Bramlette in *Anglia* (XV. 478–498), who argued in favour of a Latin original. Bramlette was, in his turn, challenged by G. C. Macaulay (*Modern Language Review*, IX, 70–78) who showed conclusively that the Latin was translated from English, and not vice versa; but after study of the French ms. (Cotton Vitellius F. vii) Macaulay argued that the English was translated from the French. But the evidence in favour of English cannot really be resisted. What is important, however, about the *Ancren Riwle*, is not the quantity of dispute it occasions, but the fact that it is a genuine contribution to English literature—almost the earliest English prose work that the ordinary person can read with pleasure. It combines religious sincerity with simple, affectionate charm in a singularly high degree.

Ancren Riwle was edited for the Camden Society by the Rev. James Morton in 1853 from the Cotton ms. (Nero A. xiv.). A collation of this text with the ms. by E. Kölbing is printed in the *Jahrbuch für romanische u. engl. Spr. und Lit.* xv. 180 seq. (1876). The *Ancren Riwle* (ed. F. A. Gasquet, 1905) is available for the ordinary reader in *The King's Classics*. For specimens of texts and discussions of details see, in addition to works quoted, Kölbing in *Englische Studien*, lii. 535; Panes in *Englische Studien*, xxx. 344–346; McNabb in *Modern Language Review*, xi. 1–8, claiming a Dominican, Friar Robert Bacon, as author; Miss Hope Allen in *Publications of the Modern Language Association of America*, xxxiii., 538–546, suggesting that the work was written for three ladies of Kilburn; Miss Dorothy Dymes in *Essays and Studies by Members of the English Association*, Vol. ix.; R. W. Chambers and others in *Review of English Studies*, Jan. 1923, Jan. 1926, April 1926; and Joseph Hall, *Selections from Early Middle English*.

ANCRUM, a village and civil parish on Ale or Alne Water, a tributary of the Teviot, Roxburghshire, Scotland. Pop. (1931) 858. The name has a Gaelic root and the village is of considerable antiquity; a Roman road forms the northeast boundary of the parish. Ancrum Moor, 2 mi. N.W., was the scene of a battle in 1545 in which the English were defeated by the Scots.

ANCUS MARCIUS (640–616 B.C.), fourth legendary king of Rome. Like Numa, his reputed grandfather, he was a friend of peace and religion, but was obliged to make war to defend his territories. He conquered the Latins, and some of them whom he settled on the Aventine formed the origin of the Plebeians.

See Livy i, 32, 33; Dion Halic. iii, 36–45; Cicero, *De Republica*, ii, 18.

ANCYLOPODA or **CHALICOTHERIOIDEA**, a group of extinct, large mammals, extraordinary in having carnivore-like claws on the feet but herbivorous teeth in the jaws. The teeth and claws were separated in the first specimens found, early in the 19th century in Germany and France, and the naturalists of that time could not believe that the two belonged together. According to Cuvier's famous "law of correlation," on which is based the mistaken popular idea that scientists can restore a whole animal from a single bone, the claws were believed to belong to a gigantic scaly anteater or pangolin and the teeth were (correctly) recognized as indicating an ungulate allied to the Lophiodontidae (*q.v.*). When more complete skeletons showed that both are surely parts of one animal, they were considered so exceptional that a supposedly distinct order of mammals, the Ancylopoda, was defined. It is now known, however, that these animals, the chalicotheres, are rather closely related to the horses and belong, with the latter, in the order Perissodactyla (*q.v.*). The claws are nothing more than transformed hoofs and they illustrate the evolutionary principle, complementary to Cuvier's "law," that one part of an animal may become highly modified at a rapid rate while other parts remain relatively primitive and retain the true evidence of ancestry.

Although never much varied or dominant in any one fauna, chalicotheres lived almost throughout the Age of Mammals (Late Eocene to Pleistocene) and ranged throughout North America, Europe and Asia. Thirteen genera are recognized. The best-known is *Moropus*, of which complete skeletons, found in the Lower Miocene strata of Nebraska, have been mounted in the natural history museums of New York city, Pittsburgh and elsewhere. This animal stood about six feet high at the shoulders and somewhat resembled a large horse except for its strange feet. The teeth were of browsing type for eating succulent vegetation, as in the earlier horses, rather than of grazing type for eating harsh grasses, as in the living horses. The feet were short and each ended in three clawed toes, the inner claw on the front feet being particularly large. The use of these claws has been the subject of much speculation. It seems most probable that they were adaptations for scratching the ground in search of food, such as bulbs or juicy roots.

The earliest chalicotheres were smaller animals, not larger than sheep, and had feet more like those of normal ungulates. Some later Tertiary forms were even more specialized and grotesque than *Moropus*.

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ANCYRA, an ancient city of Galatia (mod. *Angora*, *q.v.*), in Asia Minor, on a tributary of the Sangarius. Originally a prosperous Phrygian city, Ancyra became the centre of the Tectosages, one of the three Gaulish tribes that settled in Galatia about 232 B.C. In 189 B.C. Ancyra was occupied by Cn. Manlius Vulso, who made it his headquarters in his operations against the tribe. In 63 B.C. Pompey placed it (together with the Tectosagan territory) under one chief, and it continued under native rule till it became the capital of the Roman province of Galatia in 25 B.C. Inscriptions and coins show that its civilization in the 1st century A.D. consisted of a layer of Roman ideas and customs superimposed on Celtic tribal characteristics, and that not until about A.D. 150 did the true Hellenic spirit begin to appear. Christianity was introduced (from the north or northwest) perhaps as early as the

1st century, but there is no shred of evidence that the Ancyran Church (first mentioned A.D. 192) was founded by St. Paul or that he ever visited northern Galatia. The real greatness of the town dates from the time when Constantinople became the Roman metropolis, when its situation gave it an importance which it retained throughout the middle ages. See further **ANGORA** (1). An important ecclesiastical synod was held here in A.D. 314.

The modern town contains many remains of Roman and Byzantine periods. The most important monument is the *Augusteum*, a temple of white marble erected to "Rome and Augustus" during the lifetime of that emperor by the common council or diet of the three Galatian tribes. The temple was afterward converted into a church, and in the 16th century a fine mosque was built against its south face. On the walls of the temple is engraved the famous *Monumentum Ancyranum*, a long inscription in Latin and Greek describing the *Res gestae divi Augusti*. The inscription is a grave and majestic narrative of the public life and work of Augustus. The original was written by the emperor in his 76th year (A.D. 13–14) to be engraved on two bronze tablets placed in front of his mausoleum in Rome. (See also **GALATIA**.)

ANCYRANUM, MONUMENTUM, the tablets recording the deeds of Augustus, found on the walls of a temple at Ancyra (Angora). These tablets were copies of the *index rerum a se gestarum* (record of his deeds) set up by the emperor in Rome. The first section deals with the "deeds," largely military, between 44 and 28 B.C.; the second with domestic matters, such as honorific titles and constitutional changes; the third with finance; and the fourth with general political and diplomatic matters. See the editions by Th. Mommsen (1883) and E. G. Hardy (1923).

ÅNDALSNES, a tourist town of Norway, terminus of the railway from Oslo via Dombås, in Møre province, on Romsdalsfjord. Pop. (1930) 984. From this relatively new town a magnificently constructed highway, Trollstegveien, leads over the mountains to Sylte in Valldal. During World War II the British landed forces at Åndalsnes in April 1940 in an attempt to move into the interior. In forcing them to retire, the Germans almost completely destroyed the town.

ANDALUSIA (Span. Andalucía), an old province of Spain, broken up (1833) into the eight provinces of Almería, Cádiz, Córdoba, Granada, Huelva, Jaén, Málaga and Seville (*q.v.*).

The Arab name al-Andalus designated the entire peninsula, but was used also specifically for the Muslim area and especially for the four kingdoms of Seville, Córdoba, Jaén and Granada. It has been referred to a hypothetical form Vandalicia, the name either of Baetica when occupied by the Vandals or of the port by which the Vandals passed to Africa. The alternative "Land of the West" seems not to be considered seriously by modern Arabic scholars. In popular speech, however, Andalusia begins, not with the northern boundaries of the provinces of Córdoba and Seville, but with the descent from the Sierra Morena to the Guadalquivir lowlands. Here is one of the abrupt changes characteristic of Spain; everything changes—climate, vegetation and people—in the drop of 1,500 to 2,000 ft. from the plateau to the lowlands. These wide and undulating lowlands are the essential Andalusia; the foothills of the Cordillera which separates them from the Mediterranean, and the Cordillera itself are known in distinction as Upper Andalusia. (Nevertheless, the terms Upper and Lower Andalusia are used also to distinguish between the lowlands lying respectively along the upper and lower courses of the Guadalquivir.) Lower Andalusia opens out gradually in a funnel as it descends toward the Atlantic, at the same time it slopes gently toward the Guadalquivir, which on the north clings to the Morena foot. It is the upheaved bottom of the sea-straits which formerly separated the Spanish plateau from the Cordillera to the south, at that time still connected across the present Straits of Gibraltar with the African continent. The movement of upheaval, which led to the steady westward growth of the land, had many oscillations, so that deposits of widely differing kinds were laid down on the ocean margin as defined from time to time. Moreover, the older levels which appear at the surface where these latter deposits have been worn away often contain gypsum and salt. Thus the soils of Lower Andalusia vary widely from the fertile

marls, which are best known in the famous olive-groves of the *Ajaraque*, west of Seville, and in the vineyards of Jerez de la Frontera to the waterless, infertile soils of the wide pasture tracts (*dehesas*). To the west Lower Andalusia rises into the highly mineralized plateau leading to Portugal; to the east the lowlands, and with them the name, disappear in the narrows of the old straits, now limestone highlands leading to Murcia; in this direction the esparto and saline steppes increasingly dominate the landscape.

The excessive heat and almost absolute drought of the summer months and the mildness of winter differentiate the climate of Lower Andalusia from that of the other arid districts of Spain. The amazingly fertile "black earths," which cover large tracts south of the Guadalquivir below Córdoba and the La Janda depression east of Cape Trafalgar, have no reference to present climatic conditions; they are residual soils from an earlier, pluviose phase. The present climate is reflected in the wide extension of the olive, in the restricted extension of the orange from the coast to Palma del Río, but more especially in the frequent hedges of prickly pear, and the varieties of cactus. The towns of Lower Andalusia lie on the rivers, usually at points where these may be suitably bridged (Seville, Ecija, Córdoba), or on elevations rising from the plain (Carmona, Marchena, Baena), or in commanding positions on the borders of the foothills (Morón, Osuna, Lucena). Cádiz, however, lies on the coast on a narrow-necked peninsula. Between the Rio Tinto and the Guadalquivir a large area of marshlands, fringed with dunes along the coast, is practically uninhabited.

Upper Andalusia rises somewhat abruptly from the south side of the Guadalquivir lowlands, but as these rise towards the narrows its boundary becomes less distinct. The sierras of Upper Andalusia are aligned roughly in a cordillera, for the origin and structure of which see general article SPAIN, under heading *Geology*. They culminate in the Sierra Nevada (*q.v.*). A series of structural depressions, aligned with the sierras, provides most of the flat ground in this mountainous country, and the cities and towns are situated to command these (Granada, Antequera, Guadía and Baza), or on the coastal plains at the mouths of the short rivers of the Mediterranean slope (Málaga, Matril, etc.). The *vegas*, or fertile flats, of this area are thus unusually important. The climates of Upper Andalusia are altitudinal variants of that of Lower Andalusia. The towns of the mountain and of the coast are both, for different reasons, tolerable in summer. The coastal strips are notable for the mildest winter climate in Europe; here are to be found the sugar-cane, the plantain, the cherimoya, even the coffee-plant, and cotton is now being reintroduced experimentally under government control. Between the sub-tropical coastal district and the Nevada summits, lying some 500 or 600 ft. below the theoretical snow-line, there is a great range of climates and vegetations, which are brought into close superposition in the Alpujarras (*q.v.*). Nowhere, however, is there significant rainfall in summer; the only advantage possessed by Upper Andalusia over the lowlands is the availability of water for irrigation.

The accessibility of the interior by the waterways of the Guadalquivir (the only important river of Spain for navigation) and, to a lesser extent, of the Odiel and Rio Tinto, together with the mineral wealth of the Sierra Morena and of the plateau leading to Portugal, contributed to the early advance of civilization in Andalusia and to early contact with the outside world. The kingdom of Tartessus, perhaps the Biblical Tarshish, flourished here in the latter half of the second millennium B.C., and its port, of the same name, on the Atlantic front served both as depot for the ore of Andalusia and as *entrepôt* for the tin of northern lands, brought here in Tartessian ships. The Phoenicians, who may have been preceded here by the Cretans, established about 1100 B.C. a colony, Gadir, the earliest Cádiz, on a small coastal islet at some distance south, and also tapped the resources of Andalusia at points on the Mediterranean coast (Málaga, Adra). The Phoenicians were followed—after an interval during which the Phocæan Greeks controlled the trade with Tartessus—by the Carthaginians, who destroyed the Tartessian kingdom and finally established themselves firmly in southern Spain. Andalusia

did not blossom again until, as the senatorial province of Baetica (which extended, however, farther north and reached east only to the Linares district), it became integrally Roman. The brief occupation by the Vandals in the 5th century A.D., and the failure of the Eastern empire to hold Andalusia as an outlier of the imperial territory in Africa, seem to illustrate the untenability of Andalusia by a power not firmly established on the central plateau of Spain. The Muslim period, beginning in 711, brought Lower Andalusia to the highwater mark of its history. Córdoba, more conveniently situated with respect to the Morena passes than the other Andalusian towns, became under the Umayyads the chief centre of authority in the peninsula and a world-centre of culture. But the disadvantages, for control of the peninsula, of an administrative centre in Andalusia required to be counteracted by the energy of an Abderrahman III or an Almanzor, and with the death of the latter effective control from Córdoba and, for the time, from Andalusia ceased. In the succeeding period superior local advantages of site contributed to make Seville outstanding among the numerous small Muslim states of Spain. When, after the defeat at Las Navas de Tolosa in 1212, the Muslims lost control of the Despeñaperros pass, and their Guadiana states, now outflanked, fell to the Christians, Lower Andalusia ceased to be tenable.

The Muslim concentration in Upper Andalusia from 1257 onwards brought that region in turn to the zenith of its historical destiny. Granada, dominating the Genil depression, the most central of the Cordillera, became the centre of authority for a kingdom extending from Algeciras to the neighbourhood of Aguilas. To the loose coherence of the kingdom of Granada, regarded as ending Arab civilization, the physical isolation of the local administrative centres of Málaga, Almería, Guadix, Baza, etc., and the lack of lines of easy communication contributed.

It has been suggested, particularly by Dr. Vaughan Cornish, that an important mistake was made by the Catholic sovereigns at the close of the reconquest in failing to recognize the suitability of Seville to be the capital of reunited Spain (see article SPAIN). With the discovery of the new world the water front of Andalusia rose to a new importance. First Seville, and later Cádiz, controlled the American trade. The tedious navigation of the lowest reaches of the Guadalquivir and the isolated position of Cádiz contributed to the decline of this trade in Andalusia when the monopoly was withdrawn from these cities. Canalization and other improvements effected on the Guadalquivir revived the foreign trade of Seville in the last quarter of the 19th century; the outlook to the ocean again became an important factor in the life of Lower Andalusia. The 19th century mining revival, under foreign concessionaire companies, brought into play again another traditional factor. In Upper Andalusia modern development is largely a question of communications. During the civil war of 1936-39 the western half of Andalusia was held by the nationalists, whereas the eastern half remained loyalist.

The long period of Muslim domination in Andalusia has left behind four great monuments—the Giralda and Alcázar of Seville, the Mosque of Córdoba and the Alhambra at Granada. Though the buildings which survive from that period are few, the impress of the Muslim is still clear in the plan of cities and towns where, as in Córdoba, later economic currents have not been sufficiently strong to modify it seriously, and is everywhere traceable. The internal arrangement of the house is derived by evolution from the Arab interior. The influence of Arabic in the everyday language of the common people is obvious, but it is not possible to assess the relative parts played by physical environment and the successive immigrations in determining the "Gascon" temperament of the people, the physical type—dark complexioned, handsome, graceful—and the clipped speech and phonetic peculiarity of the *sese*s, or sibilant of the lisped Castilian *c* and *z*. The extension of the *sese*s in the new world is a testimony to the part played by Andalusia in its settlement.

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ANDALUSIA, a city of southern Alabama, U.S.A., on the Central of Georgia and the Louisville and Nashville railways; the county seat of Covington county, and the commercial centre of a farming and lumbering region. The population was 9,176 in 1950 and 6,886 in 1940 by federal census. The city's manufactures include clothing and cottonseed oil.

ANDALUSITE, a mineral with the same chemical composition as kyanite and sillimanite, being aluminium silicate, Al_2SiO_5 . As in sillimanite, its crystalline form is referable to the orthorhombic system. Crystals of andalusite have the form of almost square prisms, the prism-angle being $89^\circ 12'$. As a rule the crystals are roughly developed and rude columnar masses are common, these being frequently partially altered to kaolin or mica. Such crystals, opaque and of a greyish or brownish colour, occur abundantly in the mica-schist of the Lisesen Alp near Innsbruck in Tirol, and in Andalusia, from which place it derives its name. The unaltered mineral is found as transparent pebbles with topaz in the gem-gravels of the Minas Novas district, in Minas Geraes, Brazil. These pebbles are usually green but sometimes reddish-brown in colour and are remarkable for their very strong dichroism, the same pebble appearing green or reddish-brown according to the direction in which it is viewed. Such specimens make very effective gem-stones, the degree of hardness of the mineral ($H = 7\frac{1}{2}$) being quite sufficient for this purpose.

A curious variety of andalusite known as chiastolite is especially characteristic of clay-slates near a contact with granite. The elongated prismatic crystals enclose symmetrically arranged wedges of carbonaceous material, and in cross-section (see fig.) show a black cross on a greyish ground. Cross-sections of such crystals are polished and worn as amulets or charms. Crystals of a size suitable for this purpose are found in Brittany and the Pyrenees, while still larger specimens have been found recently in South Australia.

ANDAMANESE. The Andaman islands in the Bay of Bengal are inhabited by a pigmy stock. The men average 4ft. 10½ in., the women, 4ft. 6 in. They are markedly round headed, broad nosed, with hair generally sooty black or yellowish brown. The skin varies in colour from an intense sheeny black to reddish brown on the unexposed parts.

There are two main divisions, coast and inland people, each divided into minor local groups with definite linguistic and cultural characteristics. There are no clans or exogamic units. There is no organized government or hereditary chief. Conduct is regulated by public opinion, the direct pressure of which, in small nomadic, hunting, food-collecting groups, is effective. The stages of life are marked by a series of rites centring on food taboos. Marriage rites consist simply of publicly placing the bride on the bridegroom's lap. The encampment has separate huts for the unmarried—girls and boys apart, and for married couples. Four modes of burial are practised, tree burial being employed for those who are specially honoured. Dancing is practised, and singing, individual and collective, is cultivated. Religious beliefs are associated with the seasonal variations, the monsoon being the prominent and regulating feature. Legends display local variations. Religious ritual is not organized. Men have visions or dreams and gain reputation as in contact with the world of

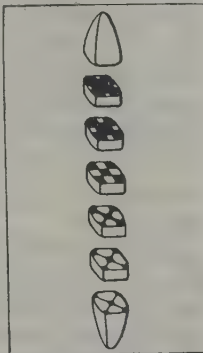
spirits. Though ignorant of methods of making fire, they preserve it carefully, cook by it and make pottery.

Language.—The languages of the ten tribes of the Great Andaman form a linguistic group distinct from that constituted by the languages of the Little Andaman and the Jarawa of the South Andaman. The vocabularies differ conspicuously, but the identities of grammatical structure show that all are derived from a common source. The phonetic system is imperfectly known, but there is no *s*, *z*, *sh* or *zh*. Vowel and consonantal changes follow regularly in the several languages. The language is built up of stems and affixes. Simple stems are generally nouns, names of simple independently existing objects. Compound stems have a prefix, which is a separable element. The prefixes show that the object is a part of, or intimately associated with, some other object. A pig is an independent object. It is a simple stem. The head of a pig is not a simple object. A class prefix is therefore required. Such objects belong to someone; a head belongs to someone. A possessory prefix is therefore required. The class prefixes also modify the meaning of the stem. Adjectives do not require a possessory prefix but do require a class prefix. Simple verbs consist of a stem and a radical prefix and must be preceded by a personal pronoun. Compound words contain more than one stem. The elements may be (1) two simple stems, (2) two compound stems, (3) simple stem plus compound stem, (4) compound stem plus simple stem. It is recorded that many words could not be analysed so that the methods of word formation may include methods not stated above. The use of specific terms to describe details regarded by them as important is carried very far. Words for one and two are known. Finger counting is employed. Ten or both hands mean all, which is also used when five is reached by fingers. The grammatical construction proceeds on logical lines. There is as yet no convincing proof of any relationship with other languages.

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ANDAMAN ISLANDS, a group of islands in the Bay of Bengal. Large and small, they number 204, and lie 590 mi. from the mouth of the Hugli, 120 mi. from Cape Negrais in Burma, the nearest point of the mainland. The Andamans and the Nicobar Islands (*q.v.*) together constitute a chief commissioner's province of British India. The extreme length of the Andamans is 219 mi.; the width is 32 mi. There are five chief islands in the group, so closely adjoining each other that they have long been known collectively as "the Great Andaman." Four narrow straits part these islands. Attached to the chief islands are, on the extreme north, Landfall Islands; Interview Island, off the west coast of the Middle Andaman; the Labyrinth Island off the south-west coast of the South Andaman; Ritchie's (or the Andaman) archipelago off the east coast of the South Andaman and Baratang. Little Andaman, roughly 26 mi. by 16, forms the southern extremity of the whole group and lies 31 mi. south of Rutland Island across Duncan Passage, in which lie the Cinque and other islands, forming Manners Strait, the main commercial highway between the Andamans and the Madras coast. Besides these are a great number of islets lying off the shores of the main islands. The land area of the Andaman Islands is 2,508 sq. miles.

Topography.—The islands forming Great Andaman consist of a mass of hills enclosing very narrow valleys, the whole covered by an exceedingly dense tropical jungle. The hills rise, especially on the east coast, to a considerable elevation; the highest being Saddle Peak (2,400 ft.) in the North Andaman. Little Andaman, with the exception of the extreme north, is practically flat. There are no rivers and few perennial streams in the islands. The scenery is everywhere strikingly beautiful and varied, and the coral beds of the more secluded bays in its harbours are conspicuous for their exquisite colouring. The coasts of the Andamans are deeply indented, giving existence to a number of safe harbours and tidal creeks, often surrounded by mangrove swamps. There are a number of good anchorages along the coast, and several harbours, notably Port Blair, Port Cornwallis and Bonington.



TRANSVERSE SECTION OF A CRYSTAL OF CHIASTOLITE

A variety of andalusite with black inclusions. The crystal sections, when polished, are worn as amulets or charms

Geology.—The Andaman islands form part of a lofty range of submarine mountains, 700m. long, running from Cape Negrais in the Arakan Yoma range of Burma, to Achin head in Sumatra. This range separates the Bay of Bengal from the Andaman sea; and it contains much that is geologically characteristic of the Arakan Yoma, and formations common also to the Nicobars and to Sumatra and the adjacent islands. The older rocks are Early Tertiary or Late Cretaceous, but there are no fossils to indicate age. The newer rocks, common also to the Nicobars and Sumatra, are chiefly in Ritchie's archipelago and contain radiolarians and foraminifera.

Climate.—Rarely affected by a cyclone, though within the influence of practically every one that blows in the Bay of Bengal, the Andamans are of the greatest importance because of the accurate information relating to the direction and intensity of storms which can be communicated from them better than from any other point in the bay, to the vast amount of shipping in this part of the Indian ocean. A well-appointed meteorological station has been established at Port Blair since 1868. Speaking generally, the climate of the Andamans themselves may be described as normal for tropical islands of similar latitude. It is warm always, but tempered by pleasant sea-breezes; very hot when the sun is northing; irregular rainfall, but usually dry during the north-east, and very wet during the south-west monsoon.

Flora and Fauna.—A section of the Forest Department of India was established in the Andamans in 1883. In the neighbourhood of Port Blair 156 sq.mi. was set apart for regular forest operations, these being conducted for long by convict labour. The chief timber of indigenous growth is padouk (*Pterocarpus dalbergioides*), used for buildings, boats, furniture, fine joinery and all purposes to which teak, mahogany, hickory, oak and ash are applied. This tree is widely spread and forms a valuable export to European markets. Other first-class timbers are koko (*Albizia Lebbek*), white chuglam (*Terminalia bialata*), black chuglam (*Myristica irya*), marble or zebra wood (*Diospyros kurzii*) and satin wood (*Muraya exotica*), which differs from the satin-wood of Ceylon (*Chloroxylon Swietenia*). All of these timbers are used for furniture and similar purposes. Among the imported flora are tea, Siberian coffee, cocoa, Ceara rubber (which has not done well), Manila hemp, teak, cocoanut and a number of ornamental trees, fruit-trees, vegetables and garden plants. The general character of the forests is Burmese with an admixture of Malay types. Great mangrove swamps supply unlimited firewood of the best quality.

Animal life is generally deficient throughout the Andamans, especially as regards mammalia, of which there are only nineteen separate species in all, twelve of these being peculiar to the islands. There is a small pig (*Sus andamanensis*), important to the food of the people, and a carnivore (*Paradoxurus tyleri*); but the bats and rats constitute nearly three-fourths of the known mammals. This paucity of animal life seems inconsistent with the theory that the islands were once connected with the mainland. Moreover, the Andaman species differ from those of the adjacent Nicobar islands. Each group has its distinct harrier-eagle, red-cheeked paroquet, oriole, sun-bird and bulbul. Fish are very numerous and many species are peculiar to the Andaman seas. Turtles are abundant and supply the Calcutta market.

The People.—The Andaman islands are the abode of savages as low in civilization as almost any known on earth. Our earliest notice of them is in a remarkable collection of early Arab notes on India and China (A.D. 851), which describes the islanders as cannibals who massacre ship-wrecked crews. The traditional charge of cannibalism has been very persistent; but it is entirely denied by the islanders themselves, and is now and probably always has been untrue. Of their massacres of shipwrecked crews, even in quite modern times, there is no doubt. The Andamanese are probably the relics of a pigmy race that once inhabited the south-east portion of Asia and its outlying islands, representatives of which are also still to be found in the Malay Peninsula and the Philippines. Their antiquity and their stagnation are attested by the remains found in their kitchen-middens, which lead to the belief that the Andamans were settled by their present inhabitants some time during the Pleistocene period, and certainly no

later than the Neolithic age. Though all descended from one stock, there are twelve distinct tribes, each with its own clearly-defined locality, its own distinct variety of the one fundamental language and to a certain extent its own separate habits. Every tribe is divided into septs fairly well defined. The average height of males is 4ft. 10½ in.; of females, 4ft. 6 in. The skin varies in colour from an intense sheeny black to a reddish-brown on the collarbones, cheeks and other parts of the body. The hair varies from a sooty black to dark and light brown and red. It grows in small rings, which give it the appearance of growing in tufts, though it is really closely and evenly distributed over the whole scalp. The figures of the men are muscular and well-formed and generally pleasing; but the women have a tendency to stoutness and ungainliness of figure, and sometimes to pronounced prognathism. The women's heads are shaved entirely and the men's into fantastic patterns. Yellow and red ochre mixed with grease are coarsely smeared over the bodies, grey in coarse patterns and white in fine patterns resembling tattoo marks. Tattooing is of two distinct varieties. In the south the body is slightly cut by women with small flakes of glass or quartz in zigzag or lineal patterns downwards. In the north it is deeply cut by men with pig-arrows in lines across the body. The male matures when about fifteen years of age, marries when about twenty-six, begins to age when about forty, and lives on to sixty or sixty-five if he reaches old age. Except as to the marrying age, these figures fairly apply to women.

The Andamanese are bright and merry companions, keen sportsmen, but when angered, cruel, jealous, treacherous and vindictive and always unstable—in fact, a people to like but not to trust. There is no idea of government, but in each sept there is a head, who has attained that position by degrees on account of some tacitly admitted superiority and commands a limited respect and some obedience. The young are deferential to their elders. Offences are punished by the aggrieved party. Property is communal and theft is recognized only as to things of absolute necessity, such as arrows, pigs' flesh and fire. Fire is the one thing they are really careful about, not knowing how to renew it. The religion consists of fear of the spirits of the wood, the sea, disease and ancestors, and of avoidance of acts traditionally displeasing to them. There is neither worship nor propitiation. Honour is shown to an adult when he dies by wrapping him in a cloth and placing him on a platform in a tree instead of burying him. At such a time the encampment is deserted for three months. The only known weapons are bows, which differ altogether with each group, but the same two kinds of arrows are in general use: (1) long and ordinary for fishing and other purposes; (2) short with a detachable head fastened to the shaft by a thong, which quickly brings pigs up short when shot in the thick jungle. Bark provides material for string, while baskets and mats are neatly and stoutly made from canes and buckets out of bamboo and wood. None of the tribes ever ventures out of sight of land, and they have no idea of steering by sun or stars. The Andaman languages are extremely interesting from the philological standpoint. They are agglutinative in nature, show hardly any signs of syntactical growth though every indication of long etymological growth, give expression to only the most direct and the simplest thought, and are purely colloquial and wanting in the modifications always necessary for communications by writing. The sense is largely eked out by manner and action.

For many years the Andamans have been the scene of a highly organized penal settlement to which life convicts and long-term convicts from India were sent; this was the "transportation" of the Indian penal code. The capital of the settlement is Port Blair, where a chief commissioner resides, in charge of the Andaman and Nicobar Islands province of British India. He has a staff of assistants and overseers, mostly Europeans, and there is a garrison of British and Indian troops and a battalion of Indian military police. The purpose of the settlement is largely reformatory. After a period of graduated labour, the well-behaved convict is given a ticket-of-leave and becomes self-supporting. He can live in one of the villages comprised in the settlement, farm, keep cattle, marry if he is single, or send to India for his family; but he must not leave the settlement or be idle. His children

receive elementary education; and there is ample hospital accommodation throughout the settlement. With approved conduct he may be released and sent home after 20 to 25 years of total transportation. In 1926 the Indian government initiated a new policy which envisaged the gradual abandonment of the penal settlement in the Andamans. It was decided that henceforth only those convicts would be sent to the islands who might volunteer to do so, the purpose being to encourage the development of a free colony of persons who would, after the terms of their sentences had expired, make the Andamans their permanent home. There was a considerable relaxation of the former restrictions on life in the settlement, the ticket-of-leave system being much extended and the convicts given occupancy rights over the land which they had cultivated. At its maximum, the total convict population of all grades in the Andamans was in the neighbourhood of 12,000. By 1931 this figure had decreased to less than 8,000, and in 1941 there were only 6,165 convicts, of whom 1,207 were on ticket-of-leave and supporting themselves. The large free-born population also making the island their home included a number of returned emigrants from Natal who elected to settle there and Karens who were brought in for forest work. Excluding the aborigines, of whom there were only 62, in 1941 the total population of the Andamans was 21,316.

HISTORY

Andaman first appears distinctly in the Arab notices of the 9th century. But it seems possible that the *Agathou daimons nēsos* (Good Spirit Island) of Ptolemy was really a misunderstanding of some form like *Agdamn̄n*. The islands are briefly noticed by Marco Polo (who probably saw without visiting them), under the name *Angamanain*, seemingly an Arabic dual, "The two Angamans," with the exaggerated but not unnatural picture of the natives, long current, as dog-faced Anthropophagi. Another notice occurs in the story of Nicolo Conti (c. 1440), who explains the name to mean "Island of Gold," and speaks of a lake with peculiar virtues as existing in it. The name is probably derived from the Malay *Handuman*, coming from the ancient *Hanuman* (monkey). Later travellers repeat the stories, too well founded, of the ferocious hostility of the people. In Sept. 1789 Capt. Archibald Blair, acting under instructions from the government of Bengal, established a penal colony, associated with a harbour of refuge on Chatham Island, in the southeast bay of the Great Andaman, now called Port Blair, but then Port Cornwallis. Two years later, urged by Admiral Sir William Cornwallis, the government transferred the colony—together with its name of Port Cornwallis—to the northeast part of Great Andaman, where a naval arsenal was to be established. But the scheme did ill; and in 1796 the government put an end to it. In 1839, Dr. Helfer, a German savant employed by the Indian government, was attacked and killed in the islands. In 1844 the troopships "Briton" and "Runnymede" were driven ashore there. The natives showed their usual hostility, killing all stragglers. Outrages on shipwrecked crews continued so frequent that the question of occupation was revived, and in 1855 a project was formed for a settlement and a convict establishment. This scheme was interrupted by the Indian Mutiny of 1857, but as soon as the revolt was broken it became more than ever urgent to provide such a resource on account of the great number of prisoners falling into British hands. Lord Canning, therefore, dispatched in Nov. 1857 a commission, headed by F. Mouat, to examine and report. The commission reported favourably, selecting as a site Blair's original Port Cornwallis but avoiding the vicinity of a salt swamp which seemed to have been pernicious to the old colony. To avoid confusion, the name of Port Blair was given to the new settlement, which was established in the beginning of 1858. For some time sickness and mortality were excessively high, but the reclamation of swamp and clearance of jungle on an extensive scale by Col. Henry Man (1868–70) was ultimately successful. The Andaman colony obtained a tragic notoriety from the murder, by a Mohammedan convict, of the viceroy, the earl of Mayo, when on a visit to the settlement on Feb. 8, 1872. In the same year the two groups, Andaman and Nicobar—the occupation of the latter

having been forced on the British government in 1869 by the continued outrages upon vessels—were united under a chief commissioner residing at Port Blair. The use of the islands as a penal settlement was abandoned gradually after 1926 and colonization by free men encouraged. In 1942, during World War II, the Andaman Islands were occupied by Japanese forces.

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ANDAMENTO (Ital.), a musical term signifying the longer and more extended type of fugal subject, as distinguished from that of the shorter and more compact kind, or *soggetto*, consisting of a single brief theme. By German writers, however, the term is more often applied, not to a fugue's subject matter, but to its episodes—another instance of the confusion of practice so often prevailing in the case of musical terminology.

ANDANTE, a musical term to indicate pace, coming between *adagio* and *allegro*; it is also used of an independent piece of music or of the slow movement in a sonata, symphony, etc. The diminutive form *andantino* is used, confusingly enough, to signify both less slow and less fast.

ANDAQUIAN, a small independent linguistic stock of South American Indians, so called from the Andaquis, its most important tribe. The Andaquis live on the eastern slope of the Cordillera Oriental in southern Colombia, on the Fragua and Ortegaza rivers, which form the sources of the Caqueta. They are said to have formerly lived on the western slope of the range, on the headwaters of the Magdalena and between it and the Suaza. In this region the remarkable ruins of San Augustin are located. The Andaquis are a warlike folk, and are but little known.

See M. M. Albis, *Los Indios del Andaquí* (Popayan, 1855).

ANDERIDA, an ancient Roman fort at Pevensey, near Eastbourne in Sussex, Eng., built about A.D. 300 as part of a scheme of land defense against Saxon pirates; repaired probably by Stilicho, about A.D. 400; and utilized by William the Conqueror for a Norman castle. Its massive Roman enceinte still stands but little damaged.

ANDERMATT, a Swiss health resort and centre for winter sports, lying at a height of 4,700 ft. at the foot of the Gürschen, in the Urseren valley. The settlement is first mentioned in the 14th century, but remained unimportant until the opening of the St. Gotthard railway from Lucerne to Milan in 1882. It now ranks among the most famous Alpine resorts. Andermatt is also the chief military station of the St. Gotthard pass in one of the most elaborately fortified valleys in Europe.

ANDERNACH, a town in Rhenish Prussia, Germany, on the left bank of the Rhine, 10 mi. N.W. of Coblenz. Pop. (1939) 14,065. Antunnacum, the Roman frontier station, was founded by Drusus. In 1109, Andernach received civic rights; in 1253 it joined the confederation of the Rhine cities, and was the most southern member of the Hanseatic league. In 1794, Andernach passed to France, but in 1815 was ceded, together with the left bank of the Rhine, to Prussia. It possesses old walls, a Romanesque parish church (12th century), a watch tower on the river and a Renaissance town hall. A famous crane, for lading merchandise, dates from 1554. Mat-making is one of the chief industries, and millstones of the local lava and tufa are exported. This product was much used by the Dutch in the construction of their dikes.

ANDERSEN, HANS CHRISTIAN (1805–1875), Danish poet and fabulist, was born at Odense, in Fünen, on April 2, 1805. He was the son of a sickly young shoemaker of 22 and his still younger wife; the whole family lived and slept in one little room. Andersen very early showed signs of imaginative temperament, which was fostered by the indulgence and superstition of his parents. In 1816 the shoemaker died and the child was left entirely to his own devices. He ceased to go to school; he built himself a little toy theatre and sat at home making clothes for

his puppets and reading all the plays that he could borrow; among them were those of Holberg and Shakespeare. At Easter 1819 he was confirmed at the church of St. Knud, Odense, and began to turn his thoughts to the future. It was thought that he was best fitted to be a tailor; but as nothing was settled, and as Andersen wished to be an opera-singer, he took matters into his own hand and started for Copenhagen in Sept. 1819. There he was taken for a lunatic, snubbed at the theatres, and nearly reduced to starvation; but he was befriended by the musicians Christoph Weyse and Siboni, and afterwards by the poet Frederik Hoëgh Guldberg (1771–1852). His voice failed, but he was admitted as a dancing pupil at the Royal Theatre. He grew idle and lost the favour of Guldberg, but a new patron appeared in the person of Jonas Collin, the director of the Royal Theatre, who became Andersen's life-long friend. King Frederick VI. was interested in the strange boy and sent him for some years, free of charge, to the great grammar-school at Slagelse. Before he started for school he published his first volume, *The Ghost at Palmatoke's Grave* (1822). Andersen, a very backward and unwilling pupil, actually remained at Slagelse and at another school in Elsinore until 1827; these years, he said, were the darkest and bitterest in his life. Collin at length consented to consider him educated, and Andersen came to Copenhagen. In 1829 he made an appreciable success with a fantastic volume entitled *A Journey on Foot from Holman's Canal to the East Point of Amager*, and he published in the same season a farce and a book of poems. He thus suddenly came into request at the moment when his friends had decided that no good thing would ever come out of his early eccentricity and vivacity. He made little further progress, however, until 1833, when he received a small travelling stipend from the king and made the first of his long European journeys. At Le Locle, in the Jura, he wrote *Agnate and the Merman*; and in Oct. 1834 he arrived in Rome. Early in 1835 Andersen's novel, *The Improvisatore*, appeared and achieved a real success; the poet's troubles were at an end at last. In the same year, 1835, the earliest instalment of Andersen's immortal *Fairy Tales* (Eventyr) was published in Copenhagen. Other parts, completing the first volume, appeared in 1836 and 1837. The value of these stories was not at first perceived, and they sold slowly. Andersen was more successful for the time being with a novel, *O.T.*, and a volume of sketches, *In Sweden*; in 1837 he produced the best of his romances, *Only a Fiddler*. He then turned his attention, with but ephemeral success, to the theatre, but was recalled to his true genius in the charming miscellanies of 1840 and 1842, the *Picture-Book without Pictures* and *A Poet's Bazaar*. Meanwhile the fame of his *Fairy Tales* had been steadily rising; a second series began in 1838, a third in 1845. Andersen was celebrated throughout Europe, although in Denmark itself there was still some resistance to his pretensions. In June 1847 he paid his first visit to England and enjoyed a triumphal social success; when he left, Charles Dickens saw him off from Ramsgate pier. After this Andersen continued to publish much; he still desired to excel as a novelist and a dramatist, which he could not do, and he still disdained the enchanting *Fairy Tales*, in the composition of which his unique genius lay. Nevertheless, he continued to write them, and in 1847 and 1848 two fresh volumes appeared. After a long silence Andersen published in 1857 another romance, *To be or not to be*. In 1863, after a very interesting journey, he issued one of the best of his travel-books, *In Spain*. His *Fairy Tales* continued to appear, in instalments, until 1872, when, at Christmas, the last stories were published. In the spring of that year Andersen had an awkward accident, falling out of bed and severely hurting himself. He was never again quite well, but he lived till Aug. 4, 1875, when he died very peacefully in the house called Rolighed, near Copenhagen.

BIBLIOGRAPHY.—Collected editions of Andersen's works were published in Copenhagen in 33 vols. (1854–79) and in 15 vols. (1876–80). The fairy tales were translated into nearly every European language, and the English editions are very numerous. For his life, see his autobiography, *The Story of My Life* (1855; Eng. trans., 1871), and R. N. Bain, *Hans Christian Andersen, a Biography* (1895). (E. G.)

ANDERSEN, HANS NIELS (1852–1937), Danish ship-owner and merchant, was born at Nakskov in poor circumstances.

He went to sea and, in 1884, having gained experience by trading with the east, he founded the business of Andersen and company at Bangkok, opening in 1894 a branch house in Copenhagen. In 1897 he established, at Copenhagen, Det Østasiatiske Kompagni (the East Asiatic company), which soon became the largest commercial enterprise in Denmark and one of the few Danish undertakings of world-wide renown. In 1912 at Copenhagen the company launched the first large motorship. Andersen rendered important services to his country during World War I.

BIBLIOGRAPHY.—A. Fraenkel, *Verden med dansk Maal eller Danmark med Verdensmaal* (1916); H. N. Andersen, *Tilbageblik, 1914–19, Udvikling* (1929); *Akts. Det Østasiatiske Kompagni, 1897–1922* (1922). (B. Ko.)

ANDERSON, ADAM (1692–1765), Scots economist and writer on commercial history. He was a clerk for 40 years in the South Sea House and was reported to have been one of the trustees for establishing the colony of Georgia. In 1764 he published a monumental work in 2 volumes, *An Historical and Chronological Deduction of the Origin of Commerce from the Earliest Accounts to the Present Time, Containing an History of the Great Commercial Interests of the British Empire*. The work is a testimony of prodigious industry, though much of it is untrustworthy. Anderson exposed several of the common fallacies in the economic doctrine of his time. His work was consulted by Adam Smith and portions of it were included in David Macpherson's *Annals of Commerce* (1805). Anderson died in London on Jan. 10, 1765.

ANDERSON, ALEXANDER (1775–1870), pioneer American wood engraver, was born in New York city on April 21, 1775, the son of a printer. At the age of 12 he made his first attempts at engraving without instruction by observing the work of jewellers and other artisans. Among his earliest efforts were copies of anatomical figures in medical works cut with a pocket-knife in plates made by rolling out pennies. In 1789, in compliance with his father's desire, he began the study of medicine and continued until he graduated at the medical department of Columbia college in 1796. But throughout this period he maintained an active interest in engraving. In 1793, upon seeing wood engravings by Thomas Bewick (*q.v.*), he obtained boxwood blocks, designed his own tools, and produced the first wood engravings made in the United States. In 1794 he illustrated with wood engravings the book entitled *Looking Glass for the Mind*. Upon the loss of his entire family from yellow fever in 1798, he withdrew from medical practice and devoted himself entirely to engraving. At first he used both metal and wood, but after 1820 he confined his work almost exclusively to wood engravings. He illustrated numerous books, chiefly after English originals, and produced during his long life an enormous volume of work. At the age of 93 he cut a series of pictures for Barker's *Historical Collection of New Jersey*. He was also a skilled miniature painter and executed numerous portraits. Widely known are his illustrations for Webster's *Elementary Spelling Book*; engravings for Shakespeare's plays; Holbein's *Dance of Death*, published as *Emblems of Mortality*, and some 300 cuts for Bewick's *Quadrupeds*. He died in Jersey City, N.J., Jan. 18, 1870.

See B. J. Lossing, *Memorial Address on Alexander Anderson* (1872), and F. M. Burr, *Life and Works of Alexander Anderson* (1893).

ANDERSON, CARL DAVID (1905–), U.S. physicist, was born in New York city on Sept. 3, 1905. He studied at the California Institute of Technology in Pasadena, where he received his Ph.D. in 1930. He joined the staff as a teaching fellow in 1928 and became professor of physics in 1939. Between 1927 and 1930 he was engaged in research on X-ray photoelectrons, and thereafter on gamma-rays and cosmic rays under Robert A. Millikan (*q.v.*). He was joint awardee of the 1936 Nobel prize for physics, for his discovery of the positron.

ANDERSON, SIR EDMUND (1530–1605), English lawyer, descended from a Scottish family settled in Lincolnshire, was born in 1530 at Flixborough or Broughton in that county. He took part in all the leading state trials which agitated England during the latter years of Elizabeth's reign. Though a great lawyer and thoroughly impartial in civil cases, he was notorious for

his excessive severity and harshness when presiding over the trials of Catholics and nonconformists, especially in those of Sir John Perrot, Sir Walter Raleigh and John Udall, the Puritan minister. Anderson was also one of the commissioners appointed to try Mary queen of Scots in 1586. He died on Aug. 1, 1605, at Eyworth, Bedfordshire.

ANDERSON, ELIZABETH GARRETT (1836-1917), English physician, and pioneer in the professional education of Englishwomen, daughter of Newson Garrett, of Aldeburgh, Suffolk. She was born in 1836, and was educated at home and at a private school. In 1860 she resolved to study medicine, an unheard-of procedure for a woman in those days. Miss Garrett managed to obtain some irregular instruction at the Middlesex hospital, London, but was refused admission as a full student there and at many other schools. She studied anatomy privately at the London hospital, as well as with some of the professors. She had difficulty in gaining a qualifying diploma to practise medicine; but in the end the Society of Apothecaries, London, allowed her to enter for the licence of Apothecaries' hall, which she obtained in 1865. In 1866 she was appointed general medical attendant to St. Mary's dispensary, a London institution started to enable poor women to obtain medical help from qualified practitioners of their own sex.

The dispensary soon developed into the New Hospital for Women. In 1870 she obtained the Paris degree of M.D. In 1871 she married, but did not give up practice. She worked steadily at the development of the New hospital, and also from 1874 at the creation of a school of medicine for women in London. Both the New hospital and London university have since been suitably housed and equipped; the New hospital is now the Elizabeth Garrett Anderson hospital. In 1897 she was elected president of the East Anglian branch of the British Medical association. In 1908 she was elected (the first woman) mayor of Aldeburgh. She died at Aldeburgh, Suffolk, Dec. 17, 1917. Her daughter, Louisa Garrett Anderson (1873-1943), took an active part in the suffrage movement. During World War I she was joint organizer of the women's hospital corps and (1915-18) chief surgeon of the military hospital at Endell street.

See Barbara Stephen, *Emily Davies and Girton College* (1927); Millicent (Garrett) Fawcett's autobiography, *What I Remember* (1925).

ANDERSON, JAMES (1662-1728), Scottish genealogist, antiquary and historian, was born at Edinburgh on Aug. 5, 1662. Just before the union the Scottish parliament commissioned him to prepare for publication what remained of the public records of the kingdom. The work was not completed at his death in 1728. The book was published posthumously in 1739, edited by Thomas Ruddiman, under the title *Selectus Diplomatum et Numismatum Scotiae Thesaurus*. Soon after his death, the numerous plates, engraved by John Sturt, were sold for £530. These plates are now lost and the book has become exceedingly rare. Anderson died on April 3, 1728.

ANDERSON, JOHN (1726-1796), Scottish natural philosopher, born at Roseneath, Dumbartonshire, was a professor of natural philosophy in the University of Glasgow. He devoted himself particularly to the application of science to industry, instituting courses of lectures intended especially for artisans, and he bequeathed his property for the foundation of Anderson's college, later merged in the Glasgow and West of Scotland Technical college. He died in Glasgow on Jan. 13, 1796. His *Institutes of Physics*, published in 1786, went through five editions in ten years.

ANDERSON, MARY (1859-1940), U.S. actress, was born in Sacramento, Calif., on July 28, 1859. Her father, an officer in the Confederate service in the Civil War, died in 1863. She was educated in various Roman Catholic institutions, and at the age of 15, with the advice of Charlotte Cushman, began to study for the stage, making her first appearance, at the age of 16, in Louisville, Ky., as Juliet, in 1875. Her remarkable beauty created an immediate success, and she played in all the large cities of the United States with increasing popularity. Between 1883 and 1889 she had several seasons in London, and was the Rosalind

in the performance of *As You Like It* which opened the Shakespeare Memorial theatre at Stratford-on-Avon. Among her chief parts were Galatea (in W. S. Gilbert's *Pygmalion and Galatea*), Clarice (in his *Comedy and Tragedy*, written for her), Hermione, Perdita, Lady Macbeth and Ion (in Noon Talfourd's *Ion*). In 1889 she retired from the stage and in 1890 married Antonio de Navarro and settled in England.

See William Winter, *Stage Life of Mary Anderson* (1886), and her own *A Few Memories* (1896).

ANDERSON, RICHARD HENRY (1821-1879), U.S. soldier, was born in South Carolina on Oct. 7, 1821. He graduated from the U.S. Military academy in 1842, and won the brevet of first lieutenant in the Mexican War, becoming first lieutenant in 1848 and captain in 1855; he took part in the following year in the Kansas troubles. At the outbreak of the Civil War in 1861 he entered the Confederate service as a brigadier general, being promoted major general in Aug. 1862 and lieutenant general in May 1864. Except for a few months spent with the army under B. Bragg in 1862, Anderson's service was wholly in the army of northern Virginia. Under R. E. Lee and J. Longstreet he served as a divisional commander in nearly every battle from 1862 to 1864, winning special distinction at Chancellorsville and Gettysburg. When Longstreet was wounded at the battle of the Wilderness, Anderson succeeded him in command of the 1st corps, which he led thereafter. His services at the battle of Spotsylvania (*q.v.*) were most important. He remained with the army as a corps commander to the close of the war, after which he retired. He died at Beaufort, S.C., on June 26, 1879.

ANDERSON, ROBERT (1750-1830), Scottish author and critic, was born at Carnwath, Lanarkshire, Jan. 7, 1750, and died at Edinburgh Feb. 20, 1830. His principal work was his edition of *The Works of the British Poets, with Prefaces Biographical and Critical* (1792-1807).

ANDERSON, SIR ROBERT ROWAND (1834-1921), British architect, was born at Forres in 1834, the son of a solicitor. He died in Edinburgh on June 1, 1921. He was educated at Edinburgh and entered the royal engineers, where he received his first training as a draughtsman. His first important work was his successful design for the Edinburgh Medical schools (1875), and this was followed by a succession of important commissions, including the Conservative club, Edinburgh (1883), the dome of Edinburgh university (1886) and the Scottish National Portrait gallery (1886-88). He also successfully carried out a series of restorations of Scottish cathedrals, including those of Dunblane cathedral, Paisley abbey, Culross abbey and the interior of Dunfermline abbey. In 1901 he was selected to superintend the alterations which were being carried out at Balmoral castle; in 1902 he was knighted.

ANDERSON, SHERWOOD (1876-1941), U.S. author, was born in Camden, O., Sept. 13, 1876. He was the third child of a family of eight; his father was a struggling harness maker. Young Anderson showed little interest in school. At 14, when his mother died, his intermittent schooling stopped and at 17 he became an itinerant house painter. He wandered through the bustling midwestern states, keenly alive to the growth of industrialization in the 1890s. In 1898 he joined the army, saw service in Cuba during the Spanish-American War and returned to Ohio a hero. He became manager of a paint factory, but, dissatisfied with office routine, he quit suddenly and went to Chicago, Ill., where he worked in an advertising agency. There he met Chicago's literary titans—Theodore Dreiser, Carl Sandburg, Floyd Dell and Ben Hecht. Under their influence he wrote his first novel, *Windy McPherson's Son*, published in 1916. In 1919 he wrote *Winesburg, Ohio*, a collection of short stories about small-town life, regarded as his best and most lasting work. Two years later he was awarded the Dial prize of \$2,000 and he went to Europe for a year. Later he purchased a home in Marion, Va., where he became editor of both the town's papers, one Republican, the other Democratic. The remainder of his life was spent at or near Marion. He died on March 8, 1941, at Colón, Pan.

In addition to those works mentioned, his writings included the novels *Marching Men* (1917), *Poor White* (1920), *Many Mar-*

riages (1922) and *Dark Laughter* (1925); short story collections, *The Triumph of the Egg* (1921), *Horses and Men* (1923) and *Death in the Woods* (1933); a book of Whitmanesque verse, *Mid-American Chants* (1918); the autobiographical *Tar—A Mid-West Childhood* (1926), *A Story Teller's Story* (1924) and *Memoirs* (1942); also *Hello Towns* (1929); *Beyond Desire* (1933), *Kit Brandon* (1936) and *Plays* (1937). Anderson's fiction, psychological in interest and sombre in tone, was striking as an attempt to express the evolution and inarticulate longings of industrial America.

BIBLIOGRAPHY.—See Biographical and critical articles by Paul Rosenfeld and R. M. Lovett in the *Dial* (Jan. 1922); "Sherwood Anderson, Corn-Fed Mystic, Historian of the Middle Age of Man," in Harry Hansen, *Mid-West Portraits* (1923); Nathan B. Fagin, *Phenomena of Sherwood Anderson* (1927); Irving Howe, *Sherwood Anderson* (1950).

ANDERSON, a city of Indiana, U.S., on the White river, about 38 mi. N.E. of Indianapolis, in a rich wheat and corn-producing region; the county seat of Madison county. It is served by the New York Central and the Pennsylvania railways, by the Central Indiana (for freight only) and by the Indiana railway. Pop. (1950) 46,809. Its importance as a manufacturing centre dates from the discovery of natural gas in the vicinity in 1887.

The city's principal manufactures are automobile starting, lighting and ignition systems; automobile horns; wiring harness; ignition locks; automatic carburettor controls; storage batteries and pistons; head, signal and cowl lamps, hub caps and bumper guards; playground equipment; corrugated boxes and shipping cartons; glass-working machinery; cold rolled strip steel; gas regulators; engine governors; pumps; insulated copper wire; files; wire fencing; floor tile; stoves; bed and auto-seat springs; silicate of soda; house dresses, aprons and lodge regalia. Property valuation in 1950 was \$52,074,710.

Anderson was founded in 1812 on the site of an Indian village; incorporated, 1865.

ANDERSON, a city in the northwestern part of South Carolina, U.S.; the county seat of Anderson county. It is on three transcontinental highways, and is served by the Southern, Charleston and Western Carolina and the Piedmont and Northern (electric) railways. Pop. (1950) 19,718; (1940) 19,424.

In the city and county are industrial plants producing principally textiles, sewing machines and building materials. The county has a widely diversified agriculture, producing cotton, poultry, dairy and beef cattle, Turkish tobacco, lespedeza, pimentos, fruits and vegetables.

Anderson was chartered in 1826. Anderson Junior college, a coeducational institution founded in 1914, is located there. Clemson Agricultural college is located at Clemson, 17 mi. northwest of Anderson.

ANDERSONVILLE, a village of Sumter county, Ga., U.S., on the Central of Georgia railway, about 60 mi. S.W. of Macon. The population in 1950 was 281. From Nov. 1863 until the close of the Civil War a Confederate military prison was maintained in an open stockade of 26½ ac. near the village. The sufferings of the prisoners—from congestion, insufficient food, exposure, pollution of the water supply and disease—were terrible. Of the 49,485 prisoners received during the war, about 13,000 died. The prisoners' burial ground was made a national cemetery. It contains 13,737 graves, of which 1,040 are marked "unknown." Federal park is maintained on the prison site adjoining the cemetery. A memorial rostrum was built by the government in 1941.

There is an impartial account of the Andersonville prison in James F. Rhodes, *History of the United States* (1904), vol. v. The partisan accounts are numerous; see, for instance, A. C. Hamlin, *Martyria*; or, *Andersonville Prison* (Boston, 1866); and R. R. Stevenson, *The Southern Side*; or *Andersonville Prison* (Baltimore, 1876).

ANDES, the name applied to the great mountain system which extends the full length of the western part of South America. The origin of the name is obscure. It has been suggested that it is derived from *anti*, the *Quechua* word for east, a name applied by the *Quechua* Indians to the range east of Cuzco. Other suggested origins of the name are the *Quechua* words *antasuya*, region of metal, or *anta*, copper. The term "Cordillera of the

Andes" is sometimes erroneously used as a name for the whole Andean system, and in South American nomenclature is often applied to the most important range of a given section of the system. From its original form, "Las Cordilleras de los Andes," a term applied by the Spanish conquerors to the series of parallel ranges of which the Andes appeared to be composed, is derived the present widespread use of the word "cordillera," meaning an extensive mountain range or system of ranges.

The Andes are narrowest at the southern end and broadest in the central or Bolivian section and at their northern end, where they divide into four distinct ranges. In Tierra del Fuego their trend is nearly east and west; on the mainland the trend is north and south as far north as Lat. 18° S., where, in one of its two broadest sections, the system turns westward to form an almost semi-circular curve convex to the west and follows the configuration of the west coast as far north as southern Colombia. There it spreads out into three distinct ranges, the easternmost of which again divides into two ranges, one of which forms the northern section of the Venezuela-Colombia boundary while the other crosses the boundary south of Lake Maracaibo and extends north-eastward toward the Caribbean sea.

The Patagonian Andes.—Until recently the dominating feature of the entire Andean system was pictured as a great mountain barrier, with a well-defined crest line of lofty peaks which coincided with the water-divide between the Pacific and Atlantic drainage systems, and effectively separated them from each other. As late as 1881, when the Governments of Chile and the Argentine republic signed a treaty in which their common boundary was defined, they described it as following the highest crest of the Andes, which formed the water-divide between the Atlantic and Pacific oceans. When the demarcation of this boundary was undertaken it was found that throughout the greater part of the cordillera the topography did not correspond to the conception of it on which the treaty was based. South of lat. 38° S. the Andes were found to be, not a simple ridge, but a broad zone, from 25 to 40m. wide, of mountain chains and narrow valleys. The higher summits shift back and forth from one chain to another and do not, except in a general way, mark the water-divide. These summits rise above a broad base, represented by high valleys and broad passes, to an average elevation of about 6,500 feet. Few are lower than this average altitude, and only individual peaks exceed



AFTER AN ENGRAVING FROM A CONFEDERATE PHOTOGRAPH IN "MARTYRIA," 1866
ANDERSONVILLE PRISON WITH THE QUAGMIRE AND CROWDS OF HUTS AND MEN BEYOND. OWING TO THE TERRIBLE CONDITIONS PREVAILING THERE 13,000 OF THE 49,000 PRISONERS ADMITTED DURING THE CIVIL WAR DIED OF HUNGER, EXPOSURE AND DISEASE

7,500 feet. Those which have a fairly uniform altitude have been carved by erosion from the older Andean rocks of the plateau-like base. The higher peaks are volcanic cones built up on the plateau. The eastern side of this part of the Andes is divided into two sections—a northern from Lake Alumíné to Lake Nahuel Huapi, and a southern from Lake Nahuel Huapi southward, which includes the island of Tierra del Fuego. Both sections are characterized by a succession of glacier-fed lakes which stretch back like fiords into the heart of the cordillera, and by valleys cut from west to east across the Patagonian tableland through which, at one time, the lakes drained toward the Atlantic.

In the northern section high transverse ridges separate the lake basins and more or less effectively obstruct passage from one to another. These ridges connect the mountain zone with the Patagonian tableland, and all but one of the streams of this section rise in the westernmost range and flow eastward to the Collocura and Limay rivers. Lake Lacar now discharges across the western range to the Chilean lake region, but there is evidence that it, too, once drained to the Atlantic.

In the southern section the tableland is separated from the cordillera by a longitudinal depression which marks the line of contact between the folded cordillera and the flat tableland and extends southward from the low pass between Lake Nahuel Huapi and Lake Bariloche and is continued beyond the mainland by the Canal Ancho of the Straits of Magellan, Useless bay, and White-side and Admiralty sounds. The continuity of this depression has, however, been frequently exaggerated. It is really divided into several compartments by masses of different kinds of rocks and by granite ridges. Between Lake Argentina and Lake Buenos Aires it is interrupted by the tableland which rises to a height of 5,000 ft. and butts against the cordillera. Similarly between Lake Buenos Aires and Lake General Paz there is no great difference in level between the tableland and the depression.

Most of the lake basins here, as well as in the northern section, are continued eastward across the Patagonian tableland as distinct valleys. This is the case even in the submerged southern end of the depression, where the east end of the Straits is a submerged valley on the axis of Otway Water and Useless bay and is continued eastward across northern Tierra del Fuego by the depression which ends in the Bay of San Sebastian. The valleys are now, however, with few exceptions, dead valleys, for the drainage is mostly west to the Pacific by way of narrow canyons in the cordillera and the interoceanic water-divide follows the terminal moraines of the old glaciers which confine the lakes on the east.

On the Pacific side of the cordillera a great longitudinal plain extends from the Chacabuco range, by which the basin of the Aconcagua river is enclosed on the south, southward to the Gulf of Ancud. The northern part of this region is narrow and irregular and is cut by ridges into small, almost completely separated valleys, and interrupted by isolated hills. At about lat. 36° S. it widens out to a width of 20 to 40 miles. A line of recent volcanoes begins a little south of Santiago and is lined on the cordillera to about 35° S. lat., where it gradually departs from the cordillera until in the south it stands well out in the central plain and forms a less continuous but higher chain west of the cordillera proper. The northern part of the plain is filled with recent geological deposits and forms the fertile "Vale of Chile." South of lat. 39° S. it is sown with glacial lakes or depressions formerly occupied by lakes. Not only because of the greater precipitation on the west side of the cordillera in the belt of the westerly winds south of lat. 39° S., but also because of the great condensation of moisture caused by the line of volcanoes in front of the cordillera, the glaciers of the Glacial period advanced much farther from the water-divide on the western slope than on the eastern, with the result that the glacial lakes on the Chilean side of the cordillera are at a much lower level than those on the Argentine side, and part of them, as, for instance, Ranco and Lanquihue, lie completely separated from the cordillera.

The cordillera of Patagonia is divided into a series of massifs separated by longitudinal and transverse depressions. Some of these depressions cut completely through the cordillera and are occupied by rivers which drain lakes on the Argentine side, or by fiords which extend through to the Argentine side. Between 41° and 46° S. lat. the altitude of these massifs is from 6,500 to 8,000 ft., only Truncador (11,000 ft.) attaining a higher altitude. Between 46° and 50° the cordillera reaches altitudes of from 10,000 to 13,000 feet. It is lower and broken up between Smith channel and the Straits of Magellan, but again rises to more than 6,500 ft. on Tierra del Fuego.

South Chilean Andes.—Northward from lat. 39° S. to lat. 30° S. the character of the Andes is greatly simplified. It consists of a double line of crests, the westernmost of which carries

the Argentine-Chile boundary. The high valleys between the crests are at an altitude of from 10,000 to 13,000 feet. The passes to the east and west in the northern part are between 13,000 and 15,000 ft. in altitude. South of lat. 31° S. they are somewhat lower. Isolated summits rise from 5,000 to 7,000 ft. above the high valleys, and between 32° and 34° S. lat. include three of the highest peaks of the Andes: Mercedario (21,870 ft.), Aconcagua (23,080 ft.), Tupungato (21,550 ft.). The interior valleys have a direction slightly oblique to the general trend of the cordillera and corresponding to the direction of the folds. The whole section has effective drainage of normal type. The water-divide which the boundary follows shifts back and forth from one ridge to another, and the boundary pillars, which are located, in general, on high passes between headwaters, follow a tortuous line. Eruptions from the chain of recent volcanoes which appears a little south of the latitude of Santiago and extends southward on the Pacific side of the main axis of the cordillera to the Gulf of Ancud have greatly complicated the topography of the cordillera by filling up high valleys or damming up lakes.

East of the cordillera in this section a continuous depression extends northward from the Mendoza river for more than 160 m. between the cordillera and the pre-cordillera (a series of short ranges reaching out into the Argentine plain and formed by a north-south alinement of narrow crests of Silurian limestones between sandstones and metamorphosed Devonian schists). The pre-cordillera continues south of the Mendoza river to about latitude 36° S. It attains heights of 13,000 ft. in the latitude of San Juan and 11,000 on the Paramillo plateau above Mendoza. In spite of their narrow width the Andes in this section offer serious obstacles to movement from one side to the other because of their elevation and covering of snow. They have no mineral wealth and the few routes across them, which include the Transandine railway between Santiago and Mendoza, are solely for the purpose of crossing the cordillera and not for exploiting its subsoil. The high valleys furnish some summer pasture and the rivers and lakes afford water for irrigation. Settlements lie not in the mountains but on their border, and the location of the more important of those on the Argentine side has been influenced by the position of the most practicable passes, since it is to cattle and goods trade with Chile that they owe their origin and growth.

The Puna de Atacama.—North of lat. 30° S. the Andes again lose their simple character. The mountain belt widens and long extensions of it reach out south-eastward to the Argentine plain, enclosing in the depressions between them long embayments of the plain. At about the 28th parallel the main range divides into a western and an eastern range, with a belt of very high and extremely cold and desolate country between them (called the Puna de Atacama), made up of mountain chains, isolated peaks, and basins of salt deposits known as salars, arranged along dominating north-south lines. The average height of the basin floors of the Puna is between 11,000 and 13,000 ft., with the interior peaks and ridges rising only from 1,000 to 5,000 ft. higher. The range which forms the western border of the Puna is known as the Cordillera de Los Andes or Maritime cordillera and consists chiefly of a line of high volcanoes with lava flows between them. The passes in the Maritime cordillera average about 15,000 ft. while the peaks reach 20,000 to 23,000 feet. In the range which forms the eastern border of the Puna the passes are from 16,500 to 17,000 ft. high, but the peaks average only from 18,000 to 20,000 feet. In contrast with the western cordillera in which the volcanic cones are high and have been built up on a lower basement of lava, the cones of the eastern cordillera are low and have been built up on broad beds of lava. West of the western cordillera is a line of depressions between 3,000 and 4,000 ft. lower than the average level of the Puna and enclosed on the west by the Cordillera Domeyko which contains a number of salars, among them the Salar de Atacama and the Salar de Punta Negra.

East of the eastern border of the Puna, the Andes of the Argentine provinces of Jujuy, Salta and Tucuman form a broad belt of ridges oriented from north to south and separated by deep depressions. Their altitudes diminish as they extend eastward into the Argentine plains, and their summits, as well as those of

the secondary ranges along the main mountains, exhibit an older aspect than their ravined borders. The tops and high upper slopes are covered with grass. The steep headwater slopes and narrow declivities of the ravines, cut into them as the result of recent uplift, are youthful features in contrast to the lawn-like high-level slopes which they are gradually invading.

The Central Andes.—The northern limit of the Puna de Atacama is a transverse range of high snow-capped peaks and ridges at about the 23rd parallel, which separates it from the drainage basin of the Salar de Uyuni. The high plateau continues northward as the *altiplano* or *altoplanicie* of Bolivia. This *altiplano* has no outlet to the sea, and is therefore one of the world's great basins of interior drainage. It is about 500m. long by 200m. wide, and slopes gently from a little over 12,500ft. at Lake Titicaca to slightly more than 12,000ft. at Lake Poopo, and a little lower at the Salar de Uyuni. It differs from most interior drainage basins in that it contains a large body of fresh water (Lake Titicaca) and an important river drainage (the Desaguadero river). Lake Titicaca is the highest large body of navigable water in the world and has a length of about 125 miles. It owes its existence to a deep tectonic depression in close proximity to a high snow-capped mountain range (the Cordillera Real) that keeps it supplied with water. Farther south the *altiplano* becomes more and more like other interior semi-deserts, for the windward mountains become lower, so that they condense less moisture, and broader, so that the precipitation is more widely distributed. As it flows southward, the Desaguadero river, the outlet of Lake Titicaca, grows smaller and smaller until Lake Poopo, into which it empties, is a shallow pond with only a small overflow to the nearby salt lake or marsh called Coipasa. The *altiplano* lies between two great table-lands with superimposed peaks and ranges. Its eastern edge is particularly well-defined by the sharp rise and straight form of the eastern cordillera. The western edge is less clearly defined because of the volcanic debris that has encroached upon it from the western or Maritime cordillera, forming hilly districts of irregular outline. Between the Salar de Coipasa and the Salar de Uyuni, the *altiplano* is divided into two interior drainage basins by a line of volcanoes and hills which extend from the western cordillera nearly across to the eastern. North of Lake Titicaca the bordering scarps converge in the Nudo de Vilcanota at about 14° S. Lat., and enclose the *altiplano* on the north.

The western cordillera descends by relatively smooth slopes to the coastal deserts of Tarapacá and Atacama, famous for their nitrate deposits, and the desert region of southern Peru. In the rare cases in which its streams permanently reach the piedmont, they furnish water to small but important fields of vegetables and alfalfa. Viewed from the west, the cordillera presents, for long distances a strikingly even skyline, generally the line along which the uplifted peneplane has been warped up to form the highlands, broken only by the summits of the highest volcanoes which stand back toward the *altiplano* or, in places, by volcanoes like El Misti and Tacora, which rise on the western edge of the cordillera. The most recent of these volcanoes, such as El Misti, Tacora and Sajama, are symmetrical cones surmounted by craters; but the greater number are much older than these, and have more or less lost their original form by erosion.

The eastern cordillera, where it borders the *altiplano*, falls into two sections of quite different physiographic aspect. In the northern section the character of the uplifted peneplane has been almost completely destroyed because the concentration of the rainfall in a narrow belt in this region and the relatively steep gradient of the rivers have combined to enable the streams to cut the old surface to pieces, leaving only the lofty snow-clad Cordillera Real standing on a narrow base. The Cordillera Real is a central core of resistant rocks whose superior hardness and greater initial elevation have preserved it from the effects of great denudation recognizable all around it. The Cordillera Real is cut between the Nevado de Illimani and the Nevado de Quimza Cruz by the chasm of the La Paz river, a tributary of the Madeira river of the Amazon system, which, by virtue of the enormous condensation of moisture on the eastward slope of the eastern cordillera, has been able to break through this great barrier to the *altiplano*; but the

axis of the Cordillera Real extends southward across the La Paz valley through the Nevados de Araca, Quimza Cruz and Vera Cruz, forming a line of heights as definite in trend and structure as the Cordillera Real and continuing its features southward nearly 50 miles.

Northward from Lake Titicaca the western range turns north-westward, while the eastern range, which has already in the Cordillera Real taken a north-westerly trend, turns still further to the west and cuts off the *altiplano* by merging with the western range in a rough mountain mass known as the Nudo de Vilcanota. The Eastern Cordillera, here called the Cordillera de Carabaya, is a lofty snow-capped range separated from the Cordillera Real by a narrow and relatively low divide between the headwaters of the Mapiro river (a tributary of the Beni) and the Lake Titicaca drainage. On the west flank of the Cordillera de Carabaya is a group of glacial lakes in narrow depressions between the spurs of the range. There is no record of any soundings having been made in them, but from descriptions of their deep colouring and the character of the depressions in which they lie, they appear to be among the deepest of the high glacial-fed lakes of the Andes. The Cordillera de Carabaya lowers very rapidly to the north-east to the Amazon plain, and larger tributaries of the Beni cut directly across the lines of low ranges which front it on the east. Farther north, however, the valleys of the tributaries of the Madre de Dios have a longitudinal trend and have cut deep troughs oriented from south-east to north-west like the ridges which separate them.

The Peruvian Plateau.—The Andes of Peru, north from the Nudo de Vilcanota, are usually described as three distinct ranges which merge in the Nudo de Pasco and then continue north again as separate ranges. Recent studies show that they are a single broad plateau from 13,000 to 15,000 ft. high, on which narrow cordilleras rise to 18,000 and 21,000 feet; and that the *nudos* or knots are only gigantic erosion remnants. The Amazon tributaries have cut deep gorges almost to the western edge of the plateau, while the numerous streams of the arid Pacific slope are short and, with the exception of the Rimac and Santa rivers, carry little water as far as the ocean.

The Andes are divided into three natural regions—the *montaña*, the eastern slopes of the Amazon forest; the *sierra*, the temperate regions of the slopes and secondary valleys of the plateau; and the *puna*, cold, monotonous regions in the cordilleras, of vast extent at altitudes of from 10,000 to 15,000 feet. In isolated sections above the *puna* are areas known as *jalcas* which resemble the *paramos* of Colombia and Ecuador. They are covered with a dense, steppe-like vegetation that varies but little from season to season. North-west of the Nudo de Vilcanota is a narrow trough sunk below the level of the plateau to an elevation of 11,000ft., known as the Cuzco valley, from the City of Cuzco which lies at its upper end, on the site of the ancient Inca capital. The trough is 19m. long and is divided into three basins of flat-lying land arranged like the links of a chain. Its bordering rims have an average altitude of 13,500ft., with peaks exceeding 14,500ft., and are cut through in many places by streams leading to the Urubamba and Apurimac rivers. The valley itself is drained by the Huantanay river which flows through the chain of basins and joins the Urubamba through a broad pass in the mountain wall. The most broken section of the Peruvian Andes is between Abancay and Huancayo where the Apurimac, Pachachaca, Pampas and Mantaro rivers have cut deep gorges 6,000ft. and more below the surface of the *puna*. The zone of the interoceanic water-divide is here a gently undulating plateau, with lakes of glacial origin which the recently eroded valleys have not yet reached. The many secondary valleys, such as those of Ayacucho and Lircay, have long been centres of grain cultivation.

From the Huancayo to Cerro de Pasco the plateau is chiefly the basin of the upper Mantaro river. In the Cordillera de Huarochiri through which the Central railway from Lima to Oroya cuts, at an altitude of nearly 16,000ft., on red porphyritic sandstones between crests of dark andesites, the divide rises to elevations of over 17,000 feet. On the western slopes of the Cordillera de Huarochiri are many glacial cirques, and immediately north of the route of the Central railway as it enters the cordillera is a great

cluster of lakes at different levels, still fed by glaciers, which drain into the Rimac river close to the edge of the plateau. East of the crest a network of glaciated valleys with many lakes descends in steps to the Mantaro river. East of the Mantaro a little known range, whose snow-capped summits approach 16,500ft., cuts off the horizon north-east of the plain of Jauja. Its altitude diminishes to the north-west, and north of Tarma no longer carries permanent snow.

The Mantaro river rises at an altitude of about 15,000ft., near the mining town of Cerro de Pasco, in a marshy plain with many shallow lakes. Most of these are only small ponds, but Lake Junin, the largest of them, is about 20m. long. A group of partially glacier-fed lakes close to the main divide, of which Lake Punrún (15m. long) is the largest, also drains to the Mantaro river near the outlet of Lake Junin. The Mantaro flows south-eastward in a long limestone gorge to the plains of Jauja and Huancayo. These plains stand at 12,500ft. and 11,600ft. respectively, and together form a depression, 25m. long by 6 to 8m. wide, bordered on both sides by rows of bare hills behind which rise snow-capped ranges. The Mantaro leaves the depression in a deep gorge and swings round in a great bend to the Amazon plain about 80m. below Huancayo. The Cerro de Pasco region, north of the plain of Junin, has been given great importance in descriptions of the Peruvian Andes as a mountain knot in which are merged three distinct cordilleras. In reality it does not exceed the altitude of the *puna* and is only a fragment of the continuous plateau of sandstones and limestones, with occasional crests of andesite, which extends north of the plain of Junin and south between the plains of Junin and Jauja.

From Cerro de Pasco to the Pongo de Manseriche the plateau forms the drainage basin of the Huallaga and the upper Marañón rivers. North-west of Cerro de Pasco the Cordillera de Huayhuash forms the interoceanic divide. The Marañón river flows from a chain of glacier-fed lakes on its north-east flank, while on the same slope, a short distance to the south, are the sources of the Huallaga river. The Huallaga valley is fairly wide as far as the gorge east of Huánuco in which it turns northward toward the Amazon and the valley floors of both the main streams and its tributaries in the plateau are well-irrigated and have a considerable population. Below the Huánuco the Huallaga is a swift-flowing stream, with many rapids and gorges, and flows in a northerly direction through the foothills and low ranges for 180m. before it finally breaks through to the Amazon plain in the gorge or *pongo* of Aguirre, at lat. 6° 30' S. The Marañón flows in a deep trench and has only a sparse population of Indian communities, which occupy the upper basins of its affluents and occasional sugar plantations at the mouth of the larger tributaries or at rare points where the valley widens.

The Cordillera Blanca, north of the Cordillera de Huayhuash has the same south-east to north-west trend as the latter but stands slightly to the west of its axis. These are both lofty snow-capped ranges with elevations that may be classed among the highest of the whole Andean highland, Cerro Carnicero in the Cordillera de Huayhuash being 21,760ft. high, and Cerro Huascarón in the Cordillera Blanca 22,180 feet. The valley of the Santa river (known as the Callejón de Huaylas) which separates the Cordillera Blanca from the Cordillera Negra (so-called because its crests do not exceed 16,500ft. and, therefore, bear no permanent snow) is the most densely populated district of this section of the Andes. The river has its source in Lake Conococha in the high *puna*; flows, with a descent of 6,500ft. in 60m., through a string of lacustrine basins of rich alluvial soil; and carries a large permanent stream through a gorge across the Cordillera Negra to the Pacific ocean.

Ecuador.—North of the Peru-Ecuador boundary the plateau is higher, rising to altitudes of over 10,000ft., but the interoceanic divide continues narrow as far north as lat. 3° S. From there northward to the Nudo de Pasto, in southern Colombia, the Andes appear to be a single broad plateau, the top of which is in places 40m. wide, surmounted by irregularly distributed volcanic masses which rise to elevations from 11,000 to 12,000ft. above the plateau, and divide it into a number of separate basins (*hoyas*)

at an average elevation of from 7,500 to 9,000 feet. It has been the custom to describe this section of the Andes as consisting of two parallel cordilleras (a western cordillera and an eastern cordillera, or Cordillera Real) with a high plateau between them which is divided into separate basins by cross ranges from the main cordilleras. Our present knowledge does not support this description, and it seems to be only the rather general north and



ONE OF THE MANY WAYSIDE SHRINES THAT TOP THE HIGH RIDGES OF THE ANDES

south alinement of some of the outstanding volcanoes on the east and west borders of the basins and, particularly, of the Quito and Latacunga-Riobamba basins themselves, that has given rise to such a characterization. In the interior basins is concentrated the population of the plateau. Their rich volcanic soil and temperate climate had permitted their Indian inhabitants to attain, long before the conquest, a state of civilization far above the savage. They are in the rain-shadow of the mountain masses which enclose them on the east and west, and have, at the most, only moderate rainfall and, in some cases, require irrigation. By contrast, both outer slopes have very heavy rainfall at about the level of the basins and are covered with luxuriant vegetation, while above 10,000 to 11,000ft. they have very heavy rainfall on both sides. These high regions of heavy rainfall are the regions of the *páramos*, cold, desolate areas on both the slopes of the cordilleras and on the cross ranges, with a covering of moss and other bog growths and enshrouded in almost perpetual mist.

The Cuenca basin, in the south, and the Latacunga-Ambato and Riobamba basins, in the central plateau, drain to the Amazon; while the Alausi basin, north of the Cuenca basin, and the Quito and Ibarra basins in the north, drain to the Pacific. The Andes in this section slope steeply to both the Pacific and the Amazon plains. The streams from the basins have, therefore, steep gradients. Because of this and the steady supply of water from the adjoining mountaintop *páramos*, the streams have eroded deep beds and few lakes remain, of which San Pablo, in the Ibarra basin, is the only one of considerable area. Erosion is slight at the parts of the basins farthest from the outlet through the mountains, but deepens rapidly as the outlet is approached. In the case of the Guallabamba river, which drains the Quito basin, the total depth is over 3,000ft., of which 1,200 is a steep-sided canyon.

An essential characteristic of the northern half of the Andes of Ecuador is the volcanoes which not only border the western side of the interior basins, from Chimborazo to the Nudo de Pasto in southern Colombia, and the eastern side from nearly lat. 2° S. to the Equator, but are grouped in many places between the basins and, in places, stand completely in them. They really owe more than half their height to the base of ancient rocks on which they stand, but so impressive are they that even conscientious observers have frequently exaggerated the steepness of their slopes. The principal volcanoes of the more westerly line of volcanoes are Chimborazo (20,702 ft.), Canhuairazo (16,784), Quilato (15,715), Iliniza (17,405), Pichincha (15,718), Catacachi (16,292), Cimbab (15,715), Chiles (15,678); of the eastern, Altar (17,729), Tunguragua (16,689), Cotopaxi (19,498), Antisana (18,851), Cayambe (19,062). Sangay (17,470) lies still farther to the east, and Sumaco (12,700), which is believed to be a volcanic cone, lies far out on the eastern slope east of the Cordillera Guacamayo.

The eastern slopes of the Andes of Ecuador are little-known. Recent explorers have described the Amazon lowland as joining the base of the plateau at elevations averaging between 3,600 and 4,000ft., and sloping gently eastward with a descent of 1,000ft. in the first 70 miles. There has been no exploration of the southern part of the lowland. North of the Napo river recent explorations have revealed a number of short ranges and mountain masses of moderate elevation rising above the general level. Among these are the Cordillera Guacamayo and the Cordillera Galeras, with elevations reaching 8,000ft. and 6,000ft. respectively, and the

cone-shaped Sumaco (12,700ft.). Still farther north a short range on the Equator called the Cordillera Lumbaki and two high mountain masses north-west of Sumaco have recently been discovered.

The Cordilleras of Colombia.—In southern Colombia the Andes divide into three separate ranges: the western cordillera, or Cordillera de Chocó; the central cordillera, or Cordillera del Quindío; and the eastern cordillera, or Cordillera de Bogotá. The valley of the Magdalena river which separates the eastern cordillera from the central and part, at least, of the Patía and Cauca valley between the central and western cordilleras are not narrow, eroded trenches, but broad tectonic depressions with a deep alluvial cover. The western cordillera forms the coast range of Colombia in the south and, to the north, extends on the east side of the valleys of the San Juan and Atrato rivers to the Caribbean coast. It is the lowest of the cordilleras, with elevations varying, in the southern section, from a little over 5,000ft. on the Pacific railway between Buenaventura and Cali, to 7,200ft. west of Cartago and 10,000ft. west of Popayán, and rising to elevations of 11,000 and 13,000ft. in the west and northwest of the province of Antioquia. The southern 250m. of the depression between the western and central cordilleras is occupied by a series of three broad longitudinal plains. The southernmost is drained by the Patía river to the Pacific ocean, while the northernmost, with a length equal to the combined length of the other two, is the famous Cauca valley and drains to the Magdalena by the Cauca river. The central plain, in which is the city of Popayán, contains the low divide between these two drainage basins. Its elevation (6,000ft.) is 3,000ft. higher than those of the Cauca and Patía plains, and its northern and southern borders are, therefore, deeply trenched. The Cauca plain has many aspects of an old lake basin filled with detritus. The city of Cali stands slightly above the level of the plain on a gently sloping alluvial fan. North of the Cauca plain the Cauca river flows by a series of gorges through a region of hills and valleys between the western and central cordilleras. Its lower plain is bordered by gradually disappearing spurs until it finally merges in the plains of the lower Magdalena river.

The central cordillera is the highest of the cordilleras of Colombia and the shortest, its last spurs disappearing south of the junction of the Cauca river with the Magdalena, 170m. from the Caribbean. It contains the only recent volcanoes in the Colombian Andes. Of these, Tolima (18,438ft.) and Ruiz (18,400ft.) are the most important. At lat. 5° 30' N. the cordillera widens to form the plateau of Antioquia, whose last spurs extend as far as lat. 8° N., where they are lost in the plains of the Magdalena. This plateau appears to be a block of ancient crystalline rocks with intrusions of diorites and diabases divided into two parts by the deep trench of the Porce and Nechi rivers. The groups of highlands on both sides of the Porce river preserve, in their gently broken surfaces, traces of a very ancient cycle of erosion. The larger of these covers an area of about 1,200 sq.m. N. of Medellín and has an average elevation of 8,500ft., with diminishing heights toward the north-east. The other extends south-east of Medellín, and contains the upper valley of the Nare or Negro river. Medellín, the second city of Colombia, occupies an advantageous position in the Porce valley, where it widens out for a distance of about 8m. into a fertile alluvial plain.

The eastern cordillera is somewhat analogous to the Andes of Ecuador in that its most marked characteristic is a series of high intermontane plains or *savannas*, at a nearly uniform elevation of 8,000 to 9,000ft., of which the most important are at the headwaters of the Bogotá, Suarez and Sogamoso rivers on the eastern border of the Magdalena basin. Their subsoil is formed of beds of fine gravels and clays, with some beds of peat, and the majority contain shallow lagoons and bogs which are partly submerged during the rainy season. Most of them have areas in their centres too wet for cultivation, so that the population is grouped about their edges. These high *savannas* were the centre of the pre-colonial Chibcha civilization and now contain a third of the entire population of Colombia. The Savanna de Bogotá is the largest and most densely populated of them, and has only a narrow strip of useless bog land in its centre. Bogotá is built on its eastern edge.

East of Girardot and Honda the cordillera is a series of parallel

ranges, running from south-south-west to north-north-east, of which only the easternmost, the Sierra de Cocuy (17,500ft.), reaches the level of permanent snow. North of the Sogamoso river the ranges have a north-south direction and in the latitude of Bucaramanga are united in a broad block. Farther north the central ranges stop and the western and eastern continue on, diverging toward the north and north-east as the Cordillera de Ocaña, of which the Sierra de Perija forms the boundary between Colombia and Venezuela, west of Lake Maracaibo. North-east of the delta of the Magdalena river, the Sierra Nevada de Santa Marta, a triangular massif with steep slopes to the north and west, rises abruptly from the Caribbean coast to snowy summits 17,000ft. high. It is separated from the Sierra de Perija by the valleys of the Cesar and Ranchería rivers.

A great many lakes exist in the cordillera east of Bogotá and on both sides of the upper Sogamoso, but the *páramos* have usually gentle forms and show traces of a long erosion period. It is, however, only on the high plains and the *páramos* that the streams of the interior now meander. They are rapidly cutting the greater part of their courses and upon leaving the *savannas* they flow through deep canyons. The falls of Tequendama south-west of Bogotá are the most striking example of the manner in which these streams have dissected the borders of the high plains, but the Suarez and Sogamoso rivers exhibit the same characteristics. Tributaries of the Orinoco river have cut through the eastern range to the neighbourhood of the *savannas* at points south of the Sogamoso and Tunja rivers. South of Bogotá the eastern cordillera is narrow. The *Páramo* de Sumapaz reaches elevations of 14,000ft., and snow remains there throughout most of the year, but farther south the range is much lower. In the Sierra de Perija, which forms its northern extremity, the cordillera narrows to about 16m., and its highest crests do not exceed 8,000 feet.

Venezuela.—The Andes of Venezuela are separated from the eastern cordillera of Colombia by a depression of about 4,600ft. altitude, between the Tachira and Torbes rivers, and extend north-east and east for about 500m., across the northern part of the country. Transverse valleys cut them into three sections, the area and altitude of which decrease from west to east. The westernmost section, from the sources of the Torbes river to the sources of the Tucuyo river is known as the Cordillera de Mérida. It is about 160m. long and 30 to 50m. wide. Its snow-capped summits are all above 10,000ft., and in the Sierra de Santo Domingo and the Sierra Nevada de Mérida exceed 14,500 feet. In the Andes of Venezuela the coastal sierras have a west to east direction, and are separated from a second line of much lower mountains by a depression in which are the basins of Lake Valencia and the Tuy river. Eastward from Puerto Cabello the range rises steeply from the coast. Its western end is only a little over 5,000ft. high near Nirgua, but it reaches 9,000ft. on the Silla de Caracas north-east of Caracas, and falls to 7,500ft. west of Cape Codera. The Caracas valley, in which is the city of Caracas at an altitude of 2,600ft., is only 6m. from the sea, and is not a part of the central depression. It appears to be, rather, a subsided local block covered with alluvial soil.

East of Cape Codera the Gulf of Barcelona interrupts the mountain zone for a distance of 80 miles. Only a narrow line of sandstones and limestones continues eastward from the interior range along the flat coast. Its altitude lowers rapidly from 4,000ft. to 1,600ft., and it is completely interrupted by the Unari and Aragua rivers, which drain a part of the llanos to the Gulf of Barcelona. The Sierra de Cumana extends for 80m. between the Aragua river and the Gulf of Paria. Its interior is a massif of sandstones and folded limestones which rises to 7,500ft. in the Cerro Turumiquire. The double peninsula of Araya and Paria is a narrow belt of crystalline schists, with an altitude of 1,300ft. west of the town of Carupano and a little over 3,000ft. at its eastern end near the Boca del Dragón, beyond which it is continued as the northern range of Trinidad island.

Geology.—The beds of the Primary series are found in the Andes in a longitudinal zone on the eastern side of the cordillera. They form the eastern part of the plateaus of Bolivia and northern Argentina, where the high anticlinal ranges are of Cambrian

quartzites, while Silurian schists, surrounding the recent granite crests of the Cordillera Real, cut by deep valleys, and overlapped in the synclines by Devonian and Secondary red sandstones, form the base of the series. They are found, also as Silurian sandstones, schists and Devonian sandstones on the eastern side of the Chile-Argentine cordillera as far south as lat. 35° S. and in the pre-cordillera.

The zone of the Secondary beds is of much greater length. Breccias and porphyritic conglomerates are the most common formation, forming almost the whole of the western part of the Andean system. In Peru they are succeeded to the east by gray limestones, which cover the greater part of the plateau. Still farther east, on the Marañón and upper Huallaga rivers, the ridges are of Secondary sandstones above Silurian schists. In Ecuador the Secondary conglomerates of the western side of the plateau rest directly upon the Andean gneisses and mica-schists, of which the eastern part is composed. In Colombia the central cordillera is formed of mica-schists, with almost no trace of sedimentary covering; while, in the eastern cordillera, even on the border of the plains of the Orinoco, the conditions which prevail farther south are completely reversed and the Secondary beds have their greatest development. The importance of the Secondary marine deposits in the Andes, especially in the Jurassic and Cretaceous series, seems to indicate that, during the Secondary period the region of the Andes was a geosyncline inundated by the sea between two continental masses, one of which occupied the place of the present Pacific ocean. The relations between the Andes and the *vorland* to the east is obscured by an enormous development of alluvial forms which partly cover the zone of contact between the lowlands and the cordilleras. It has been suggested that it is a rigid zone against which were exerted the forces to which the folding of the geosynclinal Andes was due.

The beginning of the folding of the Andes dates from the upper Cretaceous and continued during a part, at least, of the Tertiary. Tertiary marine forms are, therefore, lacking in the interior of the cordillera and are known only in eastern Patagonia, on the extreme edge of the cordillera. The Tertiary is represented in the greater part of the Andes by continental deposits without fossils, which furnish no precise information on the age of the folding. North of the Patagonian Andes as far as lat. 4° S. the western ranges contain Jurassic rocks and porphyritic rocks of similar age folded together. Both are of interest, the Jurassic because they are the only marine sediments of that age south of the Equator, the porphyritics because they are the most important evidence we have of volcanic activity in Mesozoic times. North of lat. 4° S. the Jurassic and porphyritic rocks are comparatively rare and the Primary rocks are absent. The majority of geological cross-sections which have been made in the Andes indicate foldings of the simple Jura type rather than the complex type of the Alps. The cross-sections are, however, still comparatively few, and greater complexity may be revealed by further studies.

Evidence of the uplift of the Andes is found not only in the existence of Tertiary and Quaternary marine deposits on the Pacific coast and many examples of uplifted shore-lines, but also in the frequent occurrence throughout the cordillera of surfaces which could only have been formed at an altitude near sea-level. These areas are found even in the more humid parts, where the contrast between them and the deep ravines of the headwater streams which are now invading them is most striking. The peneplane has been most completely conserved, however, in the desertic Maritime cordillera of northern Chile and southern Bolivia. In the terracing of the valleys, particularly on the eastern side of the cordillera, there is evidence of a succession of vertical movements, interrupted by periods of rest; while in the coastal terraces all the way from Paita to Antofagasta we find evidence not only of periods of rest but also of at least one subsidence followed by an uplift, which is still in progress at the present time. In fact, along the entire western seaboard the region has suffered enormous disturbances in the past, while the frequent earthquakes that have occurred in recent years in many parts of the coastal region and the cordillera are evidence that these disturbances are still going on. The abrupt transition from high tableland to abyss-

mal ocean depths that is characteristic of the entire coast indicates the remarkably unstable condition of the region. In addition to the general or regional movements of uplift and subsidence, the existence of drop-faulting has been noted throughout the whole length of the cordillera. The upper Magdalena valley, the Cuzco basin, the Iglesia and Calingasta valleys between the cordillera and the pre-cordilleras of the Argentine republic, and the central valleys of Chile have all been thus explained.

The volcanoes of the Andes occur in three notable groups, southern Colombia and northern Ecuador, southern Peru and northern Chile, and the group of central Chile, Neuquen and Patagonia. All types are present, from ancient volcanoes almost completely destroyed by erosion and extinct volcanoes, with or without craters, but still fresh in form, to active volcanoes. They have played an important part in the levelling of the interior basins. Fluid lavas exposed appear only on the Patagonian plateau. Elsewhere the lavas are chiefly of the viscous acidic type and, although accumulated to great depths in many places (as much as $1\frac{1}{2}$ m. deep in the Cordillera de Vilca pampa in southern Peru), have not been removed far from the craters. The volcanic ash, however, has been carried away by erosion in such quantities that they have overcharged the streams and filled depressions and valleys to a great depth.

Climate.—It is not on the Equator but between lat. 15° and 20° S. that the highest temperatures of the Andes are found, and we must go south of the Tropics to find mean annual temperatures comparable to those on the Equator. The abnormal depression of temperatures in the equatorial Andes is due to the heavy rainfall, and it is the lack of rainfall that raises the temperatures to the south. The effect of the higher temperatures of the drier Andes is to elevate the upper limit of agriculture and human occupation. In Colombia the highest agricultural zone is between 6,500 and 10,000ft., while on the moister portions of the Bolivia *altiplano* agriculture is carried on over 3,000ft. higher. The rich agricultural basins of Cuzco and Jauja, if they lay at the same elevation in the humid equatorial Andes, would not belong to the agricultural regions at all. The lower limit of the colder agricultural zone is not, however, parallel to the upper limit, and as one leaves the Equator frosts occur at lower and lower levels. As a result, sugar cane, which grows at a level of 6,500ft. and more in Ecuador and Colombia, does not reach above 3,000ft. in northern Argentina.

The lower limit of perpetual snow in the tropical Andes is between 15,000 and 16,000 feet. On account of the increasing aridity, it rises rapidly south of the equatorial region to 17,000ft. on the western ranges of the Peruvian Andes, above Lima, and to 18,000 and 20,000ft. in the summits which border the Puna de Atacama, to the north-east. South of the Puna de Atacama it lowers again to 18,000ft. in the Famatina ranges, and to between 14,500 and 16,500ft. in the ranges of Juan and Mendoza. From these it falls rapidly to 6,500ft. at lat. 37° S., 5,000ft. at lat. 40° S., and 2,300ft. on Tierra del Fuego. In the tropical and sub-tropical sections of the Andes the present glaciers rarely extend beyond the snow line. South of lat. 40° S., however, they have more extensive fields of supply, and come well down into the valleys. South of lat. 46° S. the ice-fields, though only a shrunken remnant of the ice-fields of the Glacial period, still form a continuous cap over the entire central zone of the cordillera. Throughout the Andes there have been recognized, in front of the present glaciers and in regions to-day free of ice, glacial moraines, cirques, outwash plains and lakes confined behind glacial dams, that are proofs of several periods of extensive Quaternary glaciation.

Mining is an important industry in all of the Andean countries. In Chile and Bolivia it far exceeds all other industries in the value of its products. The most important mineral deposits are those of the younger igneous rocks which include the gold quartz lodes of Colombia, the silver-bearing copper deposits of Peru and Chile, and the tin-silver-bismuth deposits of Bolivia. The copper deposits, which are found in many sections of the Andes, but are particularly abundant in Chile and Peru and, to a lesser degree, in Bolivia, differ greatly in their geological occurrence and characteristics. They occur most frequently as replacements of rock

near intrusions of igneous material. At Portrerillos, Chile, they have replaced the easily soluble limestone. At the Braden mines, near Rancagua, Chile, and the Cuquicamata mines, the copper minerals have filled cracks and openings in less soluble rocks with little or no replacement. In many places, as at Cerro de Pasco, Peru, rich silver ores at the surface give place to copper ores at lower levels. The tin deposits of Bolivia are true fissure veins or disseminations filled by products of igneous intrusives. The only gems occurring in the younger igneous rocks are the emeralds of Colombia. Of the ores which occur mainly in association with the ancient crystalline rocks, gold-bearing and silver-bearing veins in the pre-Cambrian schists, gneisses and granites, in many places in the cordilleras, and iron ore, chiefly magnetite, in Chile, are the most important. Mineral deposits of economic value in the sedimentary rocks are not extensive. Chile, Peru and Colombia have extensive coal deposits, but they are of inferior quality as compared with foreign coals, and except in Chile, are so inaccessible that they have been worked but little, except for local use. Petroleum resources have been studied intensively, and indications of oil-bearing strata have been reported on the eastern border of the Andes all the way from Venezuela to Tierra del Fuego. The areas which are at present yielding the most valuable flows are the Maracaibo basin, in Venezuela, the basin of the Sogamoso river on the western border of the eastern cordillera of Colombia, and the coastal region of northern Peru at Talara. Of the placer minerals, gold is the most important, and the extensive placer operations have of recent years been mainly confined to Colombia, particularly in the Choco district, where they yield considerable platinum.

From the standpoint of human occupation, the Andes are divided into three sections—an unpopulated section extending north to the Puna de Atacama; an arid central section from the Puna de Atacama to northern Peru, where mining is the chief industry; and a humid northern section, of which the chief industry is agriculture. The southernmost section has little mineral or agricultural resources, and the population is, therefore, not in the mountain zone but on its borders; concentrated in irrigated districts on the eastern side and more uniformly distributed in the central valleys of Chile on the western side. In the Puna de Atacama there is a sparse population of shepherds, and a still smaller element engaged in collecting salt from the salars for sale in the settlements on the mountain border. From there north to the Caribbean sea, however, the greater part of the population of the west coast and Caribbean republics, and, with few exceptions, the chief cities, are on the plateau. This populated section of the Andes contains a third of the whole population of South America. It consists of two sections of distinctly different character. The southern and more arid section is a region in which mining is the dominant industry, and practically the only source of export. All other industries are maintained for the purpose of supplying it with food, clothing and means of transportation. Railways which penetrate into the cordillera from the Pacific coast are constructed solely to transport the products of the mines to the nearest ports. The influence of the mining industry, since the mining districts are mainly on the high *páramos*, has combined with climatic conditions to elevate the altitudinal limits of human habitation to levels which are among the highest in the world. Since before the conquest the characteristic of this section of the Andes has been the establishment of small agricultural communities on the alluvial floors of high, sheltered valleys in close proximity to the mining centres which form the sole market for their produce. In the more humid Andes of Ecuador, Colombia and Venezuela mining is of secondary importance, the chief industries are agricultural and the chief exports the products of the tropical levels—cacao in Ecuador; coffee, in Colombia and Venezuela. Here the internal trade is not the supplying of agricultural products to a dominant industry but an exchange of products between zones at different levels and, therefore, of different climates.

Throughout the populated sections of the Andes, transportation between different parts of the plateau, between the plateau and the eastern lowlands, and, to a considerable extent, between the

plateau and the Pacific coast, is still chiefly by pack-trail. The mule has come to be the principal pack-animal, largely supplanting the llama of pre-conquest times, although the latter is still used locally in large numbers. In parts of Colombia the ox is still used for long trips with bulky commodities such as coffee and tobacco, while in the *montañas* of the eastern slopes and in the Choco region of Colombia, transportation is still dependent upon Indian bearers. Everywhere the *arrieros*, or muleteers, are an important element of the population. Often they are grouped in villages or particular districts where their work is the chief source of income. In Colombia it is estimated that they form a third of the population. Whereas the railway has supplanted the pack-train on most of the long routes from the plateau to the Pacific coast, the number of *arrieros* in the Andes as a whole has probably not been decreased, since the penetration of the railways into the plateau has increased the demand for foreign goods and, consequently, for means of distributing them from the railheads.

Except in the broad central plateau of Bolivia, the Andes offer such obstacles to road and railway construction that the west coast republics between Chile and Colombia are effectively divided into two lowland regions separated by the cordilleras. From the point of view of Government administration and national solidarity, railways across the Andes to connect the two lowland regions are of much importance; but so great would be the cost of construction and maintenance that, unless the economic interdependence of the two regions develops to a point where the cost is justified, it is probable that few of the many lines proposed will be constructed. Such rail connections as the mountain zone now has are short lines built to connect important mining or agricultural districts with the nearest seaports. Only two railway routes cross the Andes. The most famous of these is the railway opened in 1911 between Los Andes, Chile and Mendoza, Argentine republic, which crosses the Chile-Argentine boundary by a tunnel 10,000 ft. long and 10,500 ft. above sea-level, and affords direct rail connection between Buenos Aires and Valparaíso. The recently completed railway from the Bolivia-Argentine boundary to Uyuni connects on the Bolivian *altiplano* with three railways to the Pacific coast, and gives through routes from Buenos Aires to Antofagasta and Arica by rail, and by rail and steamer on Lake Titicaca, to Mollendo. (For railway lines eastward from the *altiplano* of Bolivia see BOLIVIA. For railways which penetrate the Andes in Peru, Ecuador, Colombia and Venezuela, see articles on these countries.) (R. R. P.)

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ANDESINE (named by W. H. Abich in allusion to its occurrence in the Andes mountains), a mineral of the plagioclase group of feldspars (*q.v.*) and occupying a position about midway in the isomorphous series, albite-anorthite. In petrology the name is arbitrarily restricted to solid solutions between $\text{Ab}_{70}\text{An}_{30}$ and $\text{Ab}_{50}\text{An}_{50}$. Andesine is an essential constituent of the intermediate igneous rocks, as diorite, porphyrite and andesite.

ANDESITE, a name first applied by C. L. von Buch to a series of lavas, investigated by him, from the Andes, which has passed into general acceptance as the designation of a great family of rocks playing an important part in the geology of most of the volcanic areas of the globe. Not only the Andes but most of the Cordillera of Central and North America consist largely of andesites; they occur also in great numbers in Hungary, Japan, the Philippines, Java and New Zealand. They belong to all geological epochs and are frequent among the Ordovician and Devonian rocks of Britain, forming the ranges of the Cheviots, Ochils, Breidden hills and part of the Lake district. The well-known volcanoes, Montagne Pelée, the Soufrière of St. Vincent, Krakatoa, Tarawera and Bandaisan have within recent years emitted great quantities of andesitic rocks with disastrous violence.

They are typical intermediate rocks, containing on an average about 60% of silica, but showing a considerable range of composition. Most of them correspond to the plutonic diorites, but others more nearly represent the gabbros. Their essential distinguishing features are mineralogical and consist in the presence of much soda-lime feldspar (ranging from oligoclase to acid labradorite, though phenocrysts may occasionally be still more basic), along with one or more of the ferromagnesian minerals, biotite, hornblende, augite and hypersthene. Both olivine and quartz are typically absent, though in some varieties one or other may occur in small quantity. Orthoclase may be present in small amount. In trachyandesites (latites of some authors) orthoclase and plagioclase are more or less equally developed. These rocks are conspicuously represented in the igneous fields of the Auvergne,

Siebengebirge, Canary Islands, etc. The andesites have mostly a porphyritic structure and the larger feldspars and ferromagnesian minerals are often visible to the naked eye, lying in a finer ground-mass, usually crystalline, but sometimes to a large extent vitreous. When fresh they are dark-coloured if they contain much glass, but paler in colour, red, gray or pinkish when more thoroughly crystallized.

The older (pre-Tertiary) andesites are grouped together by many German and, formerly, by British petrologists under the term porphyrites, but are distinguished only by being, as a rule, in a less fresh condition. Apart from this there are three great subdivisions of this family of rocks, the quartz-andesites or dacites, the hornblende- and biotite-andesites, and the augite- and hypersthene-andesites (or pyroxene-andesites). The dacites, a term first applied by Karl Heinrich Hektor Guido Stache (b. 1833) to quartz-bearing andesites of Transylvania or Dacia, contain primary quartz and are the most siliceous members of the family; their quartz may appear in small blebs (or phenocrysts), or may occur only as minute interstitial grains in the groundmass; other dacites are vitreous (dacite-pitchstones).

Research showed that in the younger lavas of dacitic composition, tridymite may form a conspicuous primary element in the groundmass. Cristobalite, too, is recorded in this environment but less abundantly and is sometimes seen replacing original tridymite. Observation makes clear that these silica minerals tend to concentrate in the last mineralizer-rich part of the magma. The quartz latite lavas of the San Juan region of Colorado and the dacites of the island of Montserrat, British West Indies, are particularly rich in tridymite.

In many of their structural peculiarities dacites closely simulate the rhyolites, from which they differ in containing less potash and more soda, and in consequence less orthoclase feldspar and more plagioclase. The hornblende- and biotite-andesites, like the dacites, have in most cases a pale colour (pink, yellow, or gray), being comparatively rich in feldspar. They resemble the trachytes both in appearance and in structure, but their feldspar is mostly plagioclase, not sanidine. The biotite and hornblende have much the same characters in both of these groups of rocks and are often surrounded by black borders, produced by corrosion and partial resorption by the magma. Augite is common in these andesites, but bronzite or hypersthene is comparatively rare. The pyroxene-andesites are darker, more basic rocks, with a higher specific gravity, and approach closely to the basalts and dolerites, especially when they contain a small amount of olivine. They are probably the commonest types of andesite, both at the present time and in former geological periods.

In addition to the accessory minerals, zircon, apatite and iron oxides, which are practically never absent, certain others occur which, because of their rarity and importance, are of special interest. Sharply formed little crystals of cordierite are occasionally found in andesites (Japan, Spain, St. Vincent, Cumberland); they seem to depend on more or less complete digestion of fragments of aluminous rocks in the molten lava. Garnet and sapphire have also been found in andesites, and perhaps have the same signification; a rose-red variety of epidote (withamite) is known as a secondary product in certain andesites (Glencoe, Scotland), and the famous red porphyry (*porfido rosso*) of the ancients is a rock of this type. Ore deposits very frequently occur in connection with andesitic rocks (Nevada, California, Hungary, Borneo, etc.), especially those of gold and silver. They have been laid down in fissures as veins of quartz, and the surrounding igneous rocks are frequently altered and decomposed in a peculiar way by the hot ascending metalliferous solutions. Andesites affected in this manner are known as propylites. (J. S. F.; X.)

ANDIJAN. (1) A province in Uzbek S.S.R. Area 2,824 sq.mi. Population 792,297 (144,718 urban); (2) a town, the capital of the province; pop. (1939) 83,691; sit.: 40° 55' N. 72° 16' E.; alt. 1,630ft. It is the terminus of the Transcaspian railway, on the left bank of the upper Syr-Darya. It is in an earthquake area and was destroyed in 1902, but re-built. It is a centre of the cotton trade and has cotton factories (hence the name *Andijani* for merchants in central Asia). It has gardens and a large park and

was formerly the residence of the Khans of Khokand. The province is fertile and is watered by the Syr-Darya. It produces rice, cotton, millet, winter and spring wheat, potatoes, grapes and silk.

ANDIRON (older form *anderne*), one of a pair of horizontal iron bars upon which logs are laid for burning in an open fireplace. Andirons stand upon short legs and are usually connected with an upright guard, giving the grotesque appearance of a dog (hence *firedogs*, *q.v.*). This guard, being a very conspicuous fixture, is often elaborately designed with figures, grotesque animals, emblems and the like. Andirons with little or no ornament were also used in kitchens, with ratched uprights for the spits.

ANDKHUI, northern khanate in Afghan Turkistan, allotted to Afghanistan by the Russo-Afghan boundary commission (1885). Also the chief town of the khanate, 100 mi. W. of Balkh on the edge of the low Turkoman desert, said to have been founded by Alexander the Great. Having been for a while subject to Bukhara, it was taken and ruined by Mahmud Khan in 1820, and its khans thereupon sought the help of the Afghans. The population has been estimated at 15,000 and includes Turkomans, some Uzbeks and a few Tajiks. The climate is unhealthy, but the soil fertile; the water is brackish, and flies and scorpions abound.

ANDOCIDES, one of the "ten" Attic orators, was born about 440 B.C. Implicated in the mutilation of the Hermæ (415), although he saved his life by turning informer (*see* Thuc. vi, 27, 60) he was condemned to partial loss of civil rights and went into exile. He became a merchant, and after two unsuccessful attempts returned to Athens under the general amnesty that followed the restoration of the democracy (403), and filled some important offices. In 391 he was one of the ambassadors sent to Sparta to discuss peace terms.

Speeches extant:—*De Reditu*, plea for his return and removal of civil disabilities; *De Mysteriis*, defense against the charge of impiety in attending the Eleusinian mysteries; *De Pace*, advocating peace with Sparta; *Contra Alcibiadem*, generally considered spurious. Text:—Blass (1880), Lipsius (1888); *De Myst.*, with notes by Hickie (1885); *De Red.* and *De Myst.*, with notes by Marchant (1889); *see* Jebb, *Attic Orators*; L. L. Forman, *Index Andocideus* (1897).

ANDORRA, a small autonomous and semi-independent, Catalan-speaking state on the Franco-Spanish frontier between the central and eastern Pyrenees with a population of c. 6,000 in 1950 and an area of 191 sq.mi., its greatest length being about 18 mi. from east to west, its greatest breadth 17 mi. The capital is Andorra-la-Vella (pop. c. 600).

Andorra is a cluster of mountain valleys, uniting to form the Valira, a tributary of the Segre, itself a feeder of the Ebro, surrounded, on all sides except the southwest, by peaks which rise between 5,000 and 10,000 ft. No part of the valleys is below 3,000 ft.; the main Pyrenean creaseline to the north and east is more than 8,000 ft. The valleys end in steep *cirques*, which give no passage through the mountain wall. The *ports* (passes) of Siguer, Fraymiquel and Soldeu are open for a part of the year only; while the defile of the Valira below Sant-Julia-de-Loria offers little easier, if more permanent, passage for communications with Spain. The climate is severe at all levels, and above 4,500 ft. drought becomes a serious factor; though most of the valleys are within subalpine zones, coniferous forest does not flourish, partly for this reason. Irrigation is thus indispensable to the high meadows, but in the lower valleys large-scale irrigation dates only from 1884. All cultivable areas vary in value according to their exposure to the sun, which melts the snows in spring. In the lower valleys torrential activity limits cultivable soil; the widest stretches are about Andorra-la-Vella. The lateral valleys are in better case, but their alluvial meadows are often too high to be cultivable. The most fertile soil is on artificial terraced slopes. Forests are poor and have been destroyed by animals and by man for firewood, charcoal, etc. The evergreen oak grows on the sunny slopes around Andorra-la-Vella, but the olive is found nowhere. At the limits of cultivation bad weather often prevents the ripening of the barley, there sown before or soon after the harvesttime. Higher still, in the alpine zone, are great stretches of summer pasture, which provide food for many more sheep than Andorra itself can support through the winter. When the land was first peopled is unknown. At various times the high valleys have doubtless

served as refuges for peoples pressed up from the plain, as in the Caucasus, and it is known that French and Spanish deserters have frequently retired there. The Andorran, however, is stubborn and independent and mistrusts intruders. Pastoral life is naturally well-developed, and the inhabitants of the groups of valleys hold the high pastures in common, a fact which tended toward autonomy in many mountain valleys of the Pyrenees, particularly in the middle ages. The richest soil is given up to tobacco culture, the crop constituting the main wealth of the country. Exported (mainly contraband) tobacco is found for a great distance around, both in Spain and in the Ariège basin. The need of hay for winter fodder for the sheep further limits cereal culture. Meadowland is highly prized and tends to extend at the expense of the cultivated soil; and even the potato, the introduction of which meant much to most regions of the Pyrenees, forms with barley only a poor supplement to pastoral products. Climate and soil alike are unfavourable to wheat.

Besides the local movement to high pastures in summer there is well-developed transhumance in the migration of vast flocks of sheep from the distant plains of the lower Segre (Llanos de Urgel) and the Ariège, the total summer flocks of Andorra being estimated at about 30,000 head. In most parts the frontier against France lies in areas which form natural regions, so that treaties, *lies ou paceries*, for peaceful exploitation, regardless of national or political considerations, are of long standing. Against Spain, on the east, the frontier sometimes descends beyond the crests to include the headwaters of opposing streams. Lower down the slopes, herds of horses, mules and cattle find sustenance, while the goat also plays an important part in Andorran life. For all animals, however, the problem is lack of winter food, and the autumnal fairs, visited by Catalan dealers, are important and are held both in Andorra and over the Spanish border. Industry, apart from the half-dozen tobacco "factories," is merely domestic, and lack of capital and initiative, remoteness and poorness of communications prevent development. Mineral deposits include silver, lead and, in particular, iron ores, which were formerly worked and reduced with charcoal, as several ruined forges testify. At Las Escaldas is a hydroelectric station, with a capacity of 26,500 kw., which supplies Barcelona province. A good road crosses the country from L'Hospitalet by the Port d'Embalire (8,150 ft.) to Andorra-la-Vella and thence over the Spanish frontier to Seo de Urgel; this last section is served by motor omnibus.

Another road connects Andorra-la-Vella with Ordino. Apart from these there is little but bridle paths. In 1904 France and Spain agreed to build a railway from Ax to Ripoll. This was opened in July 1929.

There are two contrasted types of settlement, the permanent and the temporary village, the houses being grouped together in both cases. The former, extending up to the limit of 6,000 ft., are generally on slopes facing south. The largest agglomerations are in the plains about Andorra-la-Vella and Encamp. The temporary (summer) habitations generally occur between 5,200 and 6,500 ft.; but "migration" there is sometimes on a small scale, although in some districts the peasants spend nine months of the year at the high villages (*cortals*). The limited resources of the high valleys necessitate emigration.

The independence of Andorra is traditionally ascribed to Charlemagne, like many other Pyrenean anomalies. Since 1278 the principality has been under the joint suzerainty of the French state (which inherited the rights of the counts of Foix) and the Spanish bishops of Urgel, and the two powers, who receive annual dues of 960 fr. and 460 pesetas, respectively, have mutually checked innovations in a land where mediaeval usages naturally persist. Thus, Andorra is not a republic; its official title is "les Vallées et Suzerainetés." It is governed by a council general of 24 members, elected for four years by the heads of families in each of the six parishes of Andorra-la-Vella (where it meets in the government house), Encamp, La Massana, Ordino, Canillo and Sant-Julia-de-Loria. A first syndic, chosen by the council, constitutes the supreme executive; and a second syndic serves as deputy. In civil matters the judicial power is exercised in the first instance by two civil judges (*battles*) nominated by the two *veguers*, also Andorrans, whom France and the bishop of Urgel appoint as their representatives. There is a court of appeal and also a supreme court at Perpignan. The final appeal is either to the supreme court or to the ecclesiastical court at Urgel. For criminal suits the *veguers* sit with the syndic, the appeal judge and two nominees of the council general at Andorra-la-Vella. A permanent delegate, the prefect of the *département* of Pyrénées-Orientales, has charge of French interests, which include certain public services. Both French and Spanish currencies are used.

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ANDOVER, municipal borough, Southampton, England, situated among chalk hills on the Anton, a tributary of the Test. Pop. (1938) 11,910. Area, 10 sq.mi. The district is rich in prehistoric earthworks and *tumuli*. The importance of the Saxon village (*Andeſeian*, *Andieura*, *Andever*) is probably related to the proximity of the Roman road from Silchester to Old Sarum. The witenagemot met here, and it is the traditional scene of meeting of Aethelred and Olaf the Dane. Andover existed as a borough before 1176, and Henry II exempted its inhabitants from toll and passage. The corporation was reconstituted in 1599 and again in 1682. The town possessed an iron market and a prosperous wool trade in the 14th century; it is the centre of a large agricultural district and also profits from various army undertakings on the Downs. The November sheep-fair dates from the 13th century. The cattle and corn markets are both ancient institutions. Malting, iron founding and printing are carried on. Extinct industries are the manufactures of silk and parchment. Andover sent two members to parliament from 1584-85 to 1867 and one from then until 1885, when it was merged in the county, being in the Basingstoke division. There is a station on the main S.R. from London to Exeter.

ANDOVER, a town of Essex county, Mass., U.S., situated on the south side of the Merrimack valley. The population was 12,261 in 1950 and was 11,122 in 1940 by federal census.

Worsted, woollens and rubber goods are produced in Andover, Ballardvale and Shawsheen village, a "model" community created by the American Woolen company. Andover, the principal business centre, is about 23 mi. N. of Boston and is served by the Boston and Maine railway and interurban bus lines.

Andover is noteworthy for its educational institutions. Abbot academy, opened in 1829, was the earliest incorporated school for girls in New England. Phillips academy, opened in 1778 (incorporated in 1780), the first incorporated academy of the state, was founded through the efforts of Samuel Phillips (1752-1802) by his father, Samuel Phillips (1715-90), and his uncle, John Phillips (1719-95), "for the purpose of instructing youth, not only in English and Latin grammar, writing, arithmetic and those sciences wherein they are commonly taught, but more especially to learn them the great end and real business of living." An archaeological department with an important collection in American archaeology was founded by Robert S. Peabody and his wife in 1901. The academy grounds include those occupied 1808-1908 by the Andover Theological seminary, which in 1931 became the Andover-Newton Theological school.

Andover was settled in 1634 and incorporated in 1646. It was named after the English town of Andover, Hampshire, the home of some of the chief settlers. North Andover was separated from it in 1855. Elizabeth Stuart Phelps-Ward lived for many years in Andover, and Harriet Beecher Stowe, who resided there from 1852 to 1864, is buried there.

ANDRADA E SYLVA, BONIFACIO JOZÉ D' (1765-1838), Brazilian statesman and naturalist, was born at Villa de Santos, near Rio de Janeiro. In 1800 he was appointed professor of geology at Coimbra, and soon after inspector-general of the Portuguese mines; in 1812 he was made perpetual secretary of the Academy of Lisbon. Returning to Brazil in 1819, he urged Dom Pedro to resist the recall of the Lisbon court, and was appointed one of his ministers in 1821. When the independence of Brazil was declared, Andrada was made minister of the interior and of foreign affairs; and when it was established he was again elected by the Constituent Assembly, but his democratic principles resulted in his dismissal from office, July 1823. On the dissolution of the Assembly in November, he was banished to France, where he lived near Bordeaux till, in 1829, he was permitted to return to Brazil. But being again arrested in 1833, and tried for intriguing on behalf of Dom Pedro I., he remained in retirement till he died at Nitheroy in 1838.

ANDRÁSSY, JULIUS, COUNT (1860-1929), Hungarian statesman, was born June 30, 1860, the son of Count Julius Andrassy. He was elected deputy in 1885, and in 1906 became Minister of the Interior, in the so-called Coalition Cabinet. At the collapse of this Ministry in 1910, he refused to join the Khuen-Hédervary Government but declared that he would not actively oppose it, and dissolved the constitutional party, of which he was leader. In 1913 he delivered three speeches in the Hungarian Delegation against the conduct of foreign affairs, advocating a policy of European *détente*, and in parliament he opposed the plan for the centralization of the internal administration of Hungary. At the outbreak of World War I he supported the Tisza Ministry, but opposed Burian on the Polish and Italian questions. In 1915 he pleaded for peace, and urged a wide extension of the franchise. Upon the resignation of Burian in Oct. 1918, he became foreign minister in Vienna and, in a note to President Wilson, made a last attempt to conclude a separate peace. He then retired from office, but in Jan. 1920 was returned for Miskolcz to the Hungarian National Assembly and later became leader of the Christian National party. In Oct. 1921, at King Charles's second attempt to regain his throne, he was taken prisoner with the king and was imprisoned for several months. In 1922 he was returned to the Nationalist Assembly as a Legitimist deputy. He died June 11, 1929.

His works include—*Ungarns Ausgleich mit Österreich vom Jahre 1867* (1897); *Die Ursachen des Bestandes des Ungarischen Staates und dessen verfassungsmässiger Freiheit* (Budapest, 1901-11); *The Development of Hungarian Constitutional Liberty* (1908); *Wer hat den Krieg verbrochen?* (Leipzig, 1915, Eng. trans. by E. J. Euphrat, New York, 1915); *Interessensolidarität des Deutschlands und Ungarns* (Munich, 1916); *Diplomatie und Weltkrieg* (1920, Eng. trans. by J. H. Reece, 1921), and *The Antecedents of the World War*, vol. 1, Hungarian (1925).

ANDRÁSSY, JULIUS (GYULA), COUNT (1823-1890), Hungarian statesman, the son of Count Károly Andrassy and Etelka Szapary, was born at Kočife, Slovakia (then in north Hungary) on March 3, 1823. In 1846 he attracted attention by his bitter articles against the Government in Kossuth's paper, the *Pesti Hírlap*, and was returned as one of the Radical candidates to the diet of 1847-48. He was one of the leaders in the Constitutional agitation in Hungary, but when Jellačić (*q.v.*) marched into Hungary, Andrassy took command of a Honvéd battalion and served at the battles of Pákoz and Schwechat. In May 1849 Kossuth sent him to Constantinople, in the hope of persuading the Porte to declare war against Austria and Russia. After the catastrophe of Világós he migrated first to London and then to Paris. On Sept. 21, 1851, he was hanged in effigy by the Austrian Government for his share in the Hungarian revolt. In 1856 he married Countess Katinka Kendeffy, and in the following year asked for and obtained an amnesty, without, however, expressing regret for the part he had played in the past. In 1858 he returned to Hungary. Here he supported Deák in his demand for the restitution of the Hungarian Constitution of 1848, and worked strongly for reconciliation, both between the monarch and the Hungarian nation, and the conflicting political parties in Hungary.

On Dec. 21, 1865, he was chosen vice-president of the diet, and in March 1866, president of the sub-committee appointed by the parliamentary commission to draw up the Composition (commonly known as the *Ausgleich*) between Austria and Hungary, of which the central idea, that of the "Delegations," originated with him. After Königgrätz he was formally consulted by the emperor for the first time. He advised the re-establishment of the constitution and the appointment of a responsible ministry.

On Feb. 17, 1867, the king appointed him the first constitutional Hungarian premier, and he took over the departments of war and foreign affairs.

It was he who, in the face of extraordinary opposition, secured for Hungary the recognition of a national militia (Honvéd), organized that force, and arranged for the "provincialization" of the Military Frontier (*q.v.*).

On Nov. 6, 1871, Beust, the Austro-Hungarian foreign minister, who had urged revenge on Prussia for the war of 1866 and a Franco-Austrian alliance, left office, and Andrassy took his place.

He had resolutely opposed the "policy of revenge," notably in his speech of July 28, 1870, and under his guidance Austria-Hungary established that firm friendship with Germany which was the most essential factor in European politics up to 1914. Andrassy was a Magyar, and a man of world-wide outlook; for both reasons he saw in Germany the only trustworthy support of his country and his nation against Russian aggression and the encroachments of the Slavonic nationalities in the dual monarchy and in the Balkans.

Ultimately, Andrassy saw in Russia his most dangerous enemy, but he was able to preserve good relations, and even to secure the signature of an agreement between Franz Joseph and Alexander II. to act together to maintain the peace of Europe (June 6, 1873). Meanwhile his wise and active policy restored Austria-Hungary's fallen international prestige. She was no longer isolated; friendly relations were cultivated with Germany and Russia, and with Great Britain and Italy. The preservation of the Ottoman empire was most desirable for Andrassy's policy; but, should this prove impossible, he did not propose to let Russia's influence eclipse that of Austria-Hungary in the Balkans. At the same time, when court and military circles in Vienna were hoping for an acquisition of territory in the Balkans, Andrassy, fearing the effects on Hungary of an increase of the Slav population in the dual monarchy, resolutely opposed any territorial aggrandisement. Thus, when serious disturbances broke out in Bosnia in 1875, Andrassy, in his famous note of Dec. 30, 1875, urged the introduction of reforms which should leave the authority of the Porte intact, while ameliorating the lot of the Christians. The maintenance of the *status quo* proved impossible; and at the Congress of Berlin, Andrassy, who was present as Austro-Hungarian plenipotentiary, accepted for his country a mandate over Bosnia and Herzegovina far more for defensive, than for offensive, reasons. Nevertheless, the occupation was intensely unpopular in Hungary, as also in German Austria; and on Oct. 8, 1879, Andrassy resigned. The offensive-defensive alliance with Germany, which placed the foreign relations of Austria-Hungary once more on a stable footing, was his work, though it was signed by Haymele.

After his retirement Andrassy continued to take an active part in public affairs both in the Delegations and in the upper house as a moderate Constitutionalist and defender of the *Ausgleich* of 1867. In the last years of his life he regained his popularity, and his death on Feb. 18, 1890, was universally mourned as a national calamity. He was the first Magyar statesman who, for centuries, had occupied a European position. Breadth of view, swift resourcefulness, and an intimate knowledge of men and things were his distinguishing qualities as a statesman. Personally he was the most amiable of men; he united in himself the Magyar magnate and the modern gentleman. If Deák was the architect, Andrassy certainly was the master-builder of the modern Hungarian state.

Count Andrassy left two sons and one daughter, Ilona (b. 1859), who married Count Lajos Batthyány. The elder son, Tivador (Theodore) Andreas (1857-1905), was elected vice-president of the lower house of the Hungarian parliament in 1890. The younger, Gyula (Julius) is noticed above.

See Andrassy's *Speeches* (Hung.) edited by Béla Lederer (1891); *Memoir* (Hung.) by Benjamin Kállay (1891); *Recollections of Count Andrassy* (Hung.) by Máno Kónyi (1891). *Graf Julius Andrassy: sein Leben und seine Zeit*, by E. von Wertheimer (Stuttgart, 1913).

"ANDRÁSSY NOTE, THE," a declaration drawn up by Count Andrassy on behalf of Russia, Austria and Germany, and presented to the Porte, after the adherence of France and Great Britain, on Jan. 31, 1876. Serious insurrections had broken out in Bosnia and Herzegovina. The Andrassy note was an attempt at conciliation: it urged the equality before the law of Christian and Muslim subjects, the abolition of the system of farming taxes, and the erection of an administrative local assembly representing both religions. Neither the Andrassy note nor the subsequent Berlin memorandum (to which Great Britain refused any support) was successful. Serbia and Montenegro declared war. The "Bulgarian atrocities" followed, precipitating the Russo-Turkish War, which was closed by the treaties of San Stefano and Berlin, 1878 (*qq.v.*). (See also EASTERN QUESTION.)

ANDRÉ, JOHN (1751-1780), British soldier, was born in London in 1751 of Genevese parents. Accident brought him in 1769 to Lichfield, where, in the house of the Rev. Thomas Seward, he met the beautiful Miss Honora Sneyd. A strong attachment sprang up between the two, but Miss Sneyd's family refused their consent to marriage. André travelled for some time in Germany, and eventually joined the 7th Royal Fusiliers in



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MAJOR JOHN ANDRÉ, BRITISH SOLDIER AND PATRIOT, WHO WAS HANGED AS A SPY DURING THE AMERICAN REVOLUTION. FROM A SKETCH MADE BY ANDRÉ ON THE MORNING OF THE DAY FIXED FOR HIS EXECUTION

Canada. Honora married in 1773 R. L. Edgeworth, the father of Maria Edgeworth, but André remained faithful. In a letter to Anna Seward, written shortly after being taken prisoner by the Americans at the capitulation of St. John's on Nov. 3 1775, he states that he has been "stripped of everything except the picture of Honora, which I concealed in my mouth. Preserving this I yet think myself fortunate." Exchanged towards the close of 1776, André received rapid promotion, and Sir Henry Clinton appointed him adjutant-general of the forces in 1778.

Early in 1780 the American general, Benedict Arnold (*q.v.*), made overtures to the British to betray to them the fortress of West Point on the Hudson river. Major André was appointed to negotiate with Arnold. For this purpose he landed from a vessel bearing a flag of truce and saw Arnold, who gave him full particulars and plans of the fortress of West Point, and arranged to co-operate with the British during an attack which was to be made in a few days. Unfortunately for André, the British vessel was fired on before the negotiations were finished and obliged to drop down the river. André was compelled to pass the night within the American lines. Exchanging his uniform for a civilian disguise, he set out next day by land for New York, provided by Arnold with a passport. When all danger of being recognized seemed past, André was stopped by three American militiamen who searched him and discovered in his boots the proofs of his negotiations for the betrayal of West Point. Washington, although admitting that André was "more unfortunate than criminal," sent him before a court-martial, by which, he was, in consequence of his own admissions, condemned to death as a spy. He was hanged at Tappan on Oct. 2 1780. Arnold escaped by flight. The justice of André's execution has been much discussed, but he undoubtedly acted as a spy, although under orders and entirely contrary to his own feelings. Washington's apparent harshness in refusing the condemned man a soldier's death by shooting has also been censured.

Major André showed considerable poetic talent in his humorous *Cow-chase*, a parody on *Chevy-chase*, which appeared in three successive parts in New York, the last on the very day of his capture. His fate excited universal sympathy, and the whole British army went into mourning for him. A mural tablet to his memory was placed in Westminster Abbey by the British Government; a monument to his captors has been erected by Americans on the spot where he was taken. André's military journal of the

British movements in America from June 1777 to the close of 1778, was taken to England in 1782 by General Grey, whose descendant, Earl Grey, discovered it in 1902.

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ANDRÉ LE CHAPELAIN (ANDREAS CAPELLANUS), mediaeval French writer and chaplain at the French court (whence his surname), was born in the second half of the 12th century, and probably held his office under Philip Augustus (1180-1223). His famous treatise, *Liber de Arte honeste amandi et de Reprobatione inhonesti Amoris*, written in Latin at the beginning of the 13th century and translated twice into French during the century, is an interesting source of information concerning mediaeval manners and morals, and the "court of love" in particular. There are 12 mss. extant, of which the most important are: the 13th century ms. in the Vatican, coll. Ottobonianæ, no. 1463; the 14th century ms. in the Bibliothèque Nationale, no. 8758; and the 15th century ms. in the Ambrosian Library, A. no. 136. The work has also been translated into German and Italian. The most widespread edition is that of D. Mühler, *Erotica seu Amatoria Andrei Capellani regii* (Dortmund, 1610); other editions are by E. Trojel, *Andree Capellani regii Francorum De Amore libri tres* (Copenhagen, 1892); and by H. M. Elster, a German translation, *3 Bücher über die Liebe . . .* (1924).

ANDREA, GIOVANNI (1275-1348), professor of canon law at Bologna, where he is said to have died of plague. Curious stories are told of him, e.g., that by way of self-mortification he lay every night for 20 years on the bare ground with only a bear's skin for a covering; that in an audience he had with Pope Boniface VIII. his extraordinary shortness of stature led the pope to believe he was kneeling, and to ask him three times to rise, to the immense merriment of the cardinals; and that he had a daughter, Novella, so accomplished in law as to be able to read her father's lectures in his absence, and so beautiful that she had to read behind a curtain lest her face should distract the attention of the students.

ANDREA DEL SARTO (1486-1530), Italian painter, was born in Florence on July 16, 1486. There were four other children. His surname has been given as Vanucchi; his name "del Sarto" was given him because his father, Agnolo, was a tailor. In 1494 Andrea was put to work under a goldsmith. He took to drawing from his master's models and was soon transferred to a skillful woodcarver and inferior painter named Gian Barile, with whom he remained until 1498. Barile recommended him to Piero di Cosimo as draughtsman and colourist. Piero retained Andrea for some years, allowing him to study from the famous cartoons of Leonardo da Vinci and Michelangelo. Finally Andrea agreed with his friend Franciabigio, who was somewhat his senior, that they would open a shop conjointly; at a date not defined they took a lodging together in the Piazza del Grano. Their first work in partnership may probably have been the "Baptism of Christ," for the Florentine Compagnia dello Scalzo. Soon afterwards the partnership was dissolved. From 1509 to 1514 the brotherhood of the Servites employed Andrea, as well as Franciabigio and Andrea Feltrini, the first-named undertaking in the portico of the Annunziata three frescoes illustrating the life of the Servite saint Filippo Benizzi (d. 1285). The subjects are the saint sharing his cloak with a leper, cursing some gamblers, and restoring a girl possessed with a devil. The second and third works excel the first, and are impulsive and able performances. These paintings gained for their author the pre-eminent title "Andrea senza errori" (Andrew the unerring). Andrea went on to the Death of S. Filippo and the Children cured by touching his Garment—all the five works being completed before the close of 1510. The youth of 23 was already, in technique, about the best fresco-painter of central Italy, barely rivalled by Raphael, who was the elder by four years. Michelangelo's Sixtine frescoes were then only in a preliminary stage. Andrea always worked in the simplest, most typical, and most trying method of fresco—that of painting the thing once and for all, without any subsequent dry-touching. He now received many commissions. The brotherhood of the Servites engaged him to do two more frescoes in the Annunziata

at a higher price; he also painted, towards 1512, an Annunciation in the monastery of S. Gallo.

The "Tailor's Andrew" appears to have been an easy-going plebeian, to whom a modest position in life and scanty gains were no grievances. As an artist he must have known his own value; but he probably rested content in the sense of his superlative powers as an executant, and did not aspire to the rank of a great inventor or leader, for which, indeed, he had no vocation. He led a social sort of life among his compeers of the art, was intimate with the sculptor Rustici, and joined a jolly dining-club at his house named the Company of the Kettle, also a second club named the Trowel. At one time, Franciabigio being then the chairman of the Kettle-men, Andrea recited, and is by some regarded as having composed, a comic epic, "The Battle of the Frogs and Mice"—a rechauffé, as one may surmise, of the Greek *Batrachomyomachia*. He fell in love with Lucrezia (del Fede), wife of a hatter named Carlo Recanati; the latter dying opportunely, on Sept. 1, 1516, Andrea married her. She was a very handsome woman and has come down to us treated with great suavity in many a picture of her lover-husband, who constantly painted her as a Madonna and otherwise; and even in painting other women he made them resemble Lucrezia in general type. Vasari, who was at one time a pupil of Andrea, describes her as faithless, jealous, overbearing, and vixenish with the apprentices. She lived to a great age, surviving her husband 40 years.

By 1514 Andrea had finished his last two frescoes in the court of the Servites, the "Nativity of the Virgin," which shows the influence of Leonardo, Domenico Ghirlandajo, and Fra Bartolommeo in effective fusion, and the "Procession of the Magi," intended as an amplification of a work by Baldovinetti; in this fresco is a portrait of Andrea himself. He also executed at some date a much-praised head of Christ over the high altar. By Nov. 1515 he had finished at the Scalzo the allegory of Justice, and the "Baptist preaching in the desert"—followed in 1517 by "John baptizing" and other subjects. Before the end of 1516 a "Pieta" of his composition and afterwards a Madonna were sent to the French court. At the invitation of Francis I. Andrea went in June 1518 to Paris, where, for the first and only time in his life he was handsomely remunerated. Lucrezia, however, wrote urging his return to Italy. The king assented on the understanding that his absence from France was to be short; and he gave Andrea a sum of money to be expended in purchasing works of art for his royal patron. Andrea spent the king's money and some of his own in building a house for himself in Florence.

In 1520 he resumed work in Florence, and executed the "Faith" and "Charity" in the cloister of the Scalzo. These were succeeded by the "Dance of the Daughter of Herodias," the "Beheading of the Baptist," the "Presentation of his head to Herod," an allegory of Hope, the "Apparition of the Angel to Zacharias" (1523), and the monochrome of the Visitation (1524). In 1525 he painted the very famous fresco named the "Madonna del Sacco," a lunette in the cloisters of the Servites, generally accounted his masterpiece. His final work at the Scalzo was the "Birth of the Baptist" (1526), executed with some enhanced elevation of style after Andrea had studied Michelangelo's figures in the sacristy of S. Lorenzo. In the following year he completed at S. Salvi, near Florence, a celebrated "Last Supper," in which all the personages seem to be portraits. This also is a very fine example of his style, though the conception of the subject is not exalted. It is the last monumental work of importance which Andrea del Sarto lived to execute. He caught the plague at Florence, and died on Jan. 22, 1530, at the comparatively early age of 43. He was buried in the church of the Servites.

Of the various portraits by Andrea said, though with doubtful reason, to represent himself, one, an admirable half-figure is in the National Gallery, London; others are in the gallery at Panshanger, in the Uffizi Gallery and the Pitti Palace. Other of his works are: in the Uffizi, the "Madonna di S. Francesco," or "Madonna delle Arpie," from certain figures of harpies which are decoratively introduced, c. 1517, and the altar-piece painted for the monastery of S. Gallo, the "Fathers disputing on the doctrine of the Trinity," c. 1517; in the Louvre, "Charity," perhaps the

only painting which Andrea executed while in France; in the Belvedere of Vienna, "The Pietà"; at Poggio a Caiano—a celebrated fresco (1521), completed by Alessandro Allori, representing Julius Caesar receiving tribute—various figures bringing animals from foreign lands; in the Pitti Gallery two separate compositions of the "Assumption of the Virgin," also a fine "Pietà"; in the Madrid museum the "Virgin and Child"; in the Louvre the "Holy Family," the Baptist pointing upwards; in Berlin a portrait of his wife; and in Panshanger a fine portrait named "Laura." The Uffizi and the Louvre possess many fine drawings from nature by his hand.

In 1523 Andrea del Sarto produced at the request of Ottaviano de' Medici a copy of the portrait group of Leo X. by Raphael; it is now in the Naples museum, the original being in the Pitti Gallery. Even Giulio Romano, who had himself manipulated the original to some extent, was misled.

Andrea had true pictorial style, a very high standard of correctness and an enviable balance of executive endowments. The point of technique in which he excelled least was perhaps that of discriminating the varying textures of different objects and surfaces. There is not much elevation or ideality in his works—much more of reality. His chiaroscuro is not carried out according to strict rule, but is adjusted to his liking for harmony of colour and fused tone and transparency; in fresco more especially his predilection for varied tints appears excessive. It may be broadly said that his taste in colouring was derived mainly from Fra Bartolommeo, and in form from Michelangelo; and his style partakes of the Venetian and Lombard, as well as the Florentine and Roman—some of his figures are even adapted from Albert Dürer. In one way or other he continued improving to the last. It is in his portraits that Andrea ranks among the greatest.

In this account of Andrea del Sarto the main lines of the narrative of Crowe and Cavalcaselle, supplemented by Vasari, Lanzi, and others, have been followed.

See H. Guinness, *Andrea del Sarto* (1899); F. Knapp, *Andrea del Sarto* (Beilefeld and Leipzig, 1907); C. Pfeiffer, *Les Madones d'Andrea del Sarto Etude Critique* (1913).

ANDREANI, ANDREA, Italian engraver on wood, in chiaroscuro, was born at Mantua about 1540 (Brulliot says 1560) and died at Rome in 1623. His engravings are scarce and valuable, and are chiefly copies of Mantegna, Dürer, and Titian.

ANDREE, KARL (1808–1875), German geographer, was born at Brunswick on Oct. 20, 1808, and died at Wildungen on Aug. 10, 1875. He was educated at Jena, Göttingen, and Berlin. From 1835 he devoted himself entirely to geography and ethnography, working successively at Leipzig and at Dresden. In 1862 he founded the important geographical periodical *Globus*. His works include *Nordamerika in geographischen und geschichtlichen Umrissen* (Brunswick, 1854), *Geographische Wanderungen* (Dresden, 1859), and an important *Geographie des Welthandels* (Stuttgart, 1867–72).

His son **RICHARD** (1835–1912) devoted himself especially to ethnography, but he also had a chief share in the production of the *Physikalisch-statistische Atlas des deutschen Reiches* (Leipzig, 1877), *Allgemeine Handatlas* (1st ed. 1881), and other atlases; and he continued the editorship of the *Globus*.

ANDRÉE, SALOMON AUGUST (1854–1897), Swedish engineer, was born at Grenna, on Lake Vetter, Oct. 18 1854. After education at the Stockholm technical college, he studied aeronautics, and in 1895 elaborated a plan for crossing the north polar region by a balloon which should be in some degree dirigible by sails and trailing ropes. After an abortive effort in 1896, the winds being contrary, Andrée started with two companions from Danes Island, Spitzbergen, on July 11 1897. They were never seen again. Of several expeditions sent in search of them, the first started in Nov. 1897, on the strength of a report of cries of distress heard by shipwrecked sailors at Spitzbergen; in 1898 and 1899 parties searched the north Asiatic coast and the New Siberia Islands; and in May 1899 Dr. Nathorst headed an expedition to eastern Greenland. None was successful, but on August 6, 1930, thirty-three years later, men from a sealer landed on White Island, and accidentally discovered the remains of the

Andrée expedition, including two bodies; the third was found later. It appeared from Andrée's diary that the balloon drifted to 83° 4' N., but soon was forced down. Andrée and his companions succeeded in reaching White Island but perished there.

ANDREINI (ahn'dra-ē'nē), **FRANCESCO**, Italian actor, was born at Pistoia in the latter half of the 16th century. He was a member of the company of the *Gelosì* which Henry IV. summoned to Paris to please his bride, Marie de' Medici. His wife ISABELLA ANDREINI (1562–1604) was a distinguished actress, and also a minor poet. Her books included a pastoral, *Mirtilla* (Verona, 1588), a volume of songs, sonnets and other poems (Milan, 1601), and a collection of letters, published after her death. Her distinguished son GIAMBATTISTA ANDREINI (1578–1650), actor and playwright, was born in Florence, and acted in Paris under the name of Leylio. Italian writers have surmised that one of his plays, *L'Adamo* (Milan, 1613), suggested to Milton the idea of *Paradise Lost*.

ANDRÉOSSY, ANTOINE-FRANÇOIS, COUNT (1761–1828), French artillery officer and diplomatist, was born March 6 1761. He served in the French Revolutionary wars on the Rhine, in Italy and in Egypt, and took part in the *coup d'état* of the 18th Brumaire. During the short peace which followed the treaties of Amiens and Lunéville he was ambassador to England, but his repeated warnings to Napoleon that the British Government desired to maintain peace, but must be treated with consideration, were disregarded. Later Napoleon sent Andréossy as ambassador in 1808 to Vienna and in 1812 to Constantinople. After his recall by Louis XVIII. in 1814 he retired into private life, and wrote works on military history and scientific memoirs. He died at Montauban in 1828.

See Marion, *Notice nécrologique sur le Lt.-Général Comte André-ossy*.

ANDRES, JUAN (1740–1817), Spanish Jesuit, wrote on science, music, etc., but his chief work was *Dell'origine, progressi, e stato attuale d'ogni Letteratura* (Parma, 1782–99). A Spanish translation was made by his brother Carlos (Madrid, 1784–1806), and an abridgment in French (1838–46) was compiled by Alexis Nerbonne.

See C. Sommervogel, *Bibliothèque de la compagnie de Jésus, première partie* (Brussels and Paris), vol. i. col. 342–350.

ANDREW, ST., the Apostle (see APOSTLE).

ANDREW II. (1175–1235), king of Hungary, son of Bela III., succeeded his nephew, the infant Ladislas III., in 1205. By his reckless generosity Andrew impoverished the crown, and made the monarchy dependent on the great feudatories, who reduced Hungary to a state bordering on anarchy. His first wife, Gertrude of Meran, was murdered (Sept. 24 1213) by rebellious nobles. In 1217 Andrew set out for the Holy Land with an army of 15,000 men, about 10,000 of whom sailed from Venice to Acre. The expedition failed, and on Andrew's return the barons extorted from him the Golden Bull which has been called the Hungarian *Magna Carta*. Andrew was thrice married. St. Elizabeth of Hungary was his daughter by his first wife, Gertrude.

BIBLIOGRAPHY.—No special monograph for the whole reign exists, but there is a good description of Andrew's crusade in Reinhold Roehrich, *Geschichte des Königreiches Jerusalem* (Innsbruck, 1898). The best account of Andrew's government is in László Szalay's *History of Hungary* (Hung.), vol. i. (Leipzig and Budapest, 1851–62).

ANDREW, JOHN ALBION (1818–1867), American political leader, "war governor" of Massachusetts, was born at Windham, Me., on May 31, 1818. He graduated at Bowdoin college in 1837, studied law in Boston, was admitted to the Suffolk bar in 1840, and practised his profession in Boston. He also took a deep interest in religious matters, was a prominent Unitarian and was assistant editor for some time of *The Christian World*. With ardent anti-slavery principles, he entered political life as a "Young Whig" opposed to the Mexican War; he became an active Free-Soiler in 1848, and in 1854 took part in the organization in Massachusetts of the new Republican party. He served one term, in 1858, in the State house of representatives. In 1859 he took such an active part in raising funds to defend John Brown, then on trial in Virginia, that he aroused the suspicions of a senatorial committee investigating Brown's raid, and was sum-

moned to Washington to tell what he knew of the affair. In 1860 he was chairman of the Massachusetts delegation to the Republican national convention at Chicago, which nominated Lincoln for the presidency; and from 1861 to January 1866, throughout the trying period of the Civil War, he was governor of Massachusetts, becoming known as one of the ablest, most patriotic and most energetic of the remarkable group of "war governors" in the North.

Immediately after his inauguration he began filling the militia regiments with young men ready for active service, saw that they were well drilled and supplied them with good modern rifles. As a result, Massachusetts was the only northern State in any way prepared for war when the Confederates fired on Fort Sumter; and her troops began to muster in Boston on April 16, the very day after President Lincoln's call for volunteers. On the next day the 6th Massachusetts Volunteer Infantry started south for the defence of Washington, and was the first fully armed and equipped volunteer regiment to reach the capital. Within six days after the call, nearly 4,000 Massachusetts volunteers had departed for Washington. In 1863, at Governor Andrew's own request, the secretary of war authorized him to raise several regiments of negro troops, with white commissioned officers, and the 54th Massachusetts Infantry was the first regiment of free negroes raised in the North. Governor Andrew's example was quickly followed in other States, and before the end of the year 36,000 negroes had been enrolled in the Union armies. When the War Department ruled that the negro troops were entitled to pay only as "labourers" and not as soldiers, Governor Andrew used all his influence with the president and the secretary of war to secure for them the same pay as white troops, and was finally successful. Notwithstanding his loyal support of the administration during the struggle, he did not fully approve of its conduct of the war, which he deemed shifting and timid; and it was with great reluctance that he supported Lincoln in 1864 for a second term.

In 1865 Andrew rejected the more radical views of his party as to the treatment to be accorded to the late Confederate States, opposed the immediate and unconditional enfranchisement of freedmen, and, though not accepting President Johnson's views in their entirety, he urged the people of Massachusetts to give the new president their support. On retiring from the governor's office he resumed the practice of law, at once achieving great success. In 1865 he presided at the first national convention of the Unitarian Church. He died suddenly of apoplexy, at Boston, on Oct. 30, 1867.

See Henry G. Pearson, *Life of John A. Andrew* (Boston and New York, 1904).

ANDREWES, LANCELOT (1555–1626), bishop of Winchester, was born in London. His family was an ancient Suffolk one; his father, Thomas, became master of Trinity House. Lancelot was educated at Merchant Taylors' school and at Pembroke Hall, Cambridge, and became a fellow of his college in 1576. He took orders in 1580, and his preferment was rapid. He was vicar of St. Giles's, Cripplegate (1588), prebendary of St. Paul's (1589), of Southwell (1589–1609), dean of Westminster (1601), bishop of Chichester (1605), of Ely (1609), and of Winchester from 1618 until his death, Sept. 26 1626. He was one of those who prepared the authorized version of the Bible (1611).

Two generations later, Richard Crashaw caught up the universal sentiment, when, in his lines "Upon Bishop Andrewes' Picture before his Sermons," he exclaims:—

"This reverend shadow cast that setting sun,
Whose glorious course through our horizon run,
Left the dim face of this dull hemisphere,
All one great eye, all drown'd in one great teare."

Andrewes was distinguished in many fields. At court, though no trifier or flatterer, he was a favourite counsellor in three successive reigns, but he never meddled much in civil or temporal affairs. His learning made him the equal and the friend of Grotius, and of the foremost contemporary scholars. His preaching was a unique combination of rhetorical splendour and scholarly richness; his

piety that of an ancient saint, semi-ascetic and unearthly in its self-denial. As a churchman he is typically Anglican, equally removed from the Puritan and the Roman positions. He stands in true succession to Richard Hooker in working out the principles of the English Reformation, though while Hooker argued mainly against Puritanism, Andrewes chiefly combated Romanism. A good summary of his position is found in his *First Answer to Cardinal Perron*, who had challenged James I.'s use of the title "Catholic." His position in regard to the Eucharist is naturally more mature than that of the first reformers. "As to the Real Presence we are agreed; our controversy is as to the *mode* of it. As to the *mode* we define nothing rashly, nor anxiously investigate, any more than in the Incarnation of Christ we ask how the human is united to the divine nature in One Person. There is a real change in the elements—we allow *ut panis iam consecratus non sit panis quem natura formavit; sed, quem benedictio consecravit, et consecrando etiam immutavit*" (*Responsio*, p. 263). Adoration is permitted, and the use of the terms "sacrifice" and "altar" maintained as being consonant with scripture and antiquity. Christ is "a sacrifice—so, to be slain; a propitiatory sacrifice—so, to be eaten" (*Sermons*, vol. ii. p. 296). "By the same rules that the Passover was, by the same may ours be termed a sacrifice. In rigour of speech, neither of them; for to speak after the exact manner of divinity, there is but one only sacrifice, *veri nominis*, that is Christ's death. And that sacrifice but once actually performed at His death, but ever before represented in figure, from the beginning; and ever since repeated in memory to the world's end. That only absolute, all else relative to it, representative of it, operative by it. . . . Hence it is that what names theirs carried, ours do the like, and the Fathers make no scruple at it—no more need we" (*Sermons*, vol. ii. p. 300). As to reservation, "it needeth not: the intent is had without it," since an invalid may always have his private communion. Andrewes declares against the invocation of saints, the apparent examples in patristic literature are "rhetorical outbursts, not theological definitions." His services to his church have been summed up thus: (1) he has a keen sense of the proportion of the faith and maintains a clear distinction between what is fundamental, needing ecclesiastical commands, and subsidiary, needing only ecclesiastical guidance and suggestion; (2) as distinguished from the earlier protesting standpoint, e.g. of the 39 Articles, he emphasized a positive and constructive statement of the Anglican position.

LITERATURE.—Of his works the *Manual of Private Devotions* is the best known, for it appeals to Christians of every church. One of the many good modern editions is that by Alex. Whyte (1900). Andrewes's other works occupy eight volumes in the Library of Anglo-Catholic Theology (1841–54). Of biographies we have those by H. Isaacson (1650), A. T. Russell (1863), R. L. Ottley (1891), and Dean Church's essay in *Masters in English Theology*. See also W. H. Frere, *Lancelot Andrewes as a Representative of Anglican Principles* (1898; Church Hist. Soc. Publications, No. 44).

ANDREW OF LONGJUMEAU (Longumeau, Lonjumeau, etc.), a French Dominican, explorer and diplomatist. He accompanied the mission under Friar Ascelin, sent by Pope Innocent IV. to the Mongols in 1247; at the Tartar camp near Kars he met a certain David, who next year (1248) appeared at the court of King Louis IX. of France in Cyprus. Andrew, who was now with St. Louis, interpreted to the king David's message, a real or pretended offer of alliance from the Mongol general, Ilchikdai (Ilchikadai), and a proposal of a joint attack upon the Islamic powers for the conquest of Syria. In reply the French sovereign despatched Andrew as his ambassador to the great Khan Kuyuk; with Longumeau went his brother, a monk, and several others—John Goderiche, John of Carcassonne, Herbert "le sommelier," Gerbert of Sens, Robert a clerk, a certain William, and an unnamed clerk of Poissy.

The party set out about Feb. 16 1249, with letters from King Louis and the papal legate, and rich presents, including a chapel-tent, lined with scarlet cloth and embroidered with sacred pictures. From Cyprus they went to the port of Antioch in Syria, and thence travelled for a year to the khan's court, going ten leagues a day. Their route led them through Persia, along the

southern and eastern shores of the Caspian (whose inland character, unconnected with the outer ocean, their journey helped to demonstrate), and probably through Talas, N.E. of Tashkent. On arrival at the supreme Mongol court—either that on the Imyl river (near Lake Ala-kul and the present Russo-Chinese frontier in the Altai), or more probably at or near Karakorum itself, S.W. of Lake Baikal—Andrew found Kuyuk Khan dead, poisoned, as the envoy supposed, by Batu's agents. The regent-mother, Ogul Gaimish (the "Camus" of Rubruquis), seems to have received and dismissed him with presents and a letter for Louis IX, the latter a fine specimen of Mongol insolence. But it is certain that before the friar had quitted "Tartary," Mangu Khan, Kuyuk's successor, had been elected.

Andrew's report to his sovereign, whom he rejoined in 1251 at Caesarea in Palestine, appears to have been a mixture of history and fable; the latter affects his narrative of the Mongols' rise to greatness, and the struggles of their leader, evidently Jenghiz Khan, with Prester John; it is still more evident in the position assigned to the Tartar homeland, close to the prison of Gog and Magog. On the other hand, the envoy's account of Tartar manners is fairly accurate, and his statements about Mongol Christianity and its prosperity, though perhaps exaggerated (e.g., as to the 800 chapels on wheels in the nomadic host), are based on fact. Mounds of bones marked his road, witnesses of devastations which other historians record in detail; he found Christian prisoners from Germany in the heart of "Tartary" (at Talas); the ceremony of passing between two fires he was compelled to observe, as a bringer of gifts to a dead khan, gifts which were of course treated by the Mongols as evidence of submission.

We only know of Andrew through references in other writers; see especially William of Rubruquis in *Recueil de voyages*, iv (Paris, 1839), pp. 261, 265, 279, 296, 310, 353, 363, 370; Joinville, ed. Francisque Michel (1858, etc.), pp. 142, etc.; Jean Pierre Sarrasin, in same vol., pp. 254-5; William of Nangis in *Recueil des historiens des Gaules*, xx 359-67; Rémusat, *Mémoires sur les relations politiques des princes chrétiens . . . avec les . . . Mongols* (1822, etc.), p. 52.

(C. R. B.)

ANDREWS, CHARLES MCLEAN (1863-1943), U.S. educator and historian, was born in Weathersfield, Conn., on Feb. 22, 1863. He was educated at Trinity college, Hartford, Conn., graduating in 1884, and at Johns Hopkins university he received the degree of doctor of philosophy in 1889. He was associate professor and professor of history in Bryn Mawr college from 1889 to 1907 and professor of history in Johns Hopkins university from 1907 until he became professor of American history in Yale university (1910-31). From 1931-33 he served as director of historical publications at Yale and from 1912-33 as editor of the Yale Historical publications. The first volume of his four volume work, *The Colonial Period of American History*, won him a Pulitzer prize in 1935. He died in New Haven, Conn., Sept. 9, 1943.

Among his extensive historical writings are: *The River Towns of Connecticut* (1889); *The Old English Manor* (1892); *The Historical Development of Modern Europe* (1896-98); *Contemporary Europe, Asia and Africa, 1871-1901* (1902); *A History of England*, a text-book (1903); "Colonial Self-Government, 1652-1689," vol. v of *The American Nation, a History* (1904); *British Commissions, Councils and Committees, 1622-1675* (1908); *A Short History of England* (1912); *The Colonial Period of American History* (1912); *The British Merchants and the Non-Importation Movement* (1917); *Fathers of New England and Colonial Folkways* (in "Chronicles of America" Series, 1919); *The Colonial Background of the American Revolution* (1924); *Colonial Period of American History* (1934-37).

ANDREWS, ELISHA BENJAMIN (1844-1917), U.S. educator, was born in Hinsdale, N.H., on Jan. 10, 1844. He fought on the Union side in the Civil War. He graduated from Brown university in 1870 and from Newton theological institution, Newton Centre, Mass., in 1874. From 1875 to 1879 he was president of Denison university, Granville, Ohio. In 1879-82 he was professor of homiletics in Newton theological institution and from 1882 to 1888 he was professor of history and political economy in Brown university. He became professor of political economy at Cornell university in 1888, and in 1889 was made president of Brown university. In 1897, because of criticism by the trustees of his advocacy of free silver, he resigned, but soon with-

drew his resignation. He served as superintendent of the public schools of Chicago from 1898 to 1900, when he was chosen chancellor of the University of Nebraska, from which he retired in 1909. He died at Interlaken, Fla., on Oct. 30, 1917.

In addition to text-books on history and economics, his published works include *An Honest Dollar* (1889); *Wealth and Moral Law* (1894); *History of the United States* (1894); and *The History of the Last Quarter Century in the United States, 1870-95* (1896), revised as *The United States in Our Own Time* (1903).

ANDREWS, JAMES PETTIT (c. 1737-1797), English historian and antiquary, was born at Shaw house, Newbury, Berkshire, and died in London on Aug. 6, 1797. He was one of the magistrates at the police court in Queen square, Westminster, from 1792 to his death. His chief work was a *History of Great Britain connected with the Chronology of Europe from Caesar's Invasion to Accession of Edward VI.* (1794-95).

ANDREWS, ROY CHAPMAN (1884-), American naturalist and explorer, was born at Beloit, Wis., on Jan. 26, 1884. Immediately after his graduation from Beloit college in 1906 he entered the American Museum of Natural History, New York, and went to Alaska on his first exploring trip in 1908. In 1909-10 he accompanied, as a naturalist, the "U.S.S. Albatross" on its voyage to the Netherlands Indies, Borneo and Celebes; in 1911-12 he explored northern Korea; and in 1913 was with the Borden Alaska expedition.

Until 1914 he specialized in the study of whales and other water mammals. From that date he devoted himself, as chief of the division of Asiatic exploration of the American Museum of Natural History, to the exploration of the lesser known portions of central Asia, China and Borneo, also serving in the U.S. Intelligence service in China, in 1918. The expeditions under his leadership explored successively, Tibet, southwest China, Burma, north China, Mongolia and central Asia. In Mongolia they found some of the richest fossil fields known to the world. The fruits of the expeditions which he led in 1921-22 and 1925 into central Asia included the discovery of new geological formations, large fossil fields, dinosaur eggs, and the skull and other parts of the *Baluchitherium*—the largest known land mammal.

The expeditions discovered the oldest known mammals and extensive evidence of primitive human life on the central Asian plateau. Evidence was discovered also pointing to central Asia as a place of origin and centre of distribution for much of the reptilian and mammalian life of the world. The expeditions continued work in central Asia until 1929.

He has written *Whale Hunting with Gun and Camera* (1916), *Camps and Trails in China*, with Yvette Borup Andrews (1918), *Across Mongolian Plains* (1921), *On the Trail of Ancient Man* (1926-27), *Ends of the Earth* (1929), *The New Conquest of Central Asia* (1932), *This Business of Exploring* (1935) and *This Amazing Planet* (1940), as well as numerous monographs and scientific bulletins.

ANDREWS, THOMAS (1813-1885), Irish chemist and physicist, was born on Dec. 19, 1813, at Belfast. In 1845 he was appointed vice-president of the newly established Queen's college, Belfast, and professor of chemistry, offices which he held till 1879, when failing health compelled his retirement. He died on Nov. 26, 1885. The work on which his reputation mainly rests, and which best displayed his skill and resourcefulness in experiment, was concerned with the liquefaction of gases. He carried out a very complete enquiry into the laws expressing the relations of pressure, temperature and volume in carbonic dioxide, in particular establishing the conceptions of critical temperature and critical pressure, and showing that the gas passes from the gaseous to the liquid state without any breach of continuity.

His scientific papers were published in a collected form in 1889 with a memoir by Profs. Tait and Crum Brown.

ANDREYEV, LEONID NICOLAIEVICH (1871-1919), Russian novelist, was born in Orel on June 18, 1871. He was educated at the government school. Poverty and an unhappy heredity drove him, in 1894, to an attempt on his own life, as a result of which he suffered from a weak heart, which ultimately caused his death. He became a reporter on *The Courier*. Then, in 1899, his story *They Lived* appeared in the monthly *Zhizn*

("Life") and attracted universal attention. It is the only work of Andreyev which contains a happy love-story.

In 1901, when the first series of his stories appeared in a separate edition, N. K. Michailovsky, the most influential critic of the time, paid a high tribute to the genius of the young author. This series included the stories *The Grand Slam*, *The Tocsin* and *The Wall*, in which Andreyev's creative genius and its characteristics were clearly visible. His subsequent works, *The Story of Serguey Petrovitch*, *Thought*, *In the Mist*, *The Life of Father Vassili Fiveisky*, *Ghosts*, etc., are similar to his first work in spirit and philosophical outlook.

His works are permeated by horror of life, which appeared to Andreyev, as to James Thomson, a "City of Dreadful Night." His manner is original and he follows the great precept that "in literary works, there should be little room for words and large space for ideas." The same terror of life is expressed in Andreyev's plays *The Life of Man* (1907), *King Hunger* and *Anathema* (1909). He was not a morbid pessimist who derided the misery of mankind, but a mournful humanist. He pities the sufferers and is filled with scorn for those who add nightmare to nightmare. Andreyev's best-known works reflect this attitude: his protest against war, *The Red Laugh* (trans. 1905); against capital punishment, *The Seven That Were Hanged* (trans. 1909), which appeared during the reign of the White Terror in 1909; and the passionate *S. O. S.* (1919), directed against the Red Terror.

Andreyev refused to follow Gorky's example in recognizing the bolshevik régime and declined the honours offered by the bolsheviks and fled to Finland. He thus lost the fortune he had accumulated by his writings, and during the last years of his life he once again experienced poverty and even want. *S. O. S.*, one of the most remarkable works of Russian literature, and Andreyev's swan-song, was published in Finland. He died at his villa at Kuokkala, Finland, Sept. 12, 1919. (I. W. S.)

ANDRIA, a town and episcopal see of Apulia, Italy, in the province of Bari; 35 mi. W. of the town of Bari by steam tramway and 6 mi. S.E. of Barletta. Pop. (1936) 54,438 (town), 56,152 (commune). It was founded probably about 1046 by Peter, the first Norman count of Andria. It was a favourite residence of the emperor Frederick II, whose second and third wives, Iolanthe and Isabella of England, were buried in the cathedral dedicated to St. Richard, who is believed to have come from England in 492. There are several other fine churches of the 13th century. The Castel del Monte, 9½ mi. S. of Andria, was constructed by Frederick II, who frequently resided there. Despite its massive and imposing exterior, its details are fine.

ANDRIEU, BERTRAND (1761-1822), French engraver of medals, was born at Bordeaux. He is considered to have restored the art in France, which had declined after the time of Louis XIV; and during the last 20 years of his life he was entrusted by the French government with the execution of every work of importance. Many of his medals are figured in the *Medallic History of Napoleon*.

ANDRIEUX, FRANÇOIS GUILLAUME JEAN STANISLAS (1759-1833), French man of letters, was born at Strasbourg on May 6, 1759, and died in Paris on May 9, 1833. He was educated for the bar, and under the convention was a civil judge in the court of cassation. He became president of the *Tribumat*, but was displaced because of his irreconcilable opposition to the civil code. In his retirement he returned to dramatic writing. He had made a hit in 1788 with *Les Étourdis* and he now produced *Molière avec ses amis* (1804). Among his later plays were *La Comédienne* (1816) and *Lucius Junius Brutus* (1830). As professor of literature at the Collège de France, he maintained the classical tradition and opposed the growing romantic school. In 1829 he became perpetual secretary to the academy, and worked hard at the completion of the dictionary.

See also A. H. Taillandier, *Notice sur la vie et les ouvrages d'Andrieux* (1850); Sainte-Beuve, *Portraits littéraires*, vol. i.

ANDRISCUS, "pseudo-Philip," a fuller of Adramyttium, claimed to be a son of Perseus, last king of Macedonia. He seized the Macedonian throne in 149 B.C., after defeating the Roman

praetor, and his conquest of Thessaly and alliance with Carthage made the situation dangerous. In 148 he was defeated by Q. Caecilius Metellus and given up to Rome. After this Macedonia was formally reduced to a province.

See Velleius Paterculus i, 11; Florus ii, 14; Livy, *Epit.* 49, 50, 52; Diod. Sic. xxxii, 9.

ANDROCLES, more correctly ANDROCLUS, a Roman slave, who lived about the time of Tiberius. He is the hero of a story by Aulus Gellius (v. 14), which tells that Androclus had taken refuge from the cruelties of his master in a cave in Africa, when a lion entered the cave and showed him his swollen paw, from which Androclus extracted a large thorn. The grateful animal subsequently recognized him when he had been captured and thrown to the wild beasts in the circus, and, instead of attacking him, began to caress him; he was then set free. (Aelian, *De Nat. An.*, vii, 48.) The story is the subject of the play, *Androcles and the Lion*, by G. Bernard Shaw.

ANDROIDES: see AUTOMATON.

ANDROMACHE, in Greek legend, the daughter of Eëtion, prince of Thebes in Mysia, and wife of Hector (*q.v.*). All her relations perished in or shortly after the taking of the town by Achilles (*Iliad*, vi, 414). After the capture of Troy her son Astyanax (or Scamandrius) was hurled from the battlements (Eurip., *Troades*, 720). When the captives were allotted, Andromache fell to Neoptolemus (Pyrrhus), the son of Achilles, whom she accompanied to Epirus, and to whom she bore three sons. When Neoptolemus was slain at Delphi, he left Andromache and the kingdom to Helenus, the brother of Hector (Virgil, *Aen.* iii, 294). After his death Andromache returned to Asia Minor with her youngest son Pergamus, who there founded a town named after himself.

ANDROMEDA, in Greek legend, the daughter of Cepheus and Cassiopeia (*q.v.*). To satisfy Poseidon, who had been offended, Andromeda, chained to a rock, was exposed to a sea monster. Perseus, returning from having slain the Gorgon, found her, slew the monster, set her free, and married her in spite of Phineus, to whom she had before been promised (Ovid, *Metam.*, v. 1). Andromeda followed her husband to Tiryns in Argos, and became the ancestress of the family of the Perseidae. After her death she was placed by Athena among the constellations in the northern sky, near Perseus and Cassiopeia. Sophocles and Euripides (and in modern times Corneille) made the story the subject of tragedies, and its incidents were represented in numerous ancient works of art.

The most famous feature of the astronomical constellation is the Great Andromeda Nebula—the brightest of the spiral nebulae. It can be seen without much difficulty with the naked eye and recognized by its diffuse appearance. It is an "island universe" probably containing millions of stars and of the same general nature as our own stellar system, though apparently of somewhat smaller dimensions. (See NEBULA.) From the brightness of the Cepheid variables in the nebula, Edwin Hubble has deduced that its distance is 900,000 light-years. A number of outbursts of Novae (temporary stars) have been observed in the nebula. Nearly all the spiral nebulae are receding from us with large velocities, but the Andromeda nebula is one of the exceptional approaching systems, its velocity in the line of sight being 300 km. per second. Photographs show in great detail its beautiful spiral structure; the plane of the spiral is tilted with respect to us, giving the nebula an apparently elongated form.

The double star γ Andromedae is a favourite object for observation with a small telescope on account of the striking contrast of colour of the two components.

The Andromedids are a swarm of meteors which made a notable display on Nov. 27, 1872, and provide some of the November meteors year by year; the swarm is believed to be the debris of Biela's comet which was last seen in 1852.

ANDRONICUS I (COMNENUS), Emperor of the East, son of Isaac, and grandson of Alexius I, Comnenus, was born about the beginning of the 12th century. In 1141 he was taken captive by the Turks (Seljuks) and remained in their hands for a year. On being ransomed he went to Constantinople to the court of his

cousin, the Emperor Manuel, with whom he was a great favourite. Andronicus repeatedly fell into disgrace with the emperor on account of his licentious conduct and his liaisons with different ladies connected with the imperial family. A great part of his life between 1152 and 1180, the date of the death of the Emperor Manuel was spent in hiding in courts in the outlying districts of the empire.

In 1180 the Emperor Manuel died and was succeeded by his son Alexius II., who was under the unpopular guardianship of the Empress Maria. He left his retirement, secured the support of the army and marched upon Constantinople, where his advent was stained by a cruel massacre of the Latin inhabitants. Alexius was compelled to acknowledge him as colleague in the empire, but was soon put to death. Andronicus, now (1183) sole emperor, married Agnes, widow of Alexius II., a child eleven years of age. His short reign was characterized by strong and wise measures. He resolved to suppress many abuses, but, above all things, to check feudalism and limit the power of the nobles. The people, who felt the severity of his laws, at the same time acknowledged their justice, and found themselves protected from the rapacity of their superiors. The aristocrats, however, were infuriated against him, and summoned to their aid William of Sicily. This prince landed in Epirus with a strong force, and marched as far as Thessalonica, which he took and destroyed; but he was shortly afterwards defeated, and compelled to return to Sicily. Andronicus seems then to have resolved to exterminate the aristocracy, and his plans were nearly crowned with success. But in 1185, during his absence from the capital, his lieutenant ordered the arrest and execution of Isaac Angelus, a descendant of the first Alexius. Isaac escaped and took refuge in the church of St. Sophia. He appealed to the populace, and a tumult arose which spread rapidly over the whole city. When Andronicus arrived he found that his power was overthrown, and that Isaac had been proclaimed emperor. Isaac delivered him over to his enemies, and for three days he was exposed to their fury and resentment. At last they hung him up by the feet between two pillars. His dying agonies were shortened by an Italian soldier, who mercifully plunged a sword into his body. He died Sept. 12 1185.

ANDRONICUS II. (PALAEOLOGUS) (1260–1332), eastern Roman emperor, was the elder son of Michael Palaologus, whom he succeeded in 1282. He allowed the fleet, which his father had organized, to fall into decay; and the empire was thus less able than ever to resist the exacting demands of the rival powers of Venice and Genoa. During his reign the Turks under Osman conquered nearly the whole of Bithynia; and to resist them the emperor called in the aid of Roger di Flor, who commanded a body of Spanish adventurers. The Turks were defeated, but Roger was found to be nearly as formidable an enemy to the imperial power. He was assassinated by Andronicus's son and colleague, the emperor Michael IX., in 1305. His adventurers (known as the Catalan Grand Company) declared war upon Andronicus, and, after devastating Thrace and Macedonia, conquered the duchy of Athens and Thebes. From 1320 onwards the emperor was engaged in war with his grandson, Andronicus. He abdicated in 1328 and died in 1332.

ANDRONICUS III. (1296?–1341), eastern Roman emperor, grandson of Andronicus II. His conduct during youth was so violent that, after the death of his father, Michael, in 1320, his grandfather resolved to deprive him of his right to the crown. Andronicus rebelled; he had a powerful party, and the first period of civil war ended in his being crowned and accepted as colleague by his grandfather (1325). The quarrel broke out again and, notwithstanding the help of the Bulgarians, the older emperor was compelled to abdicate (1328). During his reign Andronicus III. was engaged in constant war, chiefly with the Turks, who greatly extended their conquests. He annexed large regions in Thessaly and Epirus, but they were lost before his death to the rising power of Serbia under Stefan Dušan. He did something for the reorganization of the navy, and recovered Lesbos and Chios from the Genoese. He died on June 15, 1341.

ANDRONICUS OF CYRRHUS, Greek astronomer, flourished about 100 B.C. He built a *horologium* at Athens, the

so-called "tower of the winds," a considerable portion of which still exists. It is octagonal, with figures carved on each side, representing the eight principal winds. A brazen Triton on the summit, with a rod in his hand, turned round by the wind, pointed to the quarter from which it blew. From this model is derived the custom of placing weathercocks on steeples.

ANDRONICUS OF RHODES (c. 70 B.C.), the 11th scholar of the Peripatetics. He edited the writings of Aristotle and Theophrastus, and wrote paraphrases of Aristotle and commentaries. Two treatises are sometimes erroneously attributed to him, one on the emotions, the other a commentary on Aristotle's *Ethics* (really by Constantine Palaeocappa in the 16th century, or by John Callistus of Thessalonica).

See Susemihl, *Geschichte der griechischen Literatur in der Alexandrinarzeit* ii. 301–305 (Leipzig 1891–92).

ANDROPHAGI, an ancient nation of cannibals placed by Herodotus (iv. 18, 106), who denies that they are Scythians, well to the north of Scythia, probably in the forests between the upper waters of the Dnieper and Don. They were most likely Finns (Samoyed has the same meaning) and perhaps the ancestors of the Mordvinians (q.v.).

ANDROS, SIR EDMUND (1637–1714), English colonial governor in America, was born in London on Dec. 6, 1637, son of a noble Andros, royal bailiff of the island of Guernsey. In 1674 he



SIR EDMUND ANDROS BEING LED A PRISONER THROUGH BOSTON STREETS. The deposition and arrest of Sir Edmund Andros, governor of the "Dominion of New England," by his colonists in 1689, was an early expression of the spirit of independence which less than 100 years later resulted in the American Revolution.

was appointed by the duke of York (later James II.) governor of New York and the Jerseys, though his jurisdiction over the Jerseys was disputed, and until his recall in 1681 to meet an unfounded charge of dishonesty and favouritism, he proved himself to be a capable administrator. His imperious disposition, however, made him unpopular among the colonists. In 1686 he became governor, with Boston as his capital, of the "Dominion of New England," into which Massachusetts (including Maine), Plym-

outh, Rhode Island, Connecticut and New Hampshire were consolidated, and in 1688 his jurisdiction was extended over New York and the Jerseys. But his interference with colonial rights and customs aroused resentment, and on April 18, 1689, soon after news of the arrival of William, prince of Orange, in England reached Boston, the colonists deposed and arrested him, and the inter-colonial union was dissolved. Andros was sent to England for trial in 1690, but was immediately released, and from 1692 until 1698 he was governor of Virginia, but was recalled through the agency of the Commissary James Blair with whom he quarrelled. In 1693-94 he was also governor of Maryland. From 1704-06 he was governor of Guernsey. He died in London in Feb. 1714 and was buried at St. Anne's, Soho.

See *The Andros Tracts* (Boston, 1869-72).

ANDROS or **ANDRO**, the most northerly island of the Cyclades, 6 mi. S.E. of Euboea, and about 2 mi. N. of Tenos; nearly 25 mi. long; greatest breadth 10 mi. Pop. about 18,000, among whom are many Albanians, especially in the north. It is mountainous, with many fruitful and well-watered valleys. Andros, the capital, on the east coast, contains about 2,000 inhabitants. The ruins of Palaeopolis, the ancient capital, are on the west coast; the town possessed a famous temple, dedicated to Bacchus. The ancient population was mainly Ionian, perhaps with a Thracian admixture. Originally dependent on Eretria, by the 7th century B.C., it sent colonies to Chalcidice (Acanthus, Stageirus, Argilus, Sane). In 480 it supplied ships to Xerxes and was subsequently harried by the Greek fleet. Though enrolled in the Delian League it remained disaffected towards Athens, and revolted in 411. In the Hellenistic period Andros was coveted as a frontier-post by the naval powers of Macedonia and Egypt. In 200 it was captured by a combined Roman, Pergamene and Rhodian fleet, and remained a possession of Pergamum until the bequest of that kingdom to Rome in 133 B.C. Before falling under Turkish rule, Andros was from A.D. 1207 till 1566 governed by the families Zeno and Sommariva under Venetian protection. It became part of Greece in 1829 and is now an eparchy.

ANDROTION (c. 350 B.C.), Greek orator, was a pupil of Isocrates and a contemporary of Demosthenes. He is known to us chiefly from the speech of Demosthenes, in which he was accused of illegality against Androtion in proposing the usual honour of a crown to the Council of Five Hundred at the expiration of its term of office. Androtion filled several important posts, and during the Social War was appointed extraordinary commissioner to recover certain arrears of taxes. He is said to have gone into exile at Megara, and to have composed an *Atthis*, or annalistic account of Attica from earliest times to his own days (Pausanias vi. 7; x. 8). It is disputed whether the annalist and orator are identical, but an Androtion who wrote on agriculture is certainly a different person.

Professor Gaetano de Sanctis (in *L'Attide di Androzio e un papiro di Oxyrhynchus*, Turin, 1908) attributes to Androtion, the athidographer, a 4th-century historical fragment, discovered by B. P. Grenfell and A. S. Hunt (*Oxyrhynchus Papyri*, vol. v.). Strong arguments against this view were set forth by E. M. Walker in the *Classical Review*, May, 1908.

ANDUJAR (ancient *Isturgi*), town of Spain, in Jaén province; on right bank of Guadalquivir river. Pop. (1940) 22,924 (mun. 24,765). Porous jars (*alcarrasas*), which keep water cool in the hot weather, are made from a whitish clay found at Andujar.

ANECDOTE, a word originally meaning something not published. It has now two distinct significations. The primary one is something not published, in which sense it has been used to denote either secret histories—Procopius, e.g., gives this as one of the titles of his secret history of Justinian's court—or portions of ancient writers, which have remained long in ms. and are edited for the first time. Of such *anecdota* there are many collections; the earliest was probably L. A. Muratori's, in 1709. In the general acceptance of the word, anecdotes are short accounts of detached interesting particulars. Of such anecdotes the collections are almost infinite. Spence's *Anecdotes*, Horace Walpole's *Anecdotes of English Painting*, and Mrs. Thrale's *Anecdotes of the late Samuel Johnson, LL.D.* are 18th century collections. One of the best compilations is that by T. Byerley (d. 1826) and J. Clinton Robertson (d. 1852) known as the *Percy Anecdotes* (1820-23). A

more recent collection is *Literary Anecdotes of the Nineteenth Century*, edited by W. R. Nicoll and T. J. Wise.

ANEL, DOMINIQUE (1679-1730), French surgeon, was celebrated for his successful treatment of *fistula lacrymalis*. While at Genoa he invented the fine-pointed syringe, still known by his name, for use in the operation.

See F. H. Garrison, *History of Medicine* (1929).

ANEMOMETRY, the measurement of air speed. It is difficult to design instruments to measure accurately the speed of moving air; and although recent research has helped, difficulties still persist, particularly as regards the measurement of low air speeds. The trouble is mainly because direct methods are impracticable, so it is necessary to measure some physical effect arising from the motion. Three such effects have been found suitable—namely, pressure changes associated with the motion; mechanical effects, such as the rotation of certain types of windmills appropriately mounted in the stream; and, lastly, the rate of cooling of a hot body, such as an electrically heated wire, exposed to the current. The first is most important, since a properly designed instrument, suitably inserted in the stream, experiences a pressure, commonly called the velocity head, entirely characteristic of the motion, and measurable on a pressure gauge. If such an instrument is constructed on what are now established principles it may be used without calibration as a standard for measurement of wind speed. This is not true of anemometers which depend on mechanical or electrical effects; these are subject to individual variations and require calibration against a standard instrument of the pressure-tube type.

Pressure-tube anemometers in general consist of two parts; one is common to all types—namely, an open-ended tube facing the air stream. If flow through this tube is prevented, by connecting the other end to a pressure gauge, the pressure at the mouth is found to be equal invariably to the sum of the static pressure and

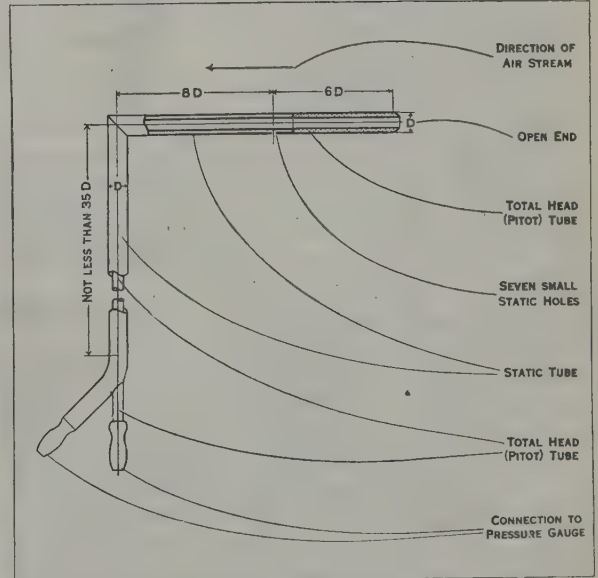


FIG. 1.—DIAGRAM OF PITOT-STATIC PRESSURE TUBE, USED AS A STANDARD FOR THE MEASUREMENT OF WIND SPEED

The wind speed is calculated from the pressures set up in the two tubes when they are placed in an air current

the velocity head in the stream at that point. The other part of the anemometer varies in detail with different types, but always consists of a second tube with orifices so arranged as to measure either the static pressure in the stream or the static pressure multiplied by a certain coefficient characteristic of the instrument.

We may consider first the case in which the static tube measures accurately the static pressure itself. If then the two tubes of the complete anemometer are connected to opposite sides of the same differential pressure gauge, the static pressure portion of the pressure transmitted by the facing or "total head" tube will be

balanced by the pressure transmitted from the static tube, and the resultant reading on the gauge will be the velocity head p , which is related to the speed of the air-stream V by the equation

$$p = 0.5 \rho V^2 \quad (1)$$

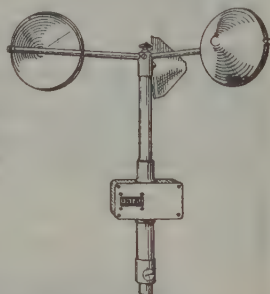
where p is measured as force per unit area and ρ is the air density (mass per unit volume), calculable in any given case from knowledge of the temperature and pressure of the air.

An instrument, whose differential readings measure the velocity-head to an accuracy of about 0.1% is shown in fig. 1. The two tubes are here arranged concentrically, the inner, $\propto$ Pitot tube (so called after Pitot, who was the first to suggest the use of pressure-tube anemometers), measuring the sum of the velocity and static heads—that is the “total” head, while the outer one measures the static pressure at the series of small orifices around its periphery as shown on the diagram. Such an instrument forms a convenient standard to which the readings of other types of anemometers may be referred.

In pressure-tube instruments of the second type, in which the static side does not indicate the true static pressure, the differential pressure p_1 is usually given by an equation of the form

$$p_1 = k \rho v^2 \quad (2)$$

where k is now a coefficient whose magnitude is in general greater than 0.5 and may vary with the wind speed. In the Dines pressure-tube, much used in meteorological work, the total head tube is mounted so that it is free to rotate about a vertical axis, and is equipped with a weathercock-vane which always points the tube into the wind. A vertical tube, pierced with a number of small holes past which the wind streams, forms the static side, the constant k in equation (2) for this instrument being about 0.75. The pressures are usually transmitted to a recording float-manometer, in which the float moves vertically by an amount corresponding to the applied pressure difference. The motion of the float is communicated to a pen which marks on a chart attached to the surface of a cylindrical drum driven by a clock, and making as a rule one complete revolution in 24 hours. Continuous records of wind speed extending over this period are thus obtained on one chart.



FRIEZ INSTRUMENT, BENDIX

FIG. 2.—A CUP ANEMOMETER
Standard small anemometer used by the U.S. navy and U.S. weather bureau. The rate of revolution of the cups is indicated or recorded at a distance by electrical means. The instrument body contains a transmitting mechanism

Many mechanical devices for measuring air speeds have been proposed, but only the rotating cup anemometer and the vane anemometer now survive to any marked degree. The former (see fig. 2) consists essentially of three or four cups, hemispherical or bluntly conical, at the ends of three or four light arms like spokes in a wheel, radiating from a central hub. Modern instruments generally have three cups, research in wind tunnels having shown this number to be the best. The aerodynamic force on a cup with its concave face presented to the wind is greater than when the wind is blowing on its convex face; therefore the wheel of cups tends to rotate in the direction of the convex faces.

The ratio of the wind speed to the linear speed of the centres of the cups is termed the *factor* of the anemometer. In the earlier patterns of cup anemometer this quantity varied rather widely with wind speed, making it necessary to apply large corrections to the indicated speeds over most of the range; but in carefully designed modern instruments with three conical cups having beaded edges the factor is practically constant for all speeds in excess of about 6 miles per hour. Cup anemometers over-indicate in fluctuating winds to an extent that may reach 30% in very gusty weather. It has been found that conical cups suffer from this defect less than hemispherical ones, but this over-indication limits the accuracy of meteorological anemometry very seriously.

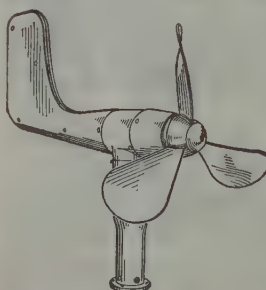
Small anemometers which are intended to be held in the hand

are often arranged with a mechanism that indicates on a dial either the number of revolutions of the cup wheel or, more commonly, the distance travelled by the wind. The relation between revolutions and the travel of the wind is determined by experiments in a wind tunnel, and the gearing arranged to suit. For general meteorological purposes the cup wheel is geared to electrical contacts so as to complete a circuit once in every mile or other unit travelled by the wind, causing a mark to be made on a chronograph at a distance, and thus providing a permanent record of the wind speed. Another useful arrangement is to gear the anemometer to give 60 contacts in each mile of wind, each contact causing a light to flash or a buzzer to sound. The number of these events in one minute is then equal to the mean speed of the wind in miles per hour during the time of observation.

Where instantaneous values of wind speed are required, a small electrical generator may be driven by the cup wheel, and connected to a voltmeter which has been calibrated experimentally in units of wind speed. This takes power to drive the generator, resulting in errors at low speeds, and electronic circuits have been devised to get over this difficulty. Such instruments can readily be made to give a record.

The vane anemometer consists of light flat vanes attached to radial arms mounted on a common spindle which rotates in two jewelled bearings. Eight vanes are usually employed; they are inclined at an angle to the axis of the spindle, which is set along the wind direction when the instrument is in use, and the wind forces acting on the vanes cause the spindle to rotate at a rate depending, in any given case, on the air speed. As in the cup anemometer, the motion of the spindle is communicated by a gear train to a pointer, or, more usually, to a number of pointers moving over dials graduated directly in feet. Instruments of this type are mainly of value for measuring air speeds in large ducts or ventilating shafts. They are particularly useful for measuring low speeds where the pressures to be measured with pressure-tube instruments are so small as to necessitate the use of extremely sensitive manometers. For meteorological applications, propeller anemometers have been devised, in which a small propeller similar in shape to that of an aeroplane is kept facing the wind by a wind vane. Such a propeller revolves at a speed very nearly proportional to that of the wind.

Vane anemometers of normal design can be used over a range of wind speeds from about five to 50 ft. per second. For higher speeds, up to 100 ft. per second, special instruments are made which are either of heavier construction or, alternatively, incorporate a device by means of which the quantity of air actually passing through the vanes can be reduced. Vane anemometers of specially light construction can also be obtained to measure speeds



FRIEZ INSTRUMENT, BENDIX

FIG. 3.—MODERN PROPELLER ANEMOMETER

The vane keeps it facing the wind

of less than 5 ft. per second, the lower limit of speed that will cause steady rotation of the vanes being the order of 0.5 ft. per second. All instruments need calibration in a wind whose speed can be controlled and adjusted to known values, for it is not possible to predict accurately the readings of a mechanical anemometer from a knowledge of its dimensions only.

In the absence of mechanical friction due to weight of moving parts and to gearing, readings of both cup and vane anemometers would depend only on the wind speed, and so would be independent of changes of air density. In most cases these frictional couples will be small compared with the aerodynamic driving torque, and no attention need therefore normally be paid to changes in air density. If, however, the changes of density are large—more than about 5%—the readings should be corrected. The simplest method is, perhaps, to alter both the ordinate and the abscissa of any point on the original calibration curve of the in-

strument in the ratio $\sqrt{\frac{\rho_0}{\rho_1}}$, where ρ_0 is the air density at the time of calibration and ρ_1 is the new air density. In this way a point on the calibration curve for density ρ_1 is obtained, and by repeating this process for a number of points on the original curve the curve for density ρ_1 can be drawn.

As regards the effect of inclination to the wind direction, it has been shown that the axis of the vane circle may be out of alignment with the wind by an angle approaching 20° before the readings of the anemometer are in error by more than about 2% or 3%. A fluctuating wind speed is another source of error, for the vane anemometer then tends to indicate more than the true mean speed, but errors will be negligible unless fluctuations are very violent. If maximum and minimum air speeds are respectively 50% above and below mean speed, the error on the mean speed indicated by the instrument may be of the order of 10% or 15% high. It can be shown, however, that the error depends on the square of the amplitude of the fluctuations, so it decreases rapidly as the wind becomes steadier. An amplitude of 50% on either side of the mean represents a very unsteady air stream.

Electrical or hot wire anemometers have not been much used because of the elaborate apparatus and manipulation involved, but certain types have been developed for industrial application. They may yield excellent laboratory results, and are, in particular, well suited to the measurement of low air speeds. (See also AERIAL NAVIGATION; METEOROLOGY.) (E. Ow.; W. E. K. M.)

ANEMONE, or WINDFLOWER, a genus of the buttercup family (Ranunculaceae), containing about 120 species, mostly in the north temperate zone. *Anemone nemorosa*, wood anemone, occurs in Britain.

The plants are perennial herbs with an underground rootstock, or tuberous-rooted, and radical, deeply cut leaves. The elongated flower stem bears white, red, blue or, rarely, yellow flowers; there is an involucre of three bracts below each flower. The fruits comprise a cluster of short-beaked achenes, differing from the *Pulsatilla* section of the genus with its long, plumose fruits.

Many are favourite garden plants; among the best known is *Anemone coronaria*, the poppy anemone, a tuberous-rooted plant, with divided leaves, and large showy poppylike blossoms on stalks from six to nine inches high; the flowers are scarlet, crimson, blue, purple or white. There are also double-flowered varieties.

The genus contains many other spring-blooming plants, of which *A. hortensis* and *A. fulgens* have less-divided leaves and rosy-purple or scarlet flowers. The splendid *A. japonica* and its white variety, Whirlwind, are fine autumn-blooming perennials; they grow well in light soil.

A group of dwarf species, represented by the European *A. nemorosa* and *A. apennina*, are beautiful spring flowers.

In the United States and Canada there are about 20 species, with representatives in all regions from arctic America and Alaska south to Florida, Texas and California. Among these are some of the most attractive North American wild flowers. Noteworthy species are the American wood anemone (*A. quinquefolia*), of low woods from Nova Scotia to Minnesota south to Georgia, very similar to the wood anemone (*A. nemorosa*) of Europe; the Canada windflower (*A. canadensis*), with large white flowers, found in low grounds from Labrador to Saskatchewan and southward to Maryland and Colorado; the tall windflower, or thimbleweed (*A. virginiana*), with greenish-white flowers, growing in woods from Nova Scotia to Alberta and south to Georgia and Arkansas; the candle anemone (*A. cylindrica*), a silky-hairy plant native to open grounds from New Brunswick to British Columbia and south in the Rocky mountains to Arizona; the Carolina windflower (*A. caroliniana*), with purple or white flowers, growing in open grounds from Florida to Texas and northward to Wisconsin and South Dakota; the mountain windflower (*A. trifolia*), with large white flowers, often growing with the lily-of-the-valley, native to the Appalachian region and central Europe; the red windflower (*A. multifida*), silky-hairy with red or greenish flowers, found throughout northern North America; the northern windflower (*A. parviflora*), a delicate plant with white flowers, ranging from Labrador to Alaska and southward to

Colorado and Oregon; and Richardson's windflower (*A. Richardsonii*), a slender boreal dwarf with yellow flowers, found from Labrador to Hudson bay and widely in arctic America and Siberia.

The best garden sorts are the poppy anemone (*A. coronaria*), Japanese anemone (*A. japonica*), *A. hortensis* and *A. fulgens*, all tuberous-rooted. They are of easy culture, especially when started from tubers.

Anemones are often forced by florists for their showy bloom, usually in midwinter. The best varieties for this purpose are the poppy anemones, which are grown in the cool greenhouse.

Most of the American species are more suited to the wild garden. For the closely related pasque-flowers see PASQUE-FLOWER; RANUNCULACEAE.

ANENCLETUS, or ANACLETUS: see CLETUS, or ANEN-CLETUS.

ANERIO, FELICE (1560-1614), composer. He studied under Giovanni Nanino, and succeeded Giovanni Palestrina in 1594 as composer to the papal chapel. Masses and motets of his are printed in Proske's *Musica Divina* and other modern anthologies. The 12-part *Stabat Mater* in vol. vii of Palestrina's works may have been by Felice Anerio. His brother, GIOVANNI FRANCESCO, also a composer, was born about 1567 and died 1620.

ANEROID BAROMETER. This instrument consists essentially of a vacuum chamber, two opposite walls of which are thin metal membranes, which respond elastically to any variation of pressure on their outer faces, their movement being controlled by a spring and communicated to the indicating needle. An instrument depending on a similar principle is the Bourdon pressure gauge. The aneroid barometer is not so accurate as the mercury barometer, but it is often employed when the use of the latter would be inconvenient. (See BAROMETER.)

ANET, town of north France, in the department of Eure-et-Loir, situated between the rivers Eure and Vègre, 10 mi. N.E. of Dreux by rail. Pop. (1946) 1,275. It possesses the remains of a magnificent castle, built in the middle of the 16th century by Henry II for Diana of Poitiers. Near Anet is the plain of Ivry, where Henry IV defeated the armies of the league in 1590.

ANEURIN, a British (Welsh) bard, author of the *Gododin*, flourished at the beginning of the 7th century. He is said to have been the son of Caw-ab-Geraint, a chief of the Gododin, who had their home on the seacoast to the south of the Firth of Forth. In some of the manuscripts which give the names of Caw's sons, the name of Gildas appears; but where the name of Aneurin appears, that of Gildas does not. It has therefore been assumed that the British historian Gildas and the bard Aneurin were one and the same person, though the internal evidence of their works appears to confute this. Thomas Stephens, the editor and translator of the *Gododin* epic, thinks that Aneurin may have been a son of Gildas. Aneurin seems to have studied at St. Cadoc's college, Llancarvan, and to have acted both as priest and bard at the battle of Catteraeth described in his epic. This fight is identified by Stephens with the battle of Degstan, assigned by the *Saxon Chronicle* to the year 603. Aneurin was taken prisoner after the battle. On his release he returned to Wales and became a friend of Taliesin. In his old age he returned to the north and lived with his brother in Galloway. The *Gododin* is vague in its language and in its description of events. It relates the defeat of the Britons of Strathclyde at the hands of the Saxon invader at the battle of Catteraeth.

ANEURYSM, or ANEURISM, is essentially an abnormal, localized dilatation of some artery which contains fluid or clotted blood. The causes are those which weaken the arterial wall in a localized area. This may result from a variety of injuries and diseases. Aneurysms are pulsating tumours which are progressive in character and may ultimately rupture, causing haemorrhages of varying degrees. Adventitious sounds are produced which are called bruits. Aneurysms cause changes in the surrounding tissues mostly because of pressure and erosion from their enlargement and pulsation. They sometimes establish a communication with adjoining veins. Their names are derived from their shapes, characters and locations. The diagnosis is made by the clinical history, the physical findings and by X-ray examination. The

treatment varies with the type and location and its effectiveness depends upon early recognition, location and type. Surgical procedures may be valuable.

(F. L. A.)

ANFRACTUOSITY, twisting and turning, circuitousness. Usually employed in the plural to denote winding channels such as occur in the depths of the sea, mountains or the fissures (*sulci*) separating the convolutions of the brain.

ANGARIA, the term used to denote the postal system adopted by the Roman imperial government from the ancient Persians, among whom, according to Xenophon, it was established by Cyrus the Great. The word is derived from the Greek form of a word, originally Babylonian, meaning "mounted courier." Couriers on horseback were posted at certain stages along the chief roads of the empire for the transmission of royal dispatches by night and day in all weathers. In the Roman system the supply of horses and their maintenance was a compulsory duty from which the emperor alone could grant exemption. The word came to mean generally "compulsory service." So *angaria*, in mediaeval Latin, and the rare English derivative "angariation," came to mean any service which was forcibly demanded and oppression in general. See Xenophon, *Cyrop.*, viii, 6; Herodotus viii, 98.

ANGARY, RIGHT OF. The term angary is derived from a Persian word signifying "a messenger" upon the royal service who was entitled to requisition means of transport. This custom was adopted in Greece in the 3rd century B.C. and passed to Rome. In *Corpus Juris*, *angaria* denotes requisition of horses, wagons, etc., in connection with the *cursus publicus*. It was extended to the requisition of neutral shipping for the transport of troops. The right survived throughout mediaeval Europe as a royal prerogative and was exercised for purposes of public and military transport, but the term was not generally applied to ships till the 17th century, when it became a rule of international law. In the 16th century the Venetians requisitioned a Genoese vessel and its cargo of corn to meet a food shortage, and its legality *ob publicam utilitatem* was approved. Requisition of neutral shipping became fairly general in the 18th century but was exceptional in the 19th, although the right was expressly recognized in a number of treaties, whether in time of peace or war, in case of public necessity, subject of course to adequate compensation.

In World War I the Italian government, while still neutral, requisitioned, in 1915, 34 German merchantmen lying in Italian ports. Germany made no protest, but when Portugal requisitioned, in 1916, 72 German vessels lying in Portuguese ports, Germany made it a *casus belli* and declared war on that power. In 1917 Brazil, having revoked its proclamation of neutrality and, prior to its declaration of war, requisitioned 42 German merchantmen. At the same time Great Britain and the United States, after fruitless negotiations with the Netherlands, requisitioned Dutch shipping to the amount of 1,000,000 tons lying in their ports "in exercise of the right of angary," one of the attributes of territorial sovereignty. In 1918 Spain requisitioned about 90 German vessels lying in Spanish ports as an act indispensable for its existence, and in view of the sinking of its own merchantmen by German submarines declared that no compensation was due. The United States also requisitioned a number of Norwegian ships under construction in U.S. yards.

Consequently, the right of angary (that is, the right of a state, whether belligerent or neutral, whether in time of peace or war, to requisition ships and goods situate in its territory, subject to adequate compensation, both by constitutional and international law) may be said to be firmly established. This right must be distinguished from that of requisition by a belligerent in territory occupied by him, which is based on military necessity under the laws of war.

(H. H. L. B.)

ANGEL, BENJAMIN FRANKLIN (1815-1894), U.S. diplomat, was born at Burlington, N.Y., on Nov. 28, 1815. He became a supporter of the Democratic party, and was surrogate of Livingston Co., N.Y., for four years. He was reappointed after the Democratic party carried the state in 1844. Admitted to the bar in 1837, he began his law practice in Geneseo, N.Y. In June 1853 he became U.S. consul at Honolulu, Hawaii, remaining there 18 months; however, his appointment was not ratified by the

senate. Angel was a presidential envoy to China, 1855, and minister to Norway and Sweden, 1857-61. He died at Geneseo, Sept. 11, 1894.

ANGEL, a term used in the Christian religion to describe a being endowed with intellect and free will, specifically distinct from and superior to man but essentially inferior to God. The term is derived from the Greek word *ἄγγελος* ("messenger"); employed in the Septuagint and the New Testament to designate beings of this description.

In the Old Testament they are variously called "messengers" (Heb. *mal'āk*, Gen. xlviii, 16), "sons of God" (Job i, 6), "spirits" (I Kings xxii, 19), "holy ones" (Zach. xiv, 5), "watchers" (Dan. iv, 14), "host of the Lord" (Jos. v, 14), "host of heaven" (I Kings xxii, 19). Their number is a myriad myriads (Dan. vii, 10). Their functions are to praise God and to attend upon His throne (Ps. xxix, 1), to execute His commands here on earth (Gen. xxii, 11; xxviii, 12), to protect the faithful (Ps. xci, 11), to punish the wicked (II Kings xix, 35) and to drive away evil spirits (Tobias viii, 3). They are of their nature invisible to man; they manifest themselves in assumed or apparent bodies (Tobias xii, 19). In the postexilic age the names of three of them were revealed: Gabriel (Dan. ix, 24), Michael (Dan. x, 21; xii, 1) and Raphael (Tobias xii, 15). Michael is the prince of the Jewish people; other nations have their guardian angels also. Not all angels are equal in rank, for Michael is one of the chief princes.

In some passages the "angel of the Lord" seems to be identified with the Lord Himself (Gen. xvi, 7, 13; Ex. iii, 2, 4; Judges ii, 1; vi, 11, 14). Various explanations are given of this phenomenon. Some think that the term angel of the Lord originally signified merely presence or manifestation of the Lord and later denoted a messenger distinct from God. Others believe that the early Hebrews at times made no distinction between the Lord and the angel who represented Him. Still others suppose that in the passages cited "angel of the Lord" was substituted in later times for "the Lord," to bring out the fact that the revelation was not made immediately by God but through the agency of an angel. That angels were the intermediaries of the Mosaic revelation is taught by St. Paul (Gal. iii, 19; Heb. ii, 2).



AFTER A MOSAIC IN THE CHURCH OF SANT'APOLLINARE IN CLASSE FUORI, RAVENNA, ITALY

MICHAEL THE ARCHANGEL. IN CHRISTIAN THEOLOGY THE LEADER OF THE HEAVENLY HOST

In Isaiah the attendants upon the divine throne are called seraphim (vi, 1); they have six wings but appear to have a human figure in other respects. Cherubim are said to be the guardians of paradise (Gen. iii, 24); in the visions of Ezekiel living beings called Cherubim, with four wings and four faces, are beneath the divine throne (i, 3 ff.; x, 1 ff.). Whether the seraphim and cherubim form distinct classes of angels is not clear from the Old Testament. Their representations are purely symbolic and are not indicative of their real nature.

In the extrabiblical postexilic Jewish literature the doctrine concerning the angels underwent considerable development. Thus, the Book of Enoch cites the names of 150 angels. The existence of the angels was denied by the Sadducees (Acts xxiii, 8).

The New Testament confirms and supplements the teaching of the Old. The angels were created by God in vast numbers and in diverse classes (Col. i, 16; Rev. v, 11). They are spirits, devoid of human flesh and blood (Heb. i, 14; Eph. vi, 12). Some

of them sinned and were cast into Hell (Jude 6; II Pet. ii, 4). Those who remained faithful enjoy eternal beatitude (Matt. xviii, 10; Heb. xii, 22). They adore Jesus Christ, who is their head (Eph. i, 21; Phil. ii, 10).

Their duties with regard to men are to manifest and execute the divine will (Matt. i, 20 ff.; ii, 13, 20; Luke i, 11, 28), to offer up the prayers of the faithful and intercede for them (Rev. viii, 3), to incite men to good (Acts viii, 26), and to save them in peril (Acts xii, 7 ff.). Each child has its guardian angel (Matt. xviii, 10).

Satan, who in the Old Testament is a malevolent, superhuman being, distinct from the angels, in the New Testament is the chief of the fallen angels or demons (Matt. ix, 34). He is also called "the Devil" (*ὁ διάβολος*), "the accuser," "the calumniator" (Matt. iv, 1 ff.); hence Christians speak of his demons as devils.

The teaching of the Catholic Church is based on the scriptural data. It is defined that the angels were created in time; it is commonly held that they were created together with the material universe.

Some of the Church Fathers ascribed subtle or ethereal bodies to the angels, but it is now considered theologically certain that they are pure spirits.

Theologians teach that the angels were elevated to a supernatural state and that they had to pass through a period of probation before being admitted to the beatific vision of God. Some, how many is not known, sinned grievously during this period and were eternally damned. This is an article of faith. Their sin is generally thought to have been one of pride. It is considered certain that every man, even though he be unbaptized and a sinner or infidel, has his guardian angel. In accordance with the doctrine popularized by Pseudo-Dionysius, theologians commonly divide the angels into nine orders or choirs differing in rank. Beginning with the highest rank, they are: Seraphim, Cherubim, Thrones, Dominations, Virtues, Powers, Principalities, Archangels, Angels.

The angelology of the Old Testament cannot be dependent upon the Iranian, for the Amesha Spentas were originally personified divine attributes.

The angels of Islam are derived from Jewish and Christian sources. (See DEVIL.)

ANGEL, a gold coin, first used in France (*angelot*, *ange*) in 1340, and introduced into England by Edward IV. in 1465 as a new issue of the "noble," and so at first called the "angel-noble." It varied in value between that period and the time of Charles I. (when it was last coined) from 6s. 8d. to 10s. The name was derived from the representation it bore of St. Michael and the dragon.

The angel was the coin given to those who came to be touched for the disease known as king's evil; after it was no longer coined, medals, called touch-pieces, with the same device, were given instead.

ANGELFISH, the popular name for several widely differing species of fishes, including

(a) *Squatina squatina*, also called the monk fish, an Elasmobranch allied to the sharks and found in tropical and sub-tropical seas, including the Mediterranean. It takes its name from the large wing-like pectoral fins and reaches a length of 4 feet.

(b) In Bermuda, Chaetodont fishes of the genus *Holacanthus*, and especially *Angelichthys*; these fishes are laterally compressed and brilliantly coloured. They haunt coral reefs. *Angelichthys* may reach a weight of 4 lb. and are delicious eating.

Species of *Holacanthus* occur on the west coast of tropical America from Cape San Lucas to the Galapagos Islands, in the East Indies, Japan and Polynesia.

In this same family (Chaetodontidae) the genus *Pomacanthus*

is also known as the angelfish.

Chaetodipterus faber, sometimes called spadefish, is also known as the angelfish. It occurs from Cape Cod to Rio de Janeiro. A very similar species occurs on the west coast of Mexico.

ANGELICA, a large genus of aromatic herbs of the family Umbelliferae, represented in Britain by one species, *A. sylvestris*, a tall perennial herb with large bipinnate leaves and large compound umbels of white or purple flowers.

The most important species is the Eurasian *A. archangelica*, the roots and fruit of which yield angelica oil, while the tender shoots are used in making certain kinds of aromatic sweet-meats.

In the Faroe Islands and in Iceland, where the plant grows abundantly, it has been used as a vegetable.

Angelica oil is used for flavour liqueurs and in perfumery.

ANGELICO, FRA (1387-1455), Italian painter. Il Beato Fra Giovanni Angelico da Fiesole is the name given to a painter-friar of the Florentine state in the 15th century. His baptismal name was Guido, Giovanni being only his name in religion. He was born at Vicchio, Tuscany, of unknown but seemingly well-to-do parentage, in 1387 (not 1390, as sometimes stated); in 1407 he became a novice in the convent of S. Domenico at Fiesole, and in 1408 he took the vows and entered the Dominican order. Whether he had previously been a painter by profession is not certain, but probable. The painter named Lorenzo Monaco may have contributed to his art training, and the influence of the Sienese school is plainly discernible in his work. According to Vasari, the first paintings of this artist were in the Certosa of Florence; none exists there now.

His earliest extant performances, in considerable number, are at Cortona, where he was sent during his novitiate, and here apparently he spent the early years of his monastic life. His first works executed in fresco were probably those, now destroyed, which he painted in the convent of S. Domenico in this city; as a fresco-painter, he may have worked under or as a follower of Gherardo Starnina. From 1418 to 1436, he was back at Fiesole; in 1436 he was transferred to the Dominican convent of S. Marco in Florence, and in 1438 undertook to paint the altar-piece for the choir, followed by many other works; he may have studied about this time the renowned frescoes in the Brancacci chapel in the Florentine church of the Carmine and also the paintings of Orcagna. In or about 1446 he was invited by the Pope, Eugenius IV., to Rome. If the story (first told by Vasari) is true—that the archbishopric of Florence had been offered to himself, and by him declined on the ground of his inaptitude—Eugenius, and not (as stated by Vasari) his successor Nicholas V., must have been the Pope who made the offer to Fra Giovanni, for Nicholas only succeeded in 1447. Certain it is that Angelico was staying in Rome in the first half of 1447; and he painted in the Vatican the Cappella del Sacramento, which was afterwards demolished by Paul III. In June 1447 he proceeded to Orvieto, to paint in the Cappella Nuova of the cathedral, with the co-operation of his pupil Benozzo Gozzoli. He afterwards returned to Rome to paint the chapel of Nicholas V. In this capital he died in 1455, and he lies buried in the church of the Minerva. The tradition of his beatification is unfounded.

Fra Giovanni led a holy and self-denying life, shunning all advancement, and was a brother to the poor; no man ever saw him angered. He painted with unceasing diligence, treating none but sacred subjects; he never retouched or altered his work. He was wont to say that he who illustrates the acts of Christ should be with Christ. It is said that he never handled a brush without fervent prayer and he wept when he painted a Crucifixion. The Last Judgment and the Annunciation were two of the subjects he most frequently treated.

Bearing in mind the details already given as to the dates of Fra Giovanni's sojournings in various localities, the reader will be able to trace approximately the sequence of his works. In Florence, in the convent of S. Marco (now converted into a national museum) is a series of frescoes beginning towards 1443, all of which are later than the altar-piece which Angelico painted (as before mentioned) for the choir connected with this convent, and which is now in the academy of Florence. It represents the Virgin



BY COURTESY OF N.Y. ZOOLOGICAL SOCIETY
CHAETODIPTERUS FABER, AN ANGEL-FISH OF A GRAYISH COLOUR WHICH INHABITS THE WARMER COAST WATERS OF AMERICA

with SS. Cosmas and Damian (the patrons of the Medici family), Dominic, Peter, Francis, Mark, John the Evangelist and Stephen; the pediment illustrated the lives of Cosmas and Damian, but it has long been severed from the main subject. In the Uffizi gallery is an altar-piece, the Virgin (life-sized), enthroned with the Infant and 12 angels. In S. Domenico, Fiesole, there are a few frescoes, less fine than those in S. Marco; also an altar-piece in tempera of the Virgin and Child, now much destroyed. The subject which originally formed the predella of this picture has, since 1860, been in the National Gallery, London. The subject is a Glory, Christ with the banner of the Resurrection, and a multitude of saints, including, at the extremities, the saints or beati of the Dominican order; here are no fewer than 266 figures or portions of figures, many of them having names inscribed. This predella was highly lauded by Vasari; still more highly another picture which used to form an altar-piece in Fiesole, and is now in the Louvre—the "Coronation of the Virgin," with eight predella subjects of the miracles of St. Dominic. For the church of Santa Trinita, Florence, Angelico executed a "Deposition from the Cross" and for the church of the Angeli, a "Last Judgment," both now in the Florentine academy; for S. Maria Novella, a "Coronation of the Virgin," with a predella in three sections, now in the Uffizi—this again is one of his masterpieces. In Orvieto cathedral he painted three triangular divisions of the ceiling, all now much repainted and damaged. In Rome, in the Chapel of Nicholas V., he painted the acts of SS. Stephen and Lawrence, also various figures of saints, and on the ceiling the four evangelists. These works of the painter's advanced age, which have suffered somewhat from restorations, show vigour superior to that of his youth, along with a more adequate treatment of the architectural perspectives. It has often been said that he frequently practised as an illuminator; illuminations executed by Giovanni's brother, Benedetto, also a Dominican, who died in 1448, have probably been ascribed to the more famous artist. Benedetto may perhaps have assisted Giovanni in the frescoes at S. Marco, but nothing of the kind is distinctly traceable. A folio series of engravings from these paintings, was published in Florence in 1852. Along with Gozzoli already mentioned, Zanobi Strozzi and Gentile da Fabriano are named as pupils of the Beato.

For an appreciation of Fra Angelico's art we may quote Sir Charles Holmes (*The National Gallery, Italian Schools*): "One very great colourist, Fra Angelico, arrives before Masaccio, and outlives him. The legend of his saintly life, the happy serenity and simplicity of his temper, tend to distract our attention from his greatness as an artist. Not only does he possess a mastery of design which enables him to treat a large variety of subjects with almost invariable success, but when his theme gives him the necessary scope he attains, as in his "Transfiguration" at Florence, to a power and sublimity which have never been surpassed. He has much of Giotto's power of making his figures seem living and substantial. But above all, he is one of the world's great colourists, and the single painting by his hand which we possess in London will enable us to understand this side of his art in some measure. His other claims to greatness can be estimated only in Florence."

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ANGELL, GEORGE THORNDIKE (1823–1909), American philanthropist, was born at Southbridge (Mass.), on June 5, 1823. He graduated at Dartmouth in 1846, studied law at the Harvard Law school, and in 1851 was admitted to the bar in Boston, where he practised for many years. In 1868 he founded and became president of the Massachusetts Society for the Prevention of Cruelty to Animals, in the same year establishing and becoming editor of *Our Dumb Animals*, a journal for the promotion of organized effort in securing the humane treatment of animals. In 1882 he initiated the movement for the establishment of Bands of Mercy (for the promotion of humane treatment of animals), of which in 1908 there were more than 72,000 in active existence. In 1889 he founded and became president of the American Humane Education Society.

ANGELL, JAMES BURRILL (1829–1916), American educationalist and diplomat, was born in Scituate, R. I., on Jan. 7, 1829. He graduated in 1849 at Brown university, at which, after travel in Europe, he was professor of modern languages and literature in 1853–60. In 1860–66 he was editor of the Providence *Daily Journal*. From 1866 to 1870 he was president of the University of Vermont. In 1871 he became president of the University of Michigan, serving until 1909, when he was made president emeritus. Under his administration the institution was brought to high rank among American universities. He was United States minister to China in 1880–81, and to Turkey in 1897–98. Besides numerous contributions to periodicals, he published *Progress in International Law* (1875), the article "Diplomacy in the United States" in the *Narrative and Critical History of America* (1888), *Reminiscences* (1912) and *Selected Addresses* (1912). He died at Ann Arbor, Mich., on April 1, 1916.

ANGELL, JAMES ROWLAND (1869–1949), U.S. educationalist, was born at Burlington, Vt., May 8, 1869. He was a son of James Burrill Angell (1829–1916). In 1893 he was appointed instructor in philosophy at the University of Minnesota. In 1894 he was called to the University of Chicago as assistant professor of psychology and, after 1905, was professor and head of the department. He was dean of the university faculties after 1911, and acting president during 1918–19. In 1906 he was elected president of the American Psychological association, in 1914 exchange professor at the Sorbonne. In 1921 he was named president of Yale, resigning in 1937. His works include: *Psychology* (1904, rev. ed., 1908), *Chapters from Modern Psychology* (1911), *American Education* (1937). He died at Hamden, Conn., March 4, 1949.

ANGELL, SIR NORMAN (1874–), English author and publicist, was a prominent journalist, first in the U. S. A., and after his return in 1898, in England. In 1928 he invented "The Money Game," a card-game which taught the elements of economics, banking and currency. He was M. P. for North Bradford, 1929–31; and was knighted in 1931. He was awarded the Nobel Peace Prize for 1933. Among his publications are the widely known *The Great Illusion* (1910; new ed. 1933); *The Economic Chaos and the Peace Treaty* (1919); *The Unseen Assassins* (1932); and *Peace with the Dictators?* (1938).

ANGELUS, a Roman Catholic devotion in memory of the Annunciation. It consists of three texts (beginning "Angelus Domini nuntiavit Mariæ," hence the name), with three Ave Marias and a concluding versicle, response and prayer. It is recited three times daily, about 6 A.M., noon and 6 P.M., when the Angelus bell is rung. In a simpler form the devotion can be traced back (as an evening observance) to 1307.

See H. Thurston in *The Catholic Encyclopaedia*.

ANGELUS SILESIUS (1624–1677), German religious poet, was born in 1624 at Breslau, and died there on July 9, 1677. His family name was JOHANN SCHEFFLER, but he is generally known by the pseudonym Angelus Silesius, under which he published his poems and which marks the country of his birth. Brought up a Lutheran, and at first physician to the duke of Württemberg-Oels, he joined in 1652 the Roman Catholic Church, and in 1661 took orders as a priest and became coadjutor to the prince bishop of Breslau. In 1657 Silesius published under the title *Heilige Seelenlust, oder geistliche Hirtenlieder der in ihren Jesum verliebten Psyche* a collection of 205 hymns, the best of which have been adopted in the German Protestant hymnal. His most important work is *Geistreiche Sinn und Schlussreime* (1657), afterwards called *Cherubinischer Wandersmann* (1674). This is a collection of "Reimsprüche" or rhymed distichs embodying a mystical pantheism drawn mainly from the writings of Jakob Böhme and his followers.

BIBLIOGRAPHY.—A complete edition of Scheffler's works (*Sämtliche poetische Werke*) was published by D. A. Rosenthal (Regensburg, 1862). Both the *Cherubinischer Wandersmann* and *Heilige Seelenlust* have been republished by G. Ellinger (1895 and 1901), and a selection from the former work by O. E. Hartleben (1866). For further notices of Silesius' life and work, see Hoffmann von Fallersleben in *Weimarisches Jahrbuch I.* (Hanover, 1854); A. Kahler, *Angelus Silesius* (1853); C. Seltmann, *Angelus Silesius und seine Mystik* (1896), and a biog. by H. Mahn (Dresden, 1896).

ANGER is an emotion consisting of antagonistic, displeased, attacking feelings toward an offending person or thing. Some psychologists have attempted to distinguish anger from rage by supposing that true anger occurs only when the sex or love emotion is opposed, as in the sex combats of rival males among animals and human beings. It is said that anger, at such times, contains a self-abandonment never found in the rage accompanying struggles for food. In popular parlance, however, anger and rage are practically synonymous. This emotion has been found in the behaviour of very young infants (J. B. Watson). It occurs when the baby's spontaneous movements are hampered or interfered with by the experimenter, and is expressed by crying, holding the breath and thrashing wildly about with arms and legs. Experiments on animals (W. B. Cannon) also have shown that anger or rage causes increased secretion of adrenalin, with heightened blood pressure, dilation of the pupils of the eyes and increase of blood sugar. Experiments on adult human beings (W. M. Marston) have shown that anger is accompanied by increased systolic blood pressure, more rapid heart beat and quicker and more explosive responses to questions or association words. The behaviour of both animals and human beings, during anger, always shows a certain element of wildness, or lack of voluntary control. For this reason anger is psychologically defined (W. M. Marston) as an abnormal, conflict emotion, consisting of interrupted or thwarted dominance, aggressiveness or self-assertion.

See J. B. and R. R. Watson, "Studies in Infant Psychology," *Scientific Monthly* (1921); W. B. Cannon, *Bodily Changes in Pain, Hunger, Fear and Rage* (1920); W. M. Marston, "Sex Characteristics of Systolic Blood Pressure Behavior," *Journal Experimental Psychology* (1923); *The Emotions of Normal People* (1928).

(W. M. M.)

ANGERBURG, chief town of the south-western sub-division of the district of Gumbinnen, East Prussia. Pop. (1939) 10,998. It lies at the northern end of a long series of lakes, and serves as a road and rail centre. It makes small machinery and clay-products.

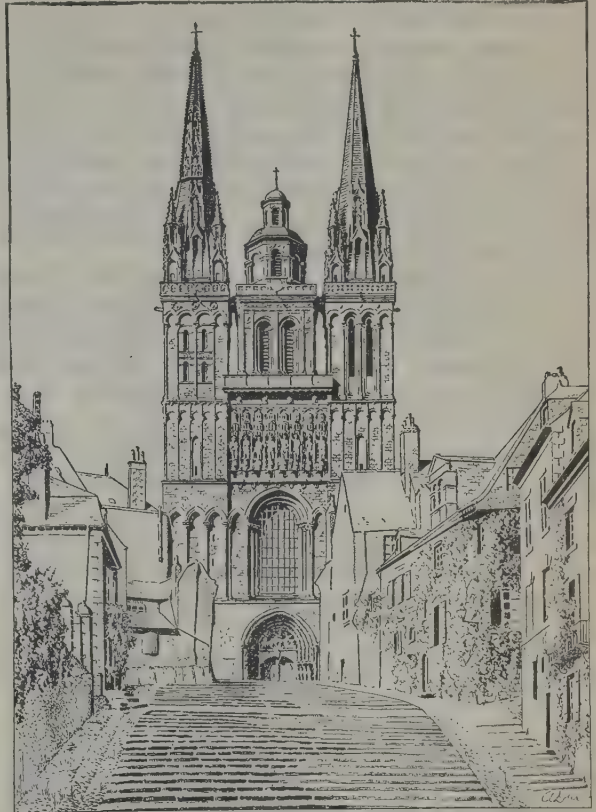
ANGERMÜNDE, a town of Germany in Brandenburg, on Lake Münde about 43 mi. from Berlin. Pop. (1933), 9,022. In 1420 the Elector Frederick I. of Brandenburg gained a victory here over the Pomeranians. The town is an important railway junction.

ANGERONA, a Roman goddess. According to ancient authorities, she relieved men from pain and sorrow, or delivered the Romans and their flocks from *angina* (quinsy); or she was the protecting goddess of Rome and the keeper of the sacred name of the city, which might not be pronounced lest it should be revealed to her enemies.

Modern scholars regard her as akin to Ops and Acca Larentia; or as the goddess of the new year and the returning sun. Her festival, called *Divalia* or *Angeronalia*, was celebrated Dec. 21. The priests offered sacrifice in the temple of Volupia, the goddess of pleasure, in which stood a statue of Angerona, with a finger on her mouth, which was bound and closed. She was worshipped as Ancharia at Faesulæ (*q.v.*), where an altar belonging to her has been discovered.

ANGERS, capital of the department of Maine-et-Loire, west France, 191 mi. S.W. of Paris by the Western railway to Nantes. Pop. (1936) 85,458. It occupies rising ground on both banks of the Maine, crossed by three bridges. The old town, on the left bank, is dominated by the cathedral and massive castle, and encircled by boulevards. On the right bank is the low-lying "Quartier de la Doutre." Angers is among the most handsome of French towns. Capital of the Gallic tribe of the Andegavi, it was known to the Romans as Juliomagus. During the 9th century it became the seat of the counts of Anjou. It suffered severely from the invasions of the Northmen after 845 and of the English in the 12th and 15th centuries; the Huguenots took it in 1585, and the Vendean royalists were repulsed near it in 1793. Till the Revolution, Angers had a celebrated university (14th century). The cathedral of St. Maurice (12th and 13th centuries) has an unusually high west front, with three towers. The incongruous central tower (16th century) has a series of eight warriors carved on its base. The vaulting of the interior takes the form

of a series of cupolas. There are rich stained-glass windows (12th and 16th centuries) and valuable tapestries (14th and 18th centuries). The adjoining bishop's palace contains a fine synodal hall (12th century). Other churches are St. Serge, an abbey-church (12th and 15th centuries), and La Trinité (12th century). The prefecture occupies the famous abbey of St. Aubin; the courtyard has elaborately sculptured arcades and there is a tower



WEST FAÇADE OF SAINT-MAURICE CATHEDRAL AT ANGERS, FRANCE, A FINE EXAMPLE OF 13TH CENTURY GOTHIC ARCHITECTURE

surviving from the abbey church (both of the 11th and 12th centuries). Ruins of the old churches of Toussaint (13th century) and Notre-Dame du Ronceray (11th century) are also to be seen. The castle of Angers (13th century), girt with towers and a moat, is now used as an armoury. The hospital of St. Jean (12th century) is occupied by an archaeological museum; and the Logis Barrault, a Renaissance house, contains the public library, the municipal museum with pictures and sculptures, and the Musée David, containing works by the famous native sculptor David d'Angers. The Hôtel de Pincé or d'Anjou (1523-30) is a fine stone mansion. Many wooden houses of the 15th and 16th centuries remain. Angers is the seat of a bishopric, dating from the 3rd century, a prefecture, a court of appeal and a court of assizes. It has a tribunal of first instance, a tribunal of commerce, a board of trade-arbitrators, a chamber of commerce, and several learned societies. The ancient university was resuscitated in 1875 as the "Université Catholique de l'Ouest." There are several free faculties (*facultés libres*). The prosperity of the town is largely due to the great slate-quarries in the vicinity (whence its old name Black Angers); other products are liqueurs (from fruit), cables, ropes, thread, boots and shoes. The weaving of sail-cloth and woollen and other fabrics, machine construction, nursery-gardening and the making of umbrellas are carried on. The chief articles of commerce, besides slate and French and Swedish iron goods, are hemp, early vegetables, fruit, flowers, wine, oil, leather and live stock. Angers is the ancient capital of Anjou, and its people are still known as Angevins.

ANGERSTEIN, JOHN JULIUS (1735–1823), London merchant and patron of the fine arts, was born at St. Petersburg, Russia, and settled in London, Eng., about 1749.

At the age of 21 he became an underwriter at Lloyd's and was soon recognized as an important authority in business and commerce. He was influential in establishing the Lloyd's insurance corporation, the successor of the institution at the "Old Lloyd's" coffee house. In 1774, under his guidance, Lloyd's moved to the Royal exchange, where it remained for more than a century and a half with the exception of the period necessary to rebuild after the fire of 1838. According to *Annual Biography and Obituary* (1824), "Great public good, as well as private advantage, resulted from his labours in this respect; for the magnitude and convenience of the new arrangement put an entire stop to the transaction of business in private offices scattered throughout the metropolis . . . In short, Lloyd's coffee house has ever since been a kind of empire within itself—an empire of almost incalculable resources." Policies approved by Angerstein soon had such great authority that they became known as "Julians."

During his business career, he was at various times the head of the largest firms in London. In spite of a great deal of opposition, he secured a loan of exchequer bills from the government in 1793 in order to avert a financial crisis. Parliament also adopted Angerstein's scheme of state lotteries. He was active as a philanthropist, and he played an important part in the re-establishment of the Veterinary college.

His collection of paintings, consisting of about 40 of the most exquisite specimens, purchased by the British government by a vote of £60,000, on his death, Jan. 22, 1823, formed the nucleus of the National gallery.

Angerstein was a great friend of Sir Thomas Lawrence, who helped him in the collection of his pictures and painted a portrait of him, which was given to the National gallery by William IV.

See Young's *Catalogue of the celebrated Collection of Pictures of the late John Julius Angerstein* (1823); also *Nat. Gal. Catalogue*, Introduction to Foreign Schools.

ANGILBERT (d. 814), Frankish Latin poet, and minister of Charlemagne, was of noble Frankish parentage, and educated at the palace school under Alcuin. He is said to have been the father of two children by Charlemagne's daughter, Bertha, one of them named Nithard. From 790 he was abbot of St. Riquier, and in 800 he accompanied Charlemagne to Rome, and was one of the witnesses to his will in 814. Angilbert's poems show the culture and tastes of a man of the world, enjoying the closest intimacy with the imperial family. He was called the "Homer" of the emperor's literary circle, and a fragment of an epic, ascribed, probably correctly, to him, and called by its editors "Charlemagne et le pape Léon" describes the life at the palace and the meeting between Charlemagne and Leo III. Of the shorter poems, besides the greetings to Pippin on his return from the campaign against the Avars (796), an epistle to David (Charlemagne) incidentally reveals a delightful picture of the poet living with his children in a house surrounded by pleasant gardens near the emperor's palace. The reference to Bertha, however, is distant and respectful, her name occurring merely on the list of princesses to whom he sends his salutation.

Angilbert's poems have been published by E. Dümmler in the *Monumenta Germaniae Historica*. For criticism of this edition see Traube in Roederer's *Schriften für germanische Philologie* (1888).

ANGINA PECTORIS, a term applied to a violent paroxysm of pain, arising almost invariably from disease of the coronary arteries with consequent degeneration of the heart muscle (see HEART, DISEASES OF THE). An attack of angina pectoris usually consists in a sudden agonizing pain, felt at first over the heart, but radiating through the chest in various directions, and frequently extending down the left arm. A feeling of constriction and of suffocation accompanies the pain, although there is seldom actual difficulty in breathing. When the attack comes on, as it often does, during bodily exertion, the sufferer is at once brought to rest. The countenance becomes pale, the surface of the body cold, the pulse feeble, and death appears to be imminent, when suddenly the attack subsides and complete relief is obtained. The

duration of a paroxysm rarely exceeds two or three minutes, but it may last longer. The attacks are apt to recur on slight exertion, and in aggravated cases without any such exciting cause. Occasionally the first seizure proves fatal. Angina pectoris is extremely rare under middle life, and is much more common in males than in females.

ANGIOSPERMS. The botanical term angiosperm (*ἀγγεῖον*, receptacle, and *σπέρμα*, seed) was coined in the form Angiospermae by Paul Hermann in 1690, as the name of that one of his primary divisions of the plant kingdom which included flowering plants possessing seeds enclosed in capsules, in contradistinction to his Gymnospermae, or flowering plants with fruits containing only one seed or dividing into distinct one-seeded portions—the whole fruit or each of its pieces being here regarded as a naked seed. These terms were maintained by Linnaeus with the same sense, but with restricted application, in the names of the orders of his class Didynamia. Their use with any approach to their modern scope became possible only after Robert Brown had established in 1827 the existence of truly naked seeds in the cycads and conifers, entitling them to be correctly called gymnosperms. From that time onward, so long as these gymnosperms were, as was usual, reckoned as dicotyledonous flowering plants, the term angiosperm was used antithetically by botanical writers, but with varying limitation, as a group-name for other dicotyledonous plants. Wilhelm Hofmeister's brilliant discovery in 1851 of the changes occurring in the embryo-sac of flowering plants, and his determination of the correct relationships of these with the cryptogams (non-flowering plants), fixed the true position of gymnosperms as a class distinct from dicotyledons, and the term angiosperm then gradually came to be accepted as the suitable designation for the whole of the flowering plants other than gymnosperms, and as including, therefore, the classes of dicotyledons and monocotyledons. This is the sense in which the term is used in this article. The trend of the evolution of the plant kingdom has been in the direction of the establishment of a vegetation of fixed habit and adapted to life on land, and the angiosperms are the highest expression of this evolution and constitute the dominant vegetation of the earth's surface at the present epoch. There is no land area, from the poles to the equator, where plant-life is possible, upon which angiosperms are not found. They occur also abundantly in the shallows of rivers and fresh-water lakes, and in less numbers in salt lakes and in the sea, such aquatic angiosperms are not, however, primitive forms, but are derived from immediate land-ancestors. Associated with this diversity of habitat is great variety in general form and manner of growth. The familiar duckweed which covers the surface of a pond consists of a tiny green thalloid shoot, one, that is, which shows no distinction of parts—stem and leaf, and a simple root growing vertically downward into the water. The great forest-tree has a shoot, which in the course perhaps of hundreds of years has developed a wide-spreading system of trunk and branches, bearing on the ultimate twigs or branchlets innumerable leaves, while beneath the soil a widely branching root-system covers an area of corresponding extent. Between these two extremes is every conceivable gradation, embracing aquatic and terrestrial herbs, creeping, erect or climbing in habit, shrubs and trees, and representing a much greater variety than is to be found in the other subdivision of seed-plants, the gymnosperms.

Internal Structure.—In internal structure also the variety of tissue-formation far exceeds that found in gymnosperms (see PLANTS AND PLANT SCIENCE: *Anatomy*). The vascular bundles of the stem belong to the collateral type, that is, the elements of the wood or xylem and the bast or phloem stand side by side on the same radius.

In the larger of the two great groups into which the angiosperms are divided, the dicotyledons, the bundles in the very young stems are arranged in an open ring, separating a central pith from an outer cortex. In each bundle, separating the xylem and phloem, is a layer of meristem or active formative tissue, known as cambium; by the formation of a layer of cambium, between the bundles (interfascicular cambium) a complete ring is formed, and a regular periodical increase in thickness results

from it by the development of xylem on the inside and phloem on the outside. The soft phloem soon becomes crushed, but the hard wood persists and forms the great bulk of the stem and branches of the woody perennial. Owing to differences in the character of the elements produced at the beginning and end of the season, the wood is marked out in transverse section into concentric rings, one for each season of growth—the so-called annual rings. In the smaller group, the monocotyledons, the bundles are more numerous in the young stem and scattered through the ground tissue. Moreover, they contain no cambium and the stem, once formed, increases in diameter only in exceptional cases.

Vegetative Organs.—As in the gymnosperms, branching is monopodial, that is, a branch is always developed below the apex of the growing point of the stem or root; dichotomy, or the forking of the growing point into two equivalent branches which replace the main stem, is absent in the case of both the stem and the root. The leaves show a remarkable variety in form (*see LEAF*), but are generally small in comparison with the size of the plant; exceptions occur in some monocotyledons, *e.g.*, in the Aroid family, where, in some genera the plant produces one huge, much-branched leaf each season, or in palms, where the unbranched stem bears a crown of large leaves.

In rare cases the main axis is unbranched and ends in a flower, as, for instance, in the tulip, where scale-leaves, forming the underground bulb, green foliage leaves and coloured floral leaves are borne on one and the same axis. Generally, flowers are formed only on shoots of a higher order, often only on the ultimate branches of a much-branched system. A potential branch or bud, either foliage or flower, is formed in the axil of each leaf; sometimes more than one bud arises, as for instance in the walnut, where two or three stand in vertical series above each leaf. Many of the buds remain dormant, or are called to development under exceptional circumstances, such as the destruction of existing branches. For instance, the clipping of a hedge or the lopping of a tree will cause to develop numerous buds which may have been dormant for years. Leaf-buds occasionally arise from the roots, when they are called adventitious; this occurs in many fruit trees, poplars, elms and others. For instance, the young shoots seen springing from the ground around a cottonwood are not seedlings but root-shoots. Frequently, as in many dicotyledons, the primary root, the original root of the seedling, persists throughout the life of the plant, forming, as often in biennials, a thickened tap-root, as in carrot, or in perennials, a much-branched root system. In many dicotyledons and most monocotyledons, the primary root soon perishes and its place is taken by adventitious roots developed from the stem.

Flower.—The most characteristic feature of the angiosperm is the flower, which shows remarkable variety in form and elaboration and supplies the most trustworthy characters for the distinction of the orders and families into which the group is divided. The flower is a stem, or terminal portion of a stem, which bears sporophylls. Except where it is terminal it arises, like the leaf-shoot, in the axil of a leaf, which is then known as a bract. Occasionally, as in the violet, a flower arises singly in the axil of an ordinary foliage leaf; it is then termed axillary. Generally, however, the flower-bearing portion of the plant is sharply distinguished from the foliage-leaf-bearing or vegetative portion and forms a more or less elaborate branch system in which the bracts are small and scale-like. Such a branch system is called an inflorescence. The primary function of the flower is to bear the spores (minute one-celled reproductive organs). These, as in gymnosperms, are of two kinds—microspores, borne in the stamens (or microsporophylls), and megaspores, contained in the ovule, which is borne enclosed in the carpel (or megasporophyll). The flower may consist only of spore-bearing leaves, as in the willow, where each flower comprises only a few stamens or two carpels. Usually, however, other leaves are present which are only indirectly concerned with the reproductive process, acting as protective organs for the sporophylls or forming an attractive envelope. These form the perianth and are in one series, when the flower is termed monochlamydeous, or in two series (dichlamydeous). In the second case the outer series (calyx of sepals) is generally green and leaf-like, its func-

tion being to protect the rest of the flower, especially in the bud; while the inner series (corolla of petals) is generally white or brightly coloured, and more delicate in structure, its function being to attract the particular insect or bird by agency of which transference of pollen (pollination) is effected. The insect, or bird, is attracted by the colour and scent of the flower and frequently also by nectar, which is secreted in some part of the flower. (For further details on the form and arrangement of the flower and its parts, *see FLOWER*.)

Stamen and Pollen.—Each stamen (microsporophyll) consists generally of a more or less elongated filament which bears at its apex an enlarged, lobed anther, usually containing four pollen sacs (microsporangia). The development of the microsporangia of angiosperms is closely comparable with that of the microsporangia in gymnosperms. In each microsporangium a number of microspore mother cells are produced, each of which, after two successive divisions of its nucleus (reduction divisions), divides to form four microspores, each with one-half the number of chromosomes found in the cells of the maternal tissue. During the course of the first division the homologous chromosomes pair and each member of the bivalent pair is split longitudinally so that for a time tetrads are formed consisting of four chromatids. Exchange of portions of the chromatids may now take place. Later the members of each tetrad separate, two of the daughter chromosomes going to each pole of the first meiotic spindle. At the next division these pairs of daughter chromosomes disjoin and each passes to a new daughter cell (spore), so that from one original cell with chromosome pairs, four cells (spores) are derived with the haploid number of chromosomes. This chromosomal mechanism provides the necessary basis for the segregation of genetic factors, and therein lies the explanation of Mendelian segregation. The development of the microspore into a microgametophyte (pollen grain) begins while the microspore is still within the pollen sac, and the mature pollen grain, when liberated, usually consists of two cells, a tube and a generative cell. The pollen is set free by the opening (dehiscence) of the anther, generally by means of longitudinal slits, as in the lily, but sometimes by terminal pores, as in the potato, or by valves, as in the barberry. The mature pollen grain has, except in the case of some submerged aquatic plants, a double wall, a thin, delicate wall of unaltered cellulose, the intine layer, and a tough outer cuticularized exine layer. The exine layer often bears spines or warts or is variously sculptured, and the character of the markings is frequently of value for the distinction of genera or higher groups.

Pistil and Megagametophyte.—The carpel (megasporophyll) or aggregate of carpels forming the pistil or gynaecium consists of a basal ovary containing one or more ovules, a more or less elongated portion, the style, and at the apex or along the side of the style a receptive surface or stigma. The ovules within the ovary are borne on a placenta, which is generally some part of the ovary wall. The development of the ovule (megasporangium) is very similar to the process in gymnosperms. When mature the ovule consists of one or two coats (integuments) surrounding the central nucellus except at the apex, where an opening, the micropyle, is left. Each ovule is borne on a distinct stalk, the funiculus. Embedded in the nucellus opposite the micropyle the megaspore mother cell is differentiated. The development of this cell varies from genus to genus; most commonly two divisions (the reduction divisions) take place and an axial row of four megaspores is formed. One megaspore, usually the one farthest from the micropyle, develops into the megagametophyte (the so-called embryo sac), and the other three spores disintegrate. The megaspore enlarges and by three repeated divisions of its nucleus eight nuclei are formed which are arranged in two groups of four, one at each end of the megagametophyte. One nucleus from each group, the polar nucleus, passes to the centre of the sac, where they come to lie side by side. The three remaining nuclei at each end of the megagametophyte become invested in cell walls, so that a seven-celled, eight-nucleate structure is formed. Of the three cells at the micropylar end of the gametophyte (the so-called egg apparatus), one is the egg and the other two are known as synergids. The three cells at the opposite end are

known as antipodal cells and the large central binucleate cell is the primary endosperm cell. The gametophytes or prothallial generations in the angiosperms are thus extremely reduced. The angiosperm ovule is characteristically low in food reserves at maturity, in contrast with the considerable storage commonly occurring in the gymnosperms.

Pollination and Fertilization.—The pollen at the time of dehiscence of the anther is dropped or carried by some external agent such as wind, water or some member of the animal kingdom on to the receptive surface (stigma) of the carpel of the same or another flower. In many species of plants varying devices are provided which favour cross pollination, such as a wide difference in the length of styles and stamens, a differential maturity of these two structures within the same flower and the occurrence of dioecious species. The floral parts of some plants are so arranged that the presence of certain insects is essential for successful pollination. The pollen germinates on the stigma and puts forth a pollen tube which grows down the tissue of the style to the ovary and makes its way along the placenta to the micropyle of the ovule. The nucleus of the tube cell has meanwhile migrated into the growing end of the tube and remains there throughout the entire growth of the tube, from stigma to ovule. The generative cell in some species divides to form two male gametes prior to the liberation of the pollen grain from the pollen sac; usually, however, this cell moves into the tube and there divides to form the two male gametes. The male cells are carried to their destination in the tip of the pollen tube, which enters the micropyle, penetrates the megagametophyte, enlarges somewhat and the two male gametes are discharged into the megagametophyte. One male cell passes into the egg, with which it fuses, the two nuclei uniting to form a zygote. The second male gamete enters the primary endosperm cell and its nucleus conjugates with the polar-fusion nucleus to form the primary endosperm nucleus. The time elapsing between pollination and the union of the gametes varies greatly in the different species, ranging from one to two hours in some of the grasses to about 14 months in certain of the oaks. The fertilized endosperm cell rapidly develops into a temporary or permanent tissue, endosperm, which supplies nourishment for the use of the embryo. The zygote by a process of growth forms the embryo of the new plant.

Participation of a male nucleus in the triple fusion giving rise to the primary endosperm nucleus, an event peculiar to the flowering plants, is significant in relation to the circumstances under which the endosperm functions as an auxiliary tissue in nourishing the embryo.

We can recognize, therefore, two products of fertilization: one, the embryo, which becomes the future plant; the other, the endosperm, usually a short-lived nurse tissue assisting in the nutrition of the former. The endosperm, like the embryo, being the product of a sexual act, gives on cross-fertilization a hybrid endosperm, and herein we have the explanation of the phenomenon of *xenia*, which is the direct effect of the male gamete on tissues other than the embryo. The antipodal cells aid more or less in the nutrition of the developing megagametophyte and the embryo and may undergo some multiplication, though they ultimately disintegrate, as do also the synergids. As in the gymnosperms and other groups, an interesting and quantitative change is associated with the process of fertilization. The number of chromosomes (*see* CYTOLOGY) in the nuclei of the spores and in the nuclei of the respective types of gametophytes developed from the spores, pollen grain and megagametophyte is only half the number found in an ordinary vegetative nucleus. The full number is restored in the fusion of the male and female gamete nuclei in the zygote and remains until the formation of the cells from which the spores are derived in the new generation. The number of chromosomes in the nuclei of the endosperm is three times the number found in the spores.

The above is a general account representing the usual sequence of events, but various departures have been noted. Thus in the families *Fagaceae*, *Rosaceae*, *Compositae* and others a number of megaspore mother cells may be differentiated within a single

ovule, several of which may pass through the reduction divisions, and even a surplus of megagametophytes may be initiated, but usually only one develops to maturity. In some instances the pollen tube does not enter by means of the micropyle but, passing along the ovary wall and through the placenta, enters at the opposite or chalazal end of the ovule. Such a method of entrance is styled chalazogamic in contrast to porogamic, or ordinary method of approach by means of the micropyle.

Development of Seed and Fruit.—Fertilization furnishes the initial stimulus for the transformation of the ovule into the seed. The ovule grows rapidly and the primary endosperm cell increases greatly in size. Growth of this cell is accompanied by division of the fusion nucleus consisting of the two polar nuclei and the male gamete nucleus and repeated division of the nuclei derived from it. Cell division is initiated in the region of the developing embryo and proceeds until the endosperm becomes a many-celled tissue. In numerous species the endosperm is cellular from the beginning. The function of the endosperm is primarily that of nourishing the growing embryo and its duration varies with the precocity of the embryo. It may be wholly absorbed by the progressive growth of the embryo or it may persist as a definite and more or less conspicuous constituent of the seed.

During the course of the early development of the endosperm a short row of cells (the proembryo) is formed from the zygote, the basal cell retaining the position of the zygote and the rest of the proembryo being projected into the developing endosperm. Most of the embryo in the dicotyledons develops from the apical cell of the proembryo and the remaining cells constitute the suspensor. The embryo becomes a multicellular structure which is eventually differentiated into two cotyledons, an epicotyl and a hypocotyl, as in *Capsella*, which give rise respectively to the primary stem and primary root, and the root cap is formed from the adjacent suspensor cells. There are, however, many dicotyledons where more than the apical cell of the proembryo enters into the development of the embryo. As the embryo approaches maturity, its cells, especially those of the cotyledons, become filled with reserve foods, as in the bean. In many monocotyledons the proembryo consists of an axial row of three cells. The basal cell is much enlarged and does not divide further, the middle cell by division and growth develops into a suspensor, a hypocotyl and a lateral epicotyl and the terminal cell develops into a single apical cotyledon, as in *Sagittaria*. In some monocotyledons the cotyledon is not really terminal. The hypocotyl in all angiosperms points toward the micropyle. The developing embryo at the end of the suspensor is closely associated with the forming endosperm, from which, by surface absorption, it derives food material for growth; at the same time the suspensor may play a direct part as a carrier of nutritive material, developing, where little or no endosperm is formed, into a haustorial root-like structure which passes out into the body and coats of the ovule and even into the placenta. In some cases cells of the megagametophyte, either synergids or antipodals, enlarge and become haustoria-like structures which penetrate the immediately adjacent maternal tissue, where they absorb nutritive materials for the growth of endosperm and embryo. As the embryo develops it may absorb all the food material available and store that portion which is not immediately required for growth as reserve food for use during germination and early seedling development and by so doing increase in size until it occupies completely the space within the integuments, or its absorptive power at this stage may be limited to what is necessary for growth, when it would remain of relatively small size, the larger portion of the seed being filled with endosperm in which the reserve food is stored. There are also intermediate states. The position of the embryo in relation to the endosperm varies: sometimes it is buried within the endosperm and in other species it lies on the surface of the endosperm, but the significance of this has not yet been established. When the endosperm persists as a massive element of the seed, its nutritive function is usually apparent, for there is accumulated within its cells reserve food and according to the dominant substance it is starchy, oily or rich in cellulose mucilage or protein.

Many deviations from the usual course of development may be noted. Often there is no sexual fusion, in which case the reproductive process is referred to as apomixis, of which there are three principal forms: (1) parthenogenesis, or the development of an embryo from an unfertilized egg, (2) apogamy, or the development of the embryo from a cell or cells of the megagametophyte other than the egg and

(3) vegetative budding, or the development of an embryo from a cell of the maternal tissue adjacent to the megagametophyte. In certain species of *Antennaria*, *Alchemilla* and *Taraxacum* the megagametophyte develops from a cell with the zygotic number of chromosomes and the egg does not require fertilization for further development. Occasionally the egg from a gametophyte with the reduced number of chromosomes may be stimulated to develop into a haploid plant, as in *Datura*, *Nicotiana* and others. Vegetative budding wherein the embryo arises from a maternal cell adjacent to the megagametophyte occurs in species of *Alchemilla*, *Citrus* and *Potentilla*. Polyembryony is generally associated with development of cells other than the egg cell. Thus, in *Erythronium*, *Tulipa*, *Lobelia* and others plural embryos arise from the same portion of the proembryo. Isolated cases show that any of the cells within the megagametophyte may exceptionally form an embryo; e.g., the synergids in *Mimosa*, *Iris*, *Lilium*, *Nicotiana* and *Allium* and in the latter the antipodal cells also. In the angiosperms, plural embryos arising from the adjacent maternal tissues appear to be more limited in distribution than other types of polyembryony. When it occurs, however, the frequency of plural embryos is extremely high. Nearly every seed is polyembryonate in certain varieties of *Citrus*. Embryos developing from the egg cell, synergids, antipodal cells and cells of the nucellus have been found in the same individual of a species of *Allium*. On the other hand in *Trillium* embryos are derived from the endosperm nucleus but in this case neither the egg nor the endosperm nucleus is fertilized, so that haploid embryos are derived parthenogenetically and the diploid embryos apogamously. The number of triploid embryos in conjunction with haploids and diploids found in numerous species of the Gramineae, *Pyrus* and *Nicotiana* indicates the possibility that embryos may be derived from the fertilized endosperm. The great diversity of these abnormal cases as shown in the examples cited suggests the use of much caution in formulating definite morphological theories upon them.

During the course of development of embryo and endosperm the nucellus, which likewise is enlarging, is commonly absorbed to near its outer limit and that portion remaining combines with the integument(s) to form the seed coat or the whole nucellus and even the integuments may be absorbed. In a few plants the nucellus is not thus absorbed but itself becomes a seat of deposit of reserve-foods constituting the perisperm, which may coexist with the endosperm, as in the water-lily family (Nymphaeaceae), or may alone store a food reserve for the embryo, as in *Canna*. Seed in which endosperm or perisperm, or both, exist are commonly termed albuminous or endospermic; those in which neither are found are termed exalbuminous or exendospermic. The presence or absence of endosperm, its relative amount when present and the position of the embryo in relation to it are valuable characters for the distinction of families and orders or groups of families. Meanwhile the ovary wall has developed to form the fruit or pericarp, the structure of which is closely associated with the manner of distribution of the seed. Frequently the influence of fertilization is felt beyond the ovary, and other parts of the flower take part in the formation of the fruit, as the floral receptacle in the apple, strawberry and others. The character of the seed-coat bears a definite relation to that of the fruit. Its function is the twofold one of protecting the embryo and of aiding in dissemination; it may also directly promote germination. If the fruit is a dehiscent one and the seed is, therefore, soon exposed, the seed-coat has to provide for the protection of the embryo and may also have to secure dissemination. On the other hand, indehiscent fruits discharge these functions for the embryo, and the seed-coat is only slightly developed.

Dissemination.—Dissemination is effected by an explosive mechanism resident in the fruit or seed, or by aid of some external agency—water, air or animals. The need for this is obvious—buoyancy in water and resistance to wetting for the first, some sort of parachute for the second and some attaching mechanism or attractive structure for the third. The methods in which these are provided are of infinite variety, and any and every part of the flower and of the inflorescence may be called into requisition to supply the adaptation (see FRUIT). Special outgrowths, arils, of the seed-coat are of frequent occurrence. In the feature of the fruit and seed, by which the distribution of angiosperms is effected, there is a distinctive character of class. In gymnosperms there are seeds, and the carpels may become modified and close around these, as in *Pinus*, during the process of ripening, to form an imitation of a box-like fruit which, subsequently opening, allows the seeds to escape; but there is never in them the closed ovary investing the ovules from the outset and ultimately forming the groundwork of the fruit.

Germination of Seed.—Their fortuitous dissemination does not always bring seeds into a suitable environment for germination, the first need for which is a sufficiency of moisture. The duration of vitality of the embryo is a point of interest since some seeds retain vitality for a period of many years, though there is no warrant for the popular notion that genuine "mummy wheat" will germinate, and on the other hand some seeds lose vitality in a very short time. Further, the older the seed the slower as a general rule will germination be in starting; but there are notable exceptions. This pause, often of so long duration, in the growth of the embryo between the time of its perfect development within the seed and the moment of germination, is one of the remarkable and distinctive features of the

life of seed-plants (spermatophytes). The aim of germination is the fixing of the embryo in the soil, effected usually by means of the root, which is the first part of the embryo to appear, in preparation for the elongation of the portion of the shoot above the cotyledons (*epicotyl*), and there is infinite variety in the details of the process. In endospermic dicotyledons the cotyledons act as the absorbents of the reserve-food of the seed and are commonly brought above ground (*epigeal*), either withdrawn from the seed-coat or carrying it upon them, and then they serve as the first green organs of the plant. The part of the stem below the cotyledons (*hypocotyl*) commonly plays the greater part in bringing this about. Exendospermic dicotyledons usually store reserve-food in their cotyledons, which may in germination remain below ground (*hypogeal*). In endospermic monocotyledons the cotyledon itself, probably in consequence of its terminal position, is commonly the agent by which the embryo is thrust out of the seed, and it may function solely as a feeder, its extremity developing as a sucker through which the endosperm is absorbed, or it may become the first green organ, the terminal sucker dropping off with the seed-coat when the endosperm is exhausted. Exendospermic monocotyledons are either hydrophytes or strongly hygrophilous plants and have often peculiar features in germination.

Vegetative Reproduction.—Distribution by seed appears to satisfy so well the requirements of angiosperms that distribution by vegetative buds is only an occasional process. At the same time every bud on a shoot has the capacity to form a new plant if placed in suitable conditions, as the horticultural practice of propagation by cuttings shows; in nature we see plants spreading by the rooting of their shoots, and buds we know may be freely formed not only on stems but on leaves and on roots. Where detachable buds are produced, which can be transported through the air to a distance, each of them is an incipient shoot which may have a root, and there is always reserve-food stored in some part of it. In essentials such a bud resembles a seed. A relation between such vegetative distribution buds and production of flower is usually marked. Where there is free formation of buds there is little flower and commonly no seed, and the converse is also the case.

In some plants the young bud or a portion of the flower is replaced by a minute plantlet which develops *in situ* and separates from the plant when it is able to maintain an independent existence. This occurs in some grasses, certain species of *Allium* and other species living in arctic or other situations where the normal course of seed development as a result of fertilization is uncertain. Viviparous plants are those wherein germination or sprouting of the seed or bud occurs while still attached to the parent plant.

Phylogeny and Taxonomy.—Reference is made in the general article BOTANY to early systems of classification and to the evolution of the idea of a natural system in which families were grouped according to their affinities. This found expression in British botany in the system elaborated by George Bentham and Joseph Hooker in the *Genera Plantarum* (1862-1883), in which all known genera of flowering plants were described and arranged in families and higher groups. The system was based on that of the De Candelles and has been widely used in Great Britain and America. It will illustrate the principles of a system which, without claiming to be phylogenetic, represents in the sequence adopted a progression from simpler to more advanced families. The families of the two great divisions, dicotyledons and monocotyledons, are grouped in cohorts (or series); those of the dicotyledons are arranged in three subdivisions: Polypetalae, where the petals are free from each other, Gamopetalae, with a corolla of united petals, and Monchlamydeae, without a corolla, and where the flower often consists merely of the reproductive organs. (See the article FLOWER for illustrations.) In the first two subdivisions the cohorts are arranged in a progressive series according to the relative position of the gynaeceum and the other floral whorls; in the simplest forms sepals, petals and stamens stand below the carpels on the floral axis (*i.e.*, are hypogynous), while in the most advanced they spring from the top of the ovary (*i.e.*, are epigynous). Diminution of the number of parts in the flower is also an indication of an advance, especially the number of carpels, which in the most advanced members of each subdivision is reduced to two. A spiral arrangement of the floral leaves is also more primitive than a whorl; and a regular flower, that is, one showing a radial structure, than one which is symmetrical only about one plane. To some extent also a woody habit indicates less advance than an herbaceous.

A great drawback to the value of this system is the inclusion among the Monchlamydeae of a number of families which are closely allied with families of Polypetalae though differing in absence of a corolla. The German systematist, A. W. Eichler, attempted to remove this disadvantage which since the time of Jussieu had characterized the French system, and in 1883 grouped the dicotyledons in two subclasses. The earlier subclass, Choripetalae, embraces the Polypetalae and Monchlamydeae of the French and English systems and is an attempt to arrange as far as possible in a linear series those families which are characterized by absence or freedom of petals. A modification of Eichler's system, embracing more recent views of the affinities of the families of angiosperms, has been put forward by Dr. Adolf Engler of Berlin, who adopts the suggestive names Archichlamydeae and Metachlamydeae for the two subdivisions of dicotyledons. Engler regarded his system as phylogenetic: simplicity of floral struc-

ture was considered primitive and the earlier orders (as groups of families are now termed) in his system are thus characterized. But he recognized that a simple type of flower may also appear in an advanced group and is then obviously derived; and many botanists would regard all families characterized by simple flowers as derived from more advanced forms.

Divergent views as to the origin of the angiosperms have some bearing on this problem. The sudden appearance of angiosperms as a well developed and widely distributed group of plants in the lower Cretaceous period, with the leaves and fruits resembling those of modern families and genera, gives little clue to the early history of the group.

The great antiquity of the gymnosperms has suggested that the origin of the angiosperms should be sought within it. Certain investigators have sought to derive a simple flower from an ancestor resembling *Ephedra* (Gnetaceae) and regard the simple flower as primitive in the angiosperms. Another group of investigators considers the extinct Mesozoic Cycadeoidea, a group allied to the cycads, as the nearest approach known to ancestral angiosperm stock. The "flower" of Bennettites (see PALAEOBOTANY), which has an elongated axis bearing sterile leaves below and micro- and megasporophylls above, is regarded as the forerunner of the angiosperm flower as exhibited, for instance, in Magnolia, a perfect bisexual flower with free sepals, petals, stamens and carpels following in spiral succession on an elongated floral receptacle. According to this viewpoint this type of flower would represent the starting point of a phylogenetic system of classification of angiosperms.

During the course of such studies an attempt has been made to trace the origin of the angiosperms backward from the living forms to such fossil remains as resemble them. The trend has been to study the oldest known seed plants and then to try to trace the general pathways of evolutionary change accomplished by the passage of time. The results of such studies lead to the conclusion that the angiosperms are of much earlier origin than has heretofore been suggested. Undoubtedly a vast number of forms must have arisen and become extinct in the course of evolution of the group and among these may be some, of which certain of the existing simple-flowered groups are surviving representatives. It is probably true that the immediate ancestral forms of existing angiosperms are not yet known or have not been recognized as such.

The relation of the two divisions, dicotyledons and monocotyledons, has also been much debated. Had each group a separate origin or has one been derived from the other? Botanists who uphold the Bennettites ancestry of dicotyledons would derive the monocotyledons from the base of the dicotyledonous stock. On the other hand strong arguments have been adduced in favour of its distinct origin, the two divisions representing parallel development.

A phylogenetic system based on the reaction to serum of members of the various families has also been developed. It seems difficult, however, to give protein characters any higher taxonomic value than other characters, since it has been shown that the same reactive substance may occur in very distantly related families.

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ANGKOR, an assemblage of ruins in Cambodia (*q.v.*), the relic of the ancient Khmer civilization. They are in forests to the north of the Great lake (Tonlé-Sap), the most conspicuous of the remains being the town of Angkor Thom and the temple of Angkor Vat, both of which lie on the right bank of the river Siem-Reap, a tributary of the Tonlé-Sap. Other remains of the same character lie scattered about the vicinity on both banks of the river. It has been decided to enclose them in a park.

Angkor Thom, according to Aymonier, was begun about A.D. 860 and finished toward A.D. 900. Within a rectangular enclosure, nearly 2 mi. in each direction, which is entered by five monumental gates, are the remains of palaces and temples, overgrown by the forest. The chief of these are: (1) the vestiges of the royal palace and the pyramidal religious structure known as the Phimeanakas, both of which stood within an enclosure to the east of which extends a terrace decorated with magnificent reliefs; (2)

the temple of Bayon, consisting of a double system of galleries enclosing a cruciform structure, at the centre of which rises a huge tower with a circular base. Fifty towers, decorated with quadruple faces of Brahma, are built at intervals upon the galleries, the whole temple ranking as perhaps the most remarkable of the Khmer remains. Angkor Thom became the capital city of the Khmers at least as early as A.D. 890. The size and magnificence of the ruins suggest a larger population than Cambodia has today. Rice from the fertile, monsoon-watered plains, plus fish from the Great lake, supported the population then as now. The city was pillaged and largely destroyed by armies of the king of Ayuthia (Thailand) in 1431, never to regain its past importance.

Angkor Vat, the best preserved example of Khmer architecture, lies less than a mile to the south of the royal city, within a park surrounded by a moat, the outer perimeter of which measures 6,000 yards. Although sometimes said to have been devoted to the worship of Brahma, the French school of the far east now thinks that the temple was consecrated to the worship of Buddha. It consists of three stages, connected by exterior staircases and decreasing in dimensions as they rise, culminating in the sanctuary, a great central tower pyramidal in form. Three galleries with vaulting supported on columns lead from the three western portals to the second stage. They are connected by a transverse gallery thus forming four square basins. Khmer decoration, profuse but harmonious, consists chiefly in the representation of gods, men and animals, which are displayed on every flat surface. Combats and legendary episodes are often depicted; floral decoration is reserved chiefly for borders, mouldings and capitals. Sandstone of various colours was the chief material employed by the Khmers, without the use of cement; limonite was also used.

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ANGLE, in plane geometry, a figure formed by two lines which meet. The point of meeting is called the *vertex* of the angle. The original idea has been extended to include the figure formed by a plane and a line which meets it, by two intersecting planes (a *dihedral angle*), by three planes having a common point (a



FIG. 1.—ACUTE, OBTUSE AND REFLEX ANGLES

trihedral angle), by any number of planes having a common point (a *polyhedral angle*), or by two intersecting curves (a *curvilinear angle*). The angle in the last case is measured by the angle formed by tangents to the curves at their common point; it may also be formed by a curve and a straight line (*mixed angle*). The concept has also been extended to include the case of two lines in space

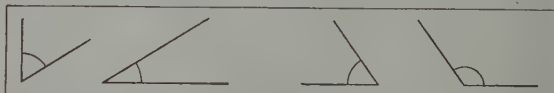


FIG. 2.—TWO COMPLEMENTARY AND TWO SUPPLEMENTARY ANGLES

that are not parallel and yet do not meet, like the upper edge of a box and a lower non-parallel one (*skew angle*). There are also *spherical angles*, formed by the intersection of two great circles of a sphere. An angle is measured by the amount of turning necessary to bring one of the lines (arms, sides, legs) into coincidence with the other, this being measured on a circle with its vertex (from Lat. *vertere*, to turn) at the centre.

The early idea of angle limited the concept to an angle less than 180°. The demands of science lead modern writers to speak of a *straight angle* (180°), a *reflex angle*, and of angles exceeding 360°, as in speaking of an angle arising from turning a radius



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OCEANIC ANGLER FISHES (CERATIOIDS)

1. (a) *Photocorynus spiniceps*, male, (b) *Edriolychnus schmidtii*, male
2. *Melanocetus johnsoni*
3. *Linophryne arborifer*
4. *Ceratias holboellii*, male
5. *Lasionathus sacostoma*
6. *Photocorynus spiniceps*, female with male
7. *Ceratias holboellii*, female with male
8. *Edriolychnus schmidtii*, female with male
9. *Gigantactis macronema*

beyond a complete revolution. This is seen in any rotary motion. An angle less than a right angle (90°) is said to be *acute*; between 90° and 180° , *obtuse*, and between 180° and 360° , *reflex*. The angle $90^\circ - a$ is the *complement* of angle a ; for example, the complement of 40° is $90^\circ - 40^\circ$, or 50° . The angle $180^\circ - b$ is the *supplement* of angle b . The term angle is itself such a basal term that it is not possible to give a satisfactory definition employing

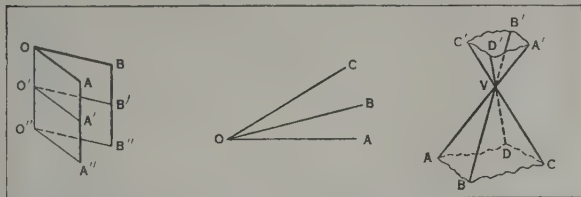


FIG. 3.—DIHEDRAL, ADJACENT AND SYMMETRIC POLYHEDRAL ANGLES

terms more simple than itself. Hilbert's definition represents one of the late efforts: "Let a be any arbitrary plane and h, k any two distinct half-rays lying in a and emanating from the point o so as to form a part of two different straight lines. We shall call the system formed by these two half-rays h, k an angle."

The notion of angle has been generalized by E. Laguerre in a way which is useful in the analytic treatment of the relation between metric and projective geometry and in the discussion of the connection between noneuclidean geometry and projective geometry. Laguerre's definition may be stated as follows:

In a plane in which an ordinary Cartesian coordinate system has been established consider two lines l_1, l_2 with slopes m_1, m_2 and intersecting at a point P . Through P are two so-called minimal lines; these are imaginary and their slopes are $i, -i$, where i is the imaginary unit defined by $i^2 = -1$. Then the natural logarithm of the anharmonic ratio of the lines l_1, l_2 and the two minimal lines through P , divided by $-2i$, is the angle θ between the lines l_1, l_2 . In symbols this statement is

$$\theta = -\frac{1}{2i} \log (m_1, m_2, i, -i),$$

where the parentheses denote the anharmonic ratio,

$$(m_1, m_2, i, -i) = \frac{i - m_1}{i - m_2} \cdot \frac{-i - m_2}{-i - m_1}.$$

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ANGLER FISHES (*Lophius piscatorius*), also called the fishing frog, belongs to the order Pediculati. It is a bottom-living fish, abundant round the coasts of Europe and eastern North America; it does not extend beyond 60° N. lat. The enormous mouth, with long, backwardly-directed, depressible teeth, and the large flattened head are diagnostic points. The fish walks along the bottom by means of its paired fins, which are modified for this purpose. The first three rays of the anterior dorsal fin are long filaments placed on the head; the first, the longest, ends in a lappet, is freely movable and acts as a lure to attract other fish. So large is the mouth and so extensible the stomach that the angler can engulf fish almost as big as itself. It may reach a length of 5 ft. The spawn consists of a transparent gelatinous sheet which may be 2 or 3 ft. broad and 25–30 ft. long. In this the eggs are embedded. A second species (*L. budegassa*) occurs in the Mediterranean and a third (*L. litulon*) on the coasts of Japan. Warm-water species have 19 vertebrae instead of 26 to 32 and are placed in a distinct genus *Lophiomus*.

The order Pediculati includes also a number of little fishes (*Antennarius*, etc.) found in shallow water in warm seas and also a group, the Ceratioidi, that live in the darkness of the middle depths of the ocean, from about 500 to 1,500 metres below the surface. These are blackish fishes, with a luminous lure; the males are dwarfed and parasitic on the females. (See **FISHES**.)

ANGLESEY, ARTHUR ANNESLEY, 1ST EARL OF (1614–1686), British statesman, son of the 1st Viscount Valentia (cr. 1621), born at Dublin on July 10, 1614, was educated at Magdalen college, Oxford, and admitted to Lincoln's Inn in 1634. He was commissioned by the English parliament in a mission to the duke of Ormonde, with whom he concluded a treaty on June 19, 1647. In that year he entered the house of commons as member for Radnorshire, and supported the Parliamentary as against the Republican or Army party. The anarchy of the last months of the commonwealth converted him to the Royalist side and he helped to bring about the restoration. In 1661 he was created Baron Annesley

and earl of Anglesey in the British peerage. From 1660 to 1667 he held various offices in the Irish administration and in the British house of commons supported Irish interests. In the bitter religious controversies of his time Anglesey showed moderation and toleration. In the panic over the "popish plot" in 1678 he kept his head. He was one of the four peers who protested in that year against the bill for the disarming of convicted recusants; he was the only peer to dissent from the motion declaring the existence of an Irish peer; he interceded for Lord Stafford, although he believed in his guilt; and in 1683 he appeared as a witness in defense of Lord Russell. He died at Bletchington in Oxfordshire on April 26, 1686. The unfavourable character drawn of him by Burnet is certainly unjust and not supported by any evidence. Pepys, a far more trustworthy judge, speaks of him invariably in terms of respect and approval as a "grave, serious man" and commends his appointment as treasurer of the navy as that of "a very notable man, and understanding, and will do things regular and understand them himself." He was a learned and cultivated man and collected a celebrated library, which was dispersed at his death. His works include *A True account of the Whole Proceedings betwixt . . . the Duke of Ormond and . . . the Earl of Anglesey* (1682). Memoirs of Lord Anglesey were published by Sir P. Pett in 1693 but contain little biographical information and were repudiated as a mere imposture by Sir John Thompson (Lord Haversham), his son-in-law, in his preface to Lord Anglesey's *State of the Government* in 1694. However, the author of the preface to *The Rights of the Lords asserted* (1702), while blaming their publication as "scattered and unfinished papers," admits their genuineness.

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ANGLESEY, HENRY WILLIAM PAGET, 1ST MARQUIS OF (1768–1854), British field-marshal, was born May 17, 1768, the eldest son of Henry Paget, 1st Earl of Uxbridge, and was educated at Westminster school and Christ Church, Oxford. He served with distinction in the French revolutionary wars and by 1808 had risen to be lieutenant-general. In command of the cavalry in Sir John Moore's Corunna campaign, he won the highest praise. His liaison with the wife of Henry Wellesley made it impossible at that time for him to serve with Wellington, and he did not serve actively, except during the disastrous Walcheren campaign, until in 1815 he commanded the British cavalry in Flanders. Wellington put him in command of the whole of the allied cavalry and horse artillery. He covered the retirement from Quatre Bras and led the cavalry charge of the British centre which checked and in part routed d'Erlon's *corps d'armée* at Waterloo. He received a severe wound, which necessitated the amputation of his leg. He received a marquise and other honours for his services, which were regarded as second only to those of the duke himself.

Anglesey became lord lieutenant of Ireland (1828) under Wellington's government, and his recall, after a brief tenure of the office, on account of his advocacy of the relief of the Catholics from the penal laws imposed on them, was much regretted in Ireland. But in 1830, after the cause was won, he again became lieutenant under Earl Grey's government. He had to face O'Connell's agitation for the repeal of the union and asked for coercive powers. In July 1833 the ministry resigned. His best legacy to Ireland was the Board of Education, established during his viceroyalty. Anglesey remained in retirement until 1846, when he became master-general of the ordnance. In that year he was promoted to the rank of field-marshal. He died April 29, 1854.

The marquis had two sons and six daughters by his first wife, and six sons and four daughters by the second. His eldest son, Henry, succeeded him in the marquise; but the title passed rapidly in succession to the 3rd, 4th and 5th marquises. The last, whose extravagances were notorious, died in 1905, when the title passed to his cousin.

Other members of the Paget family distinguished themselves in the army and the navy. Of the first marquis's brothers, one, Sir Charles Paget (1778–1839), rose to the rank of vice-admiral in the Royal navy; another, General Sir Edward Paget (1775–1849), won great distinction by his skilful handling of a division

at Corunna, and from 1822 to 1825 was commander-in-chief in India. One of the marquis's sons by his second marriage, LORD CLARENCE EDWARD PAGET (1811-95), became an admiral; another, LORD GEORGE AUGUSTUS FREDERICK PAGET (1818-80), led the 4th Light Dragoons in the charge of the Light Brigade at Balaklava; and subsequently commanded the brigade, and, for a short time, the cavalry division in the Crimea. In 1865 he was made inspector-general of cavalry, in 1871 lieutenant-general and K.C.B., and in 1877 full general. His Crimean journals were published in 1881.

ANGLESEY or ANGLESEA, an insular northern county of Wales, area 276.1 sq.mi., is cut off from the adjoining mainland of Caernarvonshire by the shallow Menai strait. The island differs strikingly from most other parts of Wales in the lowness of the land—the highest points being 720 ft., on Holy island in the north-west, and 494 ft. on Parys mountain in the north-east. It is a much worn down ancient highland, the worn ribs of which run as lines of moorland between slightly lower lines of marsh in a north-easterly to south-westerly direction. Three distinct lines of very ancient rock (pre-Cambrian schists and slates), now worn down almost to sea level, follow the general north-easterly to south-westerly trend. The north-western section includes Holyhead and Llanfaethlu, the central Aberffraw and Trefdraeth, and the south-eastern Newborough and Pentraeth. In the region between the central and north-west lowland just described, we have slightly higher ground, composed of granite on its southern side, and much folded Ordovician slates and grits on the north. The latter fan out to the north-east of the island, where volcanic intrusions have given rich veins of copper at Parys mountain. Between the central and southern pre-Cambrian penneplains the slightly raised ground is mostly composed of carboniferous limestone. Similar patches of limestone outcrop on the extreme south of the island, forming the northern shore of the Menai strait. The latter is just another of these lower north-easterly to south-westerly lines that has been submerged, and is more picturesque, if less wild, than the island marshes lying parallel to it. There are abundant evidences of glaciation, and much boulder clay and drift sand cover the older rocks. Patches of blown sand occur on the south-west coast.

The importance of Anglesey in prehistoric times is clearly indicated by the large number of megalithic monuments (chiefly dolmens, called in Wales cromlechs, and menhirs), that cover the island, especially in the south and west (see E. N. Baynes, "The Megalithic Remains of Anglesey," *Cymmrod. Soc. Trans.* 1910-11, pp. 3-91). Thus Anglesey, together with many of the western promontories of Britain, France and Spain, seems to have been an important station on the coastwise and transpeninsular routes between Spain and Ireland (see PEMBROKESHIRE). A group of mediaeval chapels in the neighbourhood of Holyhead suggests the continual use of this route along lines similar to that at St. David's (*q.v.*) in mediaeval times. There are indications that a similar maritime trade reached Anglesey in the late bronze age. Finds of exotic bronzes, a gold bracelet and jet beads have occurred in the centre of the island and near the coast at Holyhead and Beaumaris. Occupational evidences of some shortly pre-Roman period are to be found in the Hut circles at Ty Mawr on Holyhead mountain. Agricola is known to have conquered and settled Anglesey about A.D. 78. The island was known to the Romans as Mona, and recorded by them as the home of the Druids. Domestic implements of native workmanship are found at Pen-y-Bone in connection with Roman coins of the 1st and 2nd centuries, as well as Samian ware and cinerary urns of Roman origin. In the turbulent post-Roman centuries Anglesey seems to have been the prey of raiders from Ireland, Man, Scotland, England, and Wales. The Scandinavian raids, and the conquest of the island by the Saxons, under Egbert, and their ultimate expulsion seem to be the outstanding features. The raids did not cease with the arrival of the Normans, as the fatal expedition of Hugh of Chester in 1098 shows. They realized that although they could retain the lowlands of South Wales and the Border, Anglesey and Powys could not be retained without serious risk of disaster. Consequently the island retained a measure of independence throughout the early

middle ages, and at Aberffraw was located a capital of the Welsh princes of Gwynedd. The large expanses of low-lying ground (so rare in Wales) and the small rainfall, made the island one of the chief corn producing regions of the principality, and thereby earned it its name of "Môn Mam Cymru" ("Anglesey the mother [nourisher] of Wales"). The county was finally subdued by Edward I., who built an important castle at Beaumaris in 1295-96 and declared Aberffraw the capital of the island. Old traditions and customs, enriched by the age-long contacts with Ireland, lingered long in Anglesey, and gave a peculiar interest and charm to the mediaeval descriptions of the court at Aberffraw. Penmon priory, 4½ mi. from Beaumaris, was the most important monastic house, founded on an earlier site in the early 13th century.

For centuries after the Edwardian conquest, the remoteness of Anglesey from the English plain made it the centre for those who plotted against the Crown. It became important for its sea-faring and fisheries. Its people were deeply attached to the royalist cause in the 17th century. The development of Holyhead as a packet station for Ireland is the central feature in modern Anglesey, and provides an interesting example of how a route famous from prehistoric days has lived on under modern conditions. It was a regular station in the reign of William III, and was selected by the Government in 1801 as an Irish Packet station and as the terminus of Telford's great road (1815-19) from Shrewsbury, which crossed the island from south-east to north-west. A fine harbour was built by the London and North Western railway in 1880, and since then much of the Irish traffic to England has passed through Anglesey. Copper mining at Parys mountain in the north-east of the county was important between 1762-1850. Other minerals, including coal, have been worked in small quantities at different times in the island. Agriculture, sheep rearing and coastal fishing provide occupation for the bulk of the population. The county is connected with the mainland by two bridges over the Menai strait, viz., Telford's suspension bridge (1819-26) the largest in the kingdom, built at the zenith of the stage coach traffic, and Stephenson's tubular railway bridge (1850). Telford's bridge was reconstructed to withstand modern traffic.

The L.M.S. railway (Chester and Holyhead branch) crosses Anglesey from Llanfairpwllgwyngyll to Caerwen and Holyhead (Gaergybi), also from Gaerwen to Amlwch. Pop. of county (est. 1938) 46,530. Wartime movements caused an increase of 5% between Sept. 1939 and Feb. 1941. There is no parliamentary borough, but one member is returned for the county. It is in the northwest circuit, and assizes are held at Beaumaris, the only municipal borough and the county town, pop. (est. 1938) 1,589. Amlwch (2,525), Holyhead (9,964), Llangefni (1,753) and Menai Bridge (Pont y Borth) (1,639) are urban districts. The island is in the diocese of Bangor, and there are 678 parishes.

See E. Breese, *Kalendar of Gwynedd* (1873), and *The History of Powys Fadog*; E. Greenly, *The Geology of Anglesey*, vols. i. and ii., and *Memoir of Geological Survey* (1919).

ANGLESITE, a mineral consisting of lead sulphate, $PbSO_4$, crystallizing in the orthorhombic system, and isomorphous with barytes and celestite. It was first recognized as a mineral species, in 1783, by Dr. Withering, who discovered it in the Parys coppermine in Anglesey; the name anglesite, from this locality, was given by F. S. Beudant in 1832. The crystals from Anglesey are small in size and simple in form; they are brownish-yellow in colour, owing to a stain of limonite. Crystals from some other localities, notably from Monteponi in Sardinia, are transparent and colourless, possessed of a brilliant adamantine lustre, and numerous faces. The hardness is 3 and the specific gravity 6.3. There are distinct cleavages parallel to the faces of the prism (110) and the basal plane (001), but these are not so well developed as in the isomorphous minerals barytes and celestite. Anglesite is a mineral of secondary origin, having been formed by the oxidation of galena in the upper parts of mineral lodes, where these have been affected by weathering processes.

ANGLI, ANGLII or ANGLS, a Teutonic people mentioned by Tacitus in his *Germania* (cap. 40) at the end of the 1st century, without precisely indicating their geographical position. With six other tribes, including the Varini (the Warni of later times), they

worshipped a goddess named Nerthus, whose sanctuary was situated on "an island in the Ocean." Ptolemy in his *Geography* (ii. 11. § 15), half a century later, locates them between the Rhine, or rather perhaps the Ems, and the Elbe, as one of the chief tribes of the interior. This indication cannot be correct. They seem to have lived on the coasts of the Baltic, probably in the southern part of the Jutish peninsula. Striking affinities to the cult of Nerthus are found in Scandinavian, especially Swedish and Danish, religion. The island of Nerthus was probably Sjaelland (Zealand).

According to Bede the Angli before they came to Britain dwelt in a land called Angulus, and similar evidence is given by the *Historia Brittonum*. King Alfred and the chronicler Aethelweard identified this place with the district which is now called Angel in the province of Schleswig (Slesvig). During the 5th century the Angli invaded Britain (see BRITAIN, Anglo-Saxon).

The large cremation cemetery at Borgstedterfeld, in the province of Schleswig between Rendsburg and Eckernförde, has yielded many urns and brooches closely resembling those found in heathen graves in England. The great deposits at Thorsbjærg (in Angel) and Nydam contained large quantities of arms, ornaments, articles of clothing, agricultural implements, etc., and in the latter case even ships. By the help of these discoveries we are able to reconstruct a fairly detailed picture of English civilization in the age preceding the invasion of Britain.

BIBLIOGRAPHY.—Bede, *Hist. Ecc.* i. 15; King Alfred's version of *Orosius*, i. 1. §§ 12, 19; Aethelweard's *Chronicle*, lib. i. For traditions concerning the kings of Angel, see under OFFA (1). L. Weiland, *Die Angeln* (1889); A. Erdmann, *Über die Heimat und den Namen der Angeln* (Upsala, 1890—cf. H. Möller in the *Anzeiger für deutsche Altertum und deutsche Literatur*, xxii. 129 seq.); A. Kock in the *Historisk Tidskrift* (Stockholm), 1895, xv. p. 163 seq.; G. Schütte, *Var Anglerne Tyskere?* (Flensburg, 1900); H. Munro Chadwick, *The Origin of the English Nation* (Cambridge, 1907); C. Engelhardt, *Denmark in the Early Iron Age* (London, 1886); J. Mostorf, *Urnfriedhöfe in Schleswig-Holstein* (Hamburg, 1886); S. Müller, *Nordische Altertumskunde* (Ger. trans., Strassburg, 1898), ii. p. 122 seq.; see further BRITAIN, Anglo-Saxon.

ANGLICAN COMMUNION, the name used to denote that branch of the Christian Church consisting of the various ecclesiastical bodies, throughout the world, in communion with the Church of England. (See ENGLAND, CHURCH OF.)

ANGLICANISM, a general term for the ecclesiastical system, organization, and doctrine of the Church of England and the churches throughout the world in communion with it. (See ENGLAND, CHURCH OF.)

ANGLIN, MARGARET (1876–), American actress, was born on April 3, 1876, at Ottawa, Canada. She was educated in the convents of Loretto abbey, at Toronto, and Sault Recollet, at Montreal. She studied drama at the Wheatcroft school in New York, and made her stage début in 1894 as Madeline West in Charles Frohman's presentation of *Shenandoah*. In 1898 she appeared as Roxane in *Cyrano de Bergerac*. From 1900 till 1903 she was the leading woman at the Empire theatre, and in 1903–04 acted with Henry Miller in *Camille*, *The Devil's Disciple*, and other plays. Her appearance in William Vaughn Moody's *The Great Divide*, in 1907, added lustre to her growing fame. In 1909 she produced and took the leading part in *The Awakening of Helena Richie*, the dramatization of Margaret Deland's novel of that name. In 1910 she first turned to the Greek tragedies, appearing in the open air theatre in Berkeley, Calif., in *Antigone*, and in 1913 in *Electra*. In 1916 she led 1,200 players in a presentation of *As You Like It* for the Shakespeare tercentenary celebration in Forest Park, St. Louis, Mo. In 1918 she gave *Medea* and *Electra* in New York, and in 1927 her third revival of *Electra* in the same city. Apart from her rendering of character in modern plays such as *Watch on the Rhine* (1943), she is famous for her beautiful presentations of the Greek dramas and her faithful portrayal of their heroines.

ANGLING, the art or practice of the sport of catching fish by means of a baited hook or "angle" (from the Indo-European root *ank-*, meaning "bend"). It is among the most ancient of human activities, and may be said to date from the time when man was in the infancy of the stone age, eking out a precarious existence by the slaughter of any living thing which he could

reach with the rude weapons at his command. It is probable that attack on fishes was at first much the same as attack on animals: a matter of force rather than of guile, and conducted by means of a rude spear with a flint head. It is probable, too, that the primitive harpooners were not signally successful in their efforts, and so set their wits to work to devise other means of getting at the abundant food which waited for them in every piece of water near their caves. Observation would soon show them that fish fed greedily on each other and on other inhabitants of the water or living things that fell into it, and so, no doubt, arose the idea of entangling the prey by means of its appetite. Hence came the notion of the first hook, which, it seems certain, was not a hook at all but a "gorge," a piece of flint or stone which the fish could swallow with the bait but which it could not eject afterwards. From remains found in cave-dwellings and their neighbourhood in different parts of the world it is obvious that these gorges varied in shape, but in general the idea was the same: a narrow strip of stone or flake of flint, either straight or slightly curved at the ends, with a groove in the middle round which the line could be fastened. Buried in the bait it would be swallowed end first; then the tightening of the line would fix it cross-wise in the quarry's stomach or gullet and so the capture would be assured. The device still lingers in France and in a few remote parts of England in the method of catching eels which is known as "snigling." In this a needle buried in a worm plays the part of the prehistoric gorge.

The evolution of the fish-hook is still a matter of doubt. The gorge pure and simple is most efficient when perfectly straight, so the stages of its development into a curved hook—if it did so develop—are not easy to follow. But barbed harpoons of the later stone age have been found, and it is logical to conclude that once the custom of barbing fish-spears had been established, the same modification may easily have been applied to gorges also. In this case it would be found that many fish were hooked by the barb, and this form of angular hook, having the advantage of enabling fish to be "struck" without waiting for the bait to be gorged, would follow as a natural corollary to the barbed gorge. Hooks of this kind made out of thorn, and in one case out of an insect's leg, are still in use among primitive races. The transformation of this angular hook into a curved implement probably took place as a convenient method of manufacture when metal began to be used. Material used obviously varied in different parts of the world. The nature of the line or the rod that may have been used with these early hooks is largely a matter of conjecture. The first line was perhaps the tendril of a plant, the first rod possibly a sapling. But it is fairly obvious that the rod must have been suggested by the necessity of getting the bait out over obstacles which lay between the fisherman and the water, and that it was a device for increasing both the reach of the arm and the length of the line. It seems not improbable that the rod very early formed a part of the fisherman's equipment.

Literary History.—From prehistoric times down to comparatively late in the days of chronicles, angling appears to have remained a practice; its development into an art or sport is a modern idea. In the earliest literature references to angling are not very numerous, but there are passages in the Old Testament which show that fish-taking with hook as well as net was one of the common industries in the East, and that fish, where it was obtainable, formed an important article of diet. In Numbers (xi. 5) the children of Israel mourn for the fish which they "did eat in Egypt freely." So much too is proved by the monuments of Egypt; indeed more, for the figures found in some of the Egyptian fishing pictures using short rods and stout lines are sometimes attired after the manner of those who were great in the land. This indicates that angling had already, in a highly civilized country, taken its place among the methods of diversion at the disposal of the wealthy, though from the uncompromising nature of the tackle depicted and the apparent simplicity of the fish it would scarcely be safe to assume that in Egypt angling arrived at the dignity of becoming an "art." In Europe it took very much longer for the taking of fish to be regarded even as an amusement, and the earliest references to it in the Greek and

Latin classics are not very satisfying to the sportsman. There is, however, a passage in the *Odyssey* (xii. 247) which is of considerable importance, as it shows that fishing with rod and line was well enough understood in early Greece to be used as a popular illustration. It occurs in the well-known scene where Scylla seizes the companions of Odysseus out of the ship and bears them upwards, just as "some fisher on a headland with a long rod" brings small fishes gasping to the shore. Another important, though comparatively late, passage in Greek poetry is the 21st idyll of Theocritus. In this the fisherman Asphalion relates how in a dream he hooked a large golden fish and describes graphically, albeit with some obscurity of language, how he "played" it. Asphalion used a rod and fished from a rock, much after the manner of the Homeric angler. Among other Greek writers, Herodotus has a good many references to fish and fishing; the capture of fish is once or twice mentioned or implied by Plato, notably in the *Laus* (vii. 823); Aristotle deals with fishes in his *Natural History*; and there are one or two fishing passages in the anthology. But in Greek literature as a whole the subject of angling is not at all prominent. In writers of late Greek, however, there is more material. Plutarch, for instance, gives us the famous story of the fishing match between Antony and Cleopatra, which has been utilized by Shakespeare. Moreover, it is in Greek that the first complete treatise on fishing which has come down to us is written, the *Haliēutica* of Oppian (c. A.D. 169). It is a hexameter poem in five books with perhaps more technical than sporting interest, and not so much even of that as the length of the work would suggest. Still it contains some information about tackle and methods, and some passages describing battles with big fish, in the right spirit of enthusiasm. Also in Greek is what is famous as the first reference in literature to fly-fishing, in the 15th book of Aelian's *Natural History* (3rd century A.D.). It is there described how the Macedonians captured a certain spotted fish in the river Astraeus by means of a lure composed of coloured wool and feathers, which was presumably used in the manner now known as "dapping." That there were other Greek writers who dealt with fish and fishing and composed "haliēutics" we know from Athenaeus. In the first book of his *Deipnosophistae* he gives a list of them.

Latin literature allusions to angling are more numerous than in Greek, but on the whole they are unimportant. Part of a poem by Ovid, the *Haliēuticon*, composed during the poet's exile at Tomi after A.D. 9, still survives. In other Roman writers the subject is treated only by way of allusion or illustration. Martial, however, provides, among other passages, what may perhaps be entitled to rank as the earliest notice of private fishery rights—the epigram *Ad Piscatorem*, which warns would-be poachers from casting a line in the Baian lake. Pliny the elder devoted the ninth book of his *Natural History* to fishes and water-life, and Plautus, Cicero, Catullus, Horace, Juvenal, Pliny the younger and Suetonius all allude to angling here and there. Agricultural writers, too, such as Varro and Columella, deal with the subject of fish-ponds and stews rather fully. Later than any of these, but still just included in Latin literature, we have Ausonius (c. A.D. 320) and his well-known idyll the *Mosella*, which contains a good deal about the fish of the Moselle and the methods of catching them.

Post-classical Literature.—As to what happened in the world of angling in the first few centuries of the Christian era we know little. It may be inferred, however, that both fish and fishermen occupied a more honourable position in Christendom than they ever did before. The prominence of fishermen in the gospel narratives would in itself have been enough to bring this about, but it also happened that the Greek word for fish, ἰχθύς, had an anagrammatic significance which the devout were not slow to perceive. The initials of the word resolve into what is practically a confession of faith, Ἰησοῦς Χριστός Θεοῦ Υἱός Σωτὴρ (Jesus Christ, Son of God, Saviour). It is therefore not surprising that we find the fish very prominent as a sacred emblem in the painting and sculpture of the primitive church, or that Clement of Alexandria should have recommended it, among other things, as a device for signet rings or seals. The fisherman too is frequently

represented in early Christian art, and it is worthy of remark that he more often uses a line and hook than a net. The references to fish and fishing scattered about in the writings of the early fathers for the most part reflect the two ideas of the sacredness of the fish and divine authorization of the fisherman; the second idea certainly prevailed until the time of Izaak Walton, for he uses it to justify his pastime. It is also not unlikely that the practice of fasting (in many cases fish was allowed when meat was forbidden) gave the art of catching fish additional importance. It seems at any rate to have been a consideration of weight when sites were chosen for monasteries in Europe, and in many cases when no fish-producing river was at hand the lack was supplied by the construction of fish-ponds. Despite all this, however, save for an occasional allusion in the early fathers, there is hardly a connecting link between the literature of pagan Rome and the literature that sprang up on the invention of printing.

The first printed book on angling (a translation of Oppian, 1478, excepted) was a little volume printed in Antwerp probably in 1492 at the press of Matthias van der Goes. In size it is little more than a pamphlet, and it treats of birds as well as fish: *Dit Boecxken leert hoe men mach Voghelen . . . ende . . . visschen vangen metten kanden. Ende oeck andersins. . .* ("This book teaches how one may catch birds . . . and . . . fish with the hands, and also otherwise.") Only one copy apparently survives, in the Denison library, and a translation privately printed in 1872 was limited to 25 copies. At least two other editions of the book appeared in Flemish, and it also made its way, in 1502, to Germany, where, translated and with certain alterations and additions, it seems to have been re-issued frequently. Next in date comes the famous *Treatyse of Fysshynge wyth an Angle*, printed at Westminster by Wynkyn de Worde in 1496 as a part of the second edition of the *Boke of St. Albans*. The treatise is almost certainly a compilation from some earlier work on angling ("bokes of credence" are mentioned in its text), possibly from a ms. of the earlier part of the 15th century, of which a portion is preserved in the Denison collection. This was published in 1883 by Mr. Thomas Satchell under the title *An Older Form of the Treatyse of Fysshynge wyth an Angle*. But it is also possible that a still older work was the parent of both books, for it has been held that the ms. is an independent version. However this may be, it is certain that the treatise itself has been the parent of many other works. Many of the instructions contained in it are handed down from generation to generation with little change except in diction. Especially is this the case with the list of trout-flies, a meagre 12, which survives in many fishing books until well into the 18th century.

From the beginning of the 16th century the fisherman's library begins to grow apace, as, though books solely devoted to fishing are not yet frequent, works on husbandry and country pursuits almost all contain something on the subject. In Italy the fisherman and his occupation apparently were considered poetically; the word *pescatore* or its cognates are common on Italian 16th and 17th century title-pages, though in many instances the fulfilment of the implied promise is not adequate, from an angler's point of view. From the pages of *Bibliotheca Piscatoria* a fairly long list of Italian writers could be gleaned. Among them may be mentioned Sannazaro (*Piscatoria*, etc., Rome, 1526) and Andrea Calmo (*Rime pescatorie*, Venice, 1557). A century later was Parthenius, who published a volume of *Haliēutica* at Naples. This writer has an amusing reference to the art of "tickling" trout as practised in Britain. In Germany, as has been shown, the original little Flemish treatise had a wide vogue in the 16th century, and fishing played a part in a good many books on husbandry such as that of Conrad Heresbach (1570). Fish and fish-ponds formed the main topic of a Latin work by Dubravivius (1552), while Gesner in the middle of the 16th and Aldrovandi at the beginning of the 17th centuries wrote at length on the natural history of fishes. In France there were editions, now very rare, of the Flemish treatise published at Lyons about 1530, and *Les Pescheries* of Chris. de Gamon (Lyons, 1599) and *Le Plaisir des champs* of Cl. Gauchet (Paris, 1604) deserve to be noted. *Les Ruses innocentes* by François Fortin, first published

at Paris in 1600, and several times in later editions, is characterized by Messrs. Westwood and Satchell as "on the whole the most interesting contribution made by France to the literature of angling."

Modern Literature.—In 1600 appeared John Taverner's *Certain Experiments concerning Fish and Fruite*, and after this the period of angling literature proper begins. The *Secrets of Angling* (1613), by J(ohn) D(ennys), Esq., is one of the most important volumes in the angler's library, both on account of the excellence of the verse in which it is written and also on account of its practical value. Gervase Markham, "the first journalist," as he has been called, published his first book of husbandry at the same date, and, as in most of his many books on the same subject, devoted a certain amount of space to fishing. But Markham gathered his materials in a rather shameless manner and his angling passages have little originality. Thomas Barker's *The Art of Angling* (1st ed., 1651) takes a more honourable position, and received warm commendation from Izaak Walton himself, who followed it in 1653 with *The Compleat Angler*. So much has been written about this treasured classic that it is only necessary to indicate its popularity here by saying that its editions occupy some 20 pages in *Bibliotheca Piscatoria* (1883), and that since that work was published at least 40 new editions have to be added to the list. During Walton's life-time the book ran through five editions, and with the fifth (1676) was incorporated Charles Cotton's second part, the "instructions how to angle for a trout or grayling, in a clear stream." In some cases too there was added a third book, the fourth edition of *The Experienced Angler*, by Robert Venables (1st ed., 1662). The three books together bore the title of *The Universal Angler*.

A few other notable books of the century call for enumeration, *The Gentleman's Recreation* by Nicholas Cox (1674), Gilbert's *The Angler's Delight* (1676), Chetham's *Vade-Mecum* (1681), *The Complete Troller* by Robert Nobbes (1682), R. Franck's *Northern Memoirs* (1694), and *The True Art of Angling* by J. S. (1696). Of these Chetham, Nobbes, Franck and J. S. have the merit of considerable originality. Franck has gained some notoriety by his round abuse of Walton. In the 18th century among others we find *The Secrets of Angling* by C. G. (1705), Robert Howlett's *The Angler's Sure Guide* (1706), *The Whole Art of Fishing* (1714), *The Compleat Fisherman* by James Saunders (1724), *The Art of Angling* by R. Brookes (1740), another book with the same title by R. and C. Bowlker (Worcester, c. 1750), *The Complete Sportsman* by Thomas Fairfax (c. 1760), *The Angler's Museum* by T. Shirley (1784), and *A Concise Treatise on the Art of Angling* by Thomas Best (1787). Of these only Saunders', Bowlker's and Best's books are of much importance, the rest being for the most part "borrowed." One volume of verse in the 18th century calls for notice, Moses Browne's *Piscatory Eclogues* (1729).

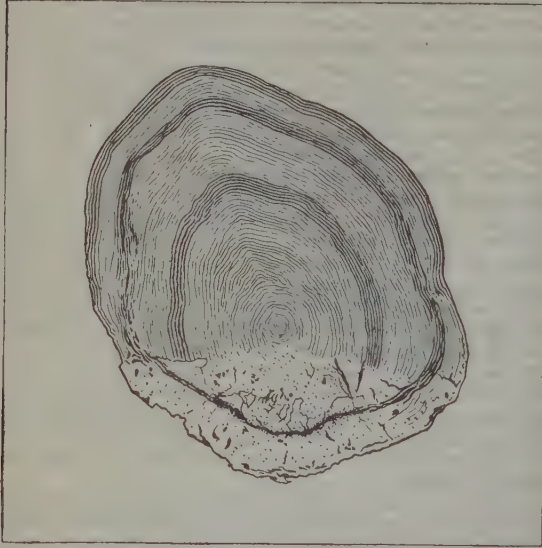
With the 19th century angling literature becomes too big a subject to be treated in detail, and it is only possible to glance at a few of the more important books and writers. Daniel's *Rural Sports* appeared in 1801; it is a treasure-house of odd facts. In 1828 Sir Humphry Davy published his famous *Salmonia*, which was reviewed in the *Quarterly* by Sir Walter Scott. At about this time too were appearing the "*Noctes Ambrosianae*" in *Blackwood's Magazine*. Christopher North (Prof. Wilson) often touched upon angling in them, besides contributing a good many angling articles to the magazine. In 1835 that excellent angling writer Thomas Tod Stoddart began his valuable series of books with *The Art of Angling as Practised in Scotland*. In 1839 he published *Songs and Poems*, among which are pieces of great merit. During this period, too, first appeared, year by year, the *Newcastle Fishers' Garlands*, collected by Joseph Crawhall afterwards and republished in 1864. These border verses, like Stoddart's, have often a genuine ring about them which is missing from the more polished effusions of Gay and Thomson. Alfred Ronalds's *The Fly-Fisher's Entomology* (1st ed., 1836) was a publication of great importance, for it marked the beginning of the scientific spirit among trout-fishers. It ran through many editions and is still a valuable book of reference. A step in angling

history is also marked by George Pulman's *Vade Mecum of Fly-fishing for Trout* (1841), for it contains the first definite instructions on fishing with a "dry fly." Another is marked by Hewett Wheatley's *The Rod and the Line* (1849), where is to be found the earliest reference to the "eyed" hook. Yet another is marked by W. C. Stewart's *The Practical Angler* (1857), in which is taught the new doctrine of "up-stream" fishing for trout. This is a book of permanent value. Among the many books of this period Charles Kingsley's *Miscellanies* (1859) stands out, for it contains the immortal "Chalk-Stream Studies." The work of Francis Francis begins at about the same time, though his *A Book on Angling*, which is still one of the most valuable text-books, was not first published till 1867. Among other English writers worthy of mention were William Senior, John Bickerdyke and F. M. Halford. (See further bibliography *ad fin.*). In America the latter half of the 19th century produced a good deal of fishing literature, much of it of a high standard. *I go a-Fishing* by Dr. W. C. Prime (1873), *Fishing with the Fly* by C. F. Orvis, A. Nelson Cheney and others (1883), *The American Salmon Fisherman* and *Fly Rods and Fly Tackle* by H. P. Wells, *Little Rivers* and other books by the Rev. H. Van Dyke—these are only a few specially distinguished in style and matter. Germany and France have not contributed so largely to the modern library, but in the first country we find several useful works by Max von dem Borne, beginning with the *Handbuch der Angelfischerei* of 1875, and there are a good many other writers who have contributed to the subject, while in France there are a few volumes on fishing by different hands. The most noticeable is M. G. Albert Petit's *La Truite de rivière* (1897), an admirable book on fly-fishing.

During the present century the output of angling books has been too great for more than a selected list to be attempted, which will be found in the bibliography below, but mention may just be made here of one or two outstanding volumes that have appeared. There is, first of all, Mr. William Radcliffe's *Fishing from the Earliest Times* (2nd ed. 1926), in which the author has collected a mass of references to angling dating from cave frescoes, and implements of the stone age, through the dawn of history, down to about A.D. 500 and discusses the allusions to fishing in classical literature, on Egyptian monuments and Chinese records, and is the only attempt as yet made to compile a complete historical record of the sport. In 1907 Mr. W. L. Calderwood, the inspector of fisheries for Scotland, published his *The Life of the Salmon*, which is perhaps the most authoritative work on the knowledge of the salmon which modern scientific research has produced. Mr. Martin E. Mosely published *The Dry Fly Fisherman's Entomology* in 1921, a continuation of Mr. Halford's works on the same subject; Mr. G. E. M. Skues has produced *Minor Tactics of the Chalk Stream* (3rd ed. 1924) and *The Way of a Trout with a Fly*, which describe, in effect, a method of applying to the wet fly the scientific knowledge on which dry-fly fishing is founded. *A Bibliography of Fishes* by Bashford Dean and others published by the American Museum of Natural History was completed in three volumes in 1923, and is the biggest work of its kind ever undertaken. In France a notable contribution to fishing literature is Lt.-Col. Vavon's *La Truite: ses mœurs: L'Art de Pêcher*, which appeared in a limited edition in 1927. In it the author has collected the modern knowledge of the life history, structure and habits of the trout, and presents his recommendations for methods of capture as a logical deduction from its past history and propensities. J. R. Norman's *History of Fishes* (London, 1931) is authoritative and is used as a standard reference for both ichthyologist and angler.

Modern Conditions.—In the modern history of angling there are one or two features that should be touched upon. A discovery in the natural history of the salmon by H. W. Johnson (*The Field*, Oct. 29, 1904) following on the work of the 17th-century Dutch naturalist, Leeuwenhoek, that the age and past history of a fish can be read on its scales, has enormously increased our knowledge of the life history of migratory salmonidae. Briefly, the discovery was that a fish, without adding to the number of its scales, accommodates its increasing size by adding

layers to them, each layer on completion turning up slightly at its edge and thus forming a series of ridges which can easily be seen under a low-powered microscope. In summer when food is plentiful the rings thus formed are wide, while in winter owing to the comparative scarcity of food, and probably to the extra amount of nourishment absorbed in maintaining bodily warmth, the resulting rings are narrow. Thus a salmon's scale shows a



SKETCH OF SALMON SCALE FROM A SPRING FISH WITH SPAWNING MARK.
ONLY A FEW OF THE RINGS ARE SHOWN

series of wide rings (summer zone) followed by a series of narrow rings (winter band) the two together forming one year in the fish's life. When a salmon enters a river for the purpose of spawning and loses condition, the edge of the scale (the greater part of which is embedded in the skin) is absorbed, and the outermost rings disappear. When scale formation starts again on recovery from spawning these rings are not replaced but new ones are laid down, the rough broken edges of the rings which have disappeared forming an uneven dark mark round the scale known as the "spawning mark." The information gained by reading the scales, supplemented by additional information from marking fish (with a metal label or similar device) and returning them to the water, has profoundly modified our ideas of the life of the salmon. Grise (immature salmon) at one time regarded as a separate species, and later believed to be fish which had spent only a few months in the sea, is now the name given to salmon which have spent only one year (none spend less) and a few months in the sea before returning to fresh water. It has also been shown that the length of a salmon's "parr" life in fresh water has a considerable effect on the length of its sojourn in the sea, the rule being, roughly, that the longer a parr takes in growing to the smolt stage before migration the shorter will be its stay in salt water and the greater likelihood of its return to the river as a grise instead of a larger and more profitable "spring" or "summer" fish (fish which have spent two or more years in the sea). It is now known, too, that very few fish return to spawn a second time, while a fish which has four or more spawning marks on its scales is worth recording as a phenomenal capture. Knowledge of sea trout, though increasing rapidly, has not kept pace with the knowledge of salmon, but the method of reading their scales is the same, though the interpretation of them is more difficult, owing to their habit of returning to fresh water for purposes other than spawning. Attempts have also been made to apply the same system to fresh-water fish other than the salmon family, but though some progress has been made it is not yet possible to interpret their rings with the same accuracy as with salmon and trout. All European trout, whether "sea," "brown" or

any of the numerous variations that used to be listed as subspecies are now regarded as one and the same species (*S. trutta*), there being no discoverable structural difference, according to the latest scientific investigations. Trout varying in colour owing to quality of food, water, or other local conditions are regarded simply as "strains" of the same species.

The great increase in the number of fishermen has had several results. One is a corresponding increase in the difficulty of obtaining fishing, and a notable rise in the value of rivers, especially those which are famed for salmon and trout. Salmon-fishing now may be said to have become a pastime of the rich, and there are signs that trout-fishing will before long have to be placed in the same exclusive category, while even the right to angle for less-esteemed fish will eventually be a thing of price. The development is natural, and it has naturally led to efforts on the part of the angling majority to counteract, if possible, the growing difficulty. These efforts have been directed chiefly in two ways, one the establishment of fishing clubs, the other the adoption of angling in salt water. The fishing club of the big towns was originally a social institution, and its members met together to sup, converse on angling topics and perhaps to display notable fish that they had caught. Later, however, arose the idea that it would be a convenience if a club could give its members privileges of fishing as well as privileges of reunion. So it comes about that all over the United Kingdom, in British colonies and dependencies, in the United States, and various countries of Europe, fishing clubs rent waters, undertake preservation and restocking and generally lead an active and useful existence. It is a good sign for the future of angling and anglers that they are rapidly increasing in number. One of the oldest fishing clubs, if not the oldest, was the Schuylkill club, founded in Pennsylvania in 1732. An account of its history was published in Philadelphia in 1830. Among the earliest clubs in London are to be numbered such societies as The True Waltonians, The Piscatorial, The Friendly Anglers and The Gresham, which are still flourishing. A certain amount of literary activity has been observable in the world of angling clubs, and several volumes of "papers" are on the records. Most noticeable perhaps are the three volumes of *Anglers' Evenings* published in 1880-94, a collection of essays by members of the Manchester Anglers' association. The other method of securing a continuance of sport, the adoption of sea-angling as a substitute for fresh-water fishing, is quite a modern thing. Within the memory of men still young the old tactics of hand-line and force were considered good enough for sea fish. Now the fresh-water angler has lent his centuries of experience in deluding his quarry; the sea-angler has adopted many of the ideas presented to him, has modified or improved others, and has developed the capture of sea-fish into a science almost as subtle as the capture of their fresh-water cousins.

During the last few years a greater development still has taken place in the capture of exceptionally large fish—sharks, swordfish, tuna, etc.—running up to weights of several hundred pounds and now known under the name of big-game fishing. This fishing was first inaugurated as a separate branch of the sport by the Tuna club of Santa Catalina. The discovery of tuna grounds on the coast of Nova Scotia, where subsequently anglers have caught some giant tuna weighing 880 lb., with rod and line, widened the geographical scope of the fishing, since then the north shore of the northern island of New Zealand has provided some wonderful takes of marlin and broadbill swordfish and Mako shark, and is now by way of being the most notable big-game fishing ground in the world.

Still more recently, the grounds off South America's Pacific coast have been opened to big-game anglers. In 1940 the world's record broadbill swordfish of 860 lb. was caught off Tocopilla, Chile. The spawning grounds of tuna are in the Mediterranean, but since, like many other fish, they seem to cease feeding on the approach of the spawning season, rod and line fishing there is little developed, but they have been caught at times in the North sea and a capture (August 1927) of large tuna (over 500 lb.) by Danish anglers in the Kattegat, off the coast of Denmark, is an indication that this fishing may be within reach of British coasts. Up to the present, however, British anglers

regard the conger, skate, halibut and tope (*Galeus vulgaris*), a small species of shark, allied to the dogfishes, as the "big-game" of home waters.

Several important fresh-water species have also become a later part of angling enterprise, notably the dorado of South American rivers, the Euphrates salmon of the Euphrates watershed, a fish resembling the mahseer in character but reaching much greater weights, and the Nile perch and tiger fish of the big African rivers. One more modern feature, which is also a result of the increase of anglers, is the great advance made in fish culture, fish stocking and fish acclimatization during the last half-century.

Fish culture is now a recognized industry; every trout stream of note and value is restocked from time to time as a matter of course; salmon hatcheries are numerous, though their practical utility is still a debated matter, in Great Britain at any rate; coarse fish are also bred for purposes of restocking; and, lastly, it is now considered a fairly simple matter to introduce fish from one country to another, and even from continent to continent.

In England the movement owes a great deal to Francis Francis, who, though he was not the earliest worker in the field, was among the first to formulate the science of fish breeding; his book *Fish-Culture*, first published in 1863, still remains one of the best treatises on the subject.

Through the U.S. government's fish and wildlife service, a bureau of the department of interior and 45 state conservation departments, fish cultural activities constantly progress in the United States. Billions of young fish and fish eggs are annually produced and distributed throughout the country by these agencies. The work has a twofold purpose: to help maintain a natural resource through methods of artificial propagation, and simultaneously to help meet the tremendous demands imposed by recreational needs.

The fish and wildlife service estimates that between 10,000,000 and 13,000,000 individuals go fresh-water fishing in the United States each season. Some 8,000,000 of these purchase licences and supply thereby part of the funds used in the restoration program. Those in the remaining group are youngsters, farm owners or others similarly exempt from buying licences.

On the continent of Europe the latter half of the 19th century saw a very considerable and rapid development in fish culture, but until comparatively recently the propagation and care of fish in most European waters have been considered almost entirely from the point of view of the fish stew and the market. As to what has been done in the way of acclimatization it is not necessary to say much.

Trout (*Salmo fario*) were introduced to New Zealand in the late '60s from England; in the '80s rainbow trout (*S. irideus*) were also introduced from California; now New Zealand provides the finest trout fishing of its kind in the world. The quinnat salmon from the Pacific coast of North America and the Atlantic salmon (*S. salar*) from European waters have also been acclimatized in New Zealand, but whereas the quinnat has adopted the life habit of its original home, the Atlantic salmon has shown peculiarities of behaviour and development that have for some time puzzled both anglers and scientists. The earlier attempts to introduce it were failures, possibly on account of the comparatively high temperature of the coastal waters as compared with the original habitat in the northern hemisphere; but the more recent attempts in the early 1900s in Lake Te Anau and the river Waiau in the south island have produced a considerable stock of fish, which are evidently spawning in those waters and may be considered, from that point of view, to have acclimatized themselves.

They, however, show several peculiarities which differentiate them from the *S. salar* of Europe.

The first and most noticeable is the fact that mature fish feed regularly in fresh water, even when approaching the spawning period; a habit unknown among sea-going *salar*, either in Europe or America. Although they descend to tidal water no specimen has, as yet, been caught in the sea out of reach of tidal influence. The rainbow trout is still regarded with some suspicion, as it has a tendency to wander from waters which do not altogether suit it.

For the rest, trout have been established in Ceylon, in Kashmir, in South Africa (where carp have also been introduced with very surprising results, being now regarded almost as a nuisance), and in British Central Africa.

In fact the possibilities of acclimatization are so great that it seems probable that in time no river of the civilized world capable of holding trout will be without them.

METHODS AND PRACTICE

Angling falls into two main divisions, fishing in fresh water and fishing in the sea. The two branches of the sport have much in common, and sea angling is really little more than an adaptation of fresh-water methods to salt-water conditions. Therefore it will not be necessary to deal with it at great length and it naturally comes in the second place. Angling in fresh water is, again, divisible into three principal parts: fishing on the surface, *i.e.*, with the fly; in mid-water, *i.e.*, with a bait simulating the movements of a small fish or with the small fish itself; and on the bottom with worms, paste or one of the many other baits which experience has shown that fish will take. With the premise that it is not intended here to go into the minutiae of instruction which may more profitably be discovered in the many works of reference cited at the end of this article, some account of the subdivisions into which these three styles of fishing fall may be given.

FRESH-WATER FISHING

Fly-fishing.—Fly-fishing is the most modern of them, but it is the most highly esteemed, principally because it is the method *par excellence* of taking members of the most valuable sporting family of fish, the *Salmonidae*. It may roughly be considered under three heads: the use of the "wet" or sunk fly, of the "dry" or floating fly, and of the natural insect. Of these the first is the most important, for it covers the widest field and is the most universally practised. There are few varieties of fish which may not either consistently or occasionally be taken with the sunk fly in one of its two forms. The large and gaudy bunch of feathers, silk and tinsel with which salmon, very large trout, black bass and occasionally other predacious fish are taken is not, strictly speaking, a fly at all. It rather represents, if anything, some small fish or subaqueous creature on which the big fish is accustomed to feed, and it may conveniently receive the generic name of salmon fly. The smaller lures, however, which are used to catch smaller trout and other fish that habitually feed on insect food are in most cases intended to represent that food in one of its forms and are entitled to the name of "artificial flies."

The dry or floating fly is simply a development of the imitation theory, and has been evolved from the wet fly in course of closer observation of the habits of flies and fish in certain waters. Both wet and dry fly methods are really a substitute for the third and oldest kind of surface fishing, the use of a natural insect as a bait. Each method is referred to incidentally below.

Spinning, etc.—Mid-water fishing, as has been said, broadly consists in the use of a small fish, or something that simulates it, and its devices are aimed almost entirely at those fish which prey on their fellows. Spinning, live baiting and trolling¹ are these devices. In the first a small dead fish or an imitation of it made in metal, India rubber, or other substance, is caused to revolve rapidly as it is pulled through the water, so that it gives the idea of something in difficulties and trying to escape. In the second a small fish is put on the angler's hook alive and conveys the same idea by its own efforts. In the third a small dead fish is caused to dart up and down in the water without revolving; it conveys the same idea as the spinning fish, though the manipulation is different.

Bottom Fishing.—Bottom fishing is the branch of angling which is the most general. There is practically no fresh-water fish that will not take some one or more of the baits on the angler's list if it is properly presented to it when it is hungry.

¹Trolling is very commonly confused in angling writing and talk with *trailing*, which simply means drawing a spinning bait along behind a boat in motion.

Usually the baited hook is on or near the bottom of the water, but the rule suggested by the name "bottom-fishing" is not invariable and often the bait is best used in mid-water; similarly, in "mid-water fishing" the bait must sometimes be used as close to the bottom as possible. Bottom-fishing is roughly divisible into two kinds, float-fishing, in which a bite is detected by the aid of a float fastened to the line above the hook and so balanced that its tip is visible above the water, and hand-fishing, in which no float is used and the angler trusts to his hand to feel the bite of a fish. In most cases either method can be adopted and it is a matter of taste, but broadly speaking the float-tackle is more suited to water which is not very deep and is either still or not rapid. In great depths or strong streams a float is difficult to manage.

THE FISH

It is practically impossible to classify the fish an angler catches according to the methods which he employs, as most fish can be taken by at least two of these methods, while many of those most highly esteemed can be caught by all three. Sporting fresh-water fish are therefore treated according to their families and merits from the angler's point of view, and it is briefly indicated which method or methods best succeed in pursuit of them.

Salmon.—First in importance come migratory *Salmonidae*, and at the head of them the salmon (*Salmo salar*), which has a twofold reputation as a sporting and as a commercial asset. The salmon fisheries of a country are a very valuable possession, but it is only comparatively recently that this has been realized and that salmon rivers have received the legal protection which is necessary to their well-being. Even now it cannot be asserted that in England the salmon question, as it is called, is settled. Partly owing to former ignorance of the life-history of the fish, partly owing to the difficulty of reconciling the opposed interests of commerce and sport, the problem as to how a river should be treated remains only partially solved, though it cannot be denied that there has been a great advance in the right direction. The life-history of the salmon, so far as it concerns the matter in hand, may be very briefly summed up. It is bred in the rivers and fed in the sea. The parent fish ascend in late autumn as high as they can get, the ova are deposited on gravel shallows, hatching out in the course of a few weeks into parr. The infant salmon remains in fresh water at least one year, generally two years, without growing more than a few inches, and then about May assumes what is called the smolt-dress; that is to say, it loses the dark parr-bands and red spots of infancy and becomes silvery all over. After this it descends without delay to the sea, where it feeds to such good purpose that in a year it has reached a weight of several pounds, and it may then reascend as a grilse. If the fish survives the perils of its first ascent and spawning season and as a kelt or spawned fish gets down to the sea again, it may come up a second time as a salmon some pounds heavier.

But in fact only a small percentage of salmon survive for a second spawning in the rivers of Great Britain though on the east coast of Canada a much larger percentage do so. The various "runs" of fish which occur in all salmon rivers do not consist of fish about to spawn for the first, second or third time, but of fish which have spent one, two or three years in the sea after their first descent to salt water. These runs are now for statistical purposes reckoned by the number of *winters* spent in the sea, the fish whose scales end in a winter band being known as "spring" fish, and those whose scales end in a summer zone as "summer" fish. The classes are: grilse (one winter), small spring and summer (two winters), large ditto (three winters), very large ditto (four winters). Why some fish are much heavier than others of the same age, what their mode of life is in the sea, why some run up in spring and summer when the breeding season is not till about November or December, whether they were originally sea-fish or river-fish—these and other similar questions await a conclusive answer. One principal fact, however, stands out amid the uncertainty, and that is that without a free passage up and down unpolluted rivers and without protection on the spawning beds salmon have a very poor chance of perpetuating their species. Economic prudence dictates therefore that every

year a considerable proportion of running salmon should be allowed to escape the dangers that confront them in the shape of nets, obstructions, pollutions, rods and poachers. And it is in the adjustment of the interests which are bound up in these dangers (the last excepted; officially poachers have no interests, though in practice their plea of "custom and right" has too often to be taken into consideration) that the salmon question consists. To secure a fair proportion of fish for the market, a fair proportion for the rods and a fair proportion for the *redds*, without unduly damaging manufacturing interests, this is the object of those who have the question at heart, and with many organizations and scientific observers at work it should not be long before the object is attained. It is very largely due to the efforts of anglers that the matter has gone so far.

Whether salmon feed in fresh water is another question of peculiar interest to anglers, for it would seem that if they do not then the whole practice of taking them must be an anomaly. Champions have arisen on both sides of the argument, some, scientists, asserting that salmon (parr and kelts excluded, for both feed greedily as opportunity occurs) do not feed; others, mostly anglers, maintaining strongly that they do, and bringing as evidence their undoubted and customary capture by rod and line, not only with the fly, but also with such obvious food-stuffs as dead baits, worms and prawns. On the other side it is argued that food is never found inside a salmon after it has been long enough in a river to have digested its last meal taken in salt water. The very few instances of food found in salmon which have been brought forward to support the contrary opinion are, in the scientific view, to be regarded with great caution.

It has been lately found, however, that there is often a kind of slime in the stomach of captured salmon, consisting of food juices, and there is a certain amount of evidence that salmon in fresh water have a habit of chewing food and then rejecting it. From this it has been suggested that while salmon may take food in fresh water they swallow merely the essence of it and reject the valueless remains. Such a theory might help to reconcile both sets of observations. At the same time, since many good salmon rivers contain only sufficient food to maintain a meagre stock of undersized trout, it is evident that the food a salmon can get in such water would only be a trifle in comparison with the sustenance necessary for so large a fish. Dr. J. Kingston Barton, in the first of the two volumes on "Fishing" (*Country Life* series), has suggested that after exertion, such as that entailed by running from pool to pool during a spate, the fish may feel a very transient hunger and be impelled thereby to snap at anything in its vicinity which looks edible. The fact that the angler's best opportunity is undoubtedly when salmon have newly arrived in a pool, supports this contention. The longer they are compelled to remain in the same spot by lack of water the worse becomes the prospect of catching them, and "unfishable" is one of the expressive words which fishermen use to indicate the condition of a river during the long periods of drought which too often distinguish the sport.

Salmon Tackle and Methods.—It is when the drought breaks up and the long-awaited rain has come that the angler has his chance and makes ready his tackle, against the period of a few days (on some short streams only a few hours) during which the water will be right; *right* is a very exact term on some rivers, meaning not only that the colour of the water is suitable to the fly, but that its height shall be within an inch or two of a given mark, prescribed by experience. As to the tackle which is made ready, there is, as in most angling matters, divergence of opinion. Salmon fly-rods are now made principally of two materials, greenheart and split-cane; the former is less expensive, the latter is more durable; it is entirely a matter of taste which a man uses, but the split-cane rod is now more in favour. It has been a matter of debate whether it is better built with a core of steel running from butt to tip and known as a "steel centre." How long the rod shall be is also a matter on which anglers differ, but from 16ft. to 17ft. 6in. represents the limits within which most rods are preferred. The tendency is to reduce rather than to increase the length of the rod, which

may be accounted for by the adoption of a heavy line. Early in the 19th century anglers used light-topped rods of 20ft. and even more, and with them a light line composed partly of horse-hair; they thought 60ft. with such material a good cast. Modern experience, however, has shown that a shorter rod with a heavier top will throw a heavy dressed silk line much farther with less exertion. Ninety feet is now considered a good fishing cast, while many men can throw a great deal more. In the United States, where rods have long been used much lighter than in England, the limits suggested would be considered too high. Single-handed rods are in common use there and are becoming popular elsewhere. The variety of reels, lines, gut collars and other forms of tackle which is now presented to the angler's consideration and for his bewilderment is too wide a subject to be touched upon here. Something, however, ought to be said about flies. One of the perennially fruitful topics of enquiry is what the fish takes a salmon-fly to be. Beyond a fairly general admission that it is regarded as something endowed with life, perhaps resembling a remembered article of marine diet, perhaps inviting gastronomic experiment, perhaps merely irritating and rousing an impulse to destroy, the discussion has not reached any definite conclusion. But more or less connected with it is the controversy as to variety of colour and pattern. Some authorities hold that a great variety of patterns with very minute differences in colour and shades of colour is essential to complete success; others contend that salmon do not differentiate between nice shades of colour, that they only draw distinctions between flies, broadly, as being light, medium or dark in general appearance, and that the size of a fly rather than its colour is the important point for the angler's consideration. Others, again, go some way with the supporters of the colour-scheme and admit the efficacy of flies whose general character is red, or yellow, or black, and so on. The opinion of the majority, however, is probably based on past experience, and a man's favourite flies for different rivers and conditions of water are those with which he or someone else has previously succeeded. It remains a fact that in most fly-books great variety of patterns will be discoverable, while certain old standard favourites, such as the Jock Scott, Durham Ranger, Silver Doctor, and Thunder and Lightning, will be prominent. Coming out of the region of controversy it is a safe generalization to say that the common rule is: big flies for spring fishing when rivers are probably high, small flies for summer and low water, and flies medium or small in autumn according to the conditions. Spring fishing is considered the cream of the sport. Though salmon are not as a rule so numerous or so heavy as during the autumn run, and though kelts are often a nuisance in the early months, yet the clean-run fish of February, March or April amply repays patience and disappointment by its fighting powers and its beauty. Summer fishing on most rivers in the British Islands is uncertain, but in Norway summer is the season, which possibly explains to some extent the popularity of that country with British anglers, for the pleasure of a sport is largely increased by good weather.

Two methods of using the fly are in vogue, casting and harling. The first is by far the more artistic, and it may be practised either from a boat, from the bank or from the bed of the river itself; in the last case the angler wades, wearing waterproof trousers or wading-stockings and stout nail-studded brogues. In either case the fishing is similar. The fly is cast across and down stream, and has to be brought over the "lie" of the fish, swimming naturally with its head to the stream, its feathers working with tempting movement and its whole appearance suggesting some live thing dropping gradually down and across stream. Most anglers add to the motion of the fly by "working" it with short pulls from the rod-top. When a fish takes, the rise is sometimes seen, sometimes not; in any case the angler should not respond with the rod until he *feels* the pull. Then he should *tighten*, not strike. The fatal word "strike," with its too literal interpretation, has caused many a breakage. Having hooked his fish, the angler must be guided by circumstances as to what he does; the salmon will usually decide that for him. But it is a sound rule to give a well-hooked fish no unnecessary advantage and to hold on as hard as the tackle will allow. Good tackle will stand an immense

strain, and with this "a minute a pound" is a fair estimate of the time in which a fish should be landed. A foul-hooked salmon (no uncommon thing, for a fish not infrequently misses the fly and gets hooked somewhere in the body) takes much longer to land. The other method of using the fly, harling, which is practised on a few big rivers, consists in trailing the fly behind a boat rowed backwards and forwards across the stream and dropping gradually downwards. Of recent years many anglers have adopted light rods for salmon-fishing. This is, in effect, trout-fishing applied to salmon, the rod used being a single-handed one of 10ft. 6in. to 11ft. and the flies of about the same size as loch trout flies. Great success has attended this method of fishing at times of low water, when, by the older methods, it would have been considered hardly worth while trying. Dry-fly fishing for salmon on calm days, more particularly perhaps in American waters, which are more liable than British to periods of high temperature, is another innovation with salmon anglers. Fly-fishing for salmon is also practised on some lakes, into which the fish run. On lakes the boat drifts slowly along a "beat," while the angler casts diagonally over the spots where salmon are wont to lie. Salmon may also be caught by "mid-water fishing," with a natural bait either spun or trolled and with artificial spinning-baits of different kinds, and by "bottom-fishing" with prawns, shrimps and worms. Spinning is usually practised when the water is too high or too coloured for the fly; trolling is seldom employed, but is useful for exploring pools which cannot be fished by spinning or with the fly; the prawn is a valuable lure in low water and when fish are unwilling to rise; while the worm is killing at all states of the river, but except as a last resource is not much in favour. There are a few waters where salmon have the reputation of not taking a fly at all; in them spinning or prawning is the usual mode of fishing. But most anglers, wherever possible, prefer to use the fly. The rod for the alternative methods is generally shorter and stiffer than the fly-rod, though made of like material. Twelve to 14ft. represents about the range of choice. Outside the British Islands the salmon-fisher finds his headquarters in Scandinavia and Iceland, and, in the New World, in some of the waters of Canada and Newfoundland.

Landlocked Salmon.—The landlocked salmon (*Salmo salar* *ouananiche* and *sebag*) of Canada and the lakes of Maine is, as its name implies, now regarded by scientists as merely a landlocked form of the salmon. It does not often attain a greater size than 20 lb., but it is a fine fighter and is highly esteemed by American anglers. In most waters it does not take a fly so well as a spinning-bait, live-bait or worm. The methods of angling for it do not differ materially from those employed for other *Salmonidae*.

Pacific Salmon.—Closely allied to *Salmo salar* both in appearance and habits is the genus *Oncorhynchus*, commonly known as Pacific salmon. It contains six species, is peculiar to the North Pacific ocean, and is of some importance to the angler, though of not nearly so much as the Atlantic salmon. The quinnat is the largest member of the genus, closely resembles *salar* in appearance and surpasses it in size. The others, sockeye, humpback, coho, dog-salmon and masu, are smaller and of less interest to the angler, though some of them have great commercial value. The last-named is found only in the waters of Japan, but the rest occur in greater or less quantities in the rivers of Kamchatka, Alaska, British Columbia and Oregon. The problems presented to science by *salar* are offered by *Oncorhynchus* also, but there are variations in its life-history, such as the fact that few if any fish of the genus are supposed to survive their first spawning season. When once in the rivers none of these salmon is of very much use to the angler, as, though it is stated that they will occasionally take a fly or spoon in fresh water, they are not nearly so responsive as their Atlantic cousin and in many streams are undoubtedly not worth trying for. At the mouths of some rivers, however, where the water is distinctly tidal, and in certain bays of the sea itself they give very fine sport, the method of fishing for them being usually to trail a heavy spoon-bait behind a boat. By this means remarkable bags of fish have been made by anglers. The sport is of quite recent development.

Sea Trout.—Next to the salmon comes the sea trout, the other migratory salmonid of Europe. This is a fish with many local names and a good deal of local variation. Modern science, however, recognizes one "race" only, *Salmo trutta*, the sea trout proper. The life history of sea trout is much the same as that of salmon, and the fish on their first return from the sea in the grilse stage are called by many names, finnock, herling and whitling being perhaps the best known. The bull trout, formerly considered a separate species, is now regarded as an old sea trout which has survived many spawnings, but its exact place in salmonology is still in dispute. It is a strong fish and grows to a great size and it is a pity that it is not of greater sporting value, if only to make up for its bad reputation as an article of food. Some amends, however, are made by its cousin the sea trout, which is one of the gamest and daintiest fish on the angler's list. It is found in most salmon rivers and also in not a few streams which are too small to harbour the bigger fish, while there are many lakes in Scotland and Ireland (where the fish is usually known as white trout) where the fishing is superb when the trout have run up into them. Fly-fishing for sea trout is not a thing apart. A three-pounder that will impale itself on a big salmon fly might equally well have taken a tiny trout fly. Many anglers, when fishing a sea-trout river where they run large, 5 lb. or more, and where there is also a chance of a salmon, effect a compromise by using a light 13 ft. or 14 ft. double-handed rod, and tackle not so slender as to make hooking a salmon a certain disaster. But undoubtedly to get the full pleasure out of sea-trout fishing a single-handed rod of 10 ft. to 12 ft. with reasonably fine gut and small flies should be used, and the way of using it is much the same as in wet-fly fishing for brown trout, which will be treated later. When the double-handed rod and small salmon flies are used, the fishing is practically the same as salmon fishing except that it is on a somewhat smaller scale. Flies for sea trout are numberless and local patterns abound, as may be expected with a fish which has so catholic a taste. But, as with salmon fishers so with sea-trout fishers, experience forms belief and success governs selection. Among the small salmon flies and loch flies which will fill his book, the angler will do well to have a store of very small trout flies at hand, while experience has shown that even the dry fly will kill sea trout on occasion, a thing that is worth remembering where rivers are low and fish shy. July, August and September are in general the best months for sea trout, and as they are dry months the angler often has to put up with indifferent sport.

Nonmigratory Salmonidae.—Of the nonmigratory members of the *Salmonidae* the most important in Great Britain is the brown trout (*Salmo fario*). Its U.S. cousin the rainbow trout (*S. irideus*) is now fairly well established in Britain, too, while other trans-Atlantic species both of trout and char (which are some of them partially migratory, that is to say, migratory when occasion offers), such as the steelhead (*S. gairdneri*), fontinalis (*Salvelinus fontinalis*) and the cut-throat trout (*S. clarkii*), are at least not unknown. All these fish, together with their allied forms in the U.S., can be captured with the fly, and speaking broadly, the wet-fly method will do well for them all. Therefore it is only necessary to deal with the methods applicable to one species, the brown trout.

Trout.—Of the game fishes the brown trout is the most popular, for it is spread over the whole of Great Britain and most of Europe, wherever there are waters suited to it. It is a fine sporting fish and is excellent for the table, while in some streams and lakes it grows to a very considerable size, examples of 16 lb. from southern rivers and 20 lb. from Irish and Scottish lakes being not unknown.

In the U.S. the brook or speckled trout (*Salvelinus fontinalis*) is one of the most beautiful and active of trout and one of the most widely distributed. Its variation of colour is brought about by conditions of environment, age, sex and size, and it is often given local names by fishermen under the impression that it is a different species. Brook trout have voracious appetites and appear to be always bent on appeasing their hunger. Some 10 to 12 lb. brook trout have been caught but these are uncommon; one record of 12½ lb. was made at Rangeley lake, Me., but the con-

tinental record is 14½ lb. for the trout taken at Nipigon river in Canada.

Both the brook and rainbow trout thrive in water which does not exceed a temperature approximating 70° F. in summer, but the rainbow is able to withstand higher temperature for longer periods than the brook. With its fondness for foamy water, its leaping characteristics when hooked and its fighting ability, the rainbow is held in high esteem by the angler. Proper classification of the so-called rainbow and steelhead trout has been the cause of much discussion among ichthyologists. Average size of the rainbows caught in the eastern United States are probably under 1 lb. but some of 15 lb. have been taken in New York state's famed Catharine's creek.

Better known as the brown trout, this fish was first introduced in the United States under the name of Von Behr trout, after the man who was instrumental in obtaining the eggs from Germany. Later the fish was called German brown and eventually brown trout. It thrives in warmer waters than the American trout and is more suitable in depleted areas of deforested streams where it would be impossible in summer temperatures to maintain brook trout. It is regarded as a wary fish, difficult to fool and runs to good size. One of the best recorded in 1942 was 17 lb. 10 oz.

Wet-Fly Fishing for Trout.—Fly-fishing for trout is divided into three kinds: fishing with the artificial fly sunk or "wet," fishing with it floating or "dry" and fishing with the natural insect. Of the first two methods the wet fly is the older and may be taken first. Time was when all good anglers cast their flies downstream and thought no harm. But in 1857 W. C. Stewart published his *Practical Angler*, in which he taught that it paid better to fish upstream, for by so doing the angler was not only less likely to be seen by the trout but was more likely to hook his fish. The doctrine was much discussed and criticized, but it gradually won adherents, until now upstream fishing is the orthodox method where it is possible. Stewart was also one of the first to advocate a lighter rod in place of the heavy 12 ft. and 13 ft. weapons that were used in the north in his time. There are still many men who use the long rod for wet-fly fishing in streams, but there are more who find 10 ft. or less enough for their purpose. For lake fishing from a boat, however, the longer rod is still in many cases preferred. In fishing rivers the main art is to place the right flies in the right places and to let them come naturally down with the stream. The right flies may be ascertained to some extent from books and from local wisdom, but the right places can only be learnt by experience. It does not, however, take long to acquire "an eye for water," and that is half the battle, for the haunts of trout in rapid rivers are very much alike. In lake fishing chance has a greater share in bringing about success, but here too the right fly and the right place are important; the actual management of rod, line and flies, of course, is easier, for there is no stream to be reckoned with. Though there is little left to be said about wet-fly fishing where the fly is an imitation more or less exact of a natural insect, there is another branch of the art which has been stimulated by modern developments. This is the use of salmon flies for big trout much in the same way as for salmon.

Dry-Fly Fishing.—The theory of dry-fly fishing is indeed very simple and consists of placing before the fish an exact imitation of the insect on which it is feeding, in such a way that it shall float down exactly as if it were an insect of the same kind. To this end special tackle and special methods have been found necessary. Not only the fly but also the line has to float on the water; the line is very heavy and therefore the rod (split cane or greenheart) must be stiff and powerful; special precautions have to be taken that the fly shall float unhindered and shall not drag; special casts have to be made to counteract awkward winds; and, lastly, the matching of the fly with the insect on the water is a matter of much nicety, for the water flies are of many shades and colours. Many brains have busied themselves with the solution of these problems. The entomology of the dry-fly stream has been studied very deeply by F. M. Halford, his friend G. S. Marryat and others, and improvements both in flies and tackle have been very great. Quite lately, however, there has been a

movement in favour of light rods for dry-fly fishing as well as wet-fly fishing. The English split-cane rod for dry-fly work weighs about an ounce to the foot, rather more or rather less. The American rod of similar action and material weighs much less—approximately 6 oz. to ro ft. The light rod, it is urged, is much less tiring and is quite powerful enough for ordinary purposes. Against it is claimed that dry-fly fishing is not “ordinary purposes,” that chalk-stream weeds are too strong and chalk-stream winds too wild for the light rod to be efficient against them. However, the light rod is growing in popular favour; British manufacturers are building rods after the American style; and anglers are taking to them more and more. The dry-fly method is now practised by many fishermen both in Germany and France, and in the United States where on some streams only dry-fly fishing is permitted.

Fishing with the Natural Fly.—The natural fly is a very killing bait for trout, but its use is not wide-spread except in Ireland. In Ireland “dapping” with the green drake or the daddy-longlegs is practised from boats on most of the big loughs. A light whole-cane rod of stiff build, about 16 ft. in length, is required with a floss-silk line light enough to be carried out on the breeze; the “dap” (generally two mayflies or daddy-longlegs on a small stout-wired hook) is carried out by the breeze and just allowed to touch the water. When a trout rises it is well to count “ten” before striking. Very heavy trout are caught in this manner during the mayfly season. In the north “creeper-fishing” is akin to this method, but the creeper is the larva of the stone-fly, not a fly itself, and it is cast more like an ordinary fly and allowed to sink. Sometimes, however, the mature insect is used with equally good results. A few anglers still practise the old style of dapping or “dibbling” after the manner advised by Izaak Walton. It is a deadly way of fishing small overgrown brooks. A stiff rod and strong gut are necessary, and a grasshopper or almost any large fly will serve for bait.

Other Methods.—The other methods of taking trout principally employed are spinning, live-baiting and worming. For big-river trout such as those of the Thames a gudgeon or bleak makes the best spinning or live bait, for great-lake trout (*ferox*) a small fish of their own species and for smaller trout a minnow. There are numberless artificial spinning-baits which kill well at times, the Devon being perhaps the favourite. The use of the drop-minnow, which is trolling on a lesser scale, is a killing method employed more in the north of England than elsewhere. The worm is most deadly in thick water, so deadly that it is looked on askance. But there is a highly artistic mode of fishing known as “clear-water worming.” This is most successful when rivers are low and weather hot, and it needs an expert angler to succeed in it. The worm has to be cast up-stream rather like a fly, and the method is little inferior to fly-fishing in delicacy and difficulty. The other baits for trout, or rather the other baits which they will take sometimes, are legion. Wasp-grubs, maggots, caterpillars, small frogs, bread—there is very little the fish will not take. But except in rural districts little effort is made to catch trout by means less orthodox than the fly, minnow and worm, and the tendency nowadays is to restrict anglers where possible to the use of the artificial fly only.

Grayling.—The only other member of the salmon family in England which gives much sport to the fly-fisher is the grayling, a fish which possesses the recommendation of rising well in winter. It can be caught with either wet or dry fly, and with the same tackle as trout, which generally inhabit the same stream. Grayling will take most small trout-flies, but there are many patterns of fly tied specially for them, most of them founded on the red tag or the green insect. Worms and maggots are also largely used in some waters for grayling, and there is a curious contrivance known as the “grasshopper,” which is a sort of compromise between the fly and bait. It consists of a leaded hook round the shank of which is twisted bright-coloured wool. The point is tipped with maggots, and the lure, half artificial, half natural, is dropped into deep holes and worked up and down in the water. In some places the method is very killing. The grayling has been very prominent of late years owing to the contro-

versy “grayling *versus* trout.” Many people hold that grayling injure a trout stream by devouring trout-ova and trout-food, by increasing too rapidly and in other ways. Beyond, however, proving the self-evident fact that a stream can only support a given amount of fish-life, the grayling’s opponents do not seem to have made out a very good case, for no real evidence of its injuring trout has been adduced.

Char.—The chars (*Salvelinus*) are a numerous family widely distributed over the world, but in Great Britain are not very important to the angler. One well-defined species (*Salvelinus alpinus*) is found in some lakes of Wales and Scotland, but principally in Westmorland and Cumberland. It sometimes takes a small fly but is more often caught with small artificial spinning-baits. The fish seldom exceeds 1½ lb. in Great Britain, though in Scandinavia it is caught up to 5 lb. or more. There are some important chars in America, *fontinalis* being one of the most esteemed. Some members of the genus occasionally attain a size scarcely excelled by the salmon. Among them are the Great Lake trout of America, *Cristivomer namaycush*, and the Danubian “salmon” or huchen, *Salmo hucho*. Both of these fish are caught principally with spinning-baits, but both will on occasion take a salmon-fly, though not with any freedom after they have reached a certain size. An attempt was once made to introduce huchen into the Thames, but it had no conclusive results.

Pike.—The pike (*Esox lucius*), which after the *Salmonidae* is the most valued sporting fish in Great Britain, is a fish of prey pure and simple. Though it will occasionally take a large fly, a worm or other ground-bait, its systematic capture is only essayed with small fish or artificial spinning-baits. A live-bait is supposed to be the most deadly lure for big pike, probably because it is the method employed by most anglers. But spinning is more artistic and has been found quite successful by those who give it a fair and full trial. Trolling, the method of “sink and draw” with a dead bait, referred to previously in this article, is not much practised nowadays, though at one time it was very popular. It was given up because the traditional form of trolling-tackle was such that the bait had to be swallowed by the pike before the hook would take hold, and that necessitated killing all fish caught, whether large or small. The same objection formerly applied to live-baiting with what was known as a gorge-hook. Now, however, what is called snap-tackle is almost invariably used in live-baiting, and the system is by some few anglers extended to the other method too. Pike are autumn and winter fish and are at their best in December. They grow to a very considerable size, fish of 20 lb. being regarded as “specimens” and an occasional 30-pounder rewarding the zealous and fortunate. The heaviest pike caught with a rod in recent years, which is sufficiently authenticated, is the 53 lb. specimen caught in Lake Conn, Ireland, in 1920, by John Garvin. River pike up to about 10 lb. in weight are excellent eating.

America has several species of pike, of which the muskellunge of the Great Lakes region (*Esox masquinongy*) is the most important. It is a very fine fish, excelling *Esox lucius* both in size and looks. From the angler’s point of view it may be considered simply as a large pike and may be caught by similar methods. It occasionally reaches the weight of 50 lb. or perhaps more. The pickerel (*Esox reticulatus*) is the only other of the American pikes which gives any sport. It reaches a respectable size, but is as inferior to the pike as the pike is to the muskellunge.

Perch.—Next to the pikes come the perches, also predatory fishes. The European perch (*Perca fluviatilis*) has a place by itself in the affections of anglers. When young it is easy to catch by almost any method of fishing, and a large number of Walton’s disciples have been initiated into the art with its help. Worms and small live-baits are the principal lures, but at times the fish will take small bright artificial spinning-baits well, and odd attractions such as boiled shrimps, caddis-grubs, small frogs, maggots, wasp-grubs, etc., are sometimes successful. The drop-minnow is one of the best methods of taking perch. Very occasionally, and principally in shallow pools, the fish will take an artificial fly greedily, a small salmon-fly being the best thing to use in such a case. A perch of 2 lb. is a good fish, and a specimen of 4½ lb.

about the limit of angling expectation. There have been rare instances of perch over 5 lb. and there are legends of eight-pounders, which, however, need authentication.

Black Bass.—The yellow perch of America (*Perca flavescens*) is very much like its European cousin in appearance and habits, but it is not so highly esteemed by American anglers, because they are fortunate in being possessed of a better fish in the black bass, another member of the perch family. There are two kinds of black bass (*Aplites salmoides* and *Micropterus dolomieu*), the large-mouthed and the small-mouthed. The first is more a lake and pond fish than the second, and they are seldom found in the same waters. As the black bass is a fly-taking fish and a strong fighter, it is as valuable to the angler as a trout and is highly esteemed. Bass-fishes are *sui generis*, but incline more to the nature of salmon-fishes than trout-fishes. An artificial frog cast with a fly-rod or very light spinning-rod is also a favourite lure. For the rest the fish will take almost anything in the nature of worms or small fish, like its cousin the perch. A 4 lb. bass is a good fish, but five-pounders are not uncommon. Black bass have to some extent been acclimatized in Italy and France, and experiments in England are in progress.

The *ruffe* or *pope* (*Acerina vulgaris*) is a little fish common in the Thames and many other slow-flowing English rivers. It is very like the perch in shape but lacks the dusky bars which distinguish the other, and is spotted with dark brown spots on a golden olive background. It is not of much use to the angler as it seldom exceeds 3 oz. in weight. It takes small worms, maggots and similar baits greedily, and is often a nuisance when the angler is expecting better fish. Allied to the perches is the pike-perch, of which two species are of some importance to the angler, one the wall-eye of eastern America (*Stizostedion vitreum*) and the other the zander of Central Europe (*Sandrus lucioperca*). The last especially is a fine fighter, occasionally reaching a weight of 20 lb. It is usually caught by spinning, but will take live-baits, worms and other things of that nature. The Danube may be described as its headquarters. It is a fish whose sporting importance will be more realized as anglers on the Continent become more numerous.

Cyprinidae.—The carp family (*Cyprinidae*) is a large one and its members constitute the majority of English sporting fishes. In America the various kinds of chub, sucker, dace, shiner, etc., are little esteemed and are regarded as spoils for the youthful angler only, or as baits for the better fish in which the Continent is so rich. In England, however, the *Cyprinidae* have an honoured place in the affections of all who angle "at the bottom," while in Europe some of them have a commercial value as food-fishes. In India at least one member of the family, the mahseer, takes rank with the salmon as a "big game" fish.

Carp, Tench, Barbel, Bream.—The family as represented in England may be roughly divided into two groups, those which feed on the bottom purely and those which occasionally take flies. The first consists of carp, tench, barbel and bream. Of these carp, tench and bream are either river or pool fish, while the barbel is found only in rivers, principally in the Thames and Trent. The carp grows to a great size, 20 lb. being not unknown; tench are big at 5 lb.; barbel have been caught up to 14 lb. or rather more; and bream occasionally reach 8 lb., while a fish of over 11 lb. is on record. All these fish are capricious feeders, particularly carp and barbel. In some waters it seems to be impossible to catch the large specimens, and the angler who seeks to gain trophies in either branch of the sport needs both patience and perseverance. Tench and bream are not quite so difficult. The one fish can sometimes be caught in great quantities, and the other is generally to be enticed by the man who knows how to set about it. Two main principles have to be observed in attacking all these fish, ground-baiting and early rising. Ground-baiting consists in casting food into the water so as to attract the fish to a certain spot and to induce them to feed. Without it very little can be done with shy and large fish of these species. Early rising is necessary because they only feed freely, as a rule, from daybreak till about three hours after sunrise. The heat of a summer or early autumn day makes them sluggish, but an hour

or two in the evening are sometimes remunerative. The bait for them all should usually lie on the bottom, and it consists mainly of worms, wasp and other grubs, pastes of various kinds; and for carp, and sometimes bream, of vegetable baits such as small boiled potatoes, beans, peas, stewed wheat, pieces of banana, etc. None of these fish feed well in winter.

Roach, Rudd, Dace, Chub.—The next group of *Cyprinidae* consists of fish which will take a bait similar to those already mentioned and also a fly. The sizes which limit the ordinary angler's aspirations are roach about 2 lb., rudd about 2½ lb., dace about 1 lb. and chub about 5 lb. There are instances of individuals heavier than this, one or two roach and many rudd of over 3 lb. being on record, while dace have been caught up to 1 lb. 6 oz., and chub of over 7 lb. are not unknown. Roach only take a fly as a rule in very hot weather when they are near the surface, or early in the season when they are on the shallows; the others will take it freely throughout the summer. Ordinary trout flies do well enough for all four species, but chub often prefer something larger, and big bushy lures called "palmers," which represent caterpillars, are generally used for them. The fly may be used either wet or dry for all these fish, and there is little to choose between the methods as regards effectiveness. Fly-fishing for these fish is a branch of angling which might be more practised than it is, as the sport is a very fair substitute for trout-fishing. Roach, chub and dace feed on bottom food and give good sport all the winter.

Gudgeon, Bleak, Minnow, etc.—The small fry of European waters, gudgeon, bleak, minnow, loach, stickleback and bullhead, are principally of value as bait for other fish, though the first-named species gives pretty sport on fine tackle and makes a succulent dish. Small red worms are the best bait for gudgeon and minnows, a maggot or small fly for bleak, and the rest are most easily caught in a small-meshed net. The loach is used principally in Ireland as a trout bait, and the other two are of small account as hook-baits, though sticklebacks are a valuable form of food for trout in lakes and pools.

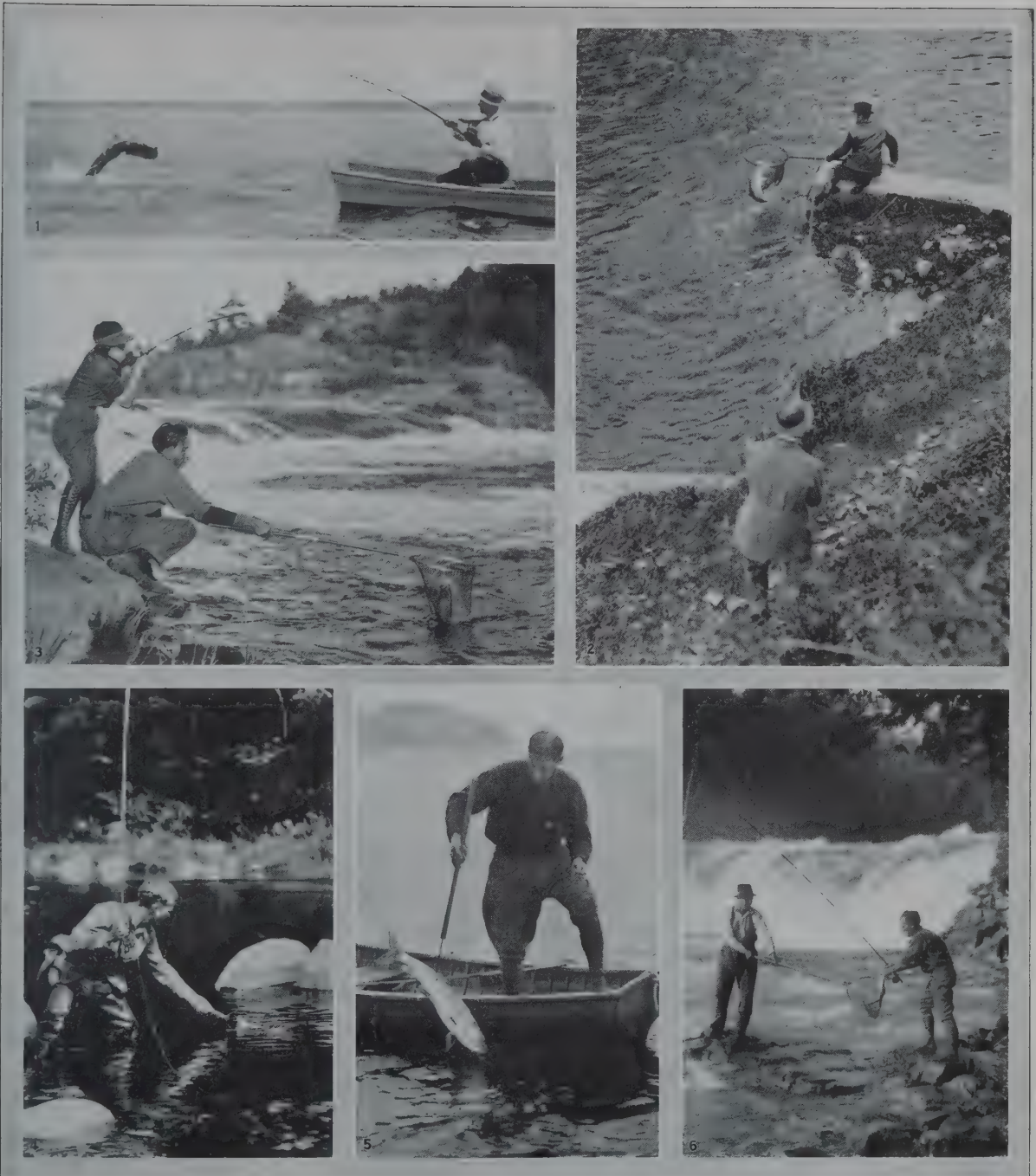
Mahseer.—Among the carps of India, several of which give good sport, special mention must be made of the mahseer (*Barbus mosal*), a fish which rivals the salmon both in size and strength. It reaches a weight of 60 lb. and sometimes more and is fished for in much the same manner as salmon, with the difference that after about 10 lb. it takes a spinning-bait, usually a heavy spoon-bait, better than a fly.

Cat-fish.—None of the fresh-water cat-fishes (of which no example is found in England) can be described as sporting fish, but several may be caught with rod and line. There are several kinds in North America, and some of them are as heavy as 100 lb., but the most important is the wels (*Silurus glanis*) of the Danube and neighbouring waters. This is the largest European fresh-water fish, and it is credited with a weight of 300 lb. or more. It is a bottom feeder and will take a fish-bait either alive or dead; it is said occasionally to run at a spinning-bait when used very deep.

Burbot.—The burbot (*Lota vulgaris*) is the only fresh-water member of the cod family in Great Britain, and it is found only in a few slow-flowing rivers such as the Trent, and there not often, probably because it is a fish of sluggish habits which feeds only at night. It reaches a weight of 3 lb. or more, and will take most flesh or fish baits on the bottom. The burbot of America has similar characteristics.

Sturgeon.—The sturgeons, of which there are a good many species in Europe and America, cannot be taken by angling. They are anadromous fishes of which little more can be said than that a specimen might take a bottom bait once in a while. In Russia they are sometimes caught on long lines armed with baited hooks, and occasionally an angler hooks one. Such a case was reported from California in *The Field* of Aug. 19, 1905.

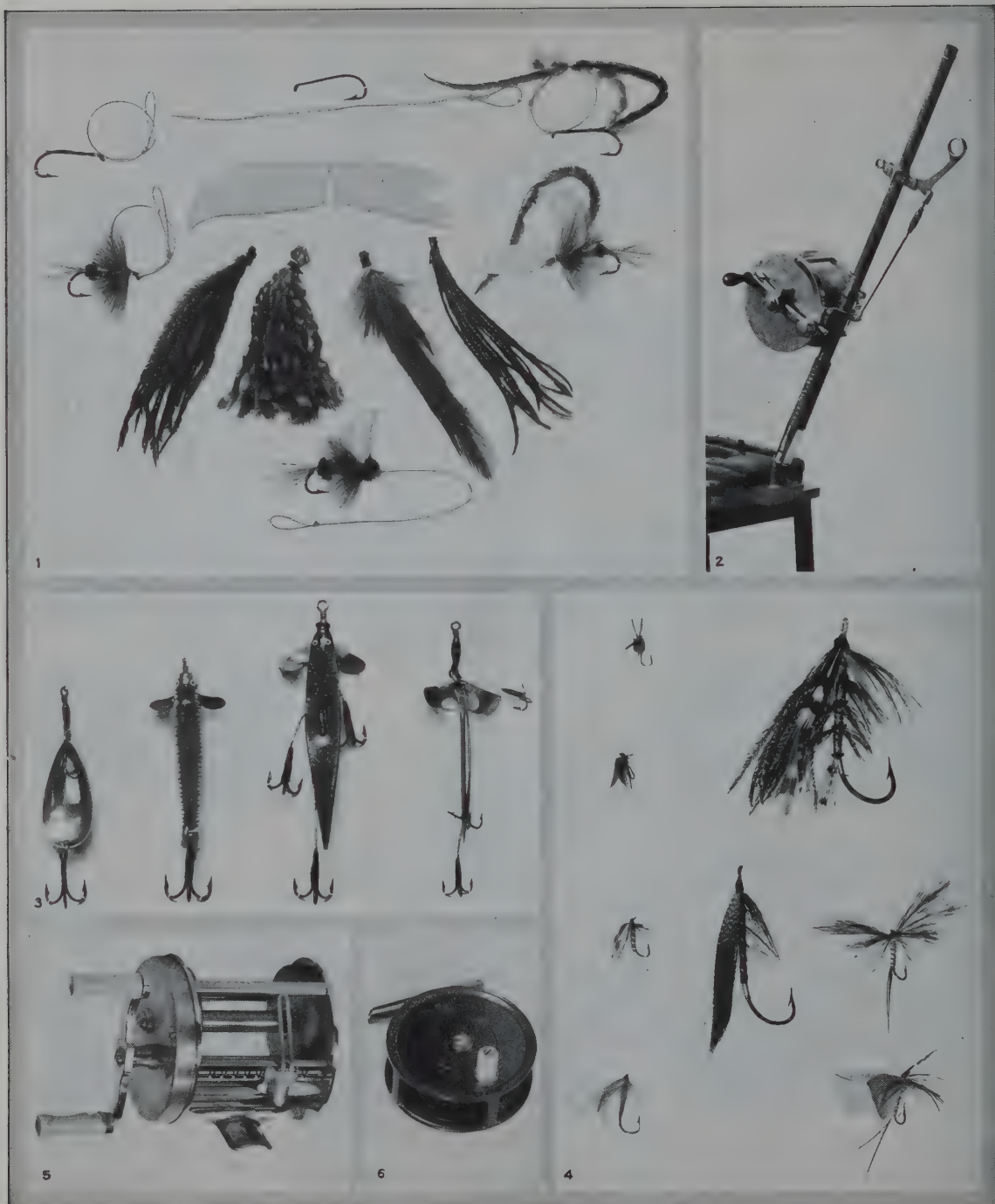
Shad.—Two other anadromous fish deserve notice. The first is the shad, a herring-like fish of which two species, allice and twaite (*Clupea alosa* and *C. finta*), ascend one or two British and several Continental rivers in the spring. The twaite is the more common, and in the Severn, Wye and Teme it sometimes gives very fair



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ANGLING IN ENGLAND AND AMERICA

1. An American entrant in the national tarpon tournament at Venice, Florida, playing an 87-pound tarpon
2. Gillie landing a salmon from the Torridge river, Devon, England, after it has been hooked and played by the angler, seen in the foreground
3. Use of a landing net on the French river, at the outlet of Lake Nipissing, in Ontario
4. Landing fish with a dip net, commonly used for catching game fish in lakes and mountain streams
5. Gaffing an 11-pound trout from Lake George, in the foothills of the Adirondack mountains
6. Trout fishing in the Nipigon river, the largest Canadian tributary to Lake Superior



BY COURTESY OF (1) THE WEBER LIFELIKE FLY COMPANY, (2) "THE FIELD," (3) W. J. CUMMINS, (4) FARLOW AND COMPANY, (5, 6) ALLCOCK AND COMPANY

TYPES OF FISHING REELS AND FLIES

- Steps taken in making a dry fly. A peacock's quill, a cock's hackle and a starling's wing feathers are all used in making a dry fly
- The reel shown in position on the rod. The butt end of the rod is attached to the angler's seat when extra leverage is needed
- Left to right: A spoon; silk phantom minnow as used on River Wye, England; Wagtail; an archer flight for mounting a natural dead minnow
- Left, reading up: trout fly, old style wet fly; trout fly, modern wet fly; trout fly with upright wings; trout fly, modern nymph. Upper right, salmon fly, old type, heavily dressed; centre, salmon fly, modern, lightly dressed; right centre, May fly, spent gnat; lower right, May fly, green drake
- Casting reel. The gearing between handle and drum compensates for the small diameter of the spool
- Fly fishing reel. This type, with narrow drum, is used for trout. A similar reel with larger drum is used for salmon

sport to anglers, taking worm and occasionally fly or small spinning bait. It is a good fighter, and reaches a weight of about 3 lb. Its sheen when first caught is particularly beautiful. America also has its shads.

Flounder.—The other is the flounder (*Platichthys flesus*), the only flat-fish which ascends British rivers. It is common a long way up such rivers as the Severn, far above tidal influence, and it will take almost any flesh-bait used on the bottom. A flounder of 1 lb. is, in a river, a large one, but heavier examples are sometimes caught.

Eel.—The eel (*Anguilla anguilla*) is regarded by the angler more as a nuisance than a sporting fish, but when of considerable size (and it often reaches a weight of 8 lb. or more) it is a splendid fighter and stronger than almost any fish that swims. Its life history has long been disputed, but it is now accepted that it breeds in the sea in the neighbourhood of the Azores and ascends rivers in its youth. It is found practically everywhere, and its occurrence in isolated ponds to which it has never been introduced by human agency has given rise to a theory that it travels overland as well as by water. The best baits for eels are worms and small fish, and the best time to use them is at night or in thundery or very wet weather.

SEA ANGLING

Sea angling is attended by almost as many refinements of tackle and method as fresh-water angling. The chief differences are differences of locality and the habits of the fish. To a certain extent sea angling may also be divided into three classes—fishing on the surface with the fly, at mid-water with spinning or other bait, and on the bottom; but the first method is only practicable at certain times and in certain places, and the others, from the great depths that often have to be sounded and the heavy weights that have to be used in searching them, necessitate shorter and stouter rods, larger reels and stronger tackle than fresh-water anglers employ. Also, of course, the sea-fisherman is liable to come into conflict with very large fish occasionally. In British waters the monster usually takes the form of a skate or halibut.

Rarely does the fisherman land those in the giant class, but in 1941, off Kangaroo island, Australia, a 1,919 lb. man-eating shark was taken on rod and reel. Other species of shark, weighing over 1,000 lb. have also been credited to anglers.

Great Game Fishes.—There are several giants of the sea which are regularly pursued by anglers, among them being the tarpon (*Tarpon atlanticus*) and the tuna or tunny (*Thynnus thynnus*), to which must now be added sharks, swordfish and others, particularly in Australian waters, that have already been mentioned in the section devoted to *modern conditions*. Jewfish and black sea-bass of over 400 lb. have been taken on rod and line. Practically all of them are taken with a fish-bait either live or dead, and used stationary on the bottom or in mid-water trailed behind a boat.

British Game Fishes.—On a much smaller scale are the fishes most esteemed in British waters. The bass (*Labrax lupus*) heads the list as a plucky and rather difficult opponent. A fish of 10 lb. is a large one, but 15-pounders have been taken. Small or "school" bass up to 3 lb. or 4 lb. may sometimes be caught with the fly (generally a roughly constructed thing with big wings), and when they are really taking, the sport is magnificent. In some few localities it is possible to cast for them from rocks with a salmon rod, but usually a boat is required. In other places bass may be caught from the shore with fish-bait used on the bottom in quite shallow water.

They may again sometimes be caught in mid-water, and in fact there are few methods and few lures employed in sea angling which will not account for them at times.

The pollack (*Pollachius virens*), or coalfish, comes next in esteem. In some places it reaches a weight of 20 lb. or more, and when young will take a fly. Usually, however, the best sport is obtained by trailing some spinning-bait, such as an artificial or natural sand-eel, behind a boat. Sometimes the bait must be kept near the bottom while at other times the fishes come closer to the surface for feeding. The larger gray mullet (*Mugil capito*) is a great favourite with many anglers, as it is

extremely difficult to hook, and when hooked fights strongly. Fishing for mullet is more akin to fresh-water fishing than any branch of sea-angling, and indeed can be carried on in almost fresh water, for the fish frequent harbours, estuaries and tidal pools. They can be caught close to the surface, at mid-water and at the bottom, and as a rule vegetable baits, such as boiled macaroni, or rag-worms are found to answer best. Usually ground-baiting is necessary, and the finer the tackle used the greater is the chance of sport. Not a few anglers fish with a float as if for river fish. The fish runs up to about 8 lb. in weight. The cod (*Gadus morrhua*) grows larger and fights less gamely than any of the fish already mentioned. It is generally caught with bait used on the bottom from a boat, but in places codling, or young cod, give some sport to anglers fishing from the shore. The mackerel (*Scomber scombrus*) gives the best sport to a bait, usually a strip of fish skin, trailed behind a boat fairly close to the surface, but it will sometimes feed on the bottom. Mackerel on light tackle are game fighters, though they do not usually much exceed 2 lb. Whiting and whiting-pout (*Gadus merlangus* and *G. luscus*) both feed on or near the bottom, do not grow to any great size, and are best sought with fine tackle, usually an arrangement of three or four hooks at intervals above a lead which is called a "paternoster." If one or more of the hooks are on the bottom the tackle will do for different kinds of flat fish as well, flounders and dabs being the two species most often caught by anglers. The bream (*Pagellus centrodontus*) is another bottom-feeder which resembles the fresh-water bream both in appearance and habits. It is an early morning or rather a nocturnal fish, and grows to a weight of 3 lb. or 4 lb. Occasionally it will feed in mid-water or even close to the surface. The conger eel (*Conger vulgaris*) is another night-feeder, which gives fine sport, as it grows to a great size and is very powerful. Strong tackle is essential for conger fishing, as so powerful an opponent in the darkness cannot be given any law. The bait must be on or near the bottom. There are, of course, many other fish which come to the angler's rod at times, but the list given is fairly complete as representing the species which are especially sought. Beside them are occasional (in some waters too frequent) captures such as dog-fish and sharks, skates and rays. Many of them run to a great size and give plenty of sport on a rod, though they are not as a rule welcomed. Lastly, it must be mentioned that certain of the *Salmonidae*, smelts (*Osmerus eperlanus*), sea trout, occasionally brown trout, and still more occasionally salmon can be caught in salt water either in sea-lochs or at the mouths of rivers. Smelts are best fished for with tiny hooks tied on fine gut and baited with fragments of shrimp, rag-worm and other delicacies.

Legislation.—A Fishery Act for England and Wales, passed in 1923, improves and consolidates previous legislation. The pollution of rivers has inspired a new movement of co-operation between industrial and fishing interests. The British government set up a pollution committee, which has been at work for several years, and from its labours some good results are apparent. A deputation to the prime minister organized by the joint efforts of the Salmon and Trout Association and the British Waterworks Association in Feb. 1927, urging the appointment of a central water authority, has resulted in the setting up of two new committees, one for technical research into ways and means of abating pollution, the other to act in an advisory capacity to the government on legislative and administrative questions in regard to rivers. A new source of danger is the dressing of roads made necessary by increased motor traffic. It has been established that tar, very largely used at first, may have disastrous effects when road washings get into streams. The trouble is in some cases being removed by the use of bitumen instead, and experiment is being carried on by the pollution committee in regard to other safeguards. (H. T. S.; H. D. T.; X.)

UNITED STATES

Sea angling in the United States has enrolled more new members since 1918 than any other sport. This is largely due to cheap and rapid transportation. Where in the days of the old sail boats it would take five or six hours to reach a spot off shore, the same run is now made in an hour or so with a cer-

tainty of getting back within a specified time. In 1918 there were perhaps five or six open deep-sea fishing boats leaving New York and nearby ports. Twenty years later the fleet which sailed from Long Island and New Jersey harbours, small charter-boats especially equipped for anglers numbered in the hundreds. Fishermen from inland cities, as a diversion from fresh-water angling, tried their luck on the west coast or in the Florida, Maine and New York areas for big-game fishing. World War II time orders halted all off-shore angling in 1942 however, and the fishing fleet assumed coastal patrol duties.

Big-fish angling has advanced more than any other branch of angling. Big-fish hunters on both the Atlantic and Pacific coasts have caught with rod and reel tuna weighing up to 927 lb. and broadbill swordfish of more than 800 lb. In 1926, in the waters of New Zealand, an American with rod and reel landed a black marlin swordfish that tipped the scale at 976 lb. There are many sea anglers who catch their fish on the lightest possible tackle, and valuable prizes are offered for landing huge game fish with this tackle. In fact, one club in America permits its members to use only cotton thread, and striped bass, weakfish or bluefish over 10 lb., handled on this thread, take considerable time and skill to land.

The tackle used for sea angling consists of a rod made of six strips of bamboo glued together, or hickory, bathabara, greenheart, black palm, lancewood or palma brava woods. To these rods are attached guides, preferably of agate. At the end of the rod is a butt upon which is affixed a reel seat, made of German silver, to which the reel is fastened. Butts are made of hickory or other wood, and wound with either cane or cork. Only lines of linen should be used and great care should be exercised when drying them as rust spots will prove disastrous. The hooks, sinkers and various lures differ according to the species of fish sought. There are hundreds of species of salt-water fish which abound on the east and west coasts of the United States. In fact in the salt waters bordering on Florida there are more than 600 species, but there will be discussed here only those that are most sought after for their gameness and flesh by the followers of Izaak Walton.

Flounders, Fluke and Halibut.—Flounders are caught on the east coast from Maine to Virginia and usually come out of their mud beds about February. They are found in bays or inlets where there is a sandy bottom. A light rod is employed in their capture, the tip of which should weigh 3 or 4 oz. A nine or ten Chestertown hook, six thread linen line and a sinker just heavy enough to hold bottom in the tide should be used. The hooks should be tied closely to the sinker as the flounder is a bottom feeder, and sand, blood or earth worms should be used as a lure. As the flounder has an exceedingly small mouth and has a habit of sucking in the bait, do not try to strike him at the first nibble, but allow plenty of time for the bait and hook to pass into the mouth before sinking the hook. Flounders weigh from $\frac{1}{2}$ lb. to 4 lb. each, with an occasional specimen of 6 lb. Net fishermen have brought them in weighing over 10 lb. each.

The fluke is of the flat species, belonging to the flounder family, but is larger in size and has a fairly big mouth with teeth. He is found in the oceans, inlets and bays, usually along sandy, clean bottoms. A rod with a tip weighing 5 oz. to 6 oz. is used and a linen line of six to nine thread, affixed to which is a gut leader about 3 ft. long. A number 4 to 10 Kirby hook is the right size. Killies spearing or cut-fish bait is used principally as lures. The fluke may be taken at any time during the day regardless of tides. The best method of capture is to allow the boat to drift over the grounds where fluke have their habitat, allowing bait to drag on the bottom. Fluke weigh from 1 lb. to 16 lb.; occasionally one is brought in by the beam trawlers weighing from 20 to 25 lb.

Halibut are rarely sought by anglers owing to the fact that their habitat is so far off shore that it is difficult to reach them. They are usually taken at the banks off Newfoundland and off the coast of California, Oregon and Washington. The largest halibut ever known to be caught was landed off the Grand Banks about 1918 and weighed 680 lb.

Striped Bass, Seabass, Porgies and Blackfish.—The striped bass is a much sought after salt-water fish, and ranges from Maine to the Carolinas. In 1886, 300 of them were taken from the

Shrewsbury river of New Jersey and planted in the waters of California. They have flourished on the west coast because of the strictly enforced laws in California protecting them. They can be taken from April to November and are found in the ocean close to shore, in bays and rivers of brackish water. The rod should weigh from 3 oz. to 10 oz. and the line should be of linen from 6 to 15 thread. A 4 to 10-O Sproat hook affixed to gut is used when bait fishing, and crabs, clams, worms, eels, mullet and cut-up fish are used as lures. They will also strike a lead squid or spoon. They are caught at any time of day or night and on almost any tide. Striped bass weigh from 1 lb. to 73 lb.—the world's record by angling. But specimens have been taken in the nets weighing over 100 lb.

Seabass range from Long Island to the Carolinas. They resemble, somewhat, fresh-water bass, and come in huge schools, having their habitat around rocks or wrecks. A 5 oz. or 6 oz. rod is used in their capture, and the line should be of from 9 to 12 thread. They feed on sea clams, squid (inkfish) and mossbunker. A 3 to 5-O Sproat or O'Shaughnessy hook should be used and a sinker heavy enough to hold bottom. As a rule when a seabass hits the lure he hooks himself and gives a fair account of himself, considering his size. Seabass weigh from $\frac{1}{2}$ lb. to 7 lb., and are eagerly sought after by the deep-sea anglers of New Jersey and Long Island.

Porgies usually make their appearance with the seabass and are caught on the same tackle. The blackfish or tautog is caught over rocks and wrecks in the oceans and bays from Maine to the Carolinas. A number 1 to 6 Virginia hook is employed and the same tackle used as prescribed for seabass. Blackfish feed on clams, crabs and worms. The larger fish, being suspicious, are hard to hook, but they usually give warning before they take hold, and it is advisable to allow a blackfish plenty of time to let the bait pass well into his jaws before setting the hook.

Cod, Pollock, Hake and Ling.—These species are caught along the Atlantic coast from Newfoundland to Virginia and also along the west coast. A rod weighing from 6 oz. to 10 oz. is used and the line should be from 12 to 15 thread. The hooks can be either 6-O to 9-O Sproat or O'Shaughnessy, and clams, conchs, scallop guts or cut-fish bait are used as lure. These species are caught during the spring and winter. At times they come fairly close to shore, but are usually taken from 1 m. to 12 m. from the shore line, in water anywhere from 60 ft. to 90 ft. deep. They can hardly be termed game fish. The cod usually captured by angling weighs from 3 to 60 lb. These four species travel together and often on one ground all four may be taken on the same day.

Bluefish and Weakfish.—These two species are eagerly sought by anglers from Massachusetts south to Florida. They are both game, hard fighting fish with the bluefish the harder fighter of the two. In fact, the bluefish is classed by many as being the gamest fish for his weight and size that swims the Seven Seas. He is a veritable bulldog at the end of a swaying rod and knows every trick of getting away. Tackle employed for the capture of weakfish and bluefish consists of a rod weighing from 3 to 6 oz. The line should be of linen from 6 to 12 thread. A 3-O to 7-O Sproat or O'Shaughnessy hook is best. Bluefish are usually caught by trolling with a lead spoon or squid or by grinding up moss bunker and throwing it overboard thus causing what is known as a slick which runs from the boat out across the water with the tide bringing the bluefish close to the boat. A piece of bunker bait is affixed to the hook, which is attached to 4 ft. or 5 ft. of German silver wire. This is thrown overboard and allowed to drift out in the chum line.

Weakfish are chummed to the boat using small shrimp or mossbunker and as a bait for weakfish, crabs, cut-fish, large sand or blood worms, squid (inkfish) or shrimp are used. These fish can be taken during the day or night and bite on the first of the flood and the last of the ebb tides. Weakfish range in weight from 1 lb. to 16 lb. and some which weighed over 20 lb. have been taken in the nets by professional fishermen. The bluefish range in weight about the same as weakfish, and a 10 or 12 pounder of either of these species is a prize worth angling for.

Channel Bass and Drum.—Channel bass or red drum is dis-

tinguishable from the ordinary drum by a black spot near its tail. It is shaped somewhat like striped bass and is a fine fighter. It may be caught from New Jersey south to Florida, and is found feeding close to shore along the surf, in inlets and bays. A rod weighing from 10 oz. to 12 oz., a linen line, 6 to 15 thread, and 3-O Ring Virginia hooks, affixed to German silver wire 2ft. long should be used. The best lures for these fish are menhaden, crabs and mullet. They are caught from May to October during the day or night; nightfall is the best, on the flood tide. Channel bass weigh from 5 lb. to 65 lb. Drum fish are often caught weighing 70 lb. and 80 lb., but do not give one the battle that the channel bass does.

Tuna, Albacore and Bonita.—These three species are similar in shape, but differ in their markings and size. The bonita is the smallest with the albacore next in size. They are usually found feeding on the same grounds and all three are swift swimmers and hard fighters. Heavy tackle is employed because one usually is seeking tuna. The tackle is so strong that little difficulty is experienced in reeling in a bonita of 6 lb. or an albacore of 20 lb., when one is after tuna weighing 200 lb. or 300 lb. These three species are usually caught while trolling and various artificial lures are affixed to a 9ft. German silver wire leader. The rod is extremely heavy, weighing in the neighbourhood of 16 oz. The reel is a huge affair, weighing 7 or 8 lb., and is capable of holding 900ft. to 1200ft. of number 36 thread line. These fish range along the Atlantic coast from Canada to Florida and in the Pacific. The record fish was taken at Ipswich bay, Mass., in 1940.

When one is fishing from an anchored boat, cut-fish bait is used as a lure. Tuna range in weight from 30 lb. to 1500 lb. The largest ever taken by angling weighed 927 lb. They are rarely caught off the Long Island or New Jersey coasts weighing more than 100 lb.; but in the Pacific ocean, many weighing well over this weight have been captured. The tuna is one of the most powerful fish that swims and a big specimen will give an angler a tussle long to be remembered. They never jump clear of the water and have a tendency after being hooked to go down to the bottom and must be "pumped" up.

Broadbill and Marlin
Swordfish.—Within recent years these two species have claimed many devotees, who concentrate their efforts around Catalina island, Calif., where hundreds of both of these species have been taken. The same tackle that is employed for tuna is used for swordfish, only a whole fish of two or three pounds is used as the lure, or a large portion of cut-fish. They are difficult to entice to take the bait and are hard to hook once they have struck it with their bill. When one is hooked, since the jaws are soft, when the fish leaps clear of the water the hook is often thrown from the fish's mouth. The most experienced broadbill swordfisherman tries to snag the fish anywhere in the body but the mouth.

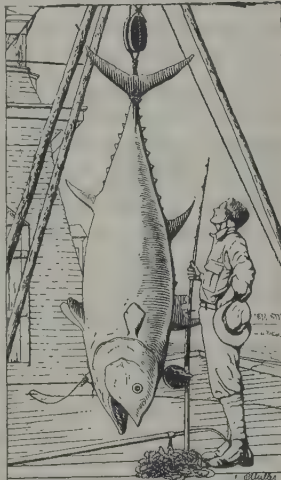
The first broadbill swordfish taken by angling off the Atlantic seaboard was landed off Montauk, L.I., in 1927. This fish weighed 193 lb. Expert broadbill swordfishermen claim this species to be more prolific off Block island, R.I., and Montauk, L. I., than at the famous waters around Catalina island, and the capture of this fish should open up a new swordfishing resort in the east. Swordfish rarely weigh under 100 lb., and go to 500 lb. or 600 lb., with the world's record for any fish caught by rod and reel being held by a black marlin 976 lb. swordfish taken in 1926 off New Zealand.

Tarpon.—Tarpon or silver king, is the most advertised fish in the world. It is caught on the east and west coasts of Florida, in

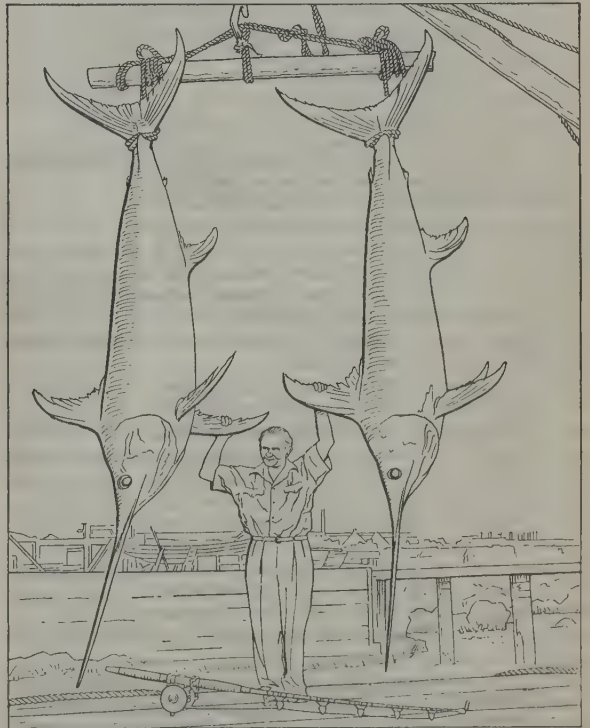
the Gulf of Mexico and off Panama. It is a huge herring and when hooked leaps many feet into the air. The rods used for its capture weigh 6 oz., 8 oz. and 12 oz. The line should be of linen 9 to 24 thread, and hooks 8-O to 10-O O'Shaughnessy. The tarpon are found in bays and inlets and the best time to seek them is on moonlight nights during the flood tide. They may be caught from February to June, May and June being the best months. One uses a spoon while trolling, and when still fishing, mullet or cut-fish. Tarpon weigh anywhere from 10 lb. to 200 lb. with the average fish weighing about 100 lb. They are practically useless as food, and many anglers after catching them allow them their freedom.

Sailfish.—The sailfish resembles the swordfish. It derives its name from the huge dorsal fin that extends a foot or two above the body, resembling a sail. They also clear the water by many feet when hooked, and are eagerly sought in the waters off Florida and off southern California. About the same tackle is employed as in the capture of the tarpon. Five to 8-O tandem hooks, baited with cut-fish, usually are most effective. The sailfish is a surface feeder and is caught by trolling in the daytime. Sailfish weigh from 30 lb. to 100 lb., a new world's record being established in 1938 with a Pacific sailfish caught off Charles island, Galapagos, that weighed 190 lb. They are an exceedingly difficult fish to hook owing to their unreadiness to take the lure into their mouths. Hooking a sailfish is an art that some anglers cannot master even after repeated trials.

Bonefish.—Veteran anglers claim the bonefish to be one of the gamest fish that swims. They are the colour of mother of pearl, are long and have a streamlike body, with tail and fins of large proportions which send them through the water with lightning speed. They are found in shallow water in Florida and the Bimini islands. The rod universally used weighs 6 oz.; the line is of linen,



BY COURTESY OF CANADIAN PACIFIC RAILWAYS
A GIANT TUNA FISH, WEIGHING 758
LB., CAUGHT IN CANADIAN WATERS



TWO BROADBILL SWORDFISH TAKEN OFF TOCOPILLA, CHILE

9 thread; the hook is 1 to 1-O Sproat. Hermit crab is the best lure. They are taken from February to June at almost any time of day. They are exceedingly shy and are usually sighted in the 18 in. to 24 in. of water in which they swim by their tails sticking out of the water when they are rooting for food at the bottom. Bonefish weigh from 3 lb. to 10 lb. When fishing in southern waters on

either the east or west coast along with the tarpon and sailfish, one catches barracuda, amberjack, yellow tail, king mackerel and a host of other species, all of which are caught on the same tackle as is used for tarpon or sailfishing. The same lures are likewise effective with these species. (F. FL.; X.)

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ANGLO-IRANIAN OIL COMPANY, LTD.: see ANGLO-PERSIAN OIL COMPANY, LTD.

ANGLO-ISRAELITE THEORY, the contention that the English-speaking peoples are the descendants of the "ten tribes" of Israel, deported by Sargon of Assyria on the fall of Samaria in 721 B.C. The theory, still held by over 2,000,000 people, materially assisted the resettlement of Jews in England in the 17th century. Richard Brothers (1757-1824), the "Nephew of the Almighty," may be regarded as its first modern apostle.

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ANGLO-JAPANESE ALLIANCE. On Jan. 30 1902, owing to the threat of Russian aggression in the Far East, Great Britain and Japan concluded an alliance of a defensive character which provided for mutual assistance in the safeguarding of British interests in China and Japanese interests in China and Korea. The agreement was a valuable asset to Japan in the war with Russia which broke out in 1904; but it did not involve Great Britain in active hostilities.

In 1905 the agreement was revised; its scope was extended to India and Eastern Asia generally, and Japan's paramount position in Korea was more definitely emphasized. Later developments, notably the annexation of Korea to the Japanese Empire in 1910, led to the renewal of the alliance on July 13, 1911. An important feature of the new agreement was the inclusion of an article exempting either high contracting party from the obligation to come to the armed assistance of the other in case of war against a Power with whom either party had concluded a general arbitration treaty (Article 4). The alliance of 1911 was to last for ten years, but in the absence of a year's notice from either contracting party to terminate the agreement it would automatically continue in existence, even after July 1921.

Abrogation of the Alliance.—In consequence of the Anglo-Japanese alliance Japan entered readily into the World War on Aug. 23 1914; but the Treaty of Versailles brought forth the League of Nations, and apart from doubts whether the alliance was not inconsistent with the obligations of the Covenant of the League, both Great Britain and Japan were becoming aware that it was increasingly unpopular in the United States and in China. At the Washington Conference (q.v.), therefore, in Dec. 1921, the agreement made for a Four-Power Pacific treaty (United States, France, British Empire, Japan) provided for the conclu-

sion of the Anglo-Japanese alliance. The alliance, therefore, ceased to exist on the deposition of the ratifications of the above treaty on Aug. 17 1923. For 21 years it had been the most stable influence in the Far Eastern position, and a cardinal factor in British and Japanese policy. (See JAPAN: History.)

BIBLIOGRAPHY.—Anglo-Japanese Agreement of Jan. 30 1902—Cd. 911: Japan No. 1 (1902); do. of Aug. 12, 1905—Cd. 2,735: Treaty No. 25 (1905); do. of July 13, 1911—Cd. 5,735: Treaty No. 18 (1911). Anglo-Japanese Declaration made to the League of Nations, dated July 8, 1920—*State Papers*, 1920, vol. cxiii. p. 370; do. dated July 7, 1921—see *The Times* (London) of July 12, 1921. For Washington Four-Power Treaty, see Conference on Limitation of Armament at Washington—Cmd. 1,627; Misc. No. 1 (1922).

ANGLO-NORMAN LITERATURE. The French language (q.v.) came over to England with William the Conqueror. During the whole of the 12th century it shared with Latin the distinction of being the literary language of England, and it was in use at the court until the 14th century. It was not until the reign of Henry IV. that English became the native tongue of the kings of England. After the loss of the French provinces, schools for the teaching of French were established in England, among the most celebrated of which we may quote that of Marlborough. The language then underwent certain changes which gradually distinguished it from the French spoken in France; but, except for some graphical characteristics, from which certain rules of pronunciation are to be inferred, the changes to which the language was subjected were the individual modifications of the various authors, so that, while we may still speak of Anglo-Norman writers, an Anglo-Norman language, properly so called, gradually ceased to exist. The prestige enjoyed by the French language, which, in the 14th century, the author of the *Manière de langage* calls "le plus bel et le plus gracieux language et plus noble parler, après latin d'escole, qui soit au monde et de touz genz mieulx prisée et amée que nul autre (quar Dieux le fist si douce et amiable principalement à l'onneur et loenge de luy mesmes. Et pour ce il peut comparer au parler des angels du ciel, pour la grand douceur et biauté d'icel)," was such that it was not till 1363 that the chancellor opened the parliamentary session with an English speech. And, although the Hundred Years' War led to a decline in the study of French and the disappearance of Anglo-Norman literature, the French language continued, through some vicissitudes, to be the classical language of the courts of justice until the 17th century. It is still the language of the Channel islands, though there too it tends more and more to give way before the advance of English.

It will be seen from the above that the most flourishing period of Anglo-Norman literature was from the beginning of the 12th century to the end of the first quarter of the 13th. The end of this period is generally said to coincide with the loss of the French provinces to Philip Augustus, but literary and political history do not correspond quite so precisely, and the end of the first period would be more accurately denoted by the appearance of the history of William the Marshal in 1225 (published for the *Société de l'histoire de France*, by Paul Meyer, 3 vols., 1891-1901). It owes its brilliancy largely to the protection accorded by Henry II. of England to the men of letters of his day. "He could speak French and Latin well, and is said to have known something of every tongue between 'the Bay of Biscay and the Jordan.' He was probably the most highly educated sovereign of his day, and amid all his busy active life he never lost his interest in literature and intellectual discussion; his hands were never empty, they always had either a bow or a book" (*Dict. of Nat. Biog.*). Wace and Benoît de Sainte-More compiled their histories at his bidding, and it was in his reign that Marie de France composed her poems. An event with which he was closely connected, viz., the murder of Thomas Becket, gave rise to a whole series of writings, some of which are purely Anglo-Norman. In his time appeared the works of Beroul and Thomas respectively, as well as some of the most celebrated of the Anglo-Norman *romans d'aventure*. It is important to keep this fact in mind when studying the different works which Anglo-Norman literature has left us.

Epic and Romance.—The French epic came over to England at an early date. We know that a *Chanson de Roland* was sung

at the battle of Hastings, and we possess Anglo-Norman mss. of a few *chansons de geste*. The *Pèlerinage de Charlemagne* (Koschwitz, *Altfranzösische Bibliothek*, 1883) was, for instance, only preserved in an Anglo-Norman manuscript of the British Museum (now lost), although the author was certainly a Parisian. The oldest manuscript of the *Chanson de Roland* that we possess is also a manuscript written in England, and amongst the others of less importance we may mention *La Chançon de Willame*, the ms. of which has (June 1903) been published in facsimile at Chiswick (cf. Suchier's edition in *Bibliotheca Normannica*. T. viii. [1911] and Elizabeth Hearn Tyler [Oxford Univ. Press, 1916]). Although the diffusion of epic poetry in England did not actually inspire any new *chansons de geste*, it developed the taste for this class of literature, and the epic style in which the tales of *Horn*, of *Bovon de Hampton*, of *Guy of Warwick* (still unpublished), of *Waldef* (still unpublished) and of *Fulk Fitz Warine* are treated, is certainly partly due to this circumstance. Although the last of these works has come down to us only in a prose version, it contains unmistakable signs of a previous poetic form, and what we possess is really only a rendering into prose similar to the transformations undergone by many of the *chansons de geste* (cf. L. Brandin, *Fouke Fitz Warin* [1928]).

The interinfluence of French and English literature can be studied in the Breton romances and the *romans d'aventure* even better than in the epic poetry of the period. The *Lay of Orpheus* is known to us only through an English imitation; the *Lai du cor* was composed by Robert Biket, an Anglo-Norman poet of the 12th century (Wulff, Lund, 1888). The *lais* of Marie de France were written in England, and the greater number of the romances composing the *matière de Bretagne* seems to have passed from England to France through the medium of Anglo-Norman. The legends of Merlin and Arthur, collected in the *Historia Regum Britanniae* by Geoffrey of Monmouth (d. 1154), passed into French literature bearing the character which the bishop of St. Asaph had stamped upon them. Chrétien de Troyes' *Perceval* (c. 1175) is doubtless based on an Anglo-Norman poem. Robert de Boron (c. 1215) took the subject of his *Merlin* (published by G. Paris and J. Ulrich, 1886, 2 vols., *Société des Anciens Textes*) from Geoffrey of Monmouth. Finally, the most celebrated love-legend of the middle ages, and one of the most beautiful inventions of world-literature, the story of Tristan and Iseult, tempted two authors, Beroul and Thomas, the first of whom is probably, and the second certainly, Anglo-Norman (see ARTHURIAN LEGEND; GRAIL, THE HOLY; TRISTAN). One *Folie Tristan* was composed in England in the last years of the 12th century. (For all these questions see *Soc. des Anc. Textes*, Muret's ed. 1903; Bédier's ed. 1902-05.) Less fascinating than the story of Tristan and Iseult, but nevertheless of considerable interest, are the two *romans d'aventure* of Hugh of Rutland, *Ipomedon* (published by Kölbinger and Koschwitz, Breslau, 1889) and *Protesilaus* (still unpublished), written about 1185. The first relates the adventures of a knight who married the young duchess of Calabria, niece of King Meleager of Sicily, but was loved by Medea, the king's wife. The second poem is the sequel to *Ipomedon*, and deals with the wars and subsequent reconciliation between Ipomedon's sons, Daunus, the elder, lord of Apulia, and Protesilaus, the younger, lord of Calabria. Protesilaus defeats Daunus, who had expelled him from Calabria. He saves his brother's life, is reinvested with the dukedom of Calabria and, after the death of Daunus, succeeds to Apulia. He subsequently marries Medea, King Meleager's widow, who had helped him to seize Apulia, having transferred her affection for Ipomedon to his younger son (cf. Ward, *Cat. of Rom.*, i. 728). To these two romances by an Anglo-Norman author, *Amadas et Idoine*, of which we possess only a Continental version, is to be added. Gaston Paris has proved indeed that the original was composed in England in the 12th century (*An English Miscellany presented to Dr. Furnivall in Honour of his Seventy-fifth Birthday*, 1901, 386-394). The Anglo-Norman poem on the *Life of Richard Coeur de Lion* is lost, and an English version only has been preserved. About 1250 Eustace of Kent introduced into England the *roman d'Alexandre* in his *Roman de toute chevalerie*, many passages of which have been imitated in one of the oldest

English poems on Alexander, namely, *King Alisaunder* (P. Meyer, *Alexandre le grand*, 1886, ii. 273, and Weber, *Metrical Romances*, Edinburgh).

Fabliaux, Fables and Religious Tales.—In spite of the incontestable popularity enjoyed by this class of literature, we have only seven *fabliaux* written in England. As to fables, one of the most popular collections in the middle ages was that written by Marie de France, which she claimed to have translated from *King Alfred*. In the *Contes moralisés*, written by Nicole Bozon shortly before 1320 (*Soc. Anc. Textes*, 1889), a few fables bear a strong resemblance to those of Marie de France.

The religious tales deal mostly with the Mary Legends, and have been handed down to us in three collections:

(i.) The Adgar's collection. Most of these were translated from William of Malmesbury (d. 1143?) by Adgar in the 12th century ("Adgar's Marien-Legenden," *Altfr. Biblioth.* ix.; J. A. Herbert, *Rom.* xxxii. 394).

(ii.) The collection of Everard of Gateley, a monk of St. Edmund at Bury, who wrote c. 1250 three Mary Legends (*Rom.* xxix. 27).

(iii.) An anonymous collection of 60 Mary Legends composed c. 1250 (Brit. Museum Old Roy. 20 B, xiv.), some of which have been published in Suchier's *Bibliotheca Normannica*; in the *Altfr. Bibl.* See also Mussafia, "Studien zu den mittelalterlichen Marienlegenden" in *Sitzungsb. der Wien. Akademie* (t. cxiii., cxv., cxix., cxliii., cxlix.).

Another set of religious and moralizing tales is to be found in Chardri's *Set dormans* and *Josaphat*, c. 1216 (Koch, *Altfr. Bibl.*, 1880; G. Paris, *Poèmes et légendes du moyen âge*).

History.—Of far greater importance, however, are the works which constitute Anglo-Norman historiography. The first Anglo-Norman historiographer is Geoffrey Gaimar, who wrote his *Estorie des Angles* (between 1147 and 1151) for Dame Constance, wife of Robert Fitz-Gislebert (*The Anglo-Norman Metrical Chronicle*, Hardy and Martin, i. ii., 1888). This history comprised a first part (now lost), which was merely a translation of Geoffrey of Monmouth's *Historia Regum Britanniae*, preceded by a history of the Trojan War, and a second part which carries us as far as the death of William Rufus. For this second part he has consulted historical documents, but he stops at the year 1087, just when he has reached the period about which he might have been able to give us some first-hand information. Similarly, Wace in his *Roman de Rou et des ducs de Normandie* (edit. Andresen, Heilbronn, 1877-79, 2 vols.), written 1160-74, stops at the battle of Tinchebray in 1107 just before the period for which he would have been so useful. His *Brut* or *Geste des Bretons* (Le Roux de Lincy, 1836-38, 2 vols.), written in 1155, is merely a translation of Geoffrey of Monmouth. "Wace," says Gaston Paris, speaking of the *Roman de Rou*, "traduit en les abrégant des historiens latins que nous possédons; mais ça et là il ajoute soit des contes populaires, par exemple sur Richard I^{er}, sur Robert I^{er}, soit des particularités qu'il savait par tradition (sur ce même Robert le magnifique, sur l'expédition de Guillaume, etc.) et qui donnent à son oeuvre un réel intérêt historique. Sa langue est excellente; son style clair, serré, simple, d'ordinaire assez monotone, vous plaît par sa saveur archaïque et quelquefois par une certaine grâce et une certaine malice."

The *History of the Dukes of Normandy* by Benoît de Sainte-More is based on the work of Wace. It was composed at the request of Henry II. about 1170, and takes us as far as the year 1135 (edit. by Francisque Michel, 1836-44, *Collection de documents inédits*, 3 vols.). The 43,000 lines which it contains are of but little interest to the historian; they are too evidently the work of a *romancier courtois*, who takes pleasure in recounting love-adventures such as those he has described in his romance of Troy. Other works, however, give us more trustworthy information, for example, the anonymous poem on Henry II.'s *Conquest of Ireland* in 1172 (edit. Francisque Michel, 1837), which, together with the *Expugnatio hibernica* of Giraud de Barri, constitutes our chief authority on this subject. The *Conquest of Ireland* was republished in 1892 by Goddard Henry Orpen, under the title of *The Song of Dermot and the Earl*. Similarly, Jourdain Fan-

tosme, who was in the north of England in 1174, wrote an account of the wars between Henry II., his sons, William the Lion of Scotland and Louis VII., in 1173 and 1174 (*Chronicle of the reigns of Stephen . . . III.*, edit. by Joseph Stevenson and Fr. Michel, 1886, pp. 202-307). Not one of these histories, however, is to be compared in value with *The History of William the Marshal, Count of Striguil and Pembroke*, regent of England from 1216-19, found and subsequently edited by Paul Meyer for the Société de l'histoire de France (3 vols., 1891-1901). This masterpiece of historiography was composed in 1225 or 1226 by a professional poet of talent at the request of William, son of the marshal. It was compiled from the notes of the marshal's squire, John d'Early (d. 1230 or 1231), who shared all the vicissitudes of his master's life and was one of the executors of his will. This work is of great value for the history of the period 1186-1219, as the information furnished by John d'Early is either personal or obtained at first hand. In the part which deals with the period before 1186, it is true, there are various mistakes, due to the author's ignorance of contemporary history, but these slight blemishes are amply atoned for by the literary value of the work. The style is concise, the anecdotes are well told, the descriptions short and picturesque; the whole constitutes one of the most living pictures of mediaeval society. Very pale by the side of this work appear the *Chronique* of Peter of Langtoft, written between 1311 and 1320, and mainly of interest for the period 1294-1307 (edit. by T. Wright, 1866-68); the *Chronique* of Nicholas Trevet (1258?-1328?), dedicated to Princess Mary, daughter of Edward I. (Dufus Hardy, *Descr. Catal.* III., 349-350); the *Scala Chronica* compiled by Thomas Gray of Heaton (died c. 1369), which carries us to the year 1362-63 (edit. by J. Stevenson, Maitland Club, Edinburgh, 1836); the *Black Prince*, a poem by the poet Chandos, composed about 1386, and relating the life of the Black Prince from 1346-76 (re-edited by Francisque Michel, 1883); and, lastly, the different versions of the *Brutes*, the form and historical importance of which have been indicated by Paul Meyer (*Bulletin de la Société des Anciens Textes*, 1878, pp. 104-145), and by F. W. D. Brie (*Geschichte und Quellen der mittellenglischen Prosa-chronik, The Brute of England or The Chronicles of England*, Marburg, 1905).

Finally we may mention, as ancient history, the translation of Eutropius and Dares, by Geoffrey of Waterford (13th century), who gave also the *Secret des Secrets*, a translation from a work wrongly attributed to Aristotle (*Rom.* xxiii. 314).

Satire and Drama.—The popularity enjoyed by the *Roman de Renart* and the Anglo-Norman version of the *Riote du Monde* (*Z. f. rom. Phil.* viii. 275-289) in England is proof enough that the French spirit of satire was keenly appreciated. The clergy and the fair sex presented the most attractive target for the shots of the satirists. However, an Englishman raised his voice in favour of the ladies in a poem entitled *La Bonté des dames* (Meyer, *Rom.* xv. 315-339), and Nicole Bozon, after having represented "Pride" as a feminine being whom he supposes to be the daughter of Lucifer, and after having fiercely attacked the women of his day in the *Char d'Orgueil* (*Rom.* xiii. 516), also composed a *Bonté des femmes* (P. Meyer, *op. cit.* 33) in which he covers them with praise, commending their courtesy, their humility, their openness and the care with which they bring up their children. A few pieces of political satire show us French and English exchanging amenities on their mutual shortcomings. The *Roman des Français*, by André de Coutances, was written on the Continent, and cannot be quoted as Anglo-Norman although it was composed before 1204 (*cf.* Gaston Paris: *Trois versions rimées de l'évangile de Nicodème*, *Soc. Anc. Textes*, 1885). It is a very spirited reply to French authors who had attacked the English.

Dramatic literature must have had a considerable influence on the development of the sacred drama in England, but none of the French plays acted in England in the 12th and 13th centuries has been preserved. *Adam*, which is generally considered to be an Anglo-Norman mystery of the 12th century, was probably written in France at the beginning of the 13th century (*Romania* xxii. 637), and the so-called Anglo-Norman *Resurrection* belongs also to continental French. It is necessary to state that the earli-

est English moralities seem to have been imitations of the French. Didactic and hagiographic literature are represented by numerous works, a complete list of which will be found in Johan Vising's *Anglo-Norman Language and Literature*.

BIBLIOGRAPHY.—J. Vising, *Anglo-Norman Language and Literature* (1923); O. H. Prior, "Remarques sur l'anglo-normand" (*Romania*, 1923); J. P. Strachey, *Poem on the Assumption*, H. J. Chaytor; *Poem on the day of Judgment*, D. H. Prior, *Divisiones Mundi*; these three pieces are published in *Cambridge Anglo-Norman Texts* (1924).

(L. B.)
ANGLO-PERSIAN (now ANGLO-IRANIAN) OIL COMPANY, LTD. This company was formed in London in 1909 to operate an oil concession over some 480,000 square miles in Iran (Persia), which had been granted in 1901 by the Government of Iran to the late William Knox D'Arcy.

After heavy expenditure, without commercial results, for some years by the Concessions Syndicate (formed by D'Arcy in conjunction with the Burmah Oil Company) oil had been discovered in large quantities in 1908 at Masjid-i-Sulaiman, some 135 miles north of the head waters of the Persian Gulf.

In 1911 this field was connected by pipeline with Abadan, on the estuary of the Shatt-al-Arab. A year later the Abadan refinery was completed, and it has since become one of the largest and most modern in the world.

By 1913 the company was in need of further capital, and this was subscribed in 1914 by the British Government, then anxious to ensure fresh sources of supply for its requirements of fuel oil. At the same time a long-term contract was concluded for the supply to the Admiralty of fuel oil, for which the company thus obtained an assured market.

In 1933 the D'Arcy Concession was replaced by a new agreement under which the period of the company's operations in Iran was extended until 1993, and further royalty payments were based principally on a tonnage basis, in place of the former percentage of "net profits." The company later selected 100,000 sq.mi. of territory in southern Iran as the definitive area of the new concession.

After 1909 other oil fields were proved in Iran, notably at Haft Kel and at Gach Saran, which were connected by pipeline with Abadan.

The general progress of the company is indicated by the increase of its annual production of oil from about 81,000 tons in 1913 to more than 10,000,000 tons in 1938; and to approximately 32,000,000 tons in 1950, the last full year of operation prior to its nationalization by Iran (*see below*). Parallel with this expansion of production was the growth of the company's refining, transport and marketing organization.

The parent company acquired subsidiary and associated companies in many European countries, in the near and middle east, Australia, India and Africa. It also acquired a substantial interest in the Iraq Petroleum company. It was the Anglo-Iranian Oil company which, in 1936, took the leading part in the first modern search for oil in Great Britain.

On April 30, 1951, the day after Mohammed Mossadegh had taken office as prime minister of Iran, the Iranian parliament passed a bill nationalizing the oil industry of the Anglo-Iranian company. Britain protested strongly but evacuated the refineries on Oct. 3, 1951.

See Comm. Paper 7419 of 1914; also Winston Churchill, *The World Crisis*, vol. i., 1923. (J. C.; X.)

ANGLO-SAXON CHRONICLE. It is usual to speak of "the Anglo-Saxon Chronicle"; it would be more correct to say that there are four Anglo-Saxon Chronicles. It is true that these all grow out of a common stock, that in some even of their later entries two or more of them use common materials; but the same may be said of several groups of mediaeval chronicles, which no one dreams of treating as single chronicles. Of this fourfold Chronicle there are seven mss. in existence: *C.C.C. Cant.* 173 (A); *Cott. Tib.* A vi. (B); *Cott. Tib.* B i. (C); *Cott. Tib.* B iv. (D); *Bodl. Laud. Misc.* 636 (E); *Cott. Domitian* A viii. (F); *Cott. Otho* B xi. (G). Of these G is now a fragment, and it is known to have been a transcript of A. F is bilingual, the entries being given both in Saxon and Latin. It is interesting as a

stage in the transition from the vernacular to the Latin chronicle; but it has little independent value, being a mere epitome, made at Canterbury in the 11th or 12th century, of a chronicle akin to E. B, as far as it goes (to 977), is identical with C, both having been copied from a common original, but A, C, D, E have every right to be treated as independent chronicles. The relations between the four vary very greatly in different parts, and the neglect of this consideration has led to much error and confusion. The common stock, out of which all grow, extends to 892. There seems to be no reason to doubt that the idea of a national, as opposed to earlier local chronicles, was inspired by Alfred, who may even have dictated, or at least revised, the entries relating to his own campaigns; while for the earlier parts pre-existing materials, both oral and written, were utilized. Among the latter the chronological epitome appended to Bede's *Ecclesiastical History* may be specially mentioned. But even this common stock exists in two different recensions, in A, B, C, on the one hand, and D, E on the other. The main points of difference are that in D, E (1) a series of northern annals have been incorporated; (2) the Bede entries are taken, not from the brief epitome, but from the main body of the *Ecclesiastical History*. The inference is that, shortly after the compiling of this Alfredian chronicle, a copy of it was sent to some northern monastery, probably Ripon, where it was expanded in the way indicated. Copies of this northernized Chronicle afterwards found their way to the south. The impulse given by Alfred was continued under Edward, and we have what may be called an official continuation of the history of the Danish wars; which, in B, C, D extends to 915, and in A to 924. After 915 B, C insert as a separate document a short register of Mercian affairs during the same period (902-924), which might be called the acts of Aethelred, the famous "Lady of the Mercians," while D has incorporated it, not very skilfully, with the official continuation. Neither of these documents exists in E. From 925 to 975 all the chronicles are very fragmentary; a few obits, three or four poems, among them the famous ballad on the battle of Brunanburh, make up the meagre tale of their common materials, which each has tried to supplement in its own way. A has inserted a number of Winchester entries, which prove that A is a Winchester book. And this local and scrappy character it retains to 1001, where it practically ends. At some subsequent time it was transferred bodily to Canterbury, where it received numerous interpolations in the earlier part, and a few later local entries which finally tail off into the Latin acts of Lanfranc. A may therefore be dismissed. C has added to the common stock one or two Abingdon entries, with which place the history of C is closely connected; while D and E have a second group of northern annals 901-966, E being, however, much more fragmentary than D, omitting, or not having access to, much both of the common and of the northern material which is found in D. From 983 to 1018 C, D and E are practically identical, and give a connected history of the Danish struggles under Aethelred II. This section was probably composed at Canterbury. From 1018 the relations of C, D, E become too complicated to be expressed by any formula; sometimes all three agree together, sometimes all three are independent; in other places each pair in turn agree against the third. It may be noted that C is strongly anti-Godwinist, while E is equally pro-Godwinist, D occupying an intermediate position. C extends to 1066, where it ends abruptly, and is probably mutilated. D ends at 1079 and is certainly mutilated. In its later history D is associated with some place in the diocese of Worcester, probably Evesham. In its present form D is a comparatively late ms., none of it probably much earlier, and some of it later, than 1100. In the case of entries in the earlier part of the chronicles, which are peculiar to D, we cannot exclude the possibility that they may be late interpolations. E is continued to 1154. In its present form it is unquestionably a Peterborough book. The earlier part is full of Peterborough interpolations, to which place many of the later entries also refer. But (apart from the interpolations) it is only the entries after 1121, where the first hand in the ms. ends, which were actually composed at Peterborough. The section 1023-67 certainly, and possibly also the section 1068-1121, was composed at St. Augustine's, Canterbury; and the former is of extreme in-

terest and value, the writer being in close contact with the events which he describes. The later parts of E show a great degeneration in language, and a querulous tone due to the sufferings of the native population under the harsh Norman rule; "but our debt to it is inestimable; and we can hardly measure what the loss to English history would have been, if it had not been written; or if, having been written, it had, like so many another English chronicle, been lost."

BIBLIOGRAPHY.—The above account is based on the introduction in vol. ii of the Rev. C. Plummer's edition of *Two of the Saxon Chronicles Parallel* (Clarendon Press, 1892, 1899); to which the student may be referred for detailed arguments. The *editio princeps* of the Anglo-Saxon Chronicle was by Abraham Wheloc, professor of Arabic at Cambridge, where the work was printed (1643-44). It was based mainly on the ms. called G above, and is the chief source of our knowledge of that ms. which perished, all but three leaves, in the Cottonian fire of 1723. Edmund Gibson of Queen's college, Oxford, afterwards bishop of London, published an edition in 1692. He used Wheloc's edition, and E, with collations or transcripts of B and F. Both Wheloc and Gibson give Latin translations. In 1823 appeared an edition by Dr. Ingram, of Trinity college, Oxford, with an English translation. Besides A, B, E, F, Ingram used C and D for the first time. But both he and Gibson made the fatal error of trying to combine the disparate materials contained in the various chronicles in a single text. An improvement in this respect is seen in the edition made by Richard Price (d. 1833) for the first (and only) volume of *Monumenta Historica Britannica* (folio 1848). There is still, however, too much conflation, and, owing to the plan of the volume, the edition only extends to 1066. A translation is appended. In 1861 appeared Benjamin Thorpe's six-text edition in the Rolls Series. Though not free from defects, this edition is absolutely indispensable for the study of the chronicles and the mutual relations of the different mss. A second volume contains the translation. In 1865 the Clarendon Press published *Two Saxon Chronicles (A and E) Parallel, with Supplementary Extracts from the Others*, by the Rev. John Earle. This edition has no translation, but in the notes and introduction a very considerable advance was made. On this edition is partly based the later edition by the Rev. C. Plummer, already cited above. In addition to the translations contained in the editions already mentioned, the following have been issued separately. The first translation into modern English was by Miss Anna Gurney, privately printed in 1819. This was largely based on Gibson's edition, and was in turn the basis of Dr. Giles' translation, published in 1847, and often reprinted. The best translation is that by the Rev. Joseph Stevenson, in his series of *Church Historians of England* (1853). Up to the Conquest it is a revision of the translation contained in *Mon. Hist. Brit.* From that point it is an independent translation. (C.P.)

ANGLO-SAXON LAW. The body of legal rules and customs which obtained in England before the Norman Conquest constitutes, with the Scandinavian laws, the most genuine expression of Teutonic legal thought. While the so-called "barbaric laws" (*leges barbarorum*) of the Continent, not excepting those compiled in the territory now called Germany, were largely the product of Roman influence, the continuity of Roman life was almost completely broken in the island, and even the Church, the direct heir of Roman tradition, did not carry on a continuous existence: Canterbury was not a see formed in a Roman province in the same sense as Tours or Reims. One of the striking expressions of this Teutonism is presented by the language in which the Anglo-Saxon laws were written. They are uniformly worded in English, while Continental laws, apart from the Scandinavian, are all in Latin. The English dialect in which the Anglo-Saxon laws have been handed down to us is in most cases a common speech derived from West Saxon—naturally enough as Wessex became the predominant English State. Traces of Kentish speech may be detected, however, in the *Textus Roffensis*, the ms. of the Kentish laws, and Northumbrian dialectical peculiarities are also noticeable, while Danish words occur as technical terms. At the conquest Latin takes the place of English in the compilations made to meet the demand for Anglo-Saxon law texts as still applied in practice.

Classification.—It is easy to group the Anglo-Saxon laws according to the manner of their publication. They would fall into three divisions: (1) laws and collections of laws promulgated by public authority; (2) statements of custom; (3) private compilations of legal rules and enactments. To the first division belong the laws of the Kentish kings, Aethelbert, Hlothhere and Eadric, Wihtraed; those of Ine of Wessex, of Alfred, Edward the Elder, Aethelstan, Edmund, Edgar, Aethelred and Canute; the treaty between Alfred and Guthrum and the so-called treaty between

Edward and Guthrum. The second division would include the law of the Northumbrian priests and fragments of local customs entered in Domesday Book. The third division would consist of the post-Conquest collections of the so-called *Pseudo-leges Canuti*, the laws of Edward the Confessor, of Henry I, and the great compilation of the *Quadripartitus*, then of a number of short notices on various matters, such as the formalities of betrothal (*Be-wifmannes beweddunge*), agricultural conditions (*Rectitudines singularium personarum*), the duties of a reeve (*gerefa*) and of a judge (*dema*), wergelds, oaths, ordeals, etc. A fourth group might be made of the charters, as they are based on Old English private and public law and supply us with most important materials in regard to it. Looking somewhat deeper at the sources from which Old English law was derived, we shall have to modify our classification to some extent, as the external forms of publication, although important from the point of view of historical criticism, are not sufficient standards as to the juridical character of the various kinds of material.

Direct statements of law would fall under the following heads, from the point of view of their legal origins: i. customary rules followed by divers communities capable of formulating law; ii. enactments of authorities, especially of kings; iii. private arrangements made under recognized legal rules. The first would comprise a great many of the rules entered in collections promulgated by kings; most of the paragraphs of Aethelbert's, Hlothhere's, and Eadric's and Ine's laws are popular legal customs that have received the stamp of royal authority by their insertion in official codes. On the other hand, from Wihtraed's and Alfred's laws downwards, the element of enactment by central authority becomes increasingly prominent, though there are no outward signs enabling us clearly to distinguish between both categories of laws in the codes, nor can we draw a line between permanent laws and personal ordinances of single sovereigns, as has been attempted in the case of Frankish legislation.

Analysis of Content.—Even in the course of a general survey of the legal lore at our disposal, one cannot help being struck by peculiarities in the distribution of legal subjects. Matters which seem of primary importance and occupy a wide place in our law-books are almost entirely absent in Anglo-Saxon laws or relegated to the background. While it is impossible to give here anything like a complete or exact survey of the field—a task rendered almost impossible by the arbitrary manner in which paragraphs are divided, by the difficulty of making Old English enactments fit into modern rubrics, and by the necessity of counting several times certain paragraphs bearing on different subjects—a brief statistical analysis of the contents of the royal codes and laws may be found instructive.

There are roughly 419 paragraphs devoted to criminal law and procedure as against 91 concerned with questions of private law and civil procedure. Of the criminal law clauses, as many as 238 are taken up with tariffs of fines, while 80 treat of capital and corporal punishment, outlawry and confiscation, and 101 include rules of procedure. On the private law side 18 clauses apply to rights of property and possession, 13 to succession and family law, 37 to contracts, including marriage when treated as an act of sale; 18 touch on civil procedure. A subject which attracted special attention was the law of status, and no less than 107 paragraphs contain disposition dictated by the wish to discriminate between the classes of society. Questions of public law and administration are discussed in 217 clauses, while 197 concern the Church in one way or another, apart from purely ecclesiastical collections.

In the public law division it is chiefly the power, interests and privileges of the king that are dealt with, in roughly 93 paragraphs, while local administration comes in for 39 and purely economic and fiscal matters for 13 clauses. Police regulations are very much to the fore and occupy no less than 72 clauses of the royal legislation. As to church matters, the most prolific group is formed by general precepts based on religious and moral considerations, roughly 115, while secular privileges conferred on the Church hold about 62, and questions of organization some 20 clauses.

A consideration of chronological sequence in the elaboration of

the laws reveals interesting results. The code of Aethelbert is almost entirely a list of fines or "compositions" for various crimes, and similar lists figure largely in the laws of Hlothhere and Eadric, Ine and Alfred. In the codes of Edward the Elder and his successors, however, lists of fines for criminal offences are much less prominent, and gradually a new penal system is evolved, based on outlawry, confiscation, capital and corporal punishment.

Fines and compensations throughout the laws are carefully graded, in accordance with the social standing of the persons concerned. In early times it would appear that the different classes of society were more sharply distinguished than they were later. From the time of Aethelstan onwards the distinction between the thegn or *twelfhynde* man (*i.e.*, the man with a wergeld of 1,200 shillings) and the ceorl or *twiwhynde* man (*i.e.*, the man with a wergeld of 200 shillings) is the chief dividing line between the classes of society. In the arrangements of the commonwealth the clauses treating of royal privileges are more or less evenly distributed over all reigns, but the systematic development of police functions, especially in regard to responsibility for crimes, the catching of thieves, the suppression of lawlessness, is mainly the object of 10th and 11th century legislation. The reign of Aethelred, which witnessed the greatest national humiliation in English history, is also marked by the most lavish expressions of religious feeling and the most frequent appeals to morality. Such an analysis of the Old English laws is by no means complete, but will convey some idea of the trend of state legislation during the period.

Derivation.—The next question to be approached concerns the pedigree of Anglo-Saxon law and the latter's natural affinities. How far has it been influenced by non-Germanic elements, especially by Roman and Canon law? The oldest Anglo-Saxon codes, especially the Kentish and the West Saxon ones, disclose a close relationship to the barbaric laws of Lower Germany—those of Saxons, Frisians, Thuringians. We find a division of social ranks which reminds us of the threefold gradation of Lower Germany (*edelings*, *frilings*, *lazzen*—Kentish *eorls*, *ceorls*, *laets*), and not of the twofold Frankish one (*ingenii Franci*, *Romani*), nor of the minute differentiation of the Upper Germans and Lombards. In subsequent history there is a good deal of resemblance between the capitularies' legislation of Charlemagne and his successors on one hand, the acts of Alfred, Edward the Elder, Aethelstan and Edgar on the other, a resemblance called forth less by direct borrowing of Frankish institutions than by the similarity of political problems and conditions. Frankish law becomes a powerful modifying element in English legal history after the Conquest, when it was introduced wholesale in royal and in feudal courts. The Scandinavian invasions brought in many northern legal customs, especially in the districts thickly populated with Danes. The Domesday survey of Lincolnshire, Nottinghamshire, Yorkshire, Norfolk, etc., shows remarkable deviations in local organization and justice (*lagmen*, *sokes*), and great peculiarities as to status (*socmen*, *free-men*), while from laws and a few charters we can perceive some influence on criminal law (*midingsvaerk*), special usages as to fines (*lahslit*), the keeping of peace, attestation and sureties of acts (*festerment*), etc. But, on the whole, the importance of the introduction of Danish and Norse elements, apart from local cases, is owing chiefly to the conflicts and compromises it called forth and its social results; the Scandinavians coalesced easily with the natives.

The direct influence of Roman law was not great during the Saxon period: we notice neither the transmission of important doctrines, nor the continuous stream of tradition in local usage. But indirectly Roman law did exert a by no means insignificant influence through the medium of the Church, which for all its insular character, was still permeated with Roman ideas and forms of culture. The Old English "books" are derived in a roundabout way from Roman models, and the tribal law of real property was deeply modified by the introduction of individualistic notions as to ownership, donations, wills, rights of women, etc. Yet here also the Norman Conquest increased the store of Roman conceptions by breaking the isolation of the English Church and opening the way for closer intercourse with France and Italy.

Folk-right and Privilege.—It would be useless to attempt to trace in a brief sketch the history of the legal principles embodied in the documents of Anglo-Saxon law. But it may be of some value to give an outline of a few particularly characteristic subjects. The Anglo-Saxon legal system cannot be understood unless one realizes the fundamental opposition between folk-right and privilege. Folk-right is the aggregate of rules, formulated or latent but susceptible of formulation, which can be appealed to as the expression of the juridical consciousness of the people at large or of the communities of which it is composed. It is tribal in its origin, and differentiated, not according to boundaries between states, but on national and provincial lines. There may be the folk-right of West and East Saxons, of East Angles, of Kentish men, Mercians, Northumbrians, Danes, Welshmen, and these main folk-right divisions remain even when tribal kingdoms disappear. The centres for the formulation and application of folk-right were in the 10th and 11th centuries the shire-moots, while the councillors (*witán*) of the realm generally placed themselves on the higher ground of state expediency, although occasionally using folk-right ideas. The older law of real property, of succession, of contracts, the customary tariffs of fines, were mainly regulated by folk-right; the reeves employed by the king and great men were supposed to take care of local and rural affairs according to folk-right. The law had to be declared and applied by the people itself in its communities, while the spokesmen of the people were the leading men—the 12 eldest thanes or a similar quorum. Folk-right could, however, be broken or modified by special law or special grant, and the fountain of such privileges was the royal power. Alterations and exceptions were, as a matter of fact, suggested by the interested parties themselves, and chiefly by the Church. Thus a privileged land-tenure was created—bookland; the rules as to the succession of kinsmen were set at naught by concession of testamentary power and confirmations of grants and wills; special exemptions from the jurisdiction of the hundreds and special privileges as to levying fines were conferred. In time the rights originating in royal grants of privilege overbalanced folk-right in many respects, and became the starting-point of a new legal system—the feudal one.

The King's Peace.—Another feature of vital importance in the history of Anglo-Saxon law is its tendency towards the preservation of peace. Society is constantly struggling to ensure the main condition of its existence—peace. Already in Aethelbert's legislation we find characteristic fines inflicted for breach of the peace of householders of different ranks—the ceorl, the eorl and the king himself appearing as the most exalted among them. Peace is considered not so much a state of equilibrium and friendly relations between parties, but rather as the rule of a third within a certain region—a house, an estate, a kingdom. This leads on one side to the recognition of private authorities—the father's, the master's, the lord's—while, on the other, the tendency to maintain peace naturally takes its course towards the strongest ruler, the king, and we witness the gradual evolution of stringent rules in respect of the king's peace.

The more ancient documents of Anglo-Saxon law show us the individual not merely as the subject and citizen of a certain commonwealth, but also as a member of some group, all the fellows of which are closely allied in claims and responsibilities. The most elementary of these groups is the *maegth*, the association of agnatic and cognatic relations. Personal protection and revenge, oaths, marriage, wardship, succession, supervision over settlement and good behaviour, are regulated by the law of kinship. A man's actions are considered not as exertions of his individual will, but as acts of the kindred, and all the fellows of the *maegth* are held responsible for them. What began as a natural alliance was used later as a means of enforcing responsibility and keeping lawless individuals in order. When the association of kinsmen failed (and it seems to have done so at an early period in England), the voluntary associations—guilds—appeared as substitutes. The guild brothers associated in mutual defense and support, and they had to share in the payment of fines. The township and the hundred came in also for certain forms of collective responsibility.

In course of time the natural associations get loosened and in-

termixed, and this calls forth the elaborate police legislation of the later Anglo-Saxon kings. Regulations are issued about the sale of cattle in the presence of witnesses. Enactments about the pursuit of thieves, and the calling in of warrantors to justify sales of chattels, are other expressions of the difficulties attending peaceful intercourse. Personal surety appears as a complement of and substitute for collective responsibility. The *hlaford* and his *hiredmen* are an institution not only of private patronage, but also of police supervision for the sake of laying hands on malefactors and suspected persons. The *landrica* assumes the same part in a territorial district. Ultimately the laws of the 10th and 11th centuries show the beginnings of the frankpledge associations, which came to act so important a part in the feudal age.

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(P. VI.; A. J. R.)

ANGLO-SAXONS. The term "Anglo-Saxon" is commonly applied to that period of English history, language and literature which preceded the Norman Conquest. It goes back to the time of King Alfred, who seems to have frequently used the title *rex Anglorum Saxonum* or *rex Angul-Saxonum*. The origin of this title is not quite clear. It is generally believed to have arisen from the final union of the various kingdoms under Alfred in 886. Bede (*Hist. Eccl.* i, 15) states that the people of the more northern kingdoms (East Anglia, Mercia, Northumbria) belonged to the Angli, while those of Essex, Sussex and Wessex were sprung from the Saxons (*q.v.*), and those of Kent and southern Hampshire from the Jutes (*q.v.*). Other early writers, however, do not observe these distinctions, and neither in language nor in custom do we find evidence of any appreciable differences between the two former groups, though in custom Kent presents most remarkable contrasts with the other kingdoms. Still more curious is the fact that West Saxon writers regularly speak of their own nation as a part of the *Angelcyn* and of their language as *Englisc*, while the West Saxon royal family claimed to be of the same stock as that of Bernicia. On the other hand, it is by no means impossible that the distinction drawn by Bede was based solely on the names Essex (East Seaxan), East Anglia, etc. We need not doubt that the Angli and the Saxons were different nations originally; but from the evidence at our disposal it seems likely that they had practically coalesced in very early times, perhaps even before the invasion.

See W. H. Stevenson, *Asser's Life of King Alfred* (1904, pp. 148 seq.); H. Munro Chadwick, *The Origin of the English Nation* (1907); also *BRITAIN: Anglo-Saxon*.

(H. M. C.)

ANGOLA. Angola is the general name of Portuguese possessions in West Africa south of the equator. The name (a Portuguese corruption of the Bantu Ngola) is sometimes confined to the 105 mi. of coast, with its hinterland, between the rivers Dande

and Kwanza; but is officially applied to the whole colony situated south of the Congo save for the enclave of Kabinda (Cabinda) which, however, is administered as part of Angola. It extends about 1,000 mi. along the coast from the Congo (6° S., 12° E.), its northern frontier for 80 mi., to the mouth of the Kunene (Cunene) river (17° 18' S., 11° 50' E.). From the Congo the frontier goes due east to the Kwango river. The eastern boundary, dividing Angola from the Belgian Congo and Barotseland (in Northern Rhodesia), is highly irregular. Angola's border towards South-West Africa, somewhat south of 17° S. lat., was demarcated jointly in 1928 by the Portuguese and Union of South Africa governments. By the convention of July 12, 1927, Portugal ceded a small area south of the Congo, near Matadi, for laying the Boma-Leopoldville railway; Belgium gave in exchange about 1,158 sq.mi. of the Bota de Dilolo, the Congo frontier passing behind and almost parallel to the river Luao. This assisted the construction of the Angola-Katanga railway. The area is about 481,226 sq.mi. The population according to the 1940 census was 3,738,010 including 44,083 Europeans, all Portuguese except 1,373 (381 Germans).

Physical Features.—The coast is for the most part flat, with occasional low cliffs of red sandstone. Great Fish bay (or Bahia dos Tigres), a little north of the Angola-South West Africa frontier, is the one deep inlet. Farther north are Port Alexander, Little Fish bay and Lobito bay, while shallower bays are numerous. The sparsely watered, sterile coast plain extends 30–100 mi. inland. The great central plateau of Africa is approached by a series of irregular terraces, covered with luxuriant vegetation. Water is fairly abundant, though in the dry season obtainable only by digging in the sandy beds of the rivers. The plateau, of altitude 4,000 to 6,000 ft., consists of well-watered, wide, rolling plains and low hills with scanty vegetation. In the east the tableland falls away to the basins of the Congo and Zambezi; to the south it merges into barren sandy desert. The numerous westward rivers, save the Kwanza and Kunene (*qq.v.*), are unimportant. The mountain chains, edging or dominating the plateau run generally parallel to the coast, as Tala Mugongo (4,400 ft.), Chella and Vissecua (5,250 ft. to 6,500 ft.). In the district of Benguela are the highest points of the province, viz., Loviti (7,780 ft.), in 12° 5' S., and Mt. Elonga (7,550 ft.). South of the Kwanza is the volcanic mountain Caculo-Cabaza (3,300 ft.). From the tableland the Kwango and many other streams flow north to join the Kasai (one of the largest affluents of the Congo), which, in its upper course, forms for fully 300 mi. the boundary between Angola and the Congo state. In the southeast the rivers flow to the Zambezi or, like the Okavango, drain to Lake Ngami.

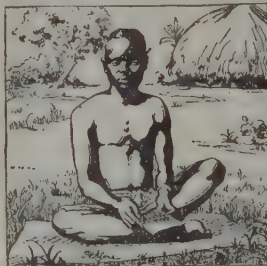
Geology.—The central plateau consists of ancient crystalline rocks with granites overlain by unfossiliferous sandstones and conglomerates considered to be of Palaeozoic age. The outcrops are largely hidden under laterite. The median zone of hills parallel with the coast is composed largely of crystalline rocks with granites and some Palaeozoic unfossiliferous rocks. The littoral zone contains the only fossiliferous strata; they are of Tertiary and Cretaceous ages, the latter rocks resting on a reddish sandstone of older date. The Cretaceous rocks of the Dombe Grande region (near Benguela) are of Albian age and belong to the *Acanthoceras mamillari* zone. The beds containing *Schloenbachia inflata* are referable to the Gault. Tertiaries are met with at Dombe Grande, Mossâmedes and near Luanda. The sandstones with gypsum, copper and sulphur of Dombe may be Triassic. Recent eruptive rocks, mainly basalts, form a line of hills almost bare of vegetation between Benguela and Mossâmedes. Nepheline basalts and liparites occur at Dombe Grande. Gum copal occurs in quantity in some superficial rocks.

Climate.—With the exception of the district of Mossâmedes, the coast plains are unsuited to Europeans. In the interior, above 3,300 ft., temperature and rainfall, together with malaria, decrease. The plateau climate is healthful and invigorating. The mean annual temperature at São Salvador do Congo is 72.5°; at Luanda, 74.3°, and at Caconda, 67.2°. The prevailing winds are west, southwest and south-southwest. The cool season lasts from June to September; and the rainy, from October to May;

the heaviest rainfall occurs with storms in April.

Flora and Fauna.—As far south as Benguela the coast is rich in oil-palms and mangroves. In the north are dense forests, in the south, towards the Kunene, regions of dense thorn scrub. Rubber vines and trees are abundant, but have been reduced by the ruthlessness of native collectors; the commonest are various root rubbers, notably *Carpodinus chylorrhiza*; *Lendolphia* are also found. Coffee, cotton and Guinea pepper are indigenous, and tobacco flourishes in several districts. Among timber trees are the tacula (*Pterocarpus tinctorius*), which grows to an immense size, its wood being blood-red in colour, and the Angola mahogany. The bark of the musuamba (*Albizia coriaria*) is used in tanning leather. The mulundo bears a hard green-shelled fruit like a cricket ball, with scarlet pips like a pomegranate. The fauna includes lion, leopard, cheetah, elephant, giraffe, rhinoceros, hippopotamus, buffalo, zebra, kudu and many other kinds of antelope, wild pig, ostrich and crocodile. Among fish are the barbel, bream and African yellow fish.

Inhabitants.—The great majority of the inhabitants are of Bantu-Negro stock mixed in the Congo district with the pure



BY COURTESY OF THE HELPS-STOKES FUND
A NATIVE MUSICIAN OF ANGOLA
The African races are fond of music, and some of their musical instruments, though primitive in construction, produce tones of haunting sweetness

Negro. In the south-east are various tribes of Bushmen. Bantu-Negroes include the Ba-Kongo (Ba-Fiot) in the north, and the Abunda (with Portuguese admixture) (Mbunda, Ba-Bundo), in the centre. The Bangala, west of the upper Kwango, must not be confounded with the Bangala of the middle Congo. The Ba-Lunda inhabit the Lunda district. The Mushi-Kongo and other divisions of the Ba-Kongo were Christian in the 16th and 17th centuries and possibly later, and they use crucifixes as fetish charms or as symbols of power, while every native has a "Santu" or Christian name and is dubbed dom or dona. Fetishism is the prevailing religion throughout the province. The natives have usually small simple huts, used for sleeping; the day is spent in an open space in front of the hut protected from the sun by a roof of palm or other leaves. Native languages reduced to writing are Kisi Kongo (in the north), Kimbundu (north central), Umbundu (highlands east of Lobito) and Luchazi (south). A considerable mulatto population, growing in number and importance, is settled mainly in the coast areas.

Administration and Government.—Angola is governed under the Colonial act of July 1930, completed by the Colonial charter of Nov. 15, 1933. A governor-general appointed by the Lisbon government and responsible to the colonial minister has powers granted expressly for specific matters of administration. He is advised by a council of ten (five officials and five Portuguese nationals elected by recognized economic organizations). By the decree of May 1934 the colony is divided into the five provinces of Luanda, Malange, Benguela, Bié and Huila. The provinces are further subdivided into the administrative districts of Luanda, Benguela, Bié, Congo, Cuanza-Norte, Cuanza-Sul, Huila, Lunda, Malange, Huambo, Mossâmedes, Moxico, Zaire and Kabinda. (Lunda is part of the old Bantu kingdom of Muata Yanvo.) Each district is divided into civil circumscriptions, each under an administrator who is resident magistrate. In each circumscription, responsible to the administrator, are "chefes do posto," responsible for outlying posts. The local council acts except in such matters as are reserved to the national assembly of the republic, or in general measures affecting more than one colony. Provincial juntas and other minor local bodies with limited powers, also exist. Gen. Norton de Matos, high commissioner 1921–24, initiated a scheme with development of communications, immigration of Portuguese settlers, supervision of foreign immigrants, introduction of Portuguese municipal institutions, inclusion of the Congo customs service in that of Angola, thus unifying the colony, pro-

gressive native policy, health services, improved military organization, education—especially technical education—scientific services, strict supervision of concessions, regulation of religious missions and the raising of loans. This policy, since de Matos' resignation, has only been partly carried out. A commission has been appointed to assist the natives, mainly medically, and technical staffs are being improved. Angola constitutes a judicial district, with nine subdivisions, each in charge of a judge of first instance. There is an appeal court at Luanda.

Ecclesiastical.—The colony forms a diocese of the Roman Catholic Church, in the province of Lisbon. This church began work at São Salvador in 1491, and controlled all educational activities till 1908. Since 1852 the Society of the Holy Ghost has carried on work in the Benguela district. The Society of the Sacred Heart has a station at Huila, in the Mossâmedes district, and some mission schools. The Baptist Missionary society has headquarters at São Salvador. The American Methodist Episcopal Foreign Missionary society works in the Luanda district, and the Canadian and American Congregational Churches and the Plymouth Brethren Mission in the highlands east of Lobito bay. In the Mossâmedes district are stations of the South Africa General Mission and the Swiss Mission. The missions have schools, especially for agriculture.

Military Forces.—The military force in 1945 comprised 112 officers and 2,440 enlisted men, including 200 Europeans.

Public Instruction.—There are about 125 primary schools, including municipal and private schools, one seminary under a mission at Huila, two secondary schools and 13 professional and technical schools. Mixed primary schools for whites exist at Malange, Cangoma, Monongue (in the Cubango district), Silva Porto and at Humpata, the last having been doubled in size. About 6,200 pupils attend Angolan schools. Native education is almost entirely in the hands of missions. A decree of 1921 prohibits teaching of native languages and printing of books of religion or instruction in native languages. This has been so far relaxed as to allow of the printing of a few books bilingually—in Portuguese and a native language.

Health.—Sleeping sickness appears especially in the north-east and on the coast between Lobito and Benguela. Common diseases are malaria, hookworm, smallpox, leprosy, elephantiasis and goitre among the women of the uplands. There are hospitals at Luanda and other coast towns, and several mission hospitals. A "travelling health mission" in the Congo district began work in 1927 for Malange and Marimba; another was being prepared for Zaire, Congo and the Kabinda enclave. There is a special fund for medical assistance to natives.

Chief Towns.—Luanda (São Paulo de Luanda), an excellent port and the capital of Angola is 8° 48' S., 13° 4' E., on a bay between the rivers Bango and Kwanza. The bay, protected from the surf by a long narrow island of sand, is backed by a low sandy cliff which sweeps sharply southward to a bold point crowned by Ft. São Miguel. The bay has silted up considerably. Extensive port works under construction in 1945 included a sea wall more than a mile long and a quay 1,000 ft. long and 500 ft. wide, at which five large vessels will be able to berth. The harbour was to be dredged to provide 75–80 ac. of a depth of 40 ft. or more. The city is divided into an upper and lower town, with the offices, governor's residence, bishop's palace and hospital in the upper town. Most European houses are large stone buildings of one story with red tile roofs. Luanda possesses a meteorological observatory.

The city, pop. (1940) 61,028, was founded in 1576, and except between 1640 and 1648, when it was occupied by the Dutch, has always been in Portuguese possession. It was the chief centre of the slave trade between Portuguese West Africa and Brazil but suppression of that trade caused depression for a time. There is a regular service to Lisbon (16 days), Liverpool and Hamburg. A larger European element exists there than in any other place on the west coast of Africa. It is connected by submarine cables with Europe and South Africa. There are two radio stations. Fully half the import and export trade of Angola passes through Luanda. In 1927 it was announced that the capital was trans-

ferred to Huambo, a modern town created by the Benguela railway, 266 mi. from the coast, but the transfer had not taken place in 1945. Huambo is an important administrative, trading and railway centre, with wireless station and aerodrome.

Lobito, 20 mi. north of Benguela, was founded in 1905, because its bay was chosen as the terminus of the Benguela railway. It has about 1,060 ac. of anchorage. Port facilities are such as to permit six steamers to discharge cargo direct. Lobito is connected with Benguela by a railway through Katumbella, a town at the mouth of the river of the same name, and the sea terminus of an ancient route from the heart of Central Africa through Bié. Old Benguela is a town about 120 mi. north of Lobito bay.

Other chief towns are, in the district of Congo: Kabinda, a good port and capital of the district; Landana, a port north of the Zaire; São Salvador do Congo (pop. 2,965), an ancient town, capital of the old kingdom of Congo, and formerly called Bonza Congo, 1,840 ft. above sea level, and about 160 mi. inland, and 100 mi. S.E. of Noki in 6° 15' S. Only scanty ruins remain of the cathedral of the 16th century. The stone of the city walls was used recently to build government offices; a fort was built about 1850. Ambrizette is a small port south of the Zaire river; Noki is at the head of navigation on the south bank of the Congo and takes large ships. In the district of Luanda: Ambriz, at the mouth of the Loje river, in 7° 50' S., 13° E., some 70 mi. N. of Luanda, lies within the free-trade area of the conventional Congo basin and exports rubber, gum, coffee and copper; its population is 2,196. Ambaca in the district of Cuanza Norte, east of Luanda, and connected with it by railway, in a fertile agricultural district; Cazungo, capital of the best coffee district; Dondo (pop. 645), a commercial town on the right bank of the Kwanza, communicating with Luanda by steamer; Novo Redondo, a small port south of Luanda. In the district of Benguela: Benguela (São Felipe de Benguela) capital of the district, on a bay of the same name, in 12° 35' S., 13° 20' E., was founded in 1617 by the Portuguese under Manoel Cerveira Pereira. It was long the centre of the slave trade to Brazil and Cuba, but has now greatly declined. The anchorage, about two miles from the town, is an open roadstead. Pop. 14,243, includes 1,461 whites. A short way beyond Benguela is Bahia Tarta, where salt is manufactured and sulphur excavated. Caconda, southwest of Benguela, on a plateau, is a commercial centre; Bié, east of Benguela, is capital of the fertile and healthy district of the same name, and a large caravan centre; Kanguamba, the residence of the former kings of Bié, is a large town; Catumbela is a port north of, and near, Benguela. In the district of Mossâmedes: Mossâmedes, capital of the district, on the south side of Little Fish bay (Bay of Mossâmedes or Angra do Negro), is a healthy port, with a harbour affording excellent anchorage (pop. 4,926). A railway (154 mi. in use) starts from the harbour and crosses the semidesert coast region to the fertile Chela plateau. Mossâmedes is the headquarters of an important fishing industry. Porto Alexandre is south of Mossâmedes. In the district of Huila: Humpata, capital of an elevated, very healthful and fertile district, recently created out of the territories of Mossâmedes, capable of growing European plants, is about 95 mi. N.E. of Mossâmedes, with Dutch settlers, and produces cereals and tobacco. The capital of Malange district is Malange, pop. 5,299, about 75 mi. from Ambaca.

Financial.—The ordinary budget of 1943 balanced at 313,670,000 angolares (one angolare=Portuguese escudo=.04 cents U.S., 1945), although expenditure generally exceeds revenue. Chief sources of revenue are native hut taxes about 33%; customs 27%; and government enterprises 22–23%. Chief expenditure items are administration 20%; defense 16–18%; government works 23%; debt service 10%; education 4%; other social services 10%.

Public debt in 1943 was 1,043,612,754 angolares (\$41,744,510). A considerable portion of this had been incurred for capital development.

Commerce.—Trade statistics for 1943 indicated imports of 328,126,702 angolares and exports of 480,353,049 angolares. Chief articles of import were textiles, foodstuffs, manufactured steel and iron goods and wine. Chief exports were coffee, maize,

sugar, diamonds, fish, palm oil and wax.

About five-eighths of the trade is with Portugal, the mother country furnishing about half of the imports and purchasing three-quarters of Angola's exports. Goods imported from Portugal have 60% reduction in Angolan import duties. Exports from Portuguese colonies enjoy 50% reduction in tariffs in the Portuguese market. Portuguese shipping is also favoured by a 10% differential in the export tax when carried in Portuguese bottoms.

Ports and Shipping.—Benguela, Lobito, Luanda, Novo Redondo, Mossamedes and Amboim are the chief ports along the coast, although some shipping takes place at Ambriz, Great Fish bay and Ambrizette. Normally there is regular steamship communication between Portugal, England, Germany, from Lobito and from Capetown; Lisbon and Southampton from Lobito. The Portuguese line which carries the bulk of the cargo is subsidized by the Portuguese government. Room for development exists. Plans are being made for improvement of facilities at Novo Redondo and Benguela. New improvements have been made at Luanda. In 1937, 365 ships called at Lobito.

Communications.—Railway mileage in the colony totals 1,442 mi. Five lines run inland from the coast. The most important line is the Benguela railway, 837 mi. from Lobito to its connection with the Katanga lines at the Belgian Congo frontier. Begun in 1904, it was completed in 1928. It was prolonged, following the exchange of 1,158 sq.mi. (Bota de Dilolo) for one sq.mi. of Belgian Congo territory at the mouth of the Congo. It is standard gauge (3' 6"), thereby permitting through shipment to Belgian Congo, to Portuguese East Africa and to South Africa by connecting lines. Service is thus extended to Beira (Lobito to Beira, 2,920 mi.), and to Lourenço Marques (3,295 mi.). The railway is operated by an English firm. The Luanda-Ambaca-Malange line (364 mi.) of 1-m. gauge was begun in 1887 as a trans-Africa railway to Mozambique. The scheme was abandoned, however, when the line reached Ambaca, 225 mi., in 1894. The line, said to have been the most expensive road to construct in tropical Africa (£8,942 per mi.) was bought by the government in 1918. The Amboim line (.60-m. gauge) is 70 mi. in length. The line inland from Mossamedes to the Chela mountains is 154 mi. in length. The line from Cino (.60-m. gauge) extends inland 19 mi.

There are 22,708 mi. of primary roads and 20,713 mi. of secondary roads.

Telecommunications.—Land telegraph lines extend 8,112 mi. and telephone lines 3,500 mi. Cables connect Angola with Europe and South Africa. There are 12 radio stations.

Industries.—The most important industries in 1945 were palm oil, whale oil, fish oil, resin and derivatives, milling of cereals, salting fish, preserving meat and sugar production. The sugar industry employs 200 Europeans and 9,000 natives, in seven factories near the Dande river, at Catumbela, Bom Jesus, Novo Redondo, Dombe Grande and Quissol; the output is 35,000–40,000 tons per annum. Fishing is an important occupation. There is a whaling station at Mossamedes (Porto Amelia). Soap is made in Luanda and Benguela for local use and for export to Belgian Congo and S. Thomé. More than 25,000 tons of salt, mainly to preserve fish, are produced annually. Several factories produce vegetable fibre. Other industries are ceramics, brick and tile-making; carpentry and joinery, practised on a large scale, especially wagon-building; saw-mills; tobacco, with two modern factories in Luanda, local growths being mixed with imported; foundries, the best being that of the state railways.

There appeared to be a good future before such industries as tanning, production of milk products, lime, paper pulp, rubber products, iron-working, etc. There are several deposits of guano. Ochres, chalks, marbles and limestones are known, and would repay working.

Agriculture.—Angola is primarily an agricultural country. Its range of altitudes enables it to produce crops of both the tropical and the temperate zones. Coffee is the principal export (20,000 tons, 1941), the chief market being Portugal where it enjoys a preferential tariff. Four types are grown, the best being that of Novo Redondo. Maize is an important crop, being grown

almost entirely by the natives (1,195,000 ac., 1938), chiefly in Benguela and about Luanda. Coco-nuts are grown haphazardly in the north. About 4,000 tons were exported in 1941. Production, if undertaken scientifically, could be increased. Other oil producing seeds are castor beans, grown almost exclusively by the natives, chiefly in Benguela, Bié, Malange and Huila (3,750 tons exported in 1940); palm kernels collected by the natives from the palms along the coastal plain; peanuts, used chiefly as a native food crop (20,014 ac. in 1939); and sesame, also used as a native food crop. Cotton is grown in Mossamedes, Amboim and Benguela (150,588 ac., 1939), but is of poor quality; wheat has done well on the Benguela plateau, in Malange, and in Huila (20,000 ac., 1939); potatoes, rice, peas, beans and other vegetables are commonly grown on the high lands; the agricultural station at Bié has proved that rye, oats and barley can do well on the high lands; cocoa does well in Kabinda and parts of Amboim; manioc is cultivated almost everywhere by natives; bananas thrive everywhere, except in the highest parts of the south; tropical fruits, such as pineapples, guavas and pawpaws, do well almost everywhere; almost all the fruits of Portugal are successfully grown on the high lands. Tobacco, of rather inferior quality, is grown. Sugar cane is one of the most important products of the province, about 40,000 tons of sugar being produced in 1941. Some factories have modern machinery. Rubber is found in the interior of Benguela, and is the basis of trade with the natives. There are possibilities of the cultivation of flax, especially on the southern plateaus. Fine timber (272,000 sq.mi.), principally hardwoods, exists but transportation to exploit this resource is lacking. The chief woods are ironwood, rosewood, kusa and blackwood.

Government agricultural stations exist at Luanda and elsewhere in the interior.

Minerals.—Thick beds of copper, probably outcrops of the Katanga mines of Belgian Congo, are found at Bembe. Other deposits are found in Mossamedes, Quibela, and on the Cuvo. Iron is known in many parts, chiefly at Oeiras (on the Lucalla affluent of the Kwanza) and in Bailundo. It is believed that about 2,000,000 tons of ore are available. Concessions for petroleum and asphalt were granted to British syndicates. Mineral salt is worked by natives in several places, e.g., Quissama, Holo and Jinga. Gold occurs in Lombije and Kassinga, lead at Caxibo and lignite in the valley of the Kwanza. Coal is found at Calucala, Quilungo, Dondo and on the Benguela plateau. This coal, of high volatile content, is exported (28,865 tons, 1940) while ordinary coal is imported. Diamonds are worked in Lunda under concession from the government which shares in the profits. Production was 787,000 carats in 1941. Other minerals are silver, manganese and sulphur.

Stock-raising.—Excellent grazing land exists in many parts of the colony. Forage is also available, but tsetse fly is prevalent in many districts. Veterinary stations at Huila and Humpata assist in improving stock. Portuguese and French merinos were imported for improving the wool-producing stock. Persian black-heads from South Africa were introduced for mutton. Good cattle, horses and donkeys were introduced (2,000,000 cattle). Goats are second only to cattle in number (600,000 head). Pigs number 350,000 (1935). British firms obtained extensive cattle-raising concessions in the vicinity of the Benguela railway. Production of honey and beeswax is almost entirely in native hands. The export of beeswax was about 1,377 tons in 1941. (H.Br.; P. W. I.)

HISTORY

The Portuguese established themselves on the west coast of Africa towards the close of the 15th century, the river Congo and the whole coast line of Angola being discovered by Diogo Cam or Cão in 1482, and the three following years. He erected a stone pillar at the mouth of the river, which accordingly took the title of Rio de Padrão, and established friendly relations with the natives, who reported that the country was subject to a great monarch, Mwani Congo or lord of Congo, resident at Bonza Congo. The Portuguese were not long in making themselves influential in the country. Gonçalo de Sousa was dispatched on a formal embassy in 1490; and the first missionaries entered the country in

his train. The king was soon after baptized and Christianity was nominally established as the national religion. In 1534 a cathedral was founded at Bonza Congo (renamed São Salvador), and in 1560 the Jesuits arrived with Paulo Diaz de Novaes. Of the prosperity of the country the Portuguese have left the most glowing and indeed incredible accounts. It was, however, about this time ravaged by cannibal invaders (Bangala) from the interior, and Portuguese influence gradually declined. The attention of the Portuguese, moreover, was now turned more particularly to the southern districts of Angola. In 1627 the bishop's seat was removed to São Paulo de Luanda and São Salvador declined in importance: but in the 18th century, in spite of hindrances from Holland and France, steps were taken towards re-establishing Portuguese authority in the northern regions. Until the "scramble for Africa" began in 1884, however, they possessed no settlement on the coast to the north of Ambriz, which was first occupied in 1855; but in 1884-85 they succeeded in securing the southern shores of the estuary of the Congo (see CONGO FREE STATE). The last of the native princes of Congo who had real authority was a potentate known as Dom Pedro V. He was placed on the throne in 1855 with the help of a Portuguese force, and reigned over 30 years. In 1888 a Portuguese resident was stationed at Salvador, and the kings of Congo became pensioners of the government.



BY COURTESY OF THE PHELPS-STOKES FUND

A CHIEF OF ANGOLA

Although chiefs still rule the native tribes, their administration is supervised by the Portuguese government

The first governor sent to Angola was Paulo Diaz, a grandson of Bartholomew Diaz, who reduced to submission the region south of the Kwanza nearly as far as Benguela. The city of Luanda was founded in 1576, Benguela in 1617. From that date the sovereignty of Portugal over the coast line, from its present southern limit as far north as Ambriz (7° 50' S.) has been undisputed save between 1640 and 1648, during which time the Dutch attempted to expel the Portuguese and held possession of the ports. While the economic development of the country was not entirely neglected and many useful food products were introduced, the prosperity of the province was very largely dependent on the slave trade with Brazil, which was not legally abolished until 1830 and in fact continued for many years subsequently.

Agreements concluded with the Congo Free State, Germany and France in 1885-86 (modified in details by subsequent arrangements) fixed the limits of the province, except in the southeast, where the frontier between Barotseland (in Northern Rhodesia) and Angola was determined by an Anglo-Portuguese agreement of 1891 and the arbitration award of the king of Italy in 1905 (see AFRICA: History). Up to the end of the 19th century the hold of Portugal over the interior of the province was slight, though its influence extended to the Congo and Zambezi basins. The abolition of the external slave trade proved very injurious to the trade of the seaports, but from 1860 onward the agricultural resources of the country were developed with increasing energy, a work in which Brazilian merchants took the lead. After the definite partition of Africa among the European powers, Portugal applied herself with some seriousness to exploit Angola and her other African possessions. Nevertheless, in comparison with its natural wealth the development of the country has been slow. Slavery and the slave trade continued to flourish in the interior in the early years of the 20th century, despite the prohibitions of the Portuguese government. The extension of authority over the inland tribes proceeded very slowly and was not accomplished without occasional reverses.

Germany has for many years looked upon Angola as a field of economic and ultimately political penetration. A treaty with Great Britain negotiated in 1913-14 recognized German economic interests as supreme in the greater part of Angola. The outbreak of World War I prevented the signature of this treaty, while the

loss of South-West Africa, conquered by General Botha in 1915, deprived Germany of a base for penetration. Nevertheless German influence and trade within the colony was maintained. German residents formed the largest European group in the colony, other than the Portuguese.

Native Policy.—A Native Affairs department was created in 1913. Various reforms were effected but under the decree of 1914 the principle of compulsory labour was maintained. Natives not habitually employed were placed at the disposition of colonists and merchants by the government, the officials of which frequently took an active part in the recruitment of labour until the repeal of the act in 1922. By the decree of Nov. 29, 1922, chiefs were authorized to receive payment for assistance to labour recruiters. Complaints of official support of labour recruitment continued and under the Native Labour code of 1928, officials, while authorized to facilitate the operation of all persons seeking to recruit labourers, were limited to pointing out suitable places for recruitment and to giving advice. The law also restricted forced labour to public purposes. Officials were specifically forbidden to accompany recruiters and to supply them with police. Gifts to native chiefs by recruiters were discouraged. The Colonial charter of Nov. 15, 1933, prohibited official intervention in aid of recruiting. The right to promote "educational" management of labour was maintained, however. The charter reaffirmed authority to requisition labour for public works and for the production of marketable crops. The law also contained provisions for establishing minimum wages, welfare conditions and labour inspections. The law, however, remained to be implemented by local regulations. The forced labour convention of the International Labour Office had not been ratified by Portugal.

The colonial government, under the law of 1935, requires every male to work five days per year on public utilities, usually roads. The extensive system of roads in Angola is principally due to this use of native labour. Such labour can be commuted for a cash payment. This requirement is in addition to the obligation to pay a native hut-tax set on all males over 16. This tax, which varies from section to section, is apparently based on the amount of wages established for contract labour. The average tax is about 100 to 108 angolares (\$4-\$4.32) per year or about the equivalent of wages for 100 days' labour.

Scarcity of labour has been accentuated by fluctuations in the native population, by the onerous conditions of contract labour, by which native men are often moved long distances from their homes, and by voluntary native migration to British Africa, particularly Northern Rhodesia and the Union of South Africa. Native population estimated at 5,378,923 in 1846 had fallen to 4,777,636 in 1900 and to 2,438,411 in 1925, after which time it fluctuated between 2,500,000 and 3,000,000 (1927-2,937,665; 1930-2,503,794; 1934-3,147,045; 1938-2,622,808). Of the 1940 population of 3,738,010, native men numbered 1,733,328 while the women numbered 1,932,501.

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(F. R. C.; P. W. L.)

ANGOLA, a conventional trade term used to describe a particular type of "union" or "mixture" yarn produced from short staple or "shoddy" wool and raw staple cotton, blended together by a "scribbling" process to ensure their thorough admixture, before spinning. The wool and cotton are blended in varying proportions chiefly according to the particular class of fabric for which it is intended, and the peculiar characteristics of texture, such as the "handle" or "feel" and other features that may be desired in the finished fabric. A typical and recognized standard quality of angola yarn is produced from wool and cotton blended in the proportion of 80% wool and 20% cotton.

The admixture of cotton with the short staple "shoddy" wool not only improves the spinning properties of the latter and thus enables yarn of finer counts to be spun than would be possible from the short fibres of wool themselves, but the cotton staple also serves to impart to the yarn a soft and mellow "feel," which is one of the distinctive characteristics of Angola fabrics.

Angola yarn is manufactured into quite a large variety of textile fabrics, both knitted and woven, in each of which classes of goods it may be employed either alone or in combination with yarns produced from any other class of textile fibre, as cotton, silk, artificial silk, and worsted yarns. In the production of certain types of warp-faced worsted fabrics, as exemplified in amazon, covert coating, venetian, and similar varieties, angola yarn is sometimes employed for the weft series of threads which, in fabrics of this class, lies entirely obscured at the back of the cloth and is not, therefore, exposed to wear and tear.

Angola yarn, however, is chiefly employed alone both as warp and weft in the production of so-called "union" fabrics, usually of some simple weave structure as the plain calico or "tabby" weave; a regular twill weave such as the 3-end or 4-end (2×2) twill; the 2×2 matt or dice, or similar elementary structure. Fabrics of this class are made up into garments for underwear, as undershirts and shirts, also for night attire, as pyjamas, night-dresses and dressing gowns.

It should be noted that the term angola is not synonymous with angora, the name of a famous breed of goats that yield a valuable fleece of wool known as "mohair." (H. N.)

ANGONI. The name, an appellation bestowed by the Bantu immediately north of them, is recognized by the Angoni as their own, and they are also known as Tuta, Gwangwara, Zitu and Fiti according to their geographical position. The Angoni, now a ruling caste rather than a distinct race, were originally a Zulu clan which was expelled by Chaka in the 19th century. Under Zwangendaba they marched northwards, incorporating with themselves Swazi and Thonga and elements of other tribes whom they victoriously traversed. During their progress they dropped colonies which have become incorporated into the neighbouring tribes. Thus the Anyanja absorbed a section known as Chekusi's men, which broke off and settled near Chindundo, south-west of Lake Nyasa. The main body, however, passed northward and reached Ufipa at the south-east corner of Lake Tanganyika, where they remained till the death of Zwangendaba in the late '40s.

The Angoni live partly in scattered homesteads, partly in villages. These are neither fenced nor fortified except in the case of a few chiefs. Quite often the village consists only of a man, his wives and children and his slaves, but a chief would naturally be surrounded by a larger following, whose huts are usually grouped in a circle round the enclosure containing the chief's hut. The huts are conical with a pointed roof, often 30 ft. in height, fully covering the substructure, a 5-ft. wall of poles and clay. It is thatched with thick bundles of grass supported by converging poles. The diameter varies but may reach 38 ft., though it is usually considerably smaller. Almost certainly the huts are indigenous and not Zulu, as they are similar to those of their neighbours and their size and structure are doubtless conditioned by the local materials. Their weapons are of the Zulu pattern: a heavy thrusting spear, a few throwing spears, a large oval shield of unframed ox-hide and a club or a battle axe.

Polygyny prevails, each wife owning a separate hut, and the number of wives is only limited by a man's means and ability to pay the dowry. The clans are exogamous and patrilineal, but

the family of the mother must be of distinguished blood when it is a question of the succession to the chieftainship.

The political organization varies with the different groups according to the degree to which the Angoni have imposed themselves on the indigenous population. The chief rules as a military autocrat, but his power is limited by his indunas or military chiefs. Those near him will be kept under control, whereas the outliers may become almost independent. The military organization is based on the Zulu model, for all freemen are liable to service, enrolled in regiments, constantly disciplined and kept in garrisons. They are under the command of indunas, who form a military and civil council to the chief. As among the Zulu, the regiments are not allowed to marry until given permission to do so by the chief.

Their religious system includes a deity *Mulungu*, the director or governor of the earth, and the worship of dead ancestors (*mahoba*), who are more intimately concerned with the affairs of men. The soul is indestructible and sacrifices are made at the graves of the dead to propitiate even more than to supplicate the ancestral spirits. The nature of *mulungu* is not quite clear, but as it is applied also to the spirits of the dead and as local deities seem to be in many instances identical with deceased chiefs it is probable that *mulungu* is the great impersonal spirit of all men who are dead.

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ANGORA or ANKARA. (1) The capital of Turkey (anc. ANCYRA), situated upon a steep, rocky hill, which rises 500 ft. above the plain, on the left bank of the Enguri Su, a tributary of the Sakaria (Sangarius), about 220 mi. E.S.E. of Istanbul. The hill is crowned by the ruins of the old citadel, which add to the picturesqueness of the view; but the town is not well built, its streets being narrow and many of its houses constructed of sun-dried mud bricks; there are, however, many fine remains of Graeco-Roman and Byzantine architecture, the most remarkable being the temple of Rome and Augustus, on the walls of which is the famous *Momentum Ancyranum* (see ANCYRA). Ancyra was the centre of the Tectosages, one of the three Gaulish tribes which settled in Galatia in the 3rd century B.C., and became the capital of the Roman province of Galatia when it was formally constituted in 25 B.C. During the Byzantine period, throughout which it occupied a position of great importance, it was captured by Persians and Arabs; then it fell into the hands of the Seljuk Turks, was held for 18 years by the Latin Crusaders, and finally passed to the Ottoman Turks in 1360. In 1402 a great battle was fought in the vicinity of Angora, in which the Turkish sultan Bayezid was defeated and made prisoner by the Tatar conqueror Timur. In 1415 it was recovered by the Turks under Mohammed I., and since that period has belonged to the Ottoman empire. In 1832 it was taken by the Egyptians under Ibrahim Pasha. Angora exports wool, mohair and grain. Mohair cloth is manufactured, and the town is noted for its honey and fruit. Pop. (1940) 157,242.

The Turkish Nationalist Movement, which was organized by Mustafa Kemal in 1919, led to the setting up of a Nationalist Government at Angora in April 1920, the city being chosen owing to the fact that, while it was far enough from the coast to be reasonably safe from attack by the Greeks, or the principal Allied Powers, it was in touch with other parts of the interior of Anatolia, and was the railhead of the north-eastern branch of the Anatolian railway. The ability of the surrounding area to supply the food requirements of the population and the raw materials needed by local industry was also of importance. On Oct. 13, 1923, by a decision of the Great National Assembly, Angora was declared the capital of Turkey.

The city is connected by the Anatolian railway with Istanbul and with the railroad net of the interior. In view of its increased importance and growing population, Angora underwent great and rapid changes in the years after 1925. The city was thoroughly modernized and provided with representative buildings and tree-lined boulevards. Considerable progress was made by

the municipality in house building, road construction and sanitation.

The swampy fields between the station and the town, a breeding ground for the malarial mosquito, were drained and in their place arose a public park; modern systems of drainage and of water supply were installed.

A new parliament house and buildings for the ministry of finance, courts of justice, general post office, etc., and a modern hotel were built. The industrial development of the city was actively encouraged, and German engineers were called in to erect factories and workshops for the production of tiles, cotton and flax goods, etc. The installation of a power station capable of furnishing electric light throughout the city was completed, saw-mills constructed, and a flour mill equipped with modern machinery.

The University of Ankara, founded in 1946, incorporated faculties of liberal arts, law, medicine, science, agriculture and veterinary medicine.

(2) A Turkish vilayet in north-central Asia Minor, area 11,442 sq.mi. It includes most of the ancient Galatia (pop. [1945], 695,526). It is an agricultural country, depending for its prosperity on its grain, wool and mohair obtained from the beautiful Angora goats. It includes the city of Angora.

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ANGOSTURA BARK (CUSPARIA BARK), obtained from the bark of *Galipea officinalis*, was formerly used as a febrifuge, antiperiodic and as an aromatic bitter to increase the appetite.

ANGOULÊME, CHARLES DE VALOIS, DUKE OF (1573-1650), natural son of Charles IX of France by Marie Touchet, was born at Fayet, Dauphiné, April 28, 1573. His mother married François de Balzac, marquis d'Entragues, and one of her daughters, Henriette, marquise de Verneuil, afterward became the mistress of Henry IV. Charles, known in his early manhood as comte d'Auvergne, was made colonel of horse by Henry IV, and served in the campaigns of Arques and Ivry. But in 1601 he was implicated in the Biron conspiracy, one of the objects of which was to persuade Henry to repudiate his wife.

Biron was executed, but Auvergne, after making a full confession, was released. He then engaged in fresh intrigues with the Spanish court, acting in concert with his half-sister, the king's mistress, and her father. Henriette was pardoned, but Auvergne spent 11 years in the Bastille. On his release in 1616 he was reinstated in the army, and employed in several campaigns. He became duke of Angoulême in 1619. He commanded at the siege of La Rochelle in 1627 and in Lorraine in 1635. He retired soon after Richelieu's death in 1643, and lived in retirement until his death in 1650.

The duke was the author of the following works: (1) *Mémoires*, from the assassination of Henri III to the battle of Arques (1589-93), published at Paris by Boneau, and reprinted by Buchon in his *Choix de chroniques* (1836) and by Petitot in his *Mémoires* (1st series, vol. xlv); (2) *Les Harangues, prononcées en assemblée de MM. les princes protestants d'Allemagne, par Monseigneur le duc d'Angoulême* (1620); (3) a translation of a Spanish work by Diego de Torres. To him has also been ascribed the work *La générale et fidèle Relation de tout ce qui s'est passé en l'isle de Ré, envoyée par le roi à la royne sa mère* (Paris, 1627).

ANGOULÊME, LOUIS-ANTOINE DE BOURBON, DUKE OF (1775-1844), the last dauphin of France, elder son of the count of Artois (afterward Charles X) and of Marie-Thérèse of Savoy, was born in Versailles on Aug. 6, 1775, and died in Goritz, Aus., on June 3, 1844. In 1789 he left France with his father and, after completing his military training at Turin, commanded a corps of émigrés in the campaign of 1792. After residing in Poland and in England he returned to France in 1814, took possession of Bordeaux, and, as lieutenant general, organized a futile attempt to resist Napoleon on the latter's return from Elba, after which Angoulême was captured and transported to Barcelona. In Louis XVIII's reign he commanded the French expedition to Spain in support of Ferdinand VII (1823); on the

accession of Charles X the duke of Angoulême became dauphin, but in 1830, with his father, he renounced his claim to the throne, and finally settled in Austria, at Goritz, under the title of count of Marne, until his death.

In 1799 he married his cousin MARIE-THÉRÈSE CHARLOTTE, the daughter of Louis XVI and Marie Antoinette, who was born at Versailles on Dec. 19, 1778, and died at Frohsdorf on Oct. 19, 1851. During the Revolution she was imprisoned for three years, from Aug. 1792 until 1795, when she was released in exchange for prisoners handed over to the Convention by Charles Dumouriez. In 1814 she returned to France in the train of Louis XVIII, and for ten days after Napoleon had entered the Tuileries during the Hundred Days she was able to maintain Bordeaux's loyalty to the royal family.

ANGOULÊME, southwest France, capital of the department of Charente, 83 mi. N.N.E. of Bordeaux on the railway from Poitiers. Pop. (1946) 44,244. The old town is on a small steep-sided peninsula washed on the north by the Charente and on the south and west by a small tributary, the Anguienne. The more important suburbs lie toward the east where the promontory joins the surrounding plateau. The main railway line passes through a tunnel beneath the town.

Angoulême (*Iculisma*) was taken by Clovis from the Visigoths in 507, and plundered by the Normans in the 9th century.

In 1360 it was surrendered by the peace of Bretigny to the English; they were, however, expelled in 1373 by Charles V, who granted the town numerous privileges. It suffered during the Wars of Religion, especially in 1568 after its capture by Protestants under Coligny.

The countship of Angoulême dated from the 9th century, the most important of the early counts being William Taillefer, whose descendants held the title till the end of the 12th century. After a short period of possession by King John of England it passed by marriage, in 1220, to the Lusignan family, counts of Marche. In 1394 the countship came to the house of Orléans, a member of which, Francis I, became king of France in 1515 and raised it to the rank of duchy. The duchy afterward changed hands several times, one of its holders being Charles of Valois, natural son of Charles IX. The last duke was Louis-Antoine, eldest son of Charles X, who died in 1844.

Angoulême is encircled by boulevards, which, as in so many French towns, are altered ramparts. The Cathedral of St. Pierre, a church in the Byzantine Romanesque style (cf. Périgueux), dates from the 11th and 12th centuries, but has been often restored. The façade, flanked by two towers with cupolas, is highly decorated. The crossing is surmounted by a dome, and the extremity of the north transept by a fine square tower more than 160 ft. high. The domed style in this district is a characteristic feature. The *hôtel de ville*, by Abadie, is modern but preserves two towers of the château of the counts. Angoulême is the seat of a bishop, a prefect and court of assizes. Its public institutions include tribunals of first instance and of commerce, a council of trade arbitrators and chamber of commerce. It also has a library and several learned societies. It is the centre of an old-established papermaking industry. Most of the mills are situated on watercourses near the town. Subsidiary industries, such as those of small machinery and wire fabrics, are numerous. Commerce is carried on in wine and brandy.

ANGOUMOIS, an old province of France, nearly corresponding to the modern department of Charente. Its capital was Angoulême.

See F. de Vaux de Foletier, *Histoire d'Aunis et de Saintonge* (Paris, 1929); E. Jarry, *Provinces et pays de France*, vol. 2 (Paris, 1943).

ANGRA or ANGRA DO HEROISMO ("Bay of Heroism," a name given it in 1829, to commemorate its successful defense against the Miguelist party), the former capital of the Azores (Portuguese) and chief town of an administrative district, comprising the islands of Terceira (on which it lies), St. George and Graciosa. Pop. (1940) 9,435. It is the headquarters of a military command and the see of a Roman Catholic bishop; its principal buildings are the cathedral, military college, arsenal and observatory. The harbour, formerly a naval station, is shel-

tered by the promontory of Mt. Brazil. Pineapples and other fruit are exported.

ANGRA PEQUENA: see LÜDERITZ.

ÅNGSTRÖM, ANDERS JONAS (1814–1874), Swedish physicist, was born on Aug. 13, 1814, at Lögö, Medelpad, Sweden. He was educated at Uppsala university, where in 1839 he became *Privatdozent* in physics. In 1843 he became observer at Uppsala Observatory. In 1858 he succeeded Adolph Ferdinand Svanberg (1806–1857) in the chair of physics at Uppsala, and there he died on June 21, 1874. His most important work was concerned with the conduction of heat and with spectroscopy. In his optical research *Optiska Undersökningar*, presented to the Stockholm Academy in 1853, he not only pointed out that the electric spark yields two superposed spectra, one from the metal of the electrode and the other from the gas in which it passes, but deduced from Euler's theory of resonance that an incandescent gas emits luminous rays of the same refrangibility as those which it can absorb. This statement entitles him to rank as one of the founders of spectroscopy. The Ångström unit was named in his honour.

From 1861 onwards he paid special attention to the solar spectrum. He announced in 1862 the existence of hydrogen, among other elements, in the sun's atmosphere, and in 1868 published his great map of the normal solar spectrum, which long remained authoritative in questions of wave-length although his measurements were inexact to the extent of one part in 7,000 or 8,000, the metre which he used as his standard having been slightly too short. He was the first, in 1867, to examine the spectrum of the aurora borealis and to detect and measure the characteristic bright line in its yellow green region; but he was mistaken in supposing that this same line, which is often called by his name, is also to be seen in the zodiacal light.

His son **KNUT JOHAN ÅNGSTRÖM** (1857–1910) became professor of physics at Uppsala in 1896. He investigated the radiation of heat from the sun and its absorption by the earth's atmosphere and devised various delicate methods and instruments, including his electric compensation pyrheliometer, invented in 1893, and apparatus for obtaining a photographic representation of the infra-red spectrum (1895).

ÅNGSTRÖM UNIT, the unit employed for measuring wavelengths of light, being equal to one ten-millionth of a millimetre, i.e., 1×10^{-10} metre. The usual abbreviation for this unit is Å.U. (See SPECTROSCOPY.)

ANGUIER, FRANÇOIS (c. 1604–1669) and **MICHEL** (1612–1686), French sculptors, were two brothers, natives of Eu in Normandy. The mausoleum of Henri II., last duc de Montmorancy, at Moulins, is the work of François. To Michel are due the sculptures of the triumphal arch at the Porte St. Denis, begun in 1674, to serve as a memorial for the conquests of Louis XIV. A marble group of the Nativity in the church of Val De Grâce was reckoned his masterpiece. It was he who superintended the decoration of the apartments of Anne of Austria in the old Louvre. F. Fouquet also employed him for his château in Vaux.

See Henri Stein, *Les frères Anguier* (1889), with catalogue of works and many references to original sources; Armand Sanson, *Deux Sculpteurs Normands; les frères Anguier* (1889).

ANGUILLA or Snake Island, British West Indies, part of the presidency of St. Kitts-Nevis, in the colony of the Leeward Islands, 18° 12' N. and 63° 5' W., about 60 mi. N.W. of St. Kitts, 16 mi. long, area 34 sq.mi.; population (est. 1942) 5,829, mostly Negroes. Charcoal burners have almost completely denuded the island, which having but little rain is very subject to drought. Nearly all the land is in the hands of peasant proprietors, who cultivate cotton for export. Salt is also a commercial product of importance. The government has developed land settlement schemes and (1943) improved sanitary and health services.

ANGULATE, shaped with corners or angles; used in botany and zoology for the shape of stems, leaves and wings.

ANGUS, EARLS OF. Angus is the official name of the former county of Forfarshire (q.v.), and was that of one of the original earldoms of Pictish, Scotland, said to have been occupied by seven brothers of whom Angus was the eldest. The Celtic line ended with Matilda (c. 1240), countess of Angus in

her own right, who married in 1243 Gilbert de Umfravill and founded the Norman line of three earls, which ended in 1381, the then holder of the title being summoned to the English parliament. Meanwhile John Stewart of Bonkyl, Co. Berwick, had been created earl of Angus in a new line. This third creation ended with Margaret Stewart, countess of Angus in her own right, and widow of Thomas, 13th earl of Mar. By an irregular connection with William, 1st earl of Douglas, who had married Mar's sister, she became the mother of George Douglas, 1st earl of Angus (c. 1380–1403), and secured a charter of her estates for her son, to whom in 1389 the title was granted by King Robert II. He was taken prisoner at Homildon Hill and died in England.

His great-grandson was **ARCHIBALD DOUGLAS** (c. 1450–c. 1514), 5th earl, known as the *Great Earl* and nicknamed *Bell-the-Cat* for his capture of Robert Cochrane, earl of Mar, the favourite of James III. He joined Alexander Stewart, earl of Albany, in intriguing with Edward IV., acknowledged the overlordship of the English Crown and was one of the leaders of the rebellion against James III. in 1487–88. He renewed his English intrigues under the reign of James IV., but was in favour with the court between 1493 and 1498 and became chancellor of the kingdom. At Flodden Field he lost two of his sons. His third son, Gavin, bishop of Dunkeld, is separately noticed.

ARCHIBALD DOUGLAS (1489?–1557), 6th earl, son of George, master of Douglas, who was killed at Flodden, succeeded on his grandfather's death. By his marriage in 1514 to his second wife, the queen dowager, Margaret of Scotland, sister of Henry VIII., he aroused the jealousy of the nobles. In the civil war which followed, Albany (the regent) besieged the queen in Stirling and obtained possession of the young king, Margaret's son. Margaret left for London, and Angus made his peace with Albany. During his wife's absence he formed a liaison with a daughter of the laird of Traquair. When Margaret returned she therefore sided with Albany against her husband. Angus was charged with high treason and sent to France in 1522. He returned two years later with the support of Henry VIII., entered Edinburgh in 1525, and called a parliament. After a short struggle he and the Douglasses became all powerful. James V. did not like his stepfather's tutelage, but all attempts at that time to secure his liberation failed. In 1528 Margaret obtained a divorce from her husband, James escaped from his custody and took refuge with Margaret and Arran at Stirling. The next year Angus took refuge in England, and James avenged himself on his kinsmen, including Angus's sister Janet, Lady Glamis, who was burned at the stake on Castle hill, Edinburgh (July 17, 1537). It was only in 1542, after the death of James V., that Angus returned to Scotland, entrusted with a mission to arrange a marriage between Mary queen of Scots and Prince Edward (afterwards Edward VI.). The marauding expedition of Lord Hertford in 1544 seems to have cured him of his English sympathies, and he was made lieutenant of the south of Scotland. On Feb. 27 1545 he defeated the English at Ancrum moor, and he led the Scottish van when the Scots were defeated at Pinkie.

The career of Angus was a long struggle for power and for the interests of his family, to which national considerations were completely subordinate. He died in Jan. 1557. By Margaret Tudor he had Margaret, his only surviving legitimate child, who married Matthew, 4th earl of Lennox, and was mother of Lord Darnley. He was succeeded by his nephew David, son of Sir George Douglas of Pittendreich.

ARCHIBALD DOUGLAS (1555–1588), 8th earl, and earl of Morton, was the son of David, 7th earl. He succeeded to the title and estates in 1558. In 1573 he was made a privy councillor and sheriff of Berwick, in 1574 lieutenant-general of Scotland, in 1577 warden of the west marches and steward of Fife, and in 1578 lieutenant-general of the realm. For his support of his uncle, the 4th earl of Morton, he was declared guilty of high treason on June 2, 1581. He appealed to the English Government for an invasion of Scotland to rescue Morton, and on the latter's execution in June went to London, where he was welcomed by Elizabeth. After the raid of Ruthven in 1582 Angus was reconciled to James, but soon afterwards was again banished from

the court. In 1584 he joined the rebellion of Mar and Glamis, but the movement failed. The rebels fled to Newcastle, which became a centre of Presbyterianism and of projects against the Scottish Government, encouraged by Elizabeth. In October they invaded Scotland and secured from James the restoration of their estates and the control of the Government. In 1586 Angus was appointed warden of the marches and lieutenant-general on the border, but he was unable to overcome the king's hostility to the establishment of Presbyterian government. He died on Aug. 4 1588. He was succeeded in the earldom by his cousin WILLIAM, who was succeeded by his son William. On a visit to France he was converted to Roman Catholicism, and on his return to Scotland became involved in various conspiracies against the Government, being twice imprisoned. In 1593 he joined the rebellion of the earls of Huntly and Erroll. The revolt failed, and in 1597 all three renounced their religion, declared themselves Presbyterians, and were restored to the lands and honours they had forfeited. Angus recanted in 1608 and withdrew to France; he died in Paris on March 3, 1611. He was succeeded by his son William (1589-1660), 11th earl, afterwards 1st marquess of Douglas. The title is now held by the dukes of Hamilton.

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ANGUS, Scotland: see FORFARSHIRE.

ANGUSSOLA or **ANGUSSCIOLA, SOPHONISBA**, Italian portrait painter of the latter half of the 16th century, was born at Cremona about 1535, and died at Palermo in 1626. In 1560, at the invitation of Philip II., she visited the court of Madrid, where her portraits elicited high praise. Vandyck is said to have declared that he had derived much knowledge of the true principles of his art from her conversation. She painted several fine portraits of herself, one of which is at the Uffizi. A few specimens of her painting are to be seen at Berlin, Milan, Rome, Bergamo, Madrid and in private collections in England. She had three sisters who were also celebrated artists.

ANHALT, a *Land* of Germany, formerly a duchy and later a Free State. The former duchy was created in 1863 by amalgamation of two duchies, Anhalt-Dessau-Cöthen and Anhalt-Bernburg, and comprised all the Anhalt territories sundered in

Western Anhalt is much smaller and its southern half forms part of the Harz range, reaching to nearly 2,000ft. in the south-east. Of the whole surface, land under tillage amounts to about 60%, meadowland to 7% and forest to 25%. The chief crops are grain (especially wheat), fruit, vegetables, potatoes, beet, tobacco, flax, linseed and hops. The country is very rich in lignite, and salt works are abundant. The chief industrial products are sugar spirits, beer and chemicals, and there is commerce in corn, cattle, timber and wool. Coal (lignite), guano, oil and bricks are also exported. The trade of the country is furthered by its excellent roads, navigable rivers and railways. There is a chamber of commerce in Dessau. The area of Anhalt is 888sq.m. Pop. (1939) 436,506. The country is divided into the districts of Dessau, Cöthen, Zerbst, Bernburg and Ballenstedt. Chief towns are Dessau, the capital (120,744), Bernburg (42,237), Cöthen (34,000) and Zerbst (23,725). The inhabitants of the state are mainly Protestant, organized under the consistory in Dessau. The Roman Catholics are under the bishop of Paderborn. After 1922 there was an assembly, with executive power in the hands of a ministry of state. After January 1940, local self-government ceased and the administration was placed in the hands of a federal regent (*Reichsstatthalter*) appointed by Hitler.

History.—During the 11th century most of Anhalt was included in the duchy of Saxony, and in the 12th century it came under the rule of Albert the Bear, margrave of Brandenburg. When Albert died in 1170, his son Bernard, who received the title of duke of Saxony in 1180, became count of Anhalt. Bernard died in 1212, and Anhalt, separated from Saxony, passed to his son Henry, who in 1218 took the title of prince and was the real founder of the house of Anhalt. On Henry's death in 1252 his three sons partitioned the principality and founded respectively the lines of Aschersleben, Bernburg and Zerbst. Early in the 16th century, however, owing to the death or abdication of several princes, the family had become narrowed down to the two branches of Anhalt-Cöthen and Anhalt-Dessau. These were united temporarily in 1570, but Anhalt was divided again in 1603.

The family of Anhalt-Cöthen became extinct in 1847, and Cöthen was added to Anhalt-Dessau. In 1863, for the same reason, Anhalt-Bernburg was united with Anhalt-Dessau.

Anhalt-Dessau had been divided in 1632, but was quickly reunited; and in 1693 it came under the rule of Leopold I. (see ANHALT-DESSAU, LEOPOLD I., PRINCE OF). Leopold IV. (reigned 1817-71) in 1863 reunited the whole of Anhalt. He took the title of duke of Anhalt and summoned one *Landtag* for the whole of the duchy. In 1871 Anhalt became a state of the German empire. In 1918, in common with the rest of Germany, it threw off its allegiance to the emperor, and on July 18, 1919, received its constitution as the Free State of Anhalt.

ANHALT-DESSAU, LEOPOLD I., PRINCE OF (1676-1747), called the "Old Dessauer" (*Der alte Dessauer*), general field marshal in the Prussian army, was the only surviving son of John George II., prince of Anhalt-Dessau, and was born on July 3, 1676, at Dessau. His first campaign was that of 1695 in the Netherlands, in which he was present at the siege of Namur. He remained in the field to the end of the war of 1697, the affairs of the principality being managed chiefly by his mother, Princess Henriette Catherine of Orange. In 1698 he married Anna Luise Föse, an apothecary's daughter, of Dessau, in spite of his mother's opposition, and subsequently he procured for her the rank of a princess from the emperor (1701). The princess acquired an influence over the stern nature of her husband which she never ceased to exert on behalf of his subjects, and after the death of Leopold's mother she performed the duties of regent when he was absent on campaign. Often, too, she accompanied him into the field. Leopold's career as a soldier in important commands begins with the outbreak of the War of the Spanish Succession. He had made many improvements in the Prussian army, notably the introduction of the iron ramrod about 1700, and he then took the field at the head of a Prussian corps on the Rhine, serving at the sieges of Kaiserswerth and Venlo. Leopold was present at Höchstädt, Blenheim, Cassano, Turin, Tournay, and Malplaquet, and in 1710 he succeeded to the command of the



BY COURTESY OF THE GERMAN RAILWAY INFORMATION BUREAU
OLD TOWN WALL GATE OR "HEIDETOR," AT ZERBST IN THE DUCHY OF ANHALT, A PART OF THE MEDIAEVAL FORTIFICATIONS ROUND THE CITY

1603. It now consists of two larger portions—eastern and western Anhalt, separated by part of Prussian Saxony—and of five enclaves surrounded by Prussian territory, viz., Alsleben, Mühlungen, Dornburg, Gödnitz and Tilkerode-Abberode. The eastern and larger portion of the State is low-lying, and occupies a section of the sandy plains of the valley of the Elbe which crosses it from east to west, and portions of the tributary valleys of Mulde and Saale, flowing northwards. There is fertile loess land east of the Saale, but the State contains much pine forest and bog land, interspersed with rich pasture.

whole Prussian contingent at the front. In 1712, at the particular desire of the crown prince, Frederick William, who had served with him as a volunteer, he was made a general field marshal. Shortly before this he had executed a *coup de main* on the castle of Mörs, which was held by the Dutch in defiance of the claims of the king of Prussia. The operation was effected with absolute precision and the castle was seized without a shot being fired. In the earlier part of the reign of Frederick William I., the prince of Dessau was one of the most influential members of the Prussian governing circle. In the war with Sweden (1715) he commanded an army of 40,000 men, and met and defeated Charles XII. in a severe battle on the island of Rügen (Nov. 16). His conduct of the siege of Stralsund which followed was equally skilful, and the great results of the war to Prussia were largely to be attributed to his leadership in the campaign.

In the years of peace he devoted himself to the training of the Prussian army. The reputation it had gained in the wars of 1675 to 1715, though good, gave no hint of its coming glory, and it was even in 1740 accounted one of the minor armies of Europe. That it proved, when put to the test, to be by far the best military force existing may be taken as the summary result of Leopold's work. The "Old Dessauer" was one of the sternest disciplinarians in an age of stern discipline, and the technical training of the infantry, under his hand, made them superior to all others in the proportion of five to three. He was essentially an infantry soldier—in his time artillery did not decide battles—but he suffered the cavalry service, in which he felt little interest, to be comparatively neglected, with results which appeared at Mollwitz. Frederick the Great formed the cavalry of Hohenfriedberg and Leuthen himself, but had it not been for the incomparable infantry trained by the "Old Dessauer" he would never have had the opportunity of doing so. Thus Leopold, heartily supported by Frederick William, who was himself called the great drill-master of Europe, turned to good account the 20 years following the peace with Sweden. Two incidents of that period in his career call for special mention: first, his intervention in the case of the crown prince Frederick, who was condemned to death for desertion, and his continued and finally successful efforts to secure Frederick's reinstatement in the Prussian army; and secondly, his part in the War of the Polish Succession on the Rhine, where he served under his old chief Eugene and held the office of field marshal of the Empire.

With the death of Frederick William in 1740, Frederick succeeded to the Prussian throne, and a few months later took place the invasion and conquest of Silesia, the first act in the long Silesian wars and the test of the work of the "Old Dessauer's" lifetime. The prince himself was not often employed in the king's own army, though his sons held high commands under Frederick. The king, indeed, found Leopold, who was reputed, since the death of Eugene, the greatest of living soldiers, somewhat difficult to manage, and the prince spent most of the campaigning years up to 1745 in command of an army of observation on the Saxon frontier. Early in that year his wife died. He was then over 70, but his last campaign was destined to be the most brilliant of his long career. A combined effort of the Austrians and Saxons to retrieve the disasters of the summer by a winter campaign towards Berlin itself led to a hurried concentration of the Prussians. Frederick from Silesia checked the Austrian main army and hastened towards Dresden. But before he had arrived, Leopold, no longer in observation, had decided the war by his overwhelming victory of Kesselsdorf (Dec. 14 1745). It was his habit to pray before battle, for he was a devout Lutheran. On this last field his words were, "O Lord God, let me not be disgraced in my old days. Or if Thou wilt not help me, do not help these scoundrels, but leave us to try it ourselves." With this great victory Leopold's career ended. He retired from active service, and the short remainder of his life was spent at Dessau, where he died on April 7, 1747.

He was succeeded by his son, LEOPOLD II., MAXIMILIAN, PRINCE OF ANHALT-DESSAU (1700-51), who was one of the best of Frederick's subordinate generals, and especially distinguished himself by the capture of Glogau in 1741, and his generalship at

Mollwitz, Chotusitz (where he was made general field marshal on the field of battle), Hohenfriedberg and Soor.

Another son, PRINCE DIETRICH OF ANHALT-DESSAU (d. 1769), was also a distinguished Prussian general.

But the most famous of the sons was PRINCE MORITZ OF ANHALT-DESSAU (1712-60), who entered the Prussian army in 1725, saw his first service as a volunteer in the War of the Polish Succession (1734-35), and in the latter years of the reign of Frederick William held important commands. In the Silesian wars of Frederick II., Moritz greatly distinguished himself, especially at the battle of Hohenfriedberg (Striegau), 1745. At Kesselsdorf it was the wing led by the young Prince Moritz that carried the Austrian lines and won the "Old Dessauer's" last fight. In the years of peace preceding the Seven Years' War, Moritz was employed by Frederick the Great in the colonizing of the waste lands of Pomerania and the Oder Valley. When the king took the field again in 1756, Moritz was in command of one of the columns which hemmed in the Saxon army in the lines of Pirna, and he received the surrender of Rutowski's force after the failure of the Austrian attempts at relief. Next year Moritz underwent changes of fortune. At the battle of Kolin he led the left wing, which, through a misunderstanding with the king, was prematurely drawn into action and failed hopelessly. In the disastrous days which followed, Moritz was under the cloud of Frederick's displeasure. But the glorious victory of Leuthen (Dec. 5, 1757) put an end to this. At the close of that day, Frederick rode down the lines and called out to General Prince Moritz, "I congratulate you, Herr Feldmarschall!" At Zorndorf he again distinguished himself, but at the surprise of Hochkirch fell wounded into the hands of the Austrians. Two years later, soon after his release, his wound proved mortal.

ANHWEI (Nganhui), a province of China lying astride the Yangtze Kiang in its final S.W.-N.E. course before it enters on its delta. It has an area of 54,319 sq.mi., and a population of about 22,704,538 (1940). Anhwei falls into two divisions, distinct from almost every point of view. Northern Anhwei, beyond the Hwai-yang shan, belongs physically to the north China plain; its level surface is liable to flooding by the Hwai-ho and it is covered by river detritus and wind-borne loess. It has too the climate and cultivates the crops (wheat, millet and beans) typical of north China. Southern Anhwei, on the other hand, enjoys a more genial climate and is part of the mountain and valley country of south China. Its hillsides are terraced and planted largely with the tea shrub and its river plains constitute rice-growing paddy-fields. Southern Anhwei is itself divided into two: the northern part is the wide valley of the Yangtze between the Hwai-yang shan on the north and Hwang shan on the south; the southern, at a rather higher elevation, lies south of the Hwang shan. The centre of the northern division, the Yangtze valley, is the capital, Anking, and of the southern division Hwei-chow, a great tea centre. The name An-hwei is compounded out of the first syllables of each. It was not constituted a separate province until the 17th century in the early days of the Ch'ing (Manchu) dynasty. After the Japanese invasion, Anhwei became war zone early in 1938.

Destruction of the dikes of the Hwang-ho flooded northern Anhwei up to the Hwai river. The Japanese occupied railways and cities; the countryside remained largely under guerrilla control.

ANHYDRIDE (an privative+ *h2o* water+ide) a compound which may be prepared by the removal of water or the elements of water from another compound. An oxide which combines with water to form an acid (*q.v.*) or which may be formed by the removal of water from an acid is called an acid anhydride; one which unites with water to form a base (*q.v.*) or which a base yields upon the loss of water is called a basic anhydride.

ANHYDRITE, a mineral, differing chemically from the more commonly occurring gypsum in containing no water of crystallization, being anhydrous calcium sulphate, CaSO₄. It crystallizes in the orthorhombic system and has three directions of perfect cleavage parallel to the three planes of symmetry. Distinctly developed crystals are somewhat rare, the mineral usually presenting the form of cuboidal cleavage masses. The hardness is 3½

and the specific gravity 2.9. The colour is white, sometimes grayish, bluish or reddish. On the best developed of the three cleavages the lustre is pearly, on other surfaces it is of the ordinary vitreous type.

Anhydrite is most frequently found in salt deposits, but it is only met with at some depth; nearer the surface it has been altered to gypsum owing to absorption of water.

A peculiar variety occurring as contorted concretionary masses is known as tripe-stone, and a scaly granular variety, from Vulpino, near Bergamo, in Lombardy, as vulpinites; the latter is cut and polished for ornamental purposes.

ANI, a ruined ancient city in the Armenian S.S.R. (anc. *Abnium*). Altitude 4,390 ft. In A.D. 961 it was the capital of the Bagratid kings of Armenia; later it was known as the city of 1,001 churches; frequently besieged by Turks, Georgians and Mongols, it was finally ruined by an earthquake in 1319. The double wall, partly in ruins, remains and also 11th, 12th and 13th century churches are extant.

See M. F. Brosset, *Les Ruines d'Ani* (St. Petersburg, 1860-61).

ANICETUS, Pope (c. 157-168). It was during his pontificate that St. Polycarp visited the Roman church to confer with him about the Paschal controversy.

ANICHINI, LUIGI, Italian engraver of seals and medals, a native of Ferrara, lived in Venice about 1550. Michelangelo pronounced his "Interview of Alexander the Great with the high-priest at Jerusalem" "the perfection of the art." His medals of Henry II of France and Pope Paul III are highly valued.

ANILINE, PHENYLAMINE or AMINOBENZENE ($C_6H_5.NH_2$), an organic base first obtained from the destructive distillation of indigo in 1826 by O. Unverdorben, who named it Crystallin. In 1834, F. Runge isolated from coal-tar a substance which produced a beautiful blue colour on treatment with calcium chloride; this he named kyanol or cyanol. In 1841, C. J. Fritzsche showed that by treating indigo with potassium hydroxide it yielded an oil, which he named aniline, from the specific name of one of the indigo-yielding plants, *Indigofera anil*, *anil* being derived from the Sanskrit *nīla*, dark-blue, and *nīlā*, the indigo plant. About the same time N. N. Zinin found that on reducing nitrobenzene a base was formed, which he named benzidam. A. W. von Hofmann investigated these variously prepared substances and proved them to be identical, and thenceforth they took their place as one substance, under the name aniline or phenylamine having the composition $C_6H_5.NH_2$. Pure aniline is a basic substance of an oily consistence, colourless, melting at -8° and boiling at $184^\circ C.$; it dissolves in 31 parts of water. On exposure to air it absorbs oxygen and slowly resinifies, becoming deep brown in colour. It possesses a somewhat pleasant vinous odour and a burning aromatic taste; it is highly poisonous, having a destructive action on the red corpuscles of the blood.

Aniline is a weak base and forms salts with the mineral acids. Aniline hydrochloride forms large colourless tables, which become greenish on exposure; it is the "aniline salt" of commerce. Although aniline is but feebly basic, it precipitates zinc, aluminum and ferric hydroxides from their salts and expels ammonia from ammonium compounds when warmed with them. When aniline hydrogen sulphate is baked at $200^\circ C.$ sulphanilic acid,



is produced. Anilides, compounds in which the amino-group is substituted by an acid radical, are prepared by heating aniline with certain acids; antifebrin or acetanilide (*q.v.*) is thus obtained from acetic acid and aniline. When aniline vapour and hydrogen are passed over finely divided nickel heated at $190^\circ C.$, the reduction products, *cyclohexylamine*, *dicyclohexylamine* and *cyclohexylaniline* are produced. The oxidation of aniline has been carefully investigated. Chromic acid converts it into quinone, while chlorates, in the presence of certain metallic salts (especially of vanadium), give aniline black. Hydrochloric acid and potassium chlorate give chloranil. Potassium permanganate oxidizes it in alkaline solution to azobenzene; Caro's acid, H_2SO_5 , converts it into nitrosobenzene. Hypochlorous acid gives para-aminophenol and para-aminodiphenylamine (E. Bamberger). Bleaching powder gives a purple coloration.

By the action of nitrous acid in acid solution, aniline is transformed into a diazonium salt. (See DIAZO-COMPOUNDS.) This reaction represents the first step in many important syntheses of dyes and other substances. The great commercial value of aniline is due to the readiness with which it yields, directly or indirectly, valuable dyestuffs. The discovery of mauve in 1858 by Sir W. H. Perkin was the first of a series of dyestuffs which are now to be numbered by hundreds. Reference should be made to the articles, DYES, SYNTHETIC; FUCHSIN; SAFRANINE, for more details on this subject. It is a starting-product for the manufacture not only of dyestuffs but of many drugs.

Aniline is manufactured by reducing nitrobenzene with iron borings and water slightly acidified with hydrochloric acid, the product being purified by steam distillation followed by distillation under reduced pressure. The action of ammonia on chlorobenzene at high pressure and temperature in the presence of a catalyst is also employed in the manufacture of aniline. Mono-methyl- and dimethyl-aniline are colourless liquids prepared by heating in an autoclave at 220° aniline, aniline hydrochloride and methyl alcohol, or aniline, methyl alcohol and about 0.5% of iodine. They are of great importance in the dye industry. Mono-methylaniline boils at $193-195^\circ$; dimethylaniline at 192° . (See also AMINES.)

ANIMAL, a term first used to denote a living thing but now used to designate one branch of living things as opposed to the other branch known as plants. Until the discovery of protoplasm and the series of investigations by which it was established that the cell was a fundamental structure essentially alike in both animals and plants (see CYTOLOGY), there was a vague belief that plants, if they could really be regarded as animated creatures, exhibited at the most a lower grade of life. We know now that in so far as life and living matter can be investigated by science, animals and plants cannot be described as being alive in different degrees. Animals and plants are extremely closely related, alike in their fundamental characters and each grading into organisms which possess some of the characters of both classes or kingdoms (see PROTOZOA). The actual boundaries between animals and plants are artificial; and are solely due to the ingenious analysis of the systematist. The most obvious distinction is that the animal cell-wall is either absent or composed of a nitrogenous material, whereas the plant cell-wall is composed of a carbohydrate material—cellulose. The animal and the plant alike require food to repair waste, to build up new tissue and to provide material which, by chemical change, may liberate the energy which appears in the processes of life. Both have the same general chemical composition, being made up of water, inorganic salts, carbohydrates, fats and proteins. Both animals and plants take their water and inorganic salts directly as such. The animal cell can absorb its carbohydrate and proteid food only in the form of complex organic substances; it is dependent, in fact, on the pre-existence of these organic substances, themselves the products of living matter, and in this respect the animal is essentially a parasite on existing animal and plant life. The plant, on the other hand, if it be green, containing chlorophyll, is capable, in the presence of light, of building up both carbohydrate material and proteid material from inorganic salts; if it be a fungus, devoid of chlorophyll, while it is dependent on pre-existing carbohydrate material and is capable of absorbing, like an animal, proteid material as such, it is able to build up its proteid food from material chemically simpler than proteid. On these basal differences are founded most of the characters which make the higher forms of animal and plant life so different. The animal body, if composed of many cells, follows a different architectural plan; the compact nature of its food, and the yielding nature of its cell-walls, result in a form of structure consisting essentially of tubular or spherical masses of cells arranged concentrically round the food-cavity. The relatively rigid nature of the plant cell-wall, and the attenuated inorganic food-supply of plants, make possible and necessary a form of growth in which the greatest surface is exposed to the exterior, and thus the plant body is composed of flattened laminae and elongated branching growths. The distinctions between animals and plants are in fact obviously secondary

and adaptive, and point clearly towards the conception of a common origin for the two forms of life, a conception which is made still more probable by the existence of many low forms in which the primary differences between animals and plants fade out.

An exact definition, delimiting all animals from all plants, is therefore impossible. In general, however, an animal is a living organism that is incapable of synthesizing carbohydrates and proteins from inorganic or simple organic substances, but must ingest them in complex form as food.

In general, also, animals are distinguished from plants by freedom of spatial movement.

For the classification of the animal kingdom, see ZOOLOGY.

ANIMAL BEHAVIOUR. As generally used, animal behaviour refers to the action of an animal with reference to its complete environment of living and nonliving things. A given behaviour pattern may start in response to some external change or it may be initiated by internal stimuli the nature of which frequently escapes analysis. Behaviour is an aspect of response physiology as contrasted with developmental, maintenance, or toleration physiology. It is extremely hard to draw definite lines between these phases of physiology. The spinning of a moth's cocoon involves complex behaviour patterns but is not greatly different in originating stimulus or in end result from the hardening of the hypodermis to form the bare outer covering of the pupating butterfly.

It is difficult to observe animal behaviour without trying to understand its meaning and without trying to correlate the observed action with similar activities shown by other animals lower or higher in the evolutionary scale, particularly with the behaviour of man. Many students also attempt to puzzle out the complicated stimulus-response processes that are involved. Close study usually reveals a complex situation with many variables and leads directly to some of the most fundamental biological and philosophical problems. These include traditionally the problems associated with mechanism versus vitalism in biology; the extent to which nonhuman animals have what in man is called consciousness and mind; and much of the controversy about whether purpose exists in nature.

Plants as well as animals show behaviour responses of many kinds. Some turn toward the sun; others give so-called sleep movements at night, and specialized forms actively catch insect prey. Plant actions are usually so slow that they escape observation, yet viewed with the help of a motion-picture film made from time-lapse exposures, the self-propelled activity of plants rooted in the wind-free forest floor are quite evident. The leaflet folding of sensitive mimosas is easily seen, and algal swarm spores swim across a microscope field as actively as do protozoans. The behaviour of plants is closely related to that of animals in many fundamentals, even though movements in higher plants are usually produced by changes in turgor or by growth responses.

Nonliving things also show varied behaviour patterns. The activity of electrons, ions, atoms, molecules, colloidal particles, the earth's crust, the planets and their satellites, the sun and other stars and galaxies of stars are as truly behaviour in the broad sense as is the flight of a bee or the tantrum of a child. One of the great problems is the extent to which the behaviour of living things is basically like that of nonliving nature. Those who believe that this unity will ultimately be demonstrated are called mechanists. This is the working hypothesis of students of experimental behaviour of lower organisms as it is for other phases of experimental biology. In contrast, vitalists hold that a distinctively new vital principle or force is involved in the behaviour of living things. This fundamental problem is by no means solved.

Animal behaviour is not limited to that shown by the individual. Organisms are frequently integrated into more or less social communities that themselves behave as units of a higher order. Under such conditions animals give both individual and group responses. A further discussion of such matters will be found in the article on ANIMAL SOCIOLOGY.

Animal behaviour, as a part of biology, cuts across many boundaries. Like other aspects of physiology, it is related to phys-

ics and chemistry; it is an integral part of ecology, and of the general and comparative phases of physiology, psychology and sociology. It draws from the lore and methods of all these fields and is used as a tool in the solution of problems in the four biological disciplines just mentioned.

History.—Aristotle recorded a somewhat systematic account of the behaviour of many kinds of animals and exerted an influence on this phase of biology that was hardly equalled until the time of Charles Darwin. Like Aristotle and Darwin, the men who contributed to knowledge concerning animal behaviour well into the period following 1850 were also prominent in other fields. The list includes such often mentioned names as: Pliny (A.D. 23-79) and Plutarch (c. 46-120), who, like other Romans, had a rather high opinion of animal intelligence. Thomas Aquinas (c. 1225-1274) and Descartes (1596-1650) separated man sharply from even the higher nonhuman animals. Konrad von Gesner (1516-1565) helped in the revival of the spirit of inquiry of the classical Greeks. Reaumur (1683-1757) worked actively with insects. Erasmus Darwin (1731-1802), Lamarck (1744-1829), and Herbert Spencer (1820-1903), each in his own way, was concerned with the development of instinct and intelligence among animals.

In the Greek period, students asked: (1) Do animals have souls? (2) If so, do their souls continue to live after the body dies? (3) Do animals reason? By way of comparison, the queries of the early post-Darwinian students of behaviour were: (1) Have animals sensations? (2) Have animals memory? (3) How are these and other animal activities related to those of men? (4) Do animals reason? Darwin himself entered this field of study and his followers to the present day have been concerned with the problem of the ancestry of the human mind. G. J. Romanes, W. Preyer, J. Fabre, K. Groos, C. O. Whitman, and E. G. and G. W. Peckham were among the outstanding students of behaviour during the early Darwinian period.

Modern experimentation in behaviour dates from the 1880s. Of the four pioneers in the movement, Sir John Lubbock and later C. Lloyd Morgan stemmed from the post-Darwinian tradition. Max Verworn and Jacques Loeb developed in part from the plant physiologists who, unaffected in their work by the controversy over the ancestry of man, had been actively studying growth and movement in plants since T. A. Knight in 1805 demonstrated the effect of gravity on the direction of the growth of seedlings.

These four early experimentalists were alike in discounting the use of anecdotes as a tool in analyzing animal activities. They all attempted to describe behaviour in objective terms and without anthropomorphisms. They studied animal behaviour for its own sake without necessary regard for the mental evolution of man. Loeb and later Lloyd Morgan applied what may be called the general scientific principle of parsimony. In the words of C. L. Morgan: "In no case may we interpret an action as the outcome of the exercise of a higher psychological faculty if it can be interpreted as the outcome of one which stands lower in the psychological scale" (*An Introduction to Comparative Psychology*, Scribner). All four men adopted, to some extent, physico-chemical explanations of behaviour—Loeb much more than the others.

The next advance came with the work of H. S. Jennings (1897 ff) who, like Verworn and Loeb, concentrated upon the behaviour of the lower organisms. Although in the early years of the 20th century there was a sharp conflict between the supporters of the tropism theory of Loeb and those who accepted the more complex trial-and-error explanations of Jennings, it may be seen in a later section that the observations of the two groups were largely complementary.

By 1896, C. B. Davenport in his *Experimental Morphology*, which covered a much wider field, could give extensive historical treatment to such topics as the following reactions and the stimuli to which they are given: chemotaxis (chemicals), hydro-taxis (water), tonotaxis (sound), thigmotaxis (touch), stereotaxis (space), rheotaxis (water currents), geotaxis (gravity), electrotaxis or galvanotaxis (electric current), phototaxis (light), and thermotaxis (heat).

The experimentalists did not always remember that they should master the normal responses of animals before introducing experimental complications. The implied naturalistic emphasis introduces the questions that ecologists began asking in the decades just before and after 1900. These are: (1) Do animals have definite reactions that enable them to find habitat niches that match their ecological tolerances? (2) Are animal responses adaptive? (3) Is a given behaviour pattern innate or conditioned (learned)?

Outstanding advances during the 20th century include I. R. Pavlov's demonstration of conditioned reflexes. In a simple, direct experiment Pavlov showed that a dog on which the sound of a bell produces no observable effect can be trained to secrete saliva when the bell rings. This is done by ringing a bell when food is presented. A hungry dog salivates in the presence of food. After sufficient training, the sound of the bell stimulates the salivary glands to activity even in the absence of food.

A second major advance came from G. E. Coghill's proof that behaviour patterns in the developing vertebrate embryo depend on the growth of detailed nervous connections. Coghill also showed that the embryo first gives broadly generalized responses like the flexure of the trunk or generalized limb movements; finer, more individualized patterns develop later. Another set of recent advances came from the demonstration of the existence and effectiveness of neurohumoral substances and of the control of much of behaviour by hormones in general. Pituitary and sex hormones are especially potent in initiating and regulating behaviour.

Content.—It is impossible to give a definite outline of the subject matter that is usually treated under the heading of animal behaviour. The subject can be approached from many different points of view. The organization given here places many of the objective, experimental phases of the subject in relation with each other. A. Kühn's classification of tropisms and taxes (taxis, singular), especially the modification by G. S. Fraenkel and D. I. Gunn (1940) has been largely accepted and placed in a more inclusive setting.

A.—INHERITED BEHAVIOUR PATTERNS

I.—Unorganized or poorly organized responses given by early embryos or by animals like sponges that have no nervous systems.

II.—Reflexes proper.—Reflex-arc movements.—Reflex movements as usually described, such as the immediate jerking away of the hand on touching a hot stove.

III.—Reflex-like activities of entire organisms.

1. **Unoriented.**—a. **Kineses.**—Undirected speeding or slowing of the rate of locomotion or of turning of whole animals; speed of movement depends on the intensity of stimulation.

(1) *Orthokinesis*.—Speed of locomotion or the frequency of change from rest to movement depends on intensity of stimulation. Lampreys are more active in high intensities of light; cockroaches in low intensities. Flatworms and many fly larvae, among others, show orthokinesis.

(2) *Klinokinesis*.—Frequency or amount of turning per unit of time depends on intensity of stimulation. This is the avoiding or trial-and-error reaction of Jennings; it is well shown by *Paramecium*.

2. **Oriented.**—a. **Tropisms.**—Directed growth-curvature movements or other oriented reactions of sessile plants and sessile animals leading to equal intensities of stimulation of symmetrically placed parts of the body; shown by many plants and by hydroid animals like the hydroid, *Eudendrium*.

b. **Taxes.**—Oriented locomotory reactions of motile organisms. They exist in purest form as oriented, forced movements, that is as reflex actions of entire organisms. When exposed to a single source of stimulation, the body is oriented in line with the source. Movement towards the source is said to be positive, that away from it is negative.

(1) *Klinotaxis*.—Attainment of orientation is indirect and is achieved by interruption of regularly alternating lateral deviations of part or all of the body. There seems to be a nonconscious comparison of intensities of stimulation that are successive in time. Klinotaxis is shown by animals with a single intensity receptor and is given by such animals as fly larvae, *Euglena* and earthworms (see fig. 1).

(2) *Tropotaxis*.—Attainment of orientation is direct and results from turning toward the less (negative) or more (positive) stimulated side as a result of simultaneous, automatic comparison of intensities on two sides of the body. No deviations are required. Tropotaxis is shown by animals with paired intensity receptors. If exposed to stimulation from two sources, orientation is to some intermediate point and is determined by the relative intensity of the sources. If one receptor is effectively covered, the animal goes round and round in spirals (circus movement). The locomotory reactions that Jacques Loeb called

tropisms belong in this category. Tropotaxis is shown by many arthropods, especially by insects. The reaction of *Notonecta*, the common backswimmer, to light is a good example.

(3) *Telotaxis*.—Known only for responses to light; attainment of orientation is direct and again is without apparent "trial" movements. When between lights from two sources, the animal orients to one light, not to some intermediate point. The animals switch orientation from one source to the other at unpredictable intervals and consequently follow a zigzag course. The response is given to the source as though it were a goal. Bilateral balance is not necessary and circus movements, if given, demonstrate that the animal is reacting tropotactically rather than telotactically. Honey bees (*Apis*) and hermit crabs (*Eupagurus*), among others, show telotaxis.

c. Orientations at an angle.

—Transverse orientations may or may not be accompanied by locomotion. They include:

(1) *The Light-Compass Reaction*.

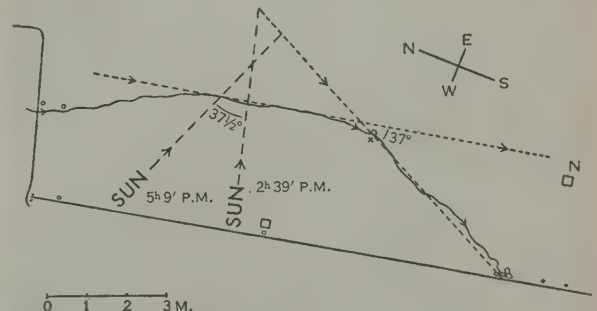
—Much given by foraging insects like ants and bees that return to a fixed nest. The general principles involved are illustrated in fig. 2, in which an ant returning to nest at N along a path approximately at right angles to the sun's rays, was covered over for 2.5 hours. On release the ant proceeded, not toward the nest, but at right angles to the rays of the late afternoon sun.

(2) *Dorsal (or Ventral) Transverse Reactions*.—Impact of the stimulus is kept at right angles to both the longitudinal and transverse axes of the body. Locomotion need not occur; given to light by various aquatic crustaceans like *Argulus*, the fish louse, and *Artemia*, the brine shrimp; given to gravity by crayfish.

IV.—Instincts.—Instinctive behaviour represents the most complicated of the inherited, unlearned behaviour patterns. Instincts are set off from kineses, tropisms and taxes by their greater intricacy. An instinct is a relatively complex activity of an animal that is acting (1) as a whole rather than by parts; (2) as the representative of a species rather than as an individual; (3) without previous experience or without modification caused by experience; and (4) with an end or purpose of which the reacting animal has no knowledge. Care must be taken to avoid confusion with early conditioned behaviour patterns. The difficulty is greater since exhibition of instincts may be deferred pending the achievement of appropriate states of development. The lack of previous experience or of modification caused by experience before approximately perfect performance is crucial evidence of the action being instinctive. Mating, nest building, and rearing of new brood by a female ant is done by instinct.

B.—CONDITIONED OR LEARNED BEHAVIOUR

In contrast with preceding categories, conditioned or learned behaviour is predominately acquired or strongly modified as a result



ADAPTED FROM G. S. FRAENKEL AND D. I. GUNN, "THE ORIENTATION OF ANIMALS," (CLARENDON PRESS, OXFORD), AFTER BRUN, 1914

FIG. 2.—THE LIGHT-COMPASS REACTION GIVEN BY AN ANT; SEE TEXT

of individual experience. The following broad categories can be recognized:

I.—Conditioned reflexes or automatisms (simple associative learning): The unconditioned stimulus (presentation of food to dog) determines the response (secretion of saliva). The conditioned stimulus (ringing of bell), at first in contiguity with the unconditioned stimulus, at length elicits the response when acting alone. As soon as the conditioned stimulus begins to be effective, further improvement comes from trial-and-error learning.

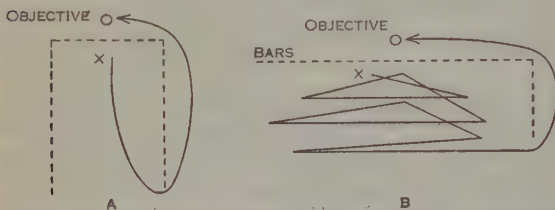
1. **Conditioned reflexes** like the substitution of the sound of a

bell for the sight of food to stimulate salivation.

2. **Conditioned automatisms** are more complex and involve reactions of the entire organism.

II.—**Trial-and-error learning** (selective learning): This type of learning is independent of a specific unconditioned stimulus; it involves reward and punishment as well as contiguity. The animal does not learn something wholly new—rather a response, often a random response, is selected as a result of reward or punishment and becomes dominant. This kind of learning is shown under diverse problem situations in which the animal is not initially acquainted with all elements in the situation.

III.—**Insight** is shown in those cases in which an animal that is accustomed to all elements in the situation taken separately finds them in new relations to each other. When typically exhibited, after the initial survey, the animal proceeds at once to make a smooth solution, or does so after a motionless pause. Reward speeds the performance (selective learning) and also repays the animal for displaying insight. An example is given with the aid of fig. 3. A dog that has had the run of the surrounding yard is at X when he sees food being placed beyond the grill. His smooth solution of the situation is indicated by the curved line. A hen under similar conditions zigzags back and forth until she finds the solution by trial and error or ceases to react. These phases of learned behaviour and their general implications are discussed more fully in the article on **PSYCHOLOGY, COMPARATIVE**.



ADAPTED FROM WOLFGANG KOHLER, "MENTALITY OF APES" (KEGAN PAUL, TRENCH, TRUBNER AND CO., LTD.)

FIG. 3.—(A) A SMOOTH SOLUTION AS GIVEN BY DOG OR APE IN CONTRAST WITH (B) THE TRIAL-AND-ERROR BEHAVIOUR OF A HEN UNDER SIMILAR CONDITIONS

Instinctive and Learned Behaviour.—The distinction between learned and unlearned behaviour is not as clear cut as might appear from the above outline. Instinctive elements enter into intelligent activities and behaviour patterns that are primarily instinctive do not usually run their course automatically. Often they contain a variable element that is more or less adapted to the particular situation, in addition to the fixed, inherited aspects.

An act A is at one and the same time often a function of a constant C and a variable V ; expressed as a formula it reads $A=f(C,V)$. In simplest cases, the constant element is unlearned and the variable is either learned or is related to learned behaviour. This analysis of action A into these two components is an abstract one. V and C do not represent more or less antagonistic agencies pushing the animal now in this direction, now in that, as they impinge on one another; they are rather two different phases of one whole. In instinctive reactions, C is greater than V , often very much greater; in intelligent behaviour, relations are reversed and V is greater than C .

The nest building of birds gives an interesting test case. The variable element appears in the way in which the individual bird sets about finding a suitable location and then by means of co-ordinated body movements collects available appropriate materials and weaves them into the structure of the nest. The general nest pattern is unlearned; it is representative of the genus or species rather than of the individual. Robin nests have a cup of dried mud between the outer sticks and the inner lining. Older birds frequently weave more skillfully than do beginners. Nest building of birds is neither purely an automatic, inherited reaction nor purely learned behaviour. Both C and V are involved.

The complex activities of other animals, man included, similarly contain both these elements. Here we come to an answer to one of the questions of the early Darwinians. The behaviour of man differs in degree rather than in kind from that of other animals. The differences, though often very great, are quantitative rather than qualitative.

Experimental Behaviour as a Tool.—Man is the only ani-

mal whose behaviour we can describe with even approximate completeness since he is the only one about which we can supplement objective behaviour observations with subjective knowledge gained personally or by communication with others. We cannot know by direct experience what animals of other species see or feel or otherwise sense; we can only find the stimuli to which they react and their methods of reacting. Using all avenues of approach open to us: observation, physical analysis of the environment, controlled experiments including discriminatory learning when possible, we find that many animals live in a different sensory world from our own.

Much of the activities of ants indicates that within their dark nests, and outside too for the blind species, ants live in a world of odour shapes somewhat as man lives primarily in a world of light and shade or of colour shapes. For many animals, smell is an important sense; it is blunted in man. Male moths of several species can find appropriate females though in observed cases the latter may be over a mile away. The physics of the situation is little short of astounding when we consider how scarce the minute odour-bearing particles must be and yet the male is not only able to detect them but also to follow the very low intensity gradient that leads him to their source.

Dogs can be trained to react to a Galton whistle pitched so high that it is inaudible to man. Bats emit and react to supersonic vibrations of the order of 45,000–50,000 cycles per sec. Man's hearing stops at about 20,000–25,000 cycles per sec. Bats avoid obstacles in total darkness apparently from reacting to the radar-like reflections of the supersonic waves they have emitted.

As compared with man, the arthropods, as a rule, are relatively unresponsive to the red end of the spectrum. K. von Frisch failed in attempts to train honey bees to react to red paper when mixed with a series of grays and covered by clean glass. He could train them to find sugar water on the other spectral colors when similarly interspersed among shades of gray. The available experimental evidence indicates that the honey bee reacts to a spectrum of from 2,700–6,770 Angstrom units though hesitatingly at the red end. This extends from the ultra-violet region into the red. *Drosophila*, the common fruit fly, reacts to the range of wave lengths from 2,350 in the ultra-violet to about 5,780 in the yellow. The span to which some vertebrates respond given in Angstrom units is: *Phoxinus*, a fish, 3,400–8,000 (near ultra-violet to infra-red); the common hen, 5,000–7,000 (green into red); adult man in daylight, 4,000–7,700 (violet through red).

A number of insects and other arthropods have been shown to be sensitive to ultra-violet radiation. Both *Drosophila* and the honey bee appear to find their highest luminosity values of light in short wave lengths to which man is totally blind. *Trigona*, a stingless bee from the American tropics, has been trained to react to an ultra-violet pattern.

Enough has been said, perhaps, to document the general principle that it cannot be assumed that other animals, even that other mammals, have the same sensory abilities and limitations found in man. One of the problems in comparative animal behaviour is to describe with all the accuracy possible the sensory field of representatives of all the major animal phyla and of the minor ones, too, when they are particularly interesting, either for functional or for evolutionary reasons.

Physico-Chemical Principles Applicable to Behaviour.

The physiology of animal behaviour is very complex. Among the factors to be considered are: (1) the present external environment; (2) environments of the recent and sometimes of the more remote past; (3) the present physiological state; (4) recent physiological states and sometimes those of the more remote past; (5) the processes involved in the resolution of one physiological state into another; (6) the physiology and anatomy of the given animal, especially (7) of the sense organs (receptors), nerves or hormonal conductors (conductors), the central nervous system (adjustor), and the different kinds of effectors.

Considering its complexity, it is impressive to find the extent to which physico-chemical principles (the natural laws of the older literature) apply in animal behaviour. The following incomplete list is long enough to make the point.

1. Most activities increase in speed with an increase in temperature between the threshold and the optimum points. The formula of Arrhenius and the Van't Hoff coefficient, devised from chemical considerations, hold in many instances.

2. With light, intensity varies inversely as the square of the distance. Animal reactions that are affected by light intensity clearly show the effect of this inverse-square relationship.

3. With light, the product of the strength of the stimulus and the length of time it operates, if constant, give constant results (Bunsen-Roscoe law).

4. The intensity of illumination of a surface element varies with the cosine of the angle of incidence (the cosine law of illumination).

5. Within the same modality and with constant experimental conditions, the ratio between two stimulus magnitudes that are correctly discriminated, in any intermediate proportion of the attempts, is a constant (Weber's law). Like several others, this principle does not hold for relatively low or high magnitudes.

6. The stimulating effect of intermittent light equals that of a constant light if both emit the same amount of energy and if the

interval between flashes is not too great (Talbot's law).

There is space to record only one illustration. *Limulus*, the king crab, is a photonegative animal. When it is exposed to light from two sources the animal swings to an orientation between the two beams. This orientation is independent of intensity (I) and of duration (D) of the light stimulus providing $I \times D$ of one equals $I \times D$ of the other. Under these conditions *Limulus* orients away from the lights and along a line equidistant from both. Given a situation in which $I \times D$ of one differs from $I \times D$ of the other light, the orientation shifts until $IT \times \cosine\text{-of-angle-of-incidence}$ of one eye equals the product of similar values for the other eye. The reaction illustrates tropotactic behaviour.

In one of the original experiments, 38 individuals tested gave fairly diagrammatic responses; 10 did not. This serves to introduce a final principle of behaviour: At all levels of the animal kingdom, if closely studied, different individuals of the same kind show distinctly individualistic responses. Despite the remarkable extent to which many animals exhibit complex behaviour patterns that accord with physico-chemical principles worked out for nonliving systems, the fact remains that under carefully controlled experimental conditions, animals often react in an unpredictable fashion. This means that, to date (1945), even the best analyses of behaviour are incomplete. Such a situation is neither a cause for reproach nor for defeatism but rather it is a stimulus to further study.

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ANIMAL BREEDING. This term is sometimes used broadly to include all the operations of producing, rearing and caring for animals, but more often is restricted to activities intended to change their heredity so that they will better satisfy human needs and desires.

Animal improvement may be made by improving either the environment of the animals or their inherited ability to utilize that environment. The improvement in the environment does not directly alter the heredity of the animal populations exposed to it, but it does lift some of the environmental limitations which previously prevented hereditary differences from manifesting themselves. Except for improving their inherent hardness, little is gained by breeding more productive animals if poor feed or care are still the main limits on what they can produce. Lifting those limits to higher levels immediately increases the incentive for improving the hereditary ability of the animals to utilize the better environment. Thus improvement in environment and improvement in animal heredity (except for hardness and disease resistance) often follow each other closely.

Changes in an animal population by improvements in environment are usually quick but last only as long as the new conditions continue. Changes in the hereditary constitution of a population are often slow but are relatively permanent unless selection toward the original condition is then practised. However, there are some characteristics (typified by those in which the maximum production results from an intermediate size or quality of organs) for which the average inherent merit of the population will decline sharply for the first generation or two after efforts at breed improvement cease.

Origin of Breeds and Breeding Customs.—The initial step in forming a breed was usually the collection of a small group of animals which the breeders thought superior to others. Having started with material sufficiently varied that all of the desired characteristics were included in at least a few of the animals, the breeders then proceeded by selecting as parents for the next generation those individuals which pleased them most. This process was repeated generation after generation, seeking to make the undesired characteristics scarcer and the desired characteristics more abundant.

At first there were no herdbooks, breed associations, or other means for helping each breeder to find others who held similar ideals. Hence it was only natural that each started with his own stock and when purchasing chose mostly from the herds of neighbours or at least from those herds which were close enough that he

could inspect them personally.

The more successful each breeder was in making his stock approach his ideal, the less likely it became that he could find, outside of his own herd or the herds of his co-operators, animals which fitted his ideal as well as his own did. If success crowned his early efforts, he was soon faced with the choice of continuing to breed within his own stock, along with any inbreeding that involved, or of using animals he thought inferior. The more pronounced his early success, the more likely he was to choose the former alternative.

The tradition of strictly pure breeding for producing seed stock became established largely in rural England in the late 18th and early 19th centuries. On the continent of Europe the contemporary animal breeding was more largely directed to attempting to improve by crossing all sorts of races from various regions. This later changed to extreme emphasis on purity of breeding. (See W. Engeler on "racial constancy.") During the last half of the 19th century the pendulum of breeder opinion in continental Europe swung toward less insistence on breed purity and more emphasis than elsewhere in the world on testing production and on inspecting, measuring or otherwise grading the merit of individual animals officially. In many importing lands purity of breeding is emphasized more than in the lands where the breed originated. Whenever a breed became so popular that it acquired a considerable export market, means of promoting and keeping that market naturally became important to the breeders and were influential in determining registration rules and other procedures.

New breeds often arose from complex mixtures of cross-breeding but this was rarely planned deliberately. In most instances the recognition that a breed existed was preceded by many years of commercially successful breeding within the cross-bred stock. Examples are Poland-China and Duroc-Jersey swine in the United States, Corriedale sheep in New Zealand, and Africander cattle in the Union of South Africa.

Defining the Ideal.—The first step in any breeding program is to decide what is ideal. Variation in the purposes and markets on which the animal products are to be sold, or in the plant resources which are to be converted into those animal products, or in the local physical and climatic conditions may cause the ideal animal to be widely different from farm to farm and from one locality to another nearby.

It may even be profitable to keep on the same farm two different types of animals of the same species for different purposes, as the keeping of some horses for draft and some for riding, or of some cattle specialized for beef production and others for dairy purposes. The animal with the highest net desirability may be a compromise between that which is ideal on the market and that which can utilize the available plant resources most effectively.

Measuring Individual Merit.—The second step in a breeding program is to measure how well or poorly each individual conforms to the ideal. This is more difficult for some characteristics than for others. The quantity and quality of milk, wool and eggs actually produced by a cow, sheep, or hen, for example, can be weighed, graded or counted with reasonable exactness. The exterior anatomical conformation of an animal used for meat purposes can be appraised fairly accurately, although subjectively. But physiological soundness and rates of functioning can be only vaguely estimated from the exterior. Measurement of internal anatomy, longevity, vitality in general, or the lifetime usefulness of work animals can not be complete until the animal has reached the end of its life. This is too late to be used in the actual decisions which the breeder must make concerning the animal itself, although not too late for use in the pedigrees of its descendants or relatives.

Even for characteristics which can be measured definitely and fairly simply, as the amount of milk or the number of eggs produced, what an animal has done in one month or one year is not a perfect guide to what it will do the following month or year. Also the usefulness of the whole animal depends on its merit in several different characteristics and on how well these complement each other.

Selection.—The third step in animal breeding practice is to estimate how nearly each available animal has the heredity for producing the ideal characteristics and to use or reject it for breeding purposes accordingly. All estimates of breeding value are based on appraisals of individual merit, either of the animal itself or of its relatives.

Selecting animals for breeding purposes solely on their own individual merit is called "mass selection." Selecting them according to the merits of their ancestors and collateral relatives is called "pedigree selection" or "family selection." The former term emphasizes the ancestors; the latter term emphasizes the collateral relatives. Estimating an animal's breeding value by the merits of its descendants is called "progeny testing."

Each of these bases for estimating breeding value has some advantages and disadvantages as compared with the others. Pedigree is available earliest and progeny test comes last. In a hitherto unselected population individuality is generally most accurate and pedigree least accurate, although progeny test and (much more rarely) pedigree can sometimes be more accurate than individuality. Many important characteristics are expressed in only one sex. For these there is no possibility of judging individuality in the members of the other sex. Examples are milk and butter fat production, egg production in fowls, size of litter in swine, and maternal instincts and other aspects of reproductive behaviour.

In practice all three bases for selection are used as opportunity offers. Each does some of the same things one or both the others do. Discarding the worst individuals prevents those which would have had the worst pedigrees in the next generation from being born. Consequently, if a breed has been steadily under selection for more than a generation the pedigree differences within it are smaller and less useful for selection than when selection is first beginning, or when a change in ideals is for the first time directing attention to characteristics previously thought unimportant. Likewise, the animals with the worst individuality do not get tried at all for breeding. Hence, when the progeny tests first become available they are usually only on animals with reasonably good pedigrees and individuality.

The possibilities of discriminating between such individuals on their pedigrees and individualities have already been partially exhausted and the new information coming from the progeny test deserves relatively more attention than if the same information were suddenly to become available in a population not previously selected.

Information concerning an individual's own merit continues to accumulate throughout its life as it matures, produces in successive years, shows resistance or susceptibility to disease or unfavourable environment, and otherwise demonstrates its productiveness and longevity. Pedigree information is added as the ancestors become older and more thoroughly tried, and as new collateral relatives show their merit. The average merit of the progeny can change as more are born and as the merits of the older ones or of their other parents become better known. Complete certainty concerning an animal's breeding value is never attained except for an occasional characteristic slightly affected by environment and simple in its inheritance. For example, no red bull can transmit black but some black bulls will be known certainly to be heterozygous, *i.e.*, can transmit unlike things, such as black or red, to various of their offspring.

Mass Selection.—When the characteristic being selected is highly hereditary, the offspring will average almost as high as their selected parents; when it is but slightly hereditary, the offspring will average only a little above the merit of the generation from which those parents were selected. Progress made by mass selection depends on the intensity of the selection and also on the amount of this "regression" from the average of the selected parents toward the average of the whole generation in which they were born. Mass selection is usually more effective for a characteristic which can express itself in many different degrees than for a characteristic which can appear only in one or the other of two alternative forms. Selection against the less desired form of an alternative characteristic usually does make it less abundant

but this change becomes very slow while the undesired form still occurs with moderately large frequency.

In a mechanism as complicated as the animal body, many parts depend closely on the size and quality of others for their optimum functioning. Selection which changes one part is likely to disturb the balance between that part and some others with which it must co-operate for good functioning. If further progress is to result, these other parts must then be changed also. This seems to be the major explanation for the cases in which mass selection makes marked progress at first but the effectiveness of further selection in the same direction is much less.

Family Selection.—Because the family average is based on the average merit of several individuals, the effects of nonhereditary differences among them have opportunity to cancel each other. Hence the average breeding value of the selected family and its average individual merit generally agree much more closely than the merit and breeding value of the individual animal. But family averages do not differ from one another as much as individual merit does, and the breeding values of the individuals within the family will not all be the same. Under family selection one cannot reach for as much as he could with mass selection, but the next generation does not regress so far from the average merit of its parents; hence under some circumstances the rate of actual improvement can be higher with family selection. Family selection is especially useful for characteristics which are slightly heritable, or cannot be appraised accurately in the individual, or appear only in alternative forms, or like longevity cannot be measured until the individuals are middle aged or old.

For family selection to be highly accurate: (1) the number in the family must be large, (2) the members of the family must be closely related to each other, and (3) each family being compared must have been exposed to a similar range and variety of environments. The most extreme form of family selection is reached in selecting between inbred but unrelated lines. Family selection cannot often be important in animals like horses, sheep and cattle, in which there are few full sibs (offspring of the same parents) and even the half sibs may not be numerous.

Family selection results in choosing many of the same animals which would be chosen by mass selection, since any family which has high average merit must contain a high proportion of individuals above average in merit. Mass and family selection differ in what they do with good individuals from poor or mediocre families and with poor or mediocre individuals from good families.

Progeny Selection is especially useful for characteristics which can be measured while the offspring are young, but which are of low heritability or are manifest in only one sex. High accuracy of the progeny test requires (1) that all the offspring or at least an unselected sample of them be included, (2) that the inheritance which they received from their other parents be discounted or appraised with reasonable accuracy, and (3) that the progenies being compared shall have been exposed to a similar range of environments. Selection by progeny test results in choosing many of the same animals which would be chosen in family selection, since a breeder, when he chooses to continue using the parents of the best progenies, automatically chooses to produce more brothers and sisters of his best families.

Artificial Insemination.—Taking semen from a male and placing it without natural service in the vagina or uterus of a female has been done in laboratories for many years and has long been used in horse breeding as one means of combatting sterility. Its widespread use on other farm animals was first developed by Russian workers in the early 1920s and then spread to many other lands, particularly for use on dairy cattle.

It permits selection among the males to be more intense, since fewer males are needed, but it has not changed the standards by which the males are selected, except that family selection and progeny tests can be more accurate if each sire has offspring reared in several different herds. It saves many breeders the bother and expense of keeping a male. The costs of service may be higher or lower than the cost of natural service. The inseminations are usually made by a man trained to recognize and

treat breeding disorders. This may help maintain the breeding health of the herd at a higher level. Many farmers must co-operate in each artificial breeding association if the overhead costs are to be kept down.

The semen is usually obtained by allowing the male to mount a dummy or by massage. With appropriate solutions and with egg yolk as a medium the semen can be diluted so that many females can be inseminated from a single service. The diluted semen may be kept viable for several days at low temperatures. Young produced by artificial insemination are as normal as those produced by natural service.

Systems of Mating.—Having chosen the individuals which are to become parents, the next step is to decide which to mate. If no definite policy is followed, the mating is random within the group selected to be parents. If the mates are chosen by their relationship to each other, the mating system can range from intense inbreeding through random breeding to the widest outbreeding possible within that group of parents. If the choice of mates is based on their own characteristics, the mating system can range from the closest mating of like to like through random mating to the crossing of as unlikes as can be found within the group selected to be parents. These mating systems can be combined or alternated and used with various methods of selection, thus making possible an almost infinite variety of breeding plans.

Mating systems do not of themselves make any gene more frequent or more rare, but they do change the proportions in which various combinations of these genes occur, and they may change the variability of the population so that selection can be more effective than it could if mating were random.

Inbreeding is the mating of close relatives. The term is often restricted to cases where the mates are at least as closely related as first cousins, since only the closest inbreeding usually produces noticeable results at once. Milder inbreeding may produce striking results if continued for many generations. Purebreeding with herdbooks entirely closed to outside blood is inbreeding relative to the whole species, but it is so extremely mild that it is rarely considered as inbreeding. Linebreeding is a combination of selection and inbreeding in which the mates are related mainly through some admired ancestor whose characteristics it is desired to preserve and concentrate, while allowing the characteristics of other ancestors to be diluted and scattered through the natural halving processes of Mendelian inheritance.

The primary effect of inbreeding is to increase homozygosis (ability to transmit the very same thing to each offspring) and to divide the breed into distinct and unrelated families. As the inbreeding proceeds each family tends to become more homogeneous within itself and more different from other families. This increases the possibilities for effective selection between families. The increase in homozygosis causes more individuals to show the recessive characteristic. Since the recessive is generally less desirable than the dominant, some average decline in individual merit is usually observed. Because it brings more of the undesirable recessives to light, inbreeding permits selection to be more effective especially when the recessives have already become rare.

When inbred but unrelated individuals are crossed, the offspring often show even more vigour and vitality than the original stock. Thus inbreeding generally causes some immediate loss but ultimately some gain when selected inbred lines are inter-crossed with each other. This alternation of inbreeding with consequent family or line selection and then crossing of the selected lines is practised in animal breeding only in a much milder form than in the breeding of such plants as maize and sugar beets.

Outbreeding.—Choosing mates which are as unrelated to each other as possible is practised either to correct specific defects or to gain hybrid vigour and combine desirable traits. Animals resulting from crossing different breeds or races of the same species often exhibit unusually rapid growth and high vitality. When these firstcross animals are mated together this hybrid vigour is generally lost. Commercial use of this hybrid vigour has long been made in the production of blue-gray feeder cattle by crossing Aberdeen Angus cattle with white Shorthorns in

Britain, black-faced Highland sheep with Leicesters for the production of commercial sheep in Scotland and northern England, Rambouillet or Merino sheep with mutton breeds for range purposes in the western United States, European breeds of cattle with the Zebu in the tropics, and in crossbreeding swine for commercial production in the United States. The mule is an example of extremely wide outbreeding.

Conclusion.—Although the animal breeder has no power to create any new fundamental units of inheritance (genes), he can create new combinations of the existing ones. Thus for practical purposes he can change the hereditary composition and average outward merit of a population, often far beyond the limits to which the original population varied. The breeder's main reliance is on selection, which means causing the individuals which come nearest to his ideal to have many offspring and those which conform least or not at all to his ideal to have few or none. Selection of the individuals can be on the basis of their own merit (mass selection), on the merit of their ancestors and collateral relatives (pedigree or family selection), or on the merit of their offspring (progeny test). Each basis has some advantages over the others. The optimum practice is some combination of them, depending mainly on whether the characteristic is strongly or slightly hereditary, the amount of information available when the decision must be made, and how fully the other bases of selection have already been utilized.

The offspring of selected parents generally average below their parents in merit, but above the average of the generation from which their parents were chosen. Selection generally changes the variability of the next generation but little. Most breeds contain enough genetic diversity that selection can change them far in the desired direction without introducing outside blood. Sometimes crossing two or more breeds before the selection begins will hasten progress, either because it increases the genetic diversity of the stock or brings together characteristics which were not together in any one of the initial breeds.

Mating systems within the group selected to be parents can change the homozygosity, variability and family structure of the next generation, and thus can make it possible for selection to be more effective or less effective than if the selected individuals had been mated at random. Generally the producer of market animals uses outbreeding, sometimes even crossbreeding, in preference to any form of inbreeding, but the breeder of seed stock may often find some form of inbreeding, such as linebreeding, advantageous. Both may often find it advantageous to mate unlikes to correct defects.

(See HEREDITY; VARIATION; SELECTION; BREEDS AND BREEDING; INBREEDING; REPRODUCTION; CATTLE; HORSE; etc.)

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ANIMAL EXPERIMENTATION. Animal experimentation is the use of animals to study living processes in health and disease. It includes their use for the testing and standardization of drugs and biologicals; for research into the causes of disease; for the diagnosis of disease; for the manufacture of antisera, antitoxins and antivenins; for the manufacture of vaccines and toxoids; for education and training in biology and medicine, including the development of surgical skill; and for research in the biological, the medical and the veterinary sciences.

In some areas animal experimentation is accepted as approved practice by common law. In Britain, Sweden and in parts of the United States it is legally defined.

In Germany, when the nazis came into power, one of the first edicts issued by their government was that prohibiting the use of lower animals in research. As a result of this edict, when it became necessary to test certain biological hypotheses, the nazis used humans, and without their consent.

Great Britain.—The law relating to animal experimentation was passed in 1876 and amended in 1906. At that time, bacteriology was in its infancy, biochemistry was unborn, and the ma-

jority of experiments were physiological. The act, therefore, was drafted with a view to physiology.

Every experiment was to be made in a registered place, open to government inspection. Inoculation experiments, however, were sometimes permitted in nonregistered places, for the immediate study of outbreaks of disease—or if circumstances rendered it impracticable to use a registered place. Every experiment must be made under a licence.

A research worker requires a licence in order to use live animals. The holder of this basic licence may perform experiments in which the animal is, during the whole of the experiment, under the influence of anaesthesia. If it is considered that, with the recovery from anaesthesia, there is likely to be pain or serious injury, the animal must be killed before it recovers.

Other types of experiments may be performed if special certificates are obtained, in addition to the licence. Certificate A permits the performance of experiments without anaesthesia. When the animal on which the experiment is performed is a cat or a dog, certificate E is also necessary. The inoculation of a guinea pig with material from a patient, for the diagnosis of tuberculosis, requires certificate A. A feeding experiment, involving a dog, requires the experimenter to hold certificates A and E. Certificate B permits the researcher to keep the animal alive after the initial operation. If the animal is a cat or a dog, the worker must also obtain certificate EE. Certificate C permits experiments to be performed as illustrations of lectures, but only under the provisions as to anaesthesia applicable under a licence alone. Certificate F permits experiments on horses, asses and mules.

Thus, in Great Britain, experiments on animals may be performed only (1) by a duly licensed person; (2) in an approved and registered place of research; (3) for an approved specific purpose; (4) on specific kinds of vertebrate animals (the act not applying to invertebrates); (5) within a specified period, or on a specified number of animals; (6) the word "experiment" is not allowed to cover more than one animal.

The amount of paper work necessitated by the law can be illustrated by an example of one piece of research. In 1908, 12,500 observations were made for the Royal Commission for the Disposal of Sewage. Young fishes and fishes' eggs were exposed to the influence of sewage effluents in different stages of purification and dilution. This is all that was done to them. Under the act, the 12,500 observations had to be returned to the home office on 12,500 forms, as "an experiment performed on a living animal without anaesthesia."

Perhaps the most costly part of the British law is the provision that makes it unlawful to operate on animals for the development of skill. This provision is not as catastrophic as it may appear, because young surgeons may obtain licences to do research on animals, and may thus develop operative skills. Although one cannot work with animals until he receives his licence, he may assist a licence-holder, and under this provision students may participate in animal work.

In Great Britain, money donated for activity against animal experimentation is not tax free.

United States.—In the United States, every large teaching hospital has a surgical research laboratory which uses dogs for both teaching and research. The federal congress can legislate in this matter only for the District of Columbia and the territories. Bills against animal experimentation were introduced in congress each biennium from 1897, but none was passed. Prior to 1945, six states (Illinois, Maine, Massachusetts, Oklahoma, South Dakota, Washington) had passed laws prohibiting animal experimentation in public schools. Eleven states had specifically endorsed animal experimentation in legal terms. Twelve cities had been supplying dogs to medical schools, instead of destroying them at the pound. St. Louis, Mo., in 1922 and Chicago, Ill., in 1931 passed specific legislation defining these provisions.

In 1945 the National Society for Medical Research was founded. Supported chiefly by medical, dental and veterinary schools and research and philanthropic institutions, the N.S.M.R. became active in informing the public about animal experimentation. From

1945, Minnesota, Michigan, New York, Oklahoma, Illinois, Pennsylvania, California, South Dakota and Wisconsin wrote new and varying chapters favouring animal experimentation. By 1952, four states (Oklahoma, South Dakota, Wisconsin, Minnesota) and 27 cities had passed legislation that made unclaimed and unwanted stray dogs available to approved research and teaching institutions from their public pounds.

Sweden.—In 1944 regulations were promulgated on the use of animals in medical and veterinary teaching and research. Permission from boards of health was made mandatory in order that animals might be used for scientific research and teaching, for diagnosis or for the production of standardized medicines. If surgery is involved in these uses of animals, all suffering must be prevented in so far as it is possible, and the animals must be painlessly killed at the end of the experiment, unless death of the animal at this time interferes with the purpose of the experiment.

* The use of animals must be under the direction of the director of the hospital or the institution concerned. If the director is not a registered doctor, veterinarian or dentist, he must be approved by the board of health. If the requirements for research or teaching can be met by means other than using warm-blooded animals, the latter use is not approved. Before experiments on warm-blooded animals are undertaken, the medical boards must be informed of the purpose and plan of the experiments. Dogs or cats bought for the purpose must not be used sooner than five days after such purchase. The applications to the boards of health for permission to use animals must state the number of animals needed, the purpose of the use, the place where the work will be done, and the facilities for the proper care of the animals in the institution.

Results of Animal Experimentation.—Animal experimentation played a great role in the development of knowledge of infections, of anaesthesias, in growth, and in the development of new and valuable drugs and their continued refinement. More than 30 years of intensive research on animals—mainly the dog—was necessary before insulin was developed in sufficient quantity to warrant its trial on people ill with diabetes mellitus. It was not until William Harvey began to observe and experiment on animals that he began to understand the heart, the blood and the circulation. Progress in the understanding, if not the control, of cancer was made when the malady was discovered in animals—and experimentally produced in animals. The mouse, not to mention many other species, served well in research on cancer. Animal experimentation was a great factor also in gaining better knowledge and control of anaemia, digestive and kidney disorders, glandular disturbances, nervous diseases, hookworm, scurvy, pellagra and malaria. Animals also produce antitoxins which are essential in the discovery and standardization of new remedies and the diagnosis of many diseases.

Knowledge and skill in blood-vessel, chest, bone, abdominal and brain surgery was achieved by the aid of experiments on animals, including the dog. Techniques for the prevention and control of shock, for safe transfusion of blood and blood plasma substitutes were developed largely through experiments on dogs.

The experiments of George H. Whipple, George R. Minot and William P. Murphy with liver therapy on nutritional anaemia in dogs led to the effective therapy of pernicious anaemia, once uniformly fatal in man.

Animals benefited in no small degree from animal experimentation. Every advance in knowledge to prevent or cure diseases of dogs was developed, at least in some degree, on animals. Veterinarians use a great deal of information for the benefit of the dog that was developed on dogs by physicians engaged in the study of problems designed primarily for the benefit of humans.

Economic Gains.—Development of the tropics and subtropics could not have been possible without animal experimentation. Completion of the Panama canal was possible because of Louis Pasteur's and Robert Koch's fundamental experiments on the role of micro-organisms in the causation of disease; Theobald Smith's demonstration that animal diseases could be transmitted by parasitic carriers, and Walter Reed's proof that yellow fever is transmitted by a mosquito.

In the latter part of the 19th century such animal diseases as infectious abortion in cattle, hog cholera, bovine tuberculosis and Texas fever in cattle were becoming increasingly prevalent. Texas fever was rampant in the southern part of the United States, in an area as large as France. Most of the cattle raised in this area were under-

sized, large-boned, and inferior producers of meat, milk and hides. The disease was known to make frequent inroads into the northern states. By means of animal experimentation scientists demonstrated that Texas fever was transmitted from one animal to another by ticks. Effective methods were developed to control the tick.

Texas fever is only one example of an animal disease that was controlled by animal experimentation. It has been estimated that the result represented a saving of more than \$40,000,000 per year in beef, milk and hides alone—even assuming that this disease would not have spread.

The following list of drugs require the use of animals for their standardization, and the establishment of standards of safety, as listed in the United States *Pharmacopeia* and the *National Formulary*:

Drug	Test Animals
Diphtheria antitoxin	Horse, rabbit, guinea pig, mouse
Diphtheria toxin	Guinea pig, mouse
Schick test toxin (diphtheria)	Rabbit, guinea pig
Scarlet fever streptococcus	Horse, human, rabbit, guinea pig, mouse
Scarlet fever streptococcus toxin	Human, rabbit
Human plasma	Human, guinea pig, mouse, rabbit
Human immune globulin	Human, guinea pig, mouse, rabbit
Human measles immune serum	Human, guinea pig, mouse, rabbit
Human serum	Human, guinea pig, mouse, rabbit
Human scarlet fever immune serum	Human, guinea pig, mouse, rabbit
Tetanus antitoxin	Horse, guinea pig, mouse, rabbit
Tetanus toxoid	Guinea pig, mouse, rabbit
Antimeningococcic serum	Horse, mouse, guinea pig, rabbit
Antipneumococcic serum	Horse, rabbit, mouse, guinea pig
Typhoid vaccine	Mouse, guinea pig, rabbit
Typhoid and paratyphoid vaccine	Rabbit, mouse, guinea pig, rabbit
Rabies vaccine	Calif. rabbit, guinea pig, mouse
Smallpox vaccine	Human, guinea pig, mouse, rabbit
Old tuberculin	Human
Liver extract	Dog
Adrenal gland	Dog
Epinephrine ampules 0.1% sol.	Rabbit
Insulin	Male dogs
Parathyroid extract	Guinea pig
Posterior pituitary extract	Human
Stomach powder	Rat
Cod liver oil	Rat
Halibut liver oil capsules	Rat
Vitamin A oil capsules	Rat
Viosterol in oil	Rat
Concentrated vitamin A and D capsules	Rat
Extract of rice bran	Rat
Hexavitamin capsules	Rat
Water for injection	Guinea pig, rabbit
Physiological salt solution	Rabbit, guinea pig
Ringer's solution	Rabbit
Dextrose ampules	Rabbit
Dextrose and sodium chloride ampules	Rabbit
Anticoagulant solution of sodium citrate	Rabbit
Arsphenamine	Rat, rabbit
Neosarsphenamine	Rat, rabbit
Sulfarsphenamine	Rat, rabbit
Tyrrasamide	Rat, rabbit
Ergot fluidextract and extract	Rooster
Digitalis: capsules, leaves, powder, ampules, extract, tablets, tincture	Cat
Quabain ampules	Frog
Strophanthin ampules	Frog
Strophanthus tincture	Frog
Apocynum fluidextract	Cat
Convallaria fluidextract	Cat
Aconite fluidextract and tincture	Guinea pig
Penicillin preparations	Rabbit, mouse
Streptomycin	Mouse, rabbit

A further example of the need for animals for life-saving purposes is the necessary use of animals for diagnostic aids. A listing of the condition to be diagnosed, and the animals necessary to aid in the diagnosis, follows:

Condition	Animal(s) Used
Tuberculosis	Guinea pig; rabbit
Anthrax	Guinea pig
Glanders	Male guinea pig
Listerellosis	Guinea pig; rabbit
Rabies	Mouse
Psittacosis	Mouse
Equine encephalomyelitis of man	Guinea pigs; mice
Foot-and-mouth disease	Guinea pig; bovine, swine
St. Louis encephalitis	Pigeons; nursing mice
Rift Valley fever	Sheep
Louping ill	Monkeys; mice; sheep
Rat-bite fever	Guinea pig; mice
Haverhill fever	Mouse; guinea pig
Weil's disease	Guinea pig
Typhus fever	Guinea pig
Rocky Mountain spotted fever	Mouse
Tsutsugamushi disease	Mice
Yellow fever	Rhesus monkey; mice
Lymphocytic choriomeningitis	Guinea pig; rats; mice
Poliomyelitis	Monkeys; guinea pigs
Meningococcal infections	Mouse
Pneumonia (Pneumococcal infections)	Mouse
Tularemia	Guinea pigs; mice
Early pregnancy	Rabbits
Sex hormone concentrations in blood and urine	Rats; mice
Urinary gonadotrophin	Rabbits

(NA. Br.)

ANIMAL EXTRACTS. The animal kingdom provides a source for a large number of substances having nutritional and

therapeutic value. Many of these active substances are complex proteins which have not been synthesized in the chemical laboratory. The structures of some of the hormones and other compounds isolated from animal extracts have been determined and have been synthesized by the chemist at a cost much lower than the cost of extraction from the animal organ. The animal extracts are obtained by extraction of the active material from the animal organ with subsequent purification by chemical means, or the secretion of an organ, such as bile and pregnant mares' urine, is extracted and provides the source of the active compounds. Some of the potent adrenal hormones are produced by the perfusion *in vitro* of animal adrenal glands with blood and the subsequent isolation of the crystalline hormones from the perfused blood. Many antibodies against diseases such as smallpox and diphtheria are obtained from the blood of animals inoculated with the organism producing the disease.

Substances such as honey and wax are obtained through the activity of a member of the animal kingdom. Some of the common animal extracts are adrenalin, beeswax, cod liver oil, gelatin, honey, insulin, lard, lanolin, suet, cantharidin, pituitary, testicular and ovarian extracts, pancreatic solution and ox-gall.

The pituitary gland has an anterior and posterior lobe. Extracts obtained from the posterior lobe contain many active principles which have not been isolated as chemically pure entities. The posterior pituitary extract exhibits striking physiologic actions on the heart, circulatory system and the smooth muscle of the body. There is a potent antidiuretic substance which increases the reabsorption of water by the kidney. Diabetes insipidus, characterized by excessive secretion of urine, is controlled by the injection or nasal insufflation of posterior pituitary extract. In obstetric medicine it is used to control postpartum bleeding and to prevent or control haemorrhage in therapeutic abortions by promoting uterine contraction. The anterior lobe of the pituitary gland also produces many hormones, some of which control the activity of other endocrine glands of the body, for example, the adrenal cortex, thyroid, ovaries and the testes. Some of these hormones have been isolated in relatively pure form and are used in the treatment of disease.

Adrenocorticotrophic hormone (ACTH) stimulates the adrenal gland to produce adrenal steroid hormones. These steroid hormones have a wide range of physiological actions. ACTH has been used in the treatment of rheumatoid arthritis, rheumatic fever and other inflammatory diseases.

The gonadotrophic hormones have been used, when there is a hypofunction of the anterior pituitary, to stimulate the ovaries in females and the testes in males. A hormone with properties of producing growth in animals has been isolated from the anterior pituitary gland. The lactogenic hormone of the anterior pituitary exercises a direct control over milk secretion and has been used to stimulate deficient lactation in postpartum women. These hormones cannot be given by mouth since they are proteins and are destroyed by the proteolytic enzymes in the intestine.

The adrenal gland is composed of the medulla and the cortex. The medulla produces at least two substances, adrenalin and nor-adrenalin. These compounds have a profound stimulating action on the cardiovascular system and are used as circulatory stimulants in conditions of shock. They are also used in the treatment of certain allergic diseases. From the adrenal cortex 28 crystalline steroid compounds had been isolated by the early 1950s. The adrenal cortex is essential for life unless adequate hormonal replacement therapy is given. Six of the 28 hormones will maintain the life of the adrenalless animal. Adrenal cortical extract has been used to treat adrenal insufficiency in man; the adrenal cortical hormones have an important role in many physiological functions in the body, such as salt and water balance as well as carbohydrate and protein metabolism. Two of the biologically active adrenal cortical steroids, cortisone and Compound F are made synthetically. These compounds have a profound effect in inhibiting the inflammatory response seen in many diseases. Most of these substances are active when given by mouth.

Extracts of the testes and ovaries are rarely used since the

active principles can be made by the chemist. The testicular androgen, testosterone, is used in the treatment of hypogonadism and for the palliative treatment of certain breast cancers. The ovarian hormones, estrogens and progesterone, are used in certain types of amenorrhoeas and dysmenorrhoeas. Estrogens are helpful in relieving symptoms of the menopause and have been used in the control of certain types of cancer. The parathyroid glands provide an extract used to treat hypoparathyroidism. This disease is characterized by muscle tetany associated with low blood calcium and high blood phosphorus. A resistance to the hormone develops after a number of injections, and therefore vitamin D compounds have been used for long-term therapy.

The pancreas produces two types of secretions, an exocrine and endocrine. The endocrine secretion, insulin, is of great importance in the treatment of diabetes mellitus. The isolated hormone can be modified by adding zinc and protamine to produce a much longer acting preparation; it plays an important role in the control of carbohydrate utilization. The exocrine secretion is made up of a number of enzymes. Two important types break down fats and proteins. They are secreted in an inactive form but are activated in the alkaline medium of the intestine. This type of pancreas extract has been used as replacement therapy in conditions of hypofunction of the pancreas.

The thyroid gland produces a hormone thyroxin which is important in regulating the energy metabolism of the body. In certain deficiency states, such as myxoedema in the adult and cretinism in children, thyroid extract provides adequate replacement therapy. This material may be taken by mouth. Liver extract is used in the treatment of pernicious anaemia and certain types of neuritis. Animal bile provides the source of bile acids which have been used in conditions of inadequate secretions of bile by the liver.

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ANIMAL FAT: see OILS, FATS AND WAXES.

ANIMAL HEAT. This subject includes the physiology of the body temperature of animals, the paths of heat loss and the heat production that is necessary to maintain body temperature. The invention of the thermometer led to a marked increase in the knowledge of variations in body temperature of man and animals. The use of electrical resistance thermometers, thermocouples and radiometers also contributed measurably to the information concerning variations in different parts of the body, the paths of heat loss, and the factors affecting them. The body temperature of man and animals is reliably obtained with a mercury thermometer placed in the rectum. With man the internal temperature is usually taken in the mouth.

Warm- and Cold-blooded Animals.—Animals in general are classified as homeothermic (practically constant body temperature independent of environment) and poikilothermic (body temperatures varying with external temperature). The first class includes the warm-blooded animals, all mammals, domestic animals and birds. The second class includes such animals as insects, snakes, lizards, tortoises, frogs and fishes. In a study of the rectal, mouth and skin temperatures of several varieties of snakes, turtles and tortoises in 1932, Francis G. Benedict found that the body temperatures of these animals almost invariably were slightly lower than the temperature of the environment. These animals acted as a wet-bulb thermometer, because all of their heat elimination was by way of vapourization of water. When a snake was placed in a calorimeter to measure its heat elimination, no heat was given off; in fact, it absorbed heat from the surrounding air. Only in the case of a python incubating a group of eggs was the body temperature higher than that of the environment.

A few animals are warm-blooded at one season of the year and cold-blooded at another. The most noted example is the marmot, or woodchuck. During the warm period of the year they are warm-blooded, but in the fall they go into a state of hibernation and become cold-blooded. The state of hibernation is brought about by absence of food and cold external temperatures. The

body temperature in hibernation has been observed to go down to 37° F. with recovery, and was usually 2° to 5° F. above that of the environment. Warm-blooded animals can behave as cold-blooded under conditions of anaesthesia. Sutherland Simpson demonstrated that when a monkey was kept deeply anaesthetized with ether and placed in a cold chamber, its temperature gradually fell. When it had reached a sufficiently low point (87° F.), the use of an anaesthetic was no longer necessary. The explanation was that the heat-regulating mechanism had been impaired. In studies on the marmot reported by Benedict in 1938, nembutal was used to produce narcosis, and the marmots had body temperatures as low as 82° F. and were usually 2° to 4° F. above that of the environment. In man and animals, injuries to or severance of the spinal cord will bring about abolition of the heat-regulating mechanism and an approach to a condition like that of cold-blooded animals. These facts tend to show that the power of maintaining a constant temperature has been a gradual development and that anything that interferes with the working of the higher nerve centres puts the animal back again, for the time being, on to a lower plane of evolution.

Variations in Body Temperature.—The body temperature of animals ranges from 96° F. in the elephant to about 109° F. in small birds. Animals may be classified according to body temperature as follows: 96°–101° F., man, monkey, mule, ass, horse, rat, mouse and elephant; 100°–103° F., cattle, sheep, dog, cat, rabbit and pig; 104°–106° F., turkey, goose, duck, owl, pelican and vulture; 107°–109° F., fowl, pigeon and several small common birds. The body temperature of a healthy man may range from about 97° F. to 100° F. during the 24 hr.; the rectal temperature is between 1° and 2° F. higher than the mouth temperature. The temperature of infants and young children has a much greater range and changes readily from comparatively slight causes. The average temperature falls slightly from infancy to puberty and again from puberty to old age.

A diurnal variation of body temperature occurs in man and in most animals. In man the lowest body temperature is from 2 to 5 A.M., and the highest from 2 to 5 P.M. With this changing temperature throughout the day it is only coincidence that the temperature may be 98.6° F., which is considered to be normal. In the early morning the oral temperature may be as low as 97° F., and in the afternoon as high as 99° F. without being abnormal. Reversal of the activity from day to night, as in night workers, does not change this rhythm, but on a trip from New Haven, Conn., to Manila, P.I., R. B. Gibson found in 1905 that the rhythm changed with the progressive changes in the hours of night and day. Therefore, it would seem that the daily rhythm of man is due to cosmic influences and not to cycles of activity. The daily rhythm of body temperature is surprisingly like the rhythm of the daily external temperature at certain times of the year on a different scale.

In women there is a monthly cycle of temperature in relation to menstruation and ovulation. T. T. Zuck in 1938 reported a study of rectal temperatures in women throughout the monthly cycle. Just before menstruation there was a slight fall in morning temperature to 98° F., which continued during menstruation. Then there was usually an additional slight fall followed by a rise to 98° F., followed in turn by an abrupt fall to 97° F. or even lower at the midperiod. Thereafter it usually rose to 98° F. and remained stationary until the next menstrual period. Records of the last menstrual cycles of 20 women identified ovulation with the approximate date of the midperiod low temperature. No pregnancy occurred before the 10th day or after the 20th day regardless of the length of the cycle.

The skin temperature of man is about 7° to 9° F. lower than the internal temperature, which is attained only at a depth of an inch or more (approximately 50% of the body is within one inch of the surface). In the basal state the rectal temperature may be 2° to 4° F. higher than the average body temperature. In fever the two may be practically alike. Men and women vary considerably in their reactions to environmental temperature.

Ingestion of food produces a rise in both skin and rectal temperatures for an hour to two hours, the skin temperature being elevated

more than the rectal. Alcohol produces an elevation in skin temperature but a lowering of internal temperature, and therefore is to be avoided during exposure to cold environment. J. H. Weatherby in 1942 found that smoking decreased the skin temperature of the extremities 4° to 13° F., but removal of nicotine from cigarettes almost completely abolished this fall. Cold applications placed in various parts of the body cause a substantial lowering of the living tissues to a considerable depth from the contacting surfaces. Children about 13 years old had a temperature drop to 95° F. after swimming 45 min. in a pool at 73° F. Variations of external temperature within ordinary limits cause very slight changes although some individuals require a period of adaptation when they change from a temperate climate to a tropical one. Muscular work usually causes a temporary rise in temperature. This rise depends on the duration and severity of the work, the temperature and the per cent humidity of the environment.

Most animals (birds and mammals) have a daily rhythm in body temperature similar to that of man. The breadth of the rhythm varies with the type of animal. Pigs have a range of 2.5° F., asses 2° F., dogs and cattle 3.5° F., and poultry 5° F. Hence man may represent the limit to which an evolutionary trend to homeothermy has been attained.

Limits Compatible with Life.—There are limits both of heat and cold that a warm-blooded animal can bear. They depend on the classes of animals and upon whether or not they have sweating mechanisms. The upper survival limit for fever in man is 107° F., but may rise in premortal states to 110° F. The lower limit of human body temperature varies with the condition of the individual. In diabetic coma a temperature of 92° F. has been recorded with survival after recovery from the coma. Lawrence W. Smith and Temple Fay in 1940 subjected patients with incurable cancer to an artificial hibernation by means of ice packs that reduced their body temperatures to a range from 74° to 90° F. Their studies showed that patients may be kept at body temperatures in the 80s for from 5 to 8 days with recovery.

Cold-blooded animals will survive until the body temperature nearly reaches the freezing point. Small cold-blooded animals therefore descend below the frost line seasonally or like some insects migrate to warmer climates. Cold-blooded animals, on the other hand, have great difficulty surviving body temperatures above 98.6° F. Snakes and lizards in hot deserts will seek shade, and if prevented from doing so, will die.

Regulation of Body Temperature.—The body temperature of man and animals is maintained by the balance between heat production and heat loss. In cold-blooded animals the heat production varies with the external temperature and in general obeys the Q_{10} law of chemical processes, which is that for an increase of 10° C. (18° F.) the heat generated is about double that of the preceding rate. This law does not hold strictly throughout the range of possible body temperatures of cold-blooded animals. The lower the body temperature, the more rapid is the increase in heat production per degree rise in body temperature. However, even at body temperatures approaching those of the warm-blooded animals the heat production is much lower than that of the warm-blooded animals.

The larger the warm-blooded animal, the greater is the heat production, but the heat production decreases quite regularly per pound of additional body weight. Also, in general, the larger the animal, the lower the heat production per unit of body surface area. It was formerly considered that a general law governed the heat production at rest fasting per unit of body surface; i.e., it was 1,000 cal. per square metre of body surface per 24 hr. in animals exposed to an environmental temperature of 16° C. (61° F.). However, Samuel Brody calculated that the average basal metabolism of the entire range of warm-blooded animals from the mouse to the elephant is equal to 70.5 cal. per 24 hr. per kilogram^{0.73}; i.e., the body weight in kilograms raised to 0.73 power times 70.5 cal. Although man fits into this generalization, his basal heat production is usually referred to body surface. The body surface of man is calculated from the Eugene F. DuBois formula, $A = Wt^{0.45} \times Ht^{0.725} \times 71.84$ in which A equals area in square metres, Wt. equals weight in kilograms and Ht.

equals height in centimetres. The normal basal heat production of men per 24 hr. varies from 46.0 cal. per square metre at 14–16 years of age to 35.5 at 70–80 years of age. Women have about 5% to 10% lower basal heat production.

The heat produced by various animals has to be eliminated in order to maintain a practically constant body temperature. The paths of heat loss are radiation, convection and vaporization of water. Radiation is actual heat rays, convection is carrying away of heat by air currents, and vaporization of water is heat used in evaporating water from the lungs and skin. In nonsweating animals there is little evaporation of water from the skin. Maintenance of constant body temperature in these animals is brought about in hot weather by increased panting and by increased exposure of the body surface so that radiation and convection are more effective. The cat licks itself in hot weather to increase evaporation, and the dog pants violently to accomplish the same end.

Domestic cattle do not stand hot weather well because they have no sweat glands, and the amount of panting they can do is sometimes insufficient to keep the body temperature within normal limits. Brody called attention to the ineffectiveness of electric fans in cooling cattle as they may actually increase the skin temperature by blowing hot air on the animals. He recommended use of wet blankets or wet spongy material on cattle in hot weather, together with electric fans. Milk production in cows is seriously affected by high body temperature, and the growth of chickens is markedly lowered in the hot months. On the contrary, cattle may be wintered at extremely low environmental temperatures in open range without serious injury. They develop highly insulating coats of fur and subcutaneous fat. Cattle native to hot countries withstand hot environments better than those native to temperate countries. The Brahman cattle, *Bos Indicus*, are used in sections where high temperatures occur in summer. They probably have more sweat glands than European cattle, *Bos Taurus*. Horses, mules and donkeys withstand hot weather much better than other farm animals because they have sweat glands. They, therefore, can be worked much more than cattle.

Poultry are likewise sensitive to hot weather. External temperatures above 80° F. produce disturbances, and temperatures of 100° F. or above cannot be withstood for more than seven hours. Good water supply in which fowls can dip their heads is required. The sheep is outstanding among domestic animals in tolerating hot atmospheres. Panting is not a marked feature as it occurs only at a rectal temperature of 106° F.

The greatest factor in heat regulation is the skin, which is regulated by the vasomotor system and by the nervous mechanism of perspiration. In hot weather the cutaneous blood vessels are dilated and there is increased blood flow so that more heat is eliminated. Contrariwise, in cold weather, the blood vessels of the skin contract, thus lowering the skin temperature and lowering heat loss. At rest in a comfortable environment, man's average loss by radiation is about 53%, by convection 19%, and by vaporization 28%. The higher the external temperature, the greater the heat lost by vaporization of water until at 97° F. external temperature, all heat elimination is by the latter method. Above this temperature the body actually absorbs heat from the environment which is compensated for by increased vaporization.

Men and women behave differently on exposure to different environmental temperatures. J. D. Hardy and E. F. DuBois, in a study of the paths of heat elimination of nude men and women at external temperatures from 72° to 95° F., found that radiation decreased steadily in men until it disappeared at 95° F. In the cold zone, vaporization was about equal in the two sexes, but at 84° F. the men started to sweat whereas the women did not sweat until the external temperature reached 91° to 93° F. The heat loss for women in the cold zone was about 10% less than that of men because their skin temperature was lower than that of men, and in the warm zone the loss of most of the women was about 14% to 20% lower than that of men because they did not sweat so much. The comfort zone in which heat production and heat loss were equal had a range of 11° F. in women and only 4° to 5° F.

in men. C. P. Yaglou and Anne Messer in 1941 pointed out that if women would dress in winter clothing comparable to that of men, they would be comfortable at 72° F. instead of 76° F. Conversely, if men would discard their coats, vests and collars in hot weather the temperature of buildings could be maintained at 83° F. for comfort instead of 76° to 80° F., and the problem of air conditioning for both sexes would be simplified.

In muscular work in hot, dry climates, enormous quantities of water are necessary to compensate for the loss of heat by vaporization. Losses of three quarts per hour have been recorded. A good acclimatization can be acquired rapidly during the first 7 days and then more gradually up to 23 days. Changes in heart rate are dramatic, as the principal reduction occurs in the first four to five days. The general course of the rectal temperature is downward as normal levels are attained in seven to ten days. Rates of sweating gradually increase. W. Machle and T. F. Hatch stated in 1947 that there was agreement among most observers that performance and appearance of men, degrees of vascular instability, and cardiac rate and rectal temperature when evaluated together are so closely related to the state of acclimatization as to comprise the most reliable indexes of the state. Fever in men is caused in some diseases by interference with heat elimination, and in others by both an increase in heat production and a lessening of heat elimination. In the human body the heat production follows the law of Q_{10} so that as the body temperature is raised the heat production is raised. T. M. Carpenter found that even in the range of normal body temperature the heat production varied directly with the body temperature.

All the arrangements in the animal economy for the production and loss of heat are themselves regulated by the central nervous system, and it is considered that the temperature centre is situated in the hypothalamus.

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ANIMAL MAGNETISM: see HYPNOTISM.

ANIMAL PLAY: see PLAY IN ANIMALS.

ANIMAL PSYCHOLOGY, the study of the behaviour of the lower animals to ascertain their mentality (see PSYCHOLOGY, COMPARATIVE).

ANIMALS, DISTRIBUTION OF: see DISTRIBUTION OF ANIMALS.

ANIMALS, DOMESTICATION OF. Domestication implies: (1) tameness; (2) living in or near the dwelling places of man; (3) being kept by man to provide him food, clothing, power or aesthetic satisfactions; (4) that the animal and its ancestors for many generations have had their movements and matings partially controlled by man; and (5) that the innate mental and physical qualities of the domesticated animal have been changed considerably from those of its wild ancestors. Not all domesticated animals conform fully to all of this definition, however.

Thus, man generally exercises little control over the movements and matings of the domestic cat. Although tameness is an important part of domestication, some domesticated animals, such as sows with very young pigs, cows with new calves, or angry bulls, may be at times more dangerous to an incautious person than most wild animals are. Wild animals such as performing seals and bears sometimes become very tame, but they are not called domesticated. Yet wild elephants in India when caught and tamed are called domesticated.

Because domestication was accomplished in prehistoric times, the methods of doing it can only be surmised from such indirect evidence as the attitudes and habits of primitive peoples concerning the animals around them, paintings or carvings which archaeologists have found in ancient camp sites or tombs, and experiences of those who work in menageries. Presumably the initial steps toward domestication were taken largely through the widespread human practice of making pets of captured young or crippled wild animals. Religious customs, such as totemism, animal cults or the reverence accorded to cattle by the Hindus in India, may have been important. Many wild animals quickly lose

much of their fear of man in game refuges. Some domestication may have been deliberately planned to serve definite needs. Prehistoric rock carvings from Egypt show hunters building a fence across the outlet of a steep-walled valley into which they had driven some wild game, presumably to keep a reserve food supply. Some wild species can be tamed easily, while others are extremely intractable. Some possibilities for domestication may still exist, although no important species has come completely from the wild to the domesticated condition within historic times. Perhaps fur-bearing animals, such as mink and foxes raised in captivity, are now being domesticated in the same slow way as cattle and sheep were many thousands of years ago.

The date of first domestication varied in different parts of the world and for different species. Peoples in a palaeolithic (old stone age) stage of culture generally had no truly domestic animal except the dog. This was still true of the aborigines of Australia when white men first found them. In Europe the dog may have been domesticated as far back as the time of Neanderthal man, possibly more than 100,000 years ago. Cattle and sheep were already important domestic animals in Europe early in the neolithic (new stone age) culture. The suddenness of their appearance as completely domesticated animals, and the considerable skeletal differences between them and the contemporary wild animals, suggest that they were brought into Europe already domesticated by people who came from farther east. Swine were domesticated early in the neolithic in several different regions. Horses first appeared on the historic scene as domesticated animals around 3000 B.C., when mounted invaders from the north brought them into the valleys of the Tigris and Euphrates. The ass was domesticated in Egypt and parts of Arabia before 3000 B.C. Cats were domesticated in or near Egypt perhaps not much longer ago than 1000 B.C. Chickens were domesticated in southeastern Asia, perhaps as recently as 1500 B.C.

The only animals domesticated in the Americas were the llama, alpaca, guinea pig and turkey. American Indians north of Mexico had no domesticated animal except dogs. African tribes south of the Sahara probably acquired their domesticated animals from the northeast long after civilization had developed in Egypt.

The wild species which was originally tamed may since have become extinct (e.g., cattle), or domestication may have changed the animal so much that its ancestor cannot be identified with certainty (e.g., sheep). The dog is zoologically the same as the wolf of the northern hemisphere, although some investigators have argued that the jackal furnished part of the ancestry of some races of dogs in Africa and in southern Asia. The horse descends from local races of the tarpan, which still existed wild from Poland to Mongolia within historic times. The chicken came from the wild jungle fowl still found in India. Whether the local races of swine domesticated around the Baltic, on the northeast shores of the Mediterranean, in China and perhaps elsewhere were different enough to be called different species is questionable. The mouflon, or wild sheep, still existing in Sardinia and Corsica is believed to be the main ancestor of the European breeds of sheep.

Formerly it was widely believed that the diversity of form, size, colour and other characteristics within some domesticated species could be explained only by supposing that two or more wild species had been tamed and subsequently intercrossed. This view is becoming less plausible as evidence accumulates that most wild species contain a large amount of genetic diversity and as there are more actual demonstrations of the power of isolation and continued selection to produce widely contrasting groups from the same initial population. Domestication did not change the laws of inheritance, but it did increase the isolation of subgroups from each other through man's control over the movements and matings of the animals. Also domestication made wider outcrosses possible because man in wars or commerce sometimes transports breeding animals over natural barriers which their wild contemporaries would not have crossed. From the very beginning of domestication man must have favoured, for breeding purposes those animals which pleased him most. For aesthetic reasons he often desired variety, and for utilitarian

reasons he often wanted several types of animals, each specialized for a purpose or set of conditions. This combination of continued artificial selection toward varied goals, inbreeding consequent upon isolation, and occasional wide outcrosses, increased greatly the rate at which distinct local races were formed and changed.

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(J. L. L.H.)

ANIMALS, PHYLOGENY OF, the branch of zoology concerned with tracing the course that evolution has followed among animals. Its ideal is to do this at all evolutionary levels and so to give a complete exposition of the relatedness of all the members of the animal kingdom to each other. Phylogeny necessarily subsumes the truth of evolution as a fact of nature, but it is not concerned with theories of the means by which evolution has been brought about; phylogenetic conclusions would not be altered by proof of the Darwinian, Lamarckian or any other explanation of evolution.

Evidence: Palaeontology.—The most direct evidence that can be used in phylogeny is that of palaeontology, in so far as fossils show us the actual changes that have taken place in animals with time. But this evidence is very incomplete. It is most complete where we can follow the changes in species through long series of sediments evenly bedded upon each other and clearly laid down without large intermissions. We have such evidence only rarely. One example is in the Devonian of Iowa, where phylogenetic sequences of brachiopods have been worked out by Carroll Fenton; others occur in the Cretaceous and some tertiary formations. Only the phylogeny of closely related species can be studied in these sequences; the periods of their formation are too short for larger results. Elsewhere, the palaeontological record gives us only occasional forms preserved at longer or shorter intervals, when the conditions of fossilization were favourable, and the palaeontologist is forced to base his phylogenetic conclusions on study of their structure. The record is also very incomplete in its preservation of structure; in general, only the hard parts of animals are preserved, soft-bodied animals being rarely fossilized. With so incomplete a record, and since many of the animals of phylogenetic interest in the earlier stages of evolution had no hard skeleton, it is clear that a complete solution of the problems of phylogeny cannot be expected from the facts of palaeontology alone.

Morphology.—In these circumstances, phylogeny must look for other evidence. It finds it in the results of comparative morphology and embryology. In general, related animals show their relatedness by similarity of structure, the similarity being greater the closer the relatedness. In using this evidence caution is necessary. Similarity of structure may be due to causes other than evolutionary relatedness; It may, for instance, arise in unrelated animals in response to similar environmental conditions; this is known as *parallel evolution*. Perhaps, in some cases, it may also arise as the result of inherent tendencies in animals to evolve in determined directions, and not at all in adaptation to the conditions of the environment. This possibility, which is the basis of the evolutionary theory of *orthogenesis*, is not universally accepted as a reality in evolution.

Special reasons may increase the phylogenetic significance of particular similarities of structure. The fundamental structure of an animal is laid down early in its development, and it is found that the earlier developmental stages of animals have altered less in evolution than later stages. Thus, resemblance in fundamental structure, and indeed in larval and embryonic structure in general, is often of special phylogenetic importance. Vestigial organs also provide good evidence. These are organs which are formed in development but later regress (or at least never become functional in the adult), but which are functional at all stages of the life-history in animals that we believe to be close to the ancestral line of those that possess them as vestigial organs. The presence of gill slits in the embryology of mammals and birds forces us to believe in the evolution of these groups from

a fish ancestry. Again, where an organ is of a peculiar structure that has an easy explanation in view of the structure of some probably ancestral animal, but is otherwise inexplicable, it provides evidence for descent from these ancestors. Thus, the recurrent laryngeal nerve of terrestrial vertebrates passes from the neighbourhood of the brain to the thorax, where it loops round the systemic artery near the heart before returning up the neck to the larynx. If we accept the evolution of terrestrial vertebrates from fish ancestors, this extraordinary course is a natural result of the arrangement of the parts in the fishes. It has received no other explanation, and must be accepted as evidence for this descent.

Finally, in reaching any conclusion in phylogeny, we have the principle that any later structure must always be such that it can be derived by modification of the presumed earlier structure. Here, it is to be remembered that evolution has not always been in the direction of increasing complexity of structure. Simplification has undoubtedly occurred on occasion.

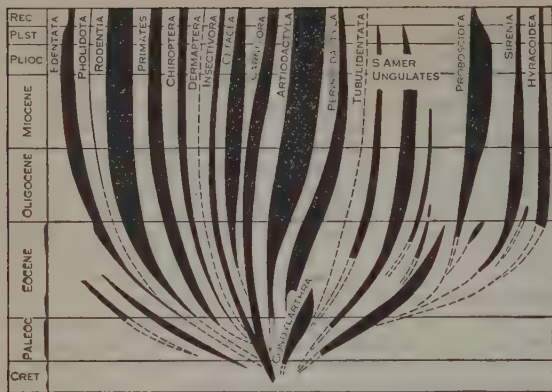
Conclusions.—In view of the uncertainty of the evidence, phylogenetic conclusions must always be tentative, and will be less certain the larger the groups of animals they relate, and therefore the earlier the evolutionary changes by which the groups were separated. However, it is often possible to collect a body of evidence which, taken as a whole, bases the main conclusions on sure ground and makes it very unlikely that they will be upset, or in many cases seriously modified, by evidence added in the future. But it must be emphasized that such results can be reached only by a broad consideration of all the available morphological and palaeontological evidence.

In one large group of animals, the Vertebrata, our knowledge of morphology and palaeontology is much more detailed than in any other group of similar size. We will first consider vertebrate phylogeny, and use the conclusions to which it leads when we come to consider the phylogeny of other animals.

VERTEBRATA

When vertebrate evolution is surveyed as a whole, several very distinct types of vertebrate organization, the Agnatha (lampreys, hag-fishes and related extinct forms), the various types of true fishes, the amphibians, reptiles, birds and mammals, stand out. Each of these types has become successful in turn and has provided a dominant fauna in its own type of environment. Thus, in secondary times the reptiles were dominant in terrestrial environments; in tertiary times, the mammals; fishes have dominated aquatic environments since their origin in the Silurian period. Broadly, these conclusions are true in spite of frequent reversions of the later groups to earlier environments; many groups of mammals and reptiles have become secondarily aquatic.

Adaptive Radiation.—These main types of vertebrate organization were evolved from each other, but between each of them the evolutionary changes were very great. With these we will deal later. Within each large group the variation of structure is much less, but we find that almost as soon as it became successful each group differentiated into a large number of smaller groups adapted to different habits of life in parts of the wider environment of the dominant group as a whole. For the placental mammals this process of differentiation is shown in fig. 1, where it will be seen that each of the smaller groups, the orders, can be traced almost to the beginning of mammalian dominance in the earliest tertiary times. This differentiation of a successful group of animals is known as *adaptive radiation*, and it is to be noted that its changes are as much in adaptation to different habits of life as to environmental conditions. The process is as well displayed in the origin of birds or reptiles as in that of the mammals; similar trees can be drawn for these groups. For earlier radiations there is less detailed evidence. It is, however, to be noted that trees such as that of fig. 1 are unnaturally simplified. Radiation is a phenomenon that occurs not only at the beginning of the successful career of a group. It continues throughout the group's dominance, each of the adaptive lines frequently giving rise by further subdivision to groups adapted to more restricted environments and habits of life.



MODIFIED FROM ROMER, "VERTEBRATE PALEONTOLOGY" (UNIV. OF CHICAGO PRESS).
FIG. 1.—ADAPTIVE RADIATIONS OF THE ORDERS OF PLACENTAL MAMMALS

The structural changes of adaptive radiation are brought about by alterations in the relative sizes of the parts of the body, alterations produced by changes in the relative growth rates of the parts during development. More fundamental changes, such as the formation of new organs, do not form any large part of the process, though physiological changes are associated with this as with other types of evolutionary change. The very large changes of form that may occur in adaptive radiation are exemplified in fig. 2, which shows a phylogenetic tree of the sharks and rays (from W. K. Gregory).

Evolution of the Main Vertebrate Types—We come now to the process by which the main types of vertebrate organization are evolved from each other. This, at first sight, appears to be very different from adaptive radiation. It is so, both in the much greater extent of the structural changes involved and in the evolution of many new organs. In the example of which we have most detailed knowledge, the origin of the mammals from the reptiles, we find that early in the radiation of the reptiles one of the radiating lines, the Synapsida, began to show modification in the direction of what was to be mammalian structure. These tendencies are already to be found in some of the earliest members of the group in Permian times. Thereafter, some synapsids became more and more mammal-like until towards the end of the Triassic period the first animals that can be classified as mammals appear. Meanwhile the Synapsida as a whole was undergoing typical radiation, and many forms diverged from the line of mammalian descent to become specialized in various directions.

The origin of mammals from reptiles thus occupied a period of some 40,000,000 years. This is not a surprisingly long time when the great complexity of the changes involved is realized. Almost every organ in the body was altered in structure and there was much evolution of new organs. Nevertheless, it may be that the evolutionary changes of this process are the same in nature as those of adaptive radiation, though greatly exaggerated. All changes of structure in organs already present may be produced by alterations in the growth rates of parts of the body, if these are on a sufficiently small and detailed scale; and new organs may be formed by differentiations in originally undifferentiated tissues. But at least these changes were extremely numerous and detailed, and they must have been correlated throughout the evolution so that the animal remained viable. It is not surprising that their evolution required a long time.

It is probable that the evolutionary process is of the same nature in the origin of all the main types of vertebrate organization.

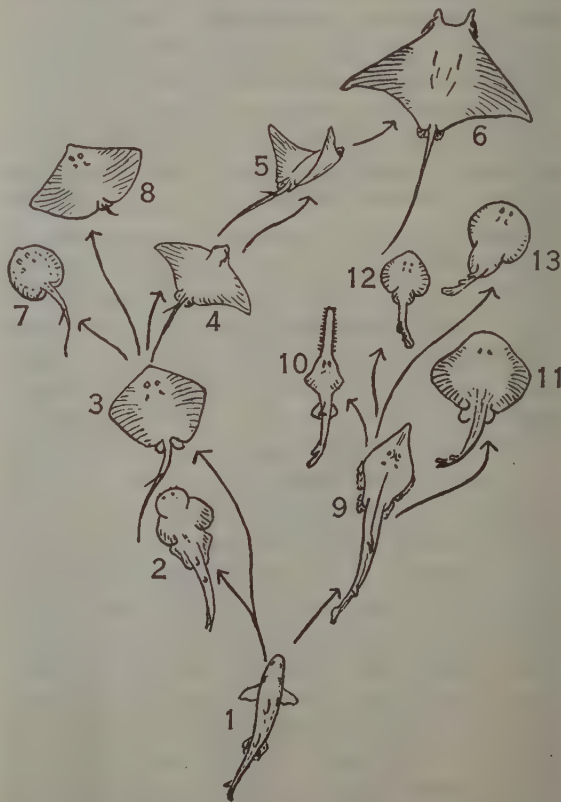
Conclusions.—From this discussion it appears that vertebrate evolution has consisted of a succession of adaptive radiations as each new type became successful, and that during each radiation another type was evolved. A phylogenetic tree illustrating these views of vertebrate phylogeny is given in fig. 3. In this the succession of radiations and types stands out clearly. It must be noted, however, that in the progress of this evolution the vertebrate has undergone other changes besides adaptation to its

environment. It has, for instance, shown continuous improvement of its organization, so that it has been able to live a more active life and one in greater isolation from and independence of its environment. Also, throughout the evolution, vertebrates have invaded and exploited new parts of the earth's surface. Starting as bottom-living and probably mud-eating fishes (Agnatha), they first, as true fishes, took dominance over all aquatic environments, beginning in the fresh-waters (most early fishes) and later on two occasions (Chondrichthyes and Teleostei) passing into the sea. The invasion of terrestrial habitats took place in two steps, to semi-terrestrial life in the Amphibia and to full terrestrialism in the reptiles. Mammals were perhaps at first arboreal, and birds have conquered the air. Throughout the evolution, passage from one environment to another has occurred more than once in smaller groups; pterodactyls and bats as well as birds became aerial. Phylogeny, then, in a successful group such as the vertebrates is concerned to display a course of evolution which is not merely a sequence of structural change, but a continuous extension of the dominance of the group, resulting from improvement of the organization of its individuals and associated with expansion into new environments and adaptation to new habits of life in these environments.

INVERTEBRATA

Here, we have to consider not, as in the Vertebrata, a single group of animals all of the same fundamental structure and all clearly the descendants of a single evolutionary line, but a considerable number of such lines, the phyla, some widespread and dominant, others with few present-day representatives. We have to consider phylogeny not only within these phyla but also between them, *i.e.*, the evolutionary relationships of the phyla to each other.

Since there is no reason to think that the processes of evolu-

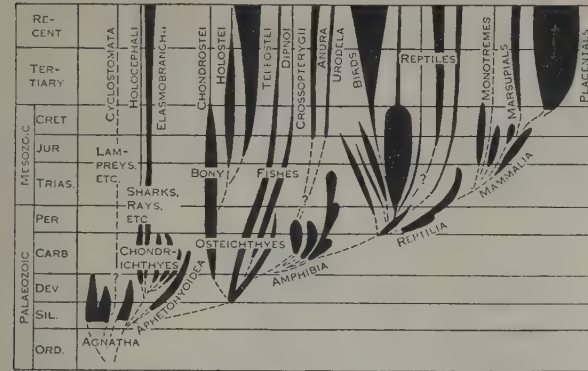


FROM GREGORY IN "BIOLOGICAL REVIEWS" (CAMBRIDGE PHILOSOPHICAL SOC.)

FIG. 2.—ADAPTIVE RADIATION OF SHARKS AND RAYS

tion found to have taken place in the vertebrates were peculiar to that group, and since our knowledge of evolution is much more detailed for the vertebrates than for other animals, it is reasonable to discuss invertebrate phylogeny in the light of conclusions derived from study of the vertebrates.

Phylogeny Within a Phylum.—It seems probable, then, that evolution within the invertebrate phyla will have proceeded,

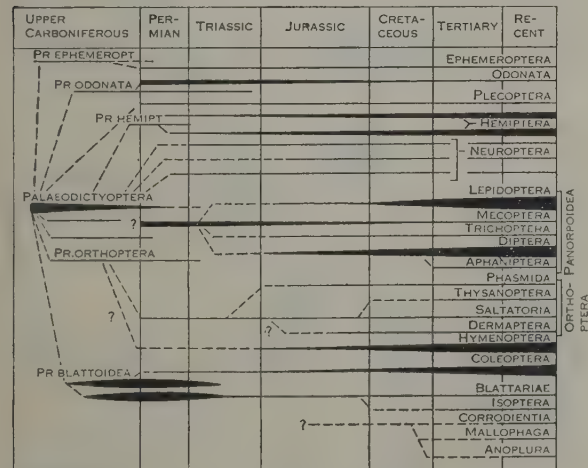


MODIFIED FROM ROMER, "VERTEBRATE PALAEOLOGY" (UNIV. OF CHICAGO PRESS)

FIG. 3.—PHYLOGENETIC TREE OF THE VERTEBRATA

as in the vertebrates, by a succession of adaptive radiations alternating with development of new types of organization. So far as the evidence goes, it supports this conception. The evolution in the insect orders gives a tree (fig. 4) which, in spite of its incompleteness, resembles that of the mammalian orders (fig. 1) in form. We see in fig. 4 many orders traced back nearly to the beginning of insect dominance in the Carboniferous, and an extensive radiation at about that time. There is also evidence of later radiations. For some other invertebrate groups, such as the gastropod molluscs, similar trees could be drawn, but in very many groups we have not the knowledge to do so. It may be assumed, until there is more evidence, that the evolution was of the same type in all.

We can sometimes associate the larger groups of an invertebrate phylum in a tree. This is done for the classes of the Arthropoda



AFTER HANDLIRSCHE

FIG. 4.—ADAPTIVE RADIATION OF THE ORDERS OF INSECTS

in fig. 5, which may be compared with fig. 3. In both is seen a succession of evolutionary types.

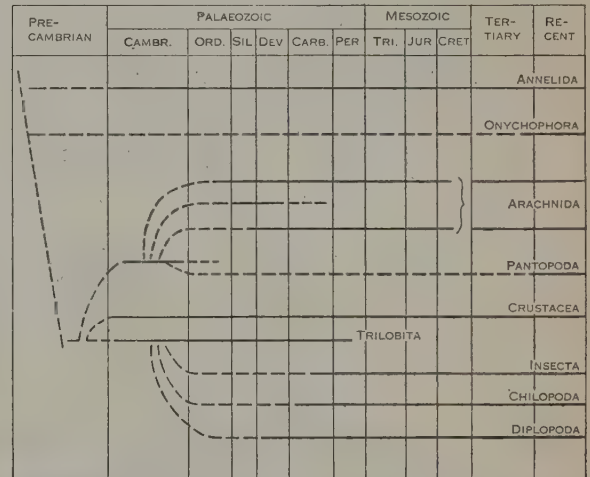
Relations of Metazoan Phyla to Each Other.—We now come to the most difficult problems that phylogeny has to face, those of tracing the relationships of the animal phyla to each other. Here, palaeontology is of little help to us, for the phyla were almost all separated before the period of the fossiliferous rocks, and, in any event, in soft-bodied animals which are unlikely

to have been preserved.

Thus, in dealing with these questions, phylogeny is forced to rely entirely on the evidence of morphology either in the adult or in developmental stages, but in many phyla the adult structure has been so greatly altered in evolution that it is difficult to form any but the broadest conclusions by comparison of it between the phyla. It has been noted above that the early stages of the life-history alter in general less than does the adult, and it has in fact been found that it is mainly on larval and embryonic structure that we must rely in discussing these basic problems of phylogeny.

In the first place, we must set aside the sponges (Parazoa or Porifera), which probably had an origin from unicellular organisms separate from that of all the other multicellular organisms (Metazoa). The sponges are certainly far from the main stock of the animal kingdom.

Adult Structure.—All the Metazoa are probably related above the unicellular level. From their adult structure we may first classify them on the general complexity of their bodies. We may separate those with two cell-layers, ectoderm and endoderm. (Diploblastica) from those which have also an intermediate cell-



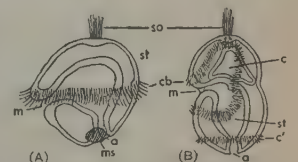
AFTER HANDLIRSCHE

FIG. 5.—PHYLOGENY OF THE CLASSES OF ARTHROPODA

layer, mesoderm, (Triploblastica). On this evidence the diploblastic coelenterates are clearly a very early off-shoot of the metazoan stock, distantly related to the rest of the Metazoa. We may, again, separate the triploblastic animals with a body-cavity lined by epithelium (Coelomata) from those in which such a body-cavity is not present (Acoelomata). But this distinction is probably not of phylogenetic value; a coelome has been evolved more than once.

Adult structure rarely carries us farther. Only one other of these phylogenetic problems can be solved on its evidence. This is the relationship of the arthropods to the annelids. Arthropod structure is in all its fundamentals so nearly identical with the simpler structure of the annelids, that there can be no doubt that arthropods are descended from animals which, if we had them today, we should call annelids.

Larval Structure.—For further conclusions we must turn to larval structure. When we compare development in the various triploblastic phyla, we find that the phyla fall into two large groups characterized by the presence of a larva of the "trochophore" type in the one, and by one of the "pluteus" type in the other. These two types of larva



FROM CARTER, "GENERAL ZOOLOGY OF THE INVERTEBRATES" (SIDGWICK & JACKSON, LTD.)

FIG. 6.—(A.) TROCHOPHORE LARVA. (B.) PLUTEUS LARVA. A, ANUS; C, COELOME; CB, CILIATED BAND; C', POSTERIOR CILIATED BAND; M, MOUTH; MS, MESODERM; SO, SENSE ORGAN; ST, STOMACH

(fig. 6) are distinguished by the position of the ciliated band which forms the locomotory (and feeding) organ of the larva and by other fundamental characters such as the mode of origin of the coelome and the arrangement of the cells in the earliest divisions of the egg. The evidence of these characters is not completely concordant in all the phyla, but we can assign to their groups most of the phyla in which the larvae occur. The two groups, or superphyla, may be called the *Trochophoralia* and the *Plutealia*. The arrangement of the phyla in these groups is shown in fig. 7. In some of the smaller phyla developmental as well as adult structure has been so altered in evolution that it is not possible to place them in the scheme with any certainty. This is true of such phyla as the Nematoda, Nematomorpha, Acanthocephala and Rotifera. These are not included in fig. 7.

These larval resemblances imply descent in each of the two superphyla from an ancestral group that possessed these characters in its larvae. Now, the form of the trees of fig. 7 suggests, when compared with the examples of adaptive radiation we have

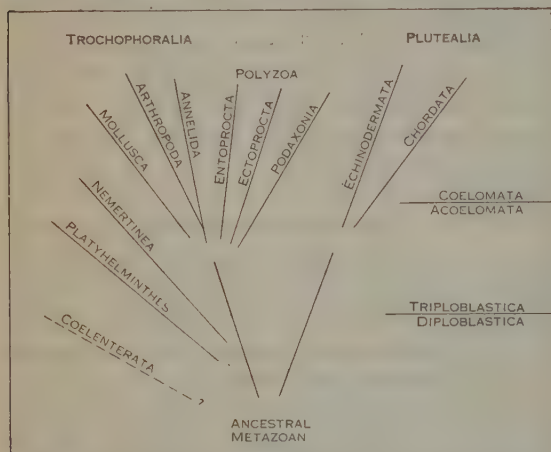


FIG. 7.—PHYLOGENY OF THE METAZOAN PHyla

already considered, that the phyla diverged by very early radiations in these two groups of multicellular animals. We can say a little more of these radiations. In each phylum the later development of the larva is characteristic of the phylum and different from that in other phyla. At this stage the organs typical of the phylum are formed; these organs are those required for the habit of life of the more primitive members of the phylum. If our ancestral groups radiated to give rise to the early members of the phyla, it would be, on the analogy of vertebrate radiation, by each of the radiating lines becoming adapted to a distinct habit of life. We may conclude that the habits we now find characteristic of the phyla were those adopted by their ancestors in this radiation, and that the characteristic organs of the phyla were those evolved at that time in adaptation to these habits.

If so, we may characterize the major phyla as follows (fig. 8): *Trochophoralia*.

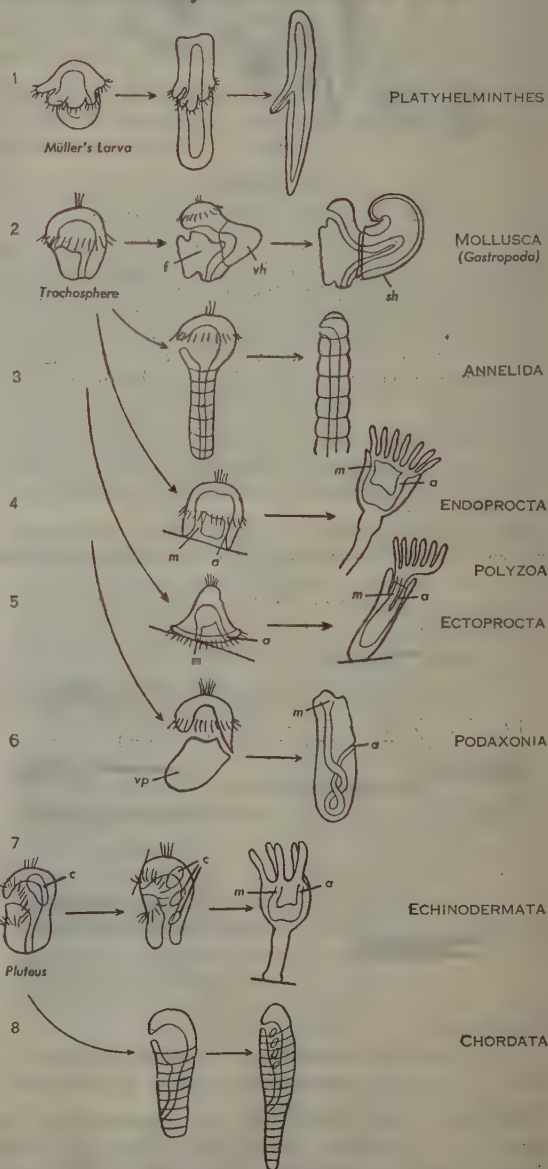
1. The Platyhelminthes (flatworms), in which the trochophore, known as Müller's larva, differs in some features from that in other phyla, were animals that took to gliding on their whole ventral surface, became elongate in an antero-posterior direction and flattened dorso-ventrally.
2. The Mollusca were also gliding animals, but glided on the region between the mouth and anus, and not on the whole ventral surface. A ventral protuberance, the foot, was formed and used as the gliding organ. On the dorsal side another protuberance, the visceral hump, developed and became covered by the shell.
3. The Annelida took to a free life, moving by rhythmical contractions of the body, which was formed as an outgrowth in the anal region. Metameric segmentation arose in adaptation to this type of locomotion.
4. and 5. The two groups usually placed in a single phylum as the Polyzoa were separate lines. Both became sessile, but in different ways.

6. The Podaxonia (sipunculids and perhaps *Phoronis*, though the latter is placed by some zoologists in the Plutealia) took to living in tubes. A protuberance was formed in the ventral region between the mouth and the anus, and this became covered by a tube.

Plutealia.

7. The Echinodermata became sessile by an attachment in front of the mouth and developed five-rayed radial symmetry around their free ends.
8. The Chordata were free-living with the same type of locomotion as the annelids. They developed metameric segmentation, as annelids did, in adaptation to their mode of locomotion.

We are thus able to give a more or less general view of the probable phylogeny of the animal kingdom. That this view must be very tentative and liable to modification with the advance of knowledge is a necessary result of the incompleteness of the evidence on which many of the conclusions are based.



FROM CARTER, "GENERAL ZOOLOGY OF THE INVERTEBRATES" (SIDGWICK & JACKSON, LTD.)
FIG. 8.—LATER DEVELOPMENT IN THE METAZOAN PHyla. A, ANUS; C, COELOME; F, FOOT; M, MOUTH; SH, SHELL; VH, VISCERAL HUMP; VP, VENTRAL PROTUBERANCE

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ANIMAL SOCIOLOGY. Sociology forms one of the two main aspects of biology. The other deals with individual organisms or with their cells, tissues, and organs as units. We are not here concerned with this individualistic biology, which forms the main content of botany, zoology and physiology. The sociological aspect has the group rather than the individual as the basic unit, and may fairly be called sociology in the broadest sense, defined as the science of organic communities.

Sociology so considered includes communities of organisms with different levels of inclusiveness and of integration. Some of these may be listed and described as follows: Biosociology deals with communities of plants and animals living together in nature. The social bonds are weak and sociality is vague among the ecological communities that are the social units at this level of organization. The same is true in plant sociology, which is concerned with plant communities. Animal sociology exists at this weaker level of sociality but also includes more closely knit groupings such as those of the social insects and of man. As usually defined, animal sociology deals with the social life of nonhuman animals and human sociology—sociology in the usual sense of the word—centres on the social life of man.

Although biosociology and plant sociology are not closely related to human sociology, they have certain resemblances. Both deal with groups or communities of individuals and the mutual relations that bind them together rather than with the individual plant, or nonhuman animal, or man standing alone. Both are concerned with mutual dependence, with co-operation, with its opposite, dis-operation, and with competition. As J. Braun-Blanquet (1932) says in his book *Plant Sociology*, "The communal values resulting from the mutual relations of organisms are the social phenomena; the co-operation of organisms is the social process. The community has an existence altogether independent of the individual." (Reprinted from Braun-Blanquet, *Plant Sociology*, copyrighted by McGraw-Hill Book Co., New York, 1932, with permission of the publisher.)

The qualitative distinction between the sociology of man and of other animals is not sharp, but since other animals lag far behind man in the development of abstract thought, in symbolic communication and in cultural institutions, there are very large quantitative differences. The distinctions are by no means absolute, and, in many relations, comparisons are continually being made between the social life of human and nonhuman animals.

From another approach, inclusive biosociology deals with general and with comparative sociology as well as with the diffuse sociality of ecological communities. The situation may be clarified by a comparison with physiology. General physiology is concerned with the reactions and principles that underlie the physiology of all organisms. It is built around the study of the properties of protoplasm. Similarly, general sociology considers the aspects and principles that underlie all sociology. It centers about the generalized property of sociality of living organisms both plant and animal.

Comparative physiology, to continue the analogy, takes up the different possible comparisons in physiological reactions between plants and animals and among the different kinds of animals. We cannot understand fully such physiological processes as respiration or nerve action of any animal, man for example, without knowing how much is distinctly human and what part is merely the human variation of more widespread phenomena. In the same way, we cannot fully understand a human social pattern without knowing its relation to similar reactions given by other

animals. In his sociology, as in other phases of his biology, man is an animal, a vertebrate, a mammal, and one of the primates. Man also is man. Other animals are likewise enmeshed in the animal kingdom; thus, all animals, each kind in its own way, and many plants, have distinctive social relations in addition to their share of a more generalized sociality.

The social life of nonhuman animals is of interest to many only because of possible comparisons and, more especially, of contrasts with that of man. Contrariwise, there are those for whom the various patterns of behaviour of other animals are of prime importance in their own right. This animal-centred focus is often found among observers of the group life of such animals as insects, fishes, birds and mammals. It is the dominant attitude among many bird watchers. Often such students are interested in comparisons that do not include man and yet even extreme zoophiles are usually aware of some of the human aspects in the social behaviour of other animals.

All too often reports concerning animal sociology are given as though the animals observed were feathered or fourfooted men. Such accounts are misleading. Man is the only animal we can know both objectively and subjectively. Except in the figurative sense, no person has ever been a worm, a fish, a snake-in-the-grass or even an ape. We have no inside information concerning the feelings or the outlook of such animals. The valid interpretation of all of their behaviour, social behaviour included, is difficult and often impossible except from the point of view of the outsider. This article, like most careful observation and writing on the subject, attempts to be carefully objective. The story remains interesting even under such conditions.

Ecological Communities.—Animals and plants live in communities. Organisms in communities may live together because of common tolerances for the nonliving environment or they may be unified by the interactions between the organisms themselves. The latter form more closely knit units and are often called biocoenoses. Both biocoenoses and habitat-controlled assemblies are recognized as communities at the ecological level. Such matters are discussed in the article *ECOLOGY, ANIMAL*. The universality of this kind of community living is the important point for us here. Plant sociology is built almost entirely about the study of communities of plants and animal ecology is much concerned with this relatively vague sort of sociality.

Animal Aggregations.—The ecological community is made up of several species living together. Animals do not spread themselves evenly throughout a community, rather they tend to collect in spaced or in contact aggregations of a few or of only one species. These so-called contagious distributions are the rule in nature. The simplest aggregations show very little integration; the more complex ones grade insensibly into closely knit insect or vertebrate social groups. Aggregations composed primarily of one species are more important in the development of society than are those of mixed composition.

The least social animal aggregations are represented by accidental collections. For example, animal drift lines occur along the margins of many bodies of water. They are particularly noticeable on the sandy beaches of the Great Lakes, where they may extend for miles. In the animal drift along the shores of Lake Michigan, one may find sizable collections of aquatic snails, small bivalves, crayfishes or even fishes, thrown up by the waves. Similar concentrations of insects are also deposited, with many of the individuals still alive; these have been carried out over the water by an offshore breeze, then caught in the water and tossed back on the land by currents and waves. So far as the animals are concerned, their aggregation is entirely accidental. They may remain aggregated through inability to move or simply as a result of inertia. Such aggregations are near the zero mark for sociality; the quality of inertia shown under these conditions has only slight social significance.

Animals aggregate under diverse conditions as a result of their own movements. Perhaps the simplest of a long, intricate series of aggregating behaviour results from so-called kinesis (*see ANIMAL BEHAVIOUR*), that is from the unoriented reflex action of the whole animal. Thus animals that are stimulated by high

light intensity slow down when they enter shaded areas. If many are moving about in a given locality, such photokinesis will cause them to aggregate in the shade somewhat as automobiles, moving freely along a through highway, aggregate automatically when slowed down by entering a village or by any other agency that reduces their rate of movement.

Aggregations result from oriented reactions to light intensities, or to any other gradient of environmental forces, when an oriented response brings numbers of individuals into a restricted region. A positive reaction to odours, leading animals to a restricted source of food, gives a common example. The collected animals must have a certain amount of toleration for the presence of, often for contact with, other individuals if the aggregations are to form and particularly if they are to continue.

In contrast with the more or less automatic aggregation of animals in response to odours, light or shade, moisture, favourable niches and other environmental factors, there are the much more definitely social situations in which animals collect as a result of positive reaction to the presence of others like themselves. The aggregations of male midges dancing in the quiet atmosphere, or the formation of schools of fishes or flocks of birds illustrate this widespread phenomenon.

Group Survival Values.—The collected animals often show group survival values as a result of being congregated together. These can be found sometimes even in the accidental aggregations such as those of the drift line along Lake Michigan. Aquatic animals piled one upon another may retard drying to such an extent that the lower, most protected individuals may survive for some hours and so have an opportunity to escape should the waves arise or rains come and sweep them back into the water. Similarly, land insects may be shaded by the piled up mass and so escape death from drying or from heat and live to make their way across the sand to vegetation and greater safety. Aggregations also have their disadvantages; surrounded animals may be smothered by their fellows, and the whole group forms a collection of food stuff easily accessible to many predators. Some ecologists writing in anthropomorphic terms have called the drift line the "lunch counter of the beach" for mice, skunks and many other insect eaters.

Other types of aggregation also show group survival values, often to a high degree. Certain phases of these values will be discussed later under the heading of natural co-operation. One common characteristic of these group effects is that as the animal aggregations become closely integrated there is a definite tendency for the group more and more to control a limited section of its own environment. Sometimes this control is gained by the death of those individuals that meet the full impact of the uncontrolled environment, to the distinct benefit of the remaining members of the group. The construction of nests, whether above or below ground, is a common method of securing partial environmental control. With the social insects, termites for example, the conditions within the nest often are quite distinct from those outside its walls, especially in reduced amplitude of fluctuation; they are much nearer to the termite optimum, particularly as regards humidity (*see* SOCIAL INSECTS).

Groups with positive survival value, for some or all of the individuals present, serve a social function whether composed of protozoans, worms, insects, other vertebrates or of men. The survival-value test of sociality must be based on real evidence, and even then it should be applied with caution. Aggregations are not necessarily beneficial for the aggregated animals, since overcrowded animals are often handicapped by long-continued close association with their fellows. Some of the relations between positive and negative survival values of the aggregating habit will be considered later in the present article.

Modification of Behaviour.—The effects produced by massed animals may not be of obvious or easily demonstrated survival value and yet give first-rate evidence of group influence. Group modifications of behaviour supply examples of this generalization. Each individual in a group of animals frequently shows decidedly different behaviour patterns from those given when the respective animals are isolated. When one animal be-

haves differently in the presence of its fellows from the way it would if alone, it is social to that extent regardless of survival values or other considerations. The behaviour of a group may be greatly modified by the presence of a single animal of an alien species; a migrating flock of birds often alters its behaviour decidedly in the sensed presence of a predatory hawk.

Division of Labour.—Aggregated social animals usually develop division of labour. In its earliest stages, the division of labour may be quite informal—some animals are on the margin and others are protected within the group. It is as simple as that. Position may change from time to time without obvious reasons; the difference in function is temporary and, perhaps, accidental. Various complexities of division of labour are known, and lasting structural as well as behaviour differences illustrate the highest stage of its development. The castes of ants and termites give good examples.

The most common division of labour is that between the sexes. This appears to some extent even among the Protozoa. In the simplest cases among higher animals, one sex produces eggs and the other sperm, both are shed into the surrounding water and that's that so far as the parental generation is concerned. In other cases, both sexes are similar in size, appearance and to some degree in behaviour; they differ in mating reactions as well as in primary sex functions; common pigeons are an example. At the other extreme stand the many instances in which one sex is larger, showier, decidedly different in form or otherwise markedly differentiated from the other sex. The common domestic fowl, many other birds, most deer and other polygamous mammals like the fur seal are examples. The concept of separate sexual castes fits the easily observed facts in such animals.

Another very common division of labour is that between continuing groups consisting of parents and their offspring. In its simplest and most widely distributed form, the division is between protector and those protected, or between food collectors that also eat and food consumers that do no collecting. In some instances, notably among certain termites, the developing nymphs act first as workers; later they moult into so-called soldiers or into sexually mature reproductives.

Group modification of behaviour finds dramatic expression in the organization of social hierarchies, in territorial behaviour and in leadership-follower relationships. These will be discussed at some length in a later section.

Social Instinct.—An instinct is most clearly understood as being a rather complicated behaviour pattern transmitted from generation to generation by organic inheritance (*see* ANIMAL BEHAVIOUR). Early naturalists thought highly of social instinct as a criterion of an animal society and sometimes spoke of animal societies as organized at the instinctive level as contrasted with human societies which they regarded as being built at an intellectual level. Some went so far as to summarize the whole social situation by the formula: if there is no social instinct, there is no society. One major difficulty comes in demonstrating the existence of a social instinct as distinct from early learning. All too often the concept of instinct has been merely a convenient cover for ignorance. Although admittedly difficult to define with exactness, there is validity in the idea that animals aggregate as a result of inherited behaviour patterns and that the more complex animal societies develop among species with inherited patterns of sufficient complexity to be called instincts. Whether known as instincts, or appetites or drives, much of social behaviour appears to result from biologically inherited responses, modified in many instances by learned reactions.

The social appetite (to use a term more acceptable to many psychologists) can be compared profitably with the action of food-hunger or thirst. At relative peaks of intensity, the social appetite is usually feeble than the others. It is also more continuous in action and less dramatic. The peaks and depressions of its expression are smoothed out, hence it is less obvious. Sex hunger is a special form of social appetite with many qualities obviously lacking in other phases of inherited drives toward sociability.

The Human Level.—Human society exhibits its full share of

social behaviour based on inherited behaviour patterns. It is much more complex than the other social levels just outlined. There is a greater development of the relatively weak binding force of abstract thought and of the strong integration growing out of symbolic communication, with all its ramifications. In man, the great increase in importance of tradition and other forms of social inheritance, as contrasted with biological heredity, also helps to separate human sociology from that of other animals.

Summary for Social Levels.—The difficulties inherent in the further elaboration of any scheme of social levels among animals is evidence of the lack of natural divisions. The whole field of social interrelationships of organisms has a degree of unity untouched by any of its parts; only arbitrarily can we single out some particular level of social appetite, group reaction, community integration, social value or exhibition of division of labour, as forming the beginning of social life. Alfred Victor Espinas, a French scholar, came to a similar conclusion in 1877 in his book called *Les Sociétés animales* that gave the modern orientation to comparative sociology. In effect, an early paragraph says:

No living plant or animal is solitary; animals especially are knit together by many ties. Even the most solitary of the sexual animals contract, if only for a moment, an intimate union with another member of its species. Social life also exists among species in which the sexes are not distinct and separate. This is particularly obvious in colonial animals that remain physically attached to each other throughout life; the food eaten by one may be shared by many. Social life is not an incident or an accident among animals; it is not the special privilege of some few that stand high in the evolutionary scale such as men, beavers, bees, and ants, but it is a normal, constant universal fact. The social relations may be summarized in the form of certain laws that are similar wherever they appear. The social facts indicate the existence of a homogeneous whole, well linked in all its parts, that forms a natural domain with distinct unity.

Forty-six years later, William M. Wheeler, the American student of social insects, put the same set of ideas even more forcefully in almost the following words:

All living things are genetically related as members of one great family, one vast, living symplasm, which, though fragmented into individuals in space, is nevertheless absolutely continuous in time. In the great majority of organic forms, each generation arises from the co-operation of two individuals. Most animals and plants live in associations, herds, colonies or societies of the same species and even the so-called solitary species are necessarily more or less co-operative members of groups or associations of different species. Living beings not only struggle and compete with one another for food, mates and safety, but they also work together to insure to one another these same indispensable conditions for development and survival. (Adapted from *Social Life Among the Insects* by William Morton Wheeler, copyright, 1923, by Harcourt, Brace and Company, Inc.)

THE ANIMAL KINGDOM

Some realization of the extent and organization of the animal kingdom is needed in order to follow intelligently the discussion of general sociology. Accumulated evidence indicates that the more specialized animal phyla (see ZOOLOGY) are grouped into two main lines of evolution that sprang from a common general ancestor at or near the coelenterate level of organization. One branch passes through the forebears of the annelid worms and molluscs and culminates in the insects. The other line, after giving rise to echinoderms, evolved into ancestral chordates and culminates in modern vertebrates (see ANIMALS, PHYLOGENY OF). This interpretation of available evidence indicates that social insects are not near relatives of social vertebrates even in a zoological sense and that neither stands in the direct evolutionary line of the other. Whatever social traits they possess in common have either been separately evolved or trace back to the much more vague sociality of their unknown, common ancestral stock.

The relative numbers of different species of animals can also be given simply. If you will imagine that all the known animal species are represented by your own reach from the tip of the outstretched fingers of your right hand through to those of your left, the following approximate relations hold: the extreme end joint of the right middle finger represents all species of mammals; the second section of the finger stands for birds; reptiles and amphibians lumped together about fill the basal joint. The length of the palm represents the fishes. All the remainder of the entire

outreach is taken over by invertebrate animals. The nonarthropod invertebrates account for the space from wrist to elbow of the right arm, and the arthropods make up all the rest, with the major part of this space needed to represent the insects. In all, there are more known species of animals than there are words defined in an unabridged English dictionary. Each of all these species, insects and noninsects, vertebrates and invertebrates, protozoans and nonprotozoans, has its own form of sociology. When sociology is restricted to the study of the relations between individuals of the same species, as it frequently is, the sociology of any species from all this multitude offers a wealth of problems, since no species is known that does not possess interindividual relations.

Social life reaches its apex with man (and the apes and monkeys), on the one hand, and with termites, wasps, bees and ants, on the other. In the main, our further discussion of animal sociology will centre on the social relations of the less definitely social animals. Though comparisons will be made back and forth, the discussion of human society will largely be left to the article on SOCIOLOGY just as treatment of insect societies will similarly be found mainly in the article on SOCIAL INSECTS.

The vertebrates furnish notable examples of more-or-less social groups in each of the classes of that subphylum. There are schooling fishes and tadpoles, breeding assemblages of frogs, hibernating aggregations of snakes, hierarchies of grouped lizards, various stages of social organization and of communal living among flocks of birds and diverse social groupings among mammals. The latter include colonies of beavers, towns of prairie dogs, herds of hooved animals and hordes or families of various monkeys and apes.

The social habit has evolved among many kinds of arthropods. According to Wheeler (1923), social habits have arisen no less than 24 times in as many different groups of insects. Although the matter is by no means clear, it seems likely that the emergences of the social habit among vertebrates and insects do not come absolutely anew in each instance. Rather, it is an attractive hypothesis that they all develop from a common substratum of more vague presocial tendencies such as Espinas and Wheeler envisaged. Some of the evidence concerning the existence and nature of this more generalized forerunner of well-developed sociality will be presented and discussed in the following sections.

NATURAL CO-OPERATION VERSUS DIS-OPERATION

The inclusive definition of sociality, on which modern animal sociology is based, assumes that integrations of two or more organisms into a supraindividualistic unity on which natural selection can act, marks at least a beginning of social life. The most feeble units may be poorly integrated but still have demonstrable survival values. They may consist of small or large groups, and the survival value may or may not be obvious. The essential point is that all groupings of animals have some small amount of sociality whenever they are sufficiently integrated to behave as a group unit under natural selection. The aggregations may be natural or the existence of probable survival values may be tested when the organisms in question are placed together in experimental populations.

It may be helpful to consider some of the simpler conditions that are found in early stages of drop cultures of protozoans. First, take the situation in which one protozoan is washed free from bacteria and then placed alone in a drop of bacteriologically sterile medium. There is one living organism in a small environment that represents a habitat-animal complex reduced to simplest terms—an uncomplicated microcosm. The living animal modifies its nonliving environment, which at the same time affects the contained organism. The whole is an ecological action system.

If a second protozoan is introduced, the increases in complexity in the ecological system result principally from the direct or indirect effects of one animal interacting with the other. Some of the possible types of interactions are illustrated in fig. 1 in which the protozoans are represented by small balls shown inside a larger drop of culture medium. The arrows indicate possible interactions between the two individuals and between them and their environment. The interaction may be neutral, beneficial or

harmful for either or both. Actually complete neutrality is rarely found in any ecological action system and needs no further consideration here.

Any interaction between the two animals may have preliminary beneficial or harmful aspects regardless of end results; and, contrariwise, the final long-run effect may be helpful or harmful for the animals concerned regardless of the immediate, or short-run effects. One animal may be benefited and the other harmed, but, in the end, it will be necessary to appraise the survival value for both organisms considered as representatives of their species.

Mating is one kind of interaction in which the habitat often plays a permissive, but beyond that, a passive role (fig. 1 F). This is an interindividual reaction in almost pure form the results of which are normally beneficial to the race regardless of the immediate effect on the individuals themselves. Under several conditions the two protozoans may both be injured or killed as a result of mating.

Besides the possibility of affecting each other, the animals modify their environment by living in it. In their reaction on the habitat, the two protozoans under conditions resembling those in fig. 1 may fix some toxic substance more efficiently or they may otherwise jointly condition their common medium more effectively

may be termed dis-operation. The two sets of processes are in fundamental opposition. With all lower forms of animal life, and often with higher ones—many of the interactions between men included—such co-operation or dis-operation is wholly nonconscious. The nonconscious character of the effects and of their underlying causation is especially evident in poorly integrated ecological systems in which man is not represented. This is a consideration that does not affect the fundamental nature of the resulting dis-operation or co-operation. It is essential to remember that, possible neutral effects aside, we are dealing with a system in which the survival values illustrate in simplest terms the basic social antithesis, that between beneficial (co-operative) and harmful (dis-operative) effects.

Competition furnishes a special phase both of co-operation and of dis-operation. In general, competition occurs when there is a common demand on a limited supply. Among other situations this criterion applies to the competition of two males for the same mate, for a limited food supply, or for limited space.

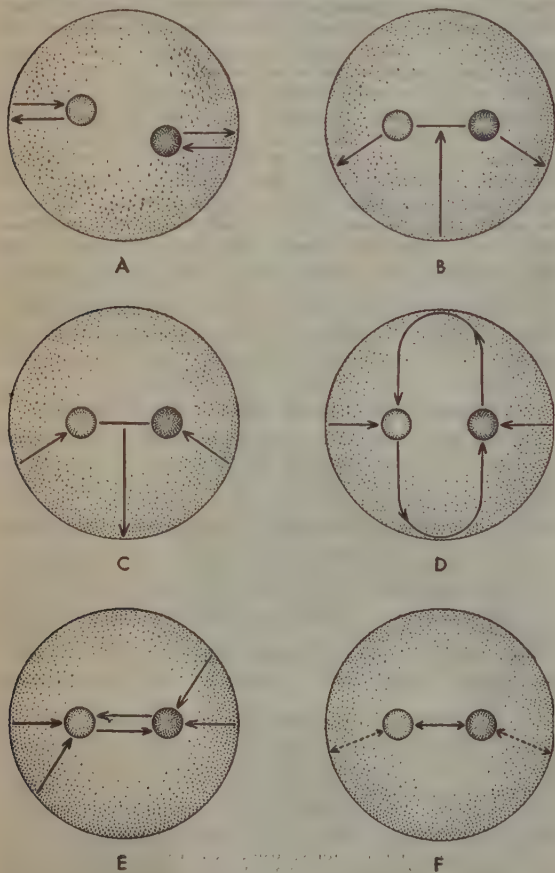
Competition frequently results in dis-operation, although the two are not synonymous. A return to the simplified ecological action system of fig. 1 may help. Two protozoans in a drop culture are often in competition for a limited amount of food. The competition may result in the stunting or death of both or in one surviving at the expense of the other.

Co-operative competition also is known. A good example is furnished by the mass physiology of the sperms of sea urchins. In nature, these spermatozoa are shed into sea water where they may fertilize the eggs that have been similarly shed. In making sperm suspensions for experimental use, the male sea urchin is placed upside down in a clean dry watch glass. If sexually "ripe," the spermatozoa are shed through the aboral genital pores. Sperm so collected is called dry sperm since it is undiluted with sea water. The massed spermatozoa live longer and retain their fertilizing power longer than do those in diluted sperm suspensions. When the sperm are shed naturally into sea water, those well within the mass are activated last and the sperm from any one male retains fertilizing power longer than they would if mass protection did not occur.

The physiological processes involved are complex but at least a part of the greater longevity of the crowded spermatozoa comes from the fact that the individual spermatozoa do not move when as closely packed together as they are in dry sea urchin sperm. Also, they are relaxed under these crowded conditions, in contrast with being highly active when diluted with sea water. The relaxation is indicated by the fact that the rate of respiration of the same number of spermatozoa is much greater when they are less crowded.

It seems reasonable to assume that inactivity of densely packed spermatozoa results from the lack of free space. Over a considerable range of dilution the specific activity of a spermatozoon is directly related to the cube root of the volume of sea water in which a given number of spermatozoa are suspended. Under such conditions, the total initial activity is proportional to the number of spermatozoa present and to the average amount of free space for each. If the available space is much restricted, the competition for it results in an inhibition of movement, a lowering of the rate of oxygen consumption, and is accompanied by a decided increase in longevity. Competition here has distinctly beneficial results for all the competitors; it is co-operative as contrasted with being dis-operative. Thus, under certain conditions, competition for space results in a form of automatic co-operation as contrasted with automatic dis-operation. This is an important consideration for general sociology. The importance is greater since all the individuals present in the given illustration benefit from the competition. Under more usual conditions of competition, not all individuals benefit and yet the end result may be favourable for the species under consideration; that is to say, the final outcome even of such competition is not necessarily dis-operative.

Certain aspects of survival values and other physiological effects associated with aggregations of animals are summarized by the curves shown in fig. 2. Curve A shows results of biological



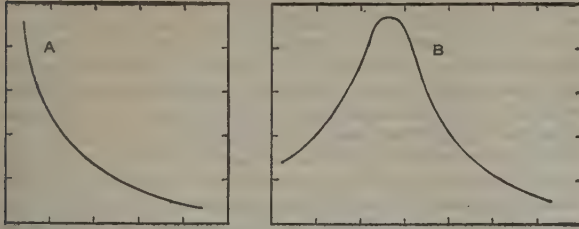
FROM "BIOLOGICAL SYMPOSIA," VOL. 4, PAGE 81, FIG. 2
FIG. 1.—SOME OF THE POSSIBLE TYPES OF ECOLOGICAL ACTION SYSTEMS WHEN TWO ORGANISMS ARE LIVING IN A COMMON ENVIRONMENT

than either can do acting alone. Many of the possibilities will be considered in more detail and under more complex conditions in a later section of this article.

We can now introduce an important set of ideas. Interactions between organisms that prove to be helpful are evidence of the existence of co-operation, or at least of proto-co-operation, even in such a simple action system; opposing, harmful tendencies

processes in which the highest recorded value is given by the smallest possible population. A pig born as a litter of one normally grows faster than do members of larger litters and this is a common relation for many animals.

In contrast, grouped animals often show increased efficiency that is sometimes reflected in longer survival, or they otherwise



ADAPTED FROM ALLEE, "THE SOCIAL LIFE OF ANIMALS" (NORTON)

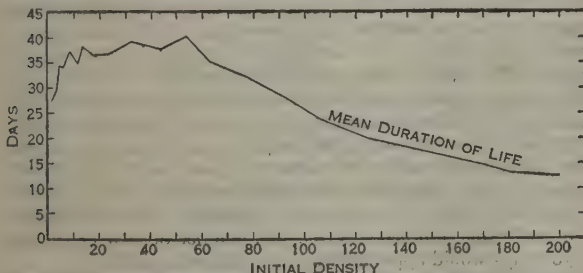
FIG. 2.—IN SOME PHASES OF POPULATION PHYSIOLOGY THE OPTIMUM POPULATION IS THE SMALLEST POSSIBLE (A); IN OTHERS, IT IS INTERMEDIATE IN SIZE (B)

may grow better or live longer if neither too few nor too many animals are present; they have an optimal population density at some intermediate point of the possible range of numbers. This situation is summarized by fig. 2 B. In both A and B, the rate of action of the measured process is given by the vertical axis and population density by the horizontal axis with the least crowded conditions shown to the left. Thus, with curve B, as the population density increases, conditions become more favourable, or the rate of reaction is faster, or some comparable change occurs, until an optimal density is reached beyond which a further increase in density produces a reversal of the observed trend.

Consideration of the two curves A and B, and of the phenomena on which they are based, indicates correctly that under most conditions overcrowding produces harmful results. This fact has long been known and can be verified easily. The existence of harmful results associated with undercrowding is a more recent and less well-known discovery. The biological results of undercrowding and of optimal population size imply the existence of natural co-operation just as the effects of overcrowding imply dis-operation.

SUMMARY FOR NATURAL CO-OPERATION

The available information concerning the extent and the nature of co-operative processes among living organisms, especially among animals, should be presented in some detail because only so can the quantity and quality of existing evidence concerning proto-co-operation be realized. Much of this material is summarized by W. C. Allee (1938, 1945). Probably more of the con-



FROM ALLEE, "ANIMAL AGGREGATIONS" (U. OF CHI. PRESS) AFTER PEARL

FIG. 3.—DROSOPHILA CULTURED IN 1 OZ. BOTTLES LIVE LONGER WITH FROM 35 TO 55 PRESENT PER BOTTLE THAN AT OTHER POPULATION DENSITIES

crete details should be given here in order to be able to clinch, with Darwin-like thoroughness, the pre-experimental insight of Espinas, Wheeler and others that natural, unconscious mutualism is, in fact, one of the basic principles of biology.

The science of animal sociology, as contrasted with human sociology, is being constructed on this principle, and the social relations of man need reinterpreting from the point of view that

altruism did not arise entirely as a unique human attribute without biological antecedents. Limitations of space allow only the following brief summary of the evidence for this conclusion.

1. At all levels in the animal kingdom, and under a variety of conditions, there is added safety in numbers up to a given point (see fig. 3). There is danger also in overcrowding but it is the ill effects from undercrowding that gives evidence for natural co-operation among living organisms. Macerated cells of a sponge will not develop if too few are present, and the smallest embryonic transplants often fail to grow although somewhat larger ones succeed. If a population in nature becomes reduced to a few individuals, it is in danger of dying out even though theoretically able to persist.

2. Many plants and animals are able to change an unfavourable environment, to such an extent that, though some or all of the pioneers may be killed, others following and some associated with them can survive and even thrive when they could not do so in a raw environment.

3. Certain vital processes are adaptively retarded by increased numbers up to a given population density. For example, scattered spermatozoa of many marine animals lose fertilizing power more rapidly than they do when massed together.

4. Other biological processes are accelerated, sometimes beneficially, in the presence of populations of optimal size and density. Such processes are retarded both with oversparse and with overcrowded populations. The cleavage rates in sea-urchin eggs and certain other aquatic eggs follow this rule.

5. Various kinds of Protozoa show an acceleration in rate of asexual reproduction with a medium rather than a sparse population density, and similar phenomena may have been a forerunner of

6. The evolution of sex that, according to this attractive hypothesis, grew out of certain proto-co-operations of asexual organisms. Once evolved, sexual relations have played a large part in the further development of the social life of animals, man included.

7. Colonial protozoa could hardly have arisen from solitary forms unless the colony of cells that remained attached to each other after divisions had shown survival values over and above those exhibited when the cells were scattered singly.

8. The evolution of the many-celled animals, the Metazoa, from the Protozoa was probably based on similar relationships.

9. Each advance in complexity of metazoan individuals came from the natural selection of an increased ability in natural co-operation on the part of the evolving stock; the greater natural co-operation came first, then it was selected.

10. Charles Darwin recognized that a relatively large population is a highly important factor in evolution by natural selection. In more recent years, Sewall Wright and others have presented good evidence that, at least under certain conditions, evolution proceeds most rapidly in population of inter-breeding organisms that are intermediate in size, as compared with similar populations that are overlarge or oversmall. The rate of evolution is still more rapid when a large, widely distributed, species population is broken into relatively small breeding colonies that are not completely isolated from each other.

11. The interdependence of organisms is shown by the repeated observation that all living things, from the simplest to the most complex, live in ecological communities. This is easily seen in such microcosms as those of a protozoan culture dish, or a small lake, or in biocoenoses like those of an oyster bed.

12. The evolution of truly social animals—such as termites, bees, and ants on the one hand and man on the other—has occurred independently in widely separated divisions of the animal kingdom. These could hardly have arisen so many times and from such diverse sources if a strong substratum of generalized natural co-operation were not widespread among animals in nature. No animal is solitary throughout its life history.

13. As with the individual organism, each advance in complexity of the social life of any group of animals is based on the development of some means of closer co-operation between the individual units of the evolving group.

GROUP MODIFICATION OF STRUCTURE AND BEHAVIOUR

The mass physiology of aggregated animals differs in various ways from the physiology of individuals. Illustrations include the acceleration of early development in certain aquatic eggs, the increased rate of asexual division in various protozoans and the decreased rate of mortality in populations of optimal density as contrasted with those more dense or more sparse.

Fundamental group effects are also known for size and structure and for behaviour. Even the determination of sex may be modified or controlled in several forms by the density of the interbreeding population. Each of these aspects of aggregation biology bears, often quite directly, on the field of general sociology. Pertinent phases of these relations will be reviewed briefly.

Structure.—Crowding may affect the body size of animals. It is particularly easy to demonstrate the stunting effect of overcrowding such as normally results from an inadequate food supply during the period of growth, or from the accumulation of excretions, or of their decomposition products. Overcrowding often has these effects and is a potent cause of retarded growth. Frequently an optimum population density, somewhat larger than the minimum, can be demonstrated at which larger animals are produced. *Drosophila*, for example, grow larger in small culture vials when from 8 to 16 are present as contrasted with the size attained when fewer or more flies develop in the same volume.

Body form may be directly controlled by the population density. This is easily apparent among sessile animals which, like trees and many other plants, show a decidedly different growth form when crowded and when standing alone. The common barnacles and the ascidians of coastal marine waters grow to be much taller and more slender in the centre of a crowded group than when isolated. Even motile forms may be similarly affected; snails of the genus *Lymnaea*, kept under crowded conditions for four successive generations, became successively smaller and more slender until they were quite unlike the parent stock; the proportions of various body organs were also differentially altered.

Polarity of Fucus.—The structural effects produced by crowding may be much more fundamental. Polarity is one of the basic structural properties of almost all organisms. In some marine plants like the algae *Fucus* and *Ascophyllum*, the polarity of the fertilized eggs can be experimentally controlled by a variety of environmental relationships, including the presence of other similar eggs in the vicinity.

The first cleavage of these eggs normally separates the developing zygote into two unequal cells, one of which gives rise to the apical part of the new plant and the other, more pointed in shape, divides and redivides to form the rhizoid or holdfast section that anchors the alga to the substrate. The future axis was apparently undetermined at fertilization but has become fixed by the time of the first cleavage. When *Fucus* eggs are in a small group, as they often are in nature, the first cleavage plane divides the egg into an apical cell oriented away from the centre of the group and a rhizoidal cell that is pointed toward it. This group effect shows most readily in total darkness but may appear in lighted situations.

Groups of two to four eggs will show the phenomenon as well as masses of 50 to 100. Radiating designs of striking beauty are frequent in smaller aggregations. The rhizoids are directed toward the centre of the group regardless of the experimental arrangement and rearrangement of the eggs before germination. When large, compact masses of eggs are surrounded by others that are two egg diameters or less away from the periphery of the group, the latter develop their rhizoids toward the central mass. The eggs near the outer margin of a large group also show a similar orientation, while those in the very centre, surrounded by equal influences on all sides, tend to divide to form equal and similar cells at first cleavage.

Locust Phases.—Swarming locusts are a widespread phenomenon, especially in or near the warm, semiarid, regions of the world. The phase theory accounts for the differences in structure, behaviour and colour patterns of related swarming and solitary forms of locusts on the basis of effects produced as a result of

the density of the locust population.

Much field observation strongly suggests a general natural history story something as follows: In an exceptionally favourable season, the population density of grasshoppers in a given area increases notably. If the animals belong to species that lack swarming phases, no marked emigration occurs; and the numbers eventually fall when the environment becomes unfavourable. If the crowded population arises primarily from an increase in numbers of the solitary phase of a polymorphic species, then, when the nymphs become so abundant that individuals repeatedly come into close contact with one another, the latent tendency toward gregariousness is awakened and the development of a swarming phase has begun. The processes so started increase in intensity with continued crowding until swarming and emigration or other factors bring the population density below the critical level that awakens the drive towards close aggregation and leads to the solitary phase with its altered body proportions and changed behaviour. The decrease in density may result from emigration, from changes in the physical conditions or from the increased activity of enemies (man included), or from some combination of these population-checking forces.

In addition to field observations, there is a growing mass of evidence that artificial crowding among polymorphic species tends to produce nymphs whose characteristics approach those of phase *gregaria* and that isolation brings trends towards phase *solitaria*. One striking characteristic of the crowded nymphs is their great increase in activity. Those interested in the details should consult P. B. Uvarov's book *Locusts and Grasshoppers* (London: Imperial Bureau of Entomology, 352 pp., 1928) and Jacobus C. Faure's extensive paper called "The Phases of Locusts in South Africa" (London: Bulletin Entomological Research, 33: 298-405; 202 figures, 1932).

There is much that we do not know about the underlying causal physiology of the behaviour of these locusts. Existing evidence indicates that mutual stimulation raises the rate of activity of the aggregated grasshopper nymphs. It is not known how the increased activity is related to the production of the distinctive black and orange or yellow coloration of the gregarious nymphs or how its absence results in forms lacking these colours. All we have is in the form of suggestive hypothesis and theory. Such unsettled problems in mass physiology need not concern us overmuch in the present state of animal sociology. The important point contributed by these polyphasic grasshoppers and locusts to general sociology is the very strong suggestion that, in these species, not only striking behaviour patterns but coloration and structural patterns as well, are controlled by population density.

Aphid Wings.—Aphids are the soft-bodied insects commonly known as plant lice. An aphid obtains its food by inserting its long, sucking mouth-parts into a plant and sucking up the plant juices. The schematized life history runs as follows: sexual forms appear in the autumn and an over-wintering, fertilized egg is formed that hatches out the following spring into a wingless female. This female, the so-called stem-mother, produces eggs that develop without fertilization—that is, by natural parthenogenesis (*g.v.*). Like the stem-mother, the new females are usually wingless and, in turn, soon give rise to young by parthenogenesis. The progeny settle near the mother and soon build up a densely crowded colony. The rate of reproduction under favourable conditions is very fast. It has been calculated that, if all the progeny of a single stem-mother survived, the number present at the end of 300 days would approximate the 17th power of two.

Winged females appear after a time and fly to new host plants where, still without sexual fertilization, each produces a new crop of wingless, parthenogenetic females. The induction of wings is distinct from the production of bisexual forms; in fact, most female aphids that require fertilization are wingless although the males are usually winged.

The production of winged aphids by members of a wingless colony is often most opportune, coming as it frequently does when a given food plant is becoming overcrowded. Several environmental factors are known to affect the process, among them temperature, length of day and incipient starvation. The degree of

crowding is also a potent factor for many species; sometimes it is the dominant influence. For such species, the more crowded the mothers the more winged forms develop among the offspring.

In some instances, crowding works by means of decreasing or modifying the food supply or by the change that the crowded, juice-sucking aphids produce in the tissues or liquids of the host plant.

The racial importance of such a control of wing production in aphids is easily seen. The power to emigrate thus attained by the progeny of a crowded colony facing a diminishing food supply brings survival values for the species. Here, more than in most instances among animals, man included, the dangers of overcrowding have been avoided by the evolution of adaptations that give an obvious illustration of the principle of unconscious, natural co-operation.

Sex.—Sex plays an important role in the development of sociality among relatively solitary animals as well as in the more closely knit aggregations of social species. The relations of the adult sex pair make significant contributions to social patterns and sex-based behaviour is seen to be more important when the rich variety of parent-offspring interactions are also considered. As stated earlier, sex itself may have originated in the Protozoa as a result of selection based on the mutual stimulation to more rapid division that often accompanies the close contiguity of two asexual individuals. We are now ready to inspect evidence that, in certain widely distributed instances in the animal kingdom, the determination of the sex of the developing individual depends on association with another organism.

The Effect of Conditioned Medium.—The story begins logically with the flagellate *Chlamydomonas*, a protozoan that is claimed by the botanists to be one of the algae. These organisms show much lability. They lack the characteristic flagellum when grown in the dark in Knop-agar cultures. The flagella and resulting mobility develop if the cultures are placed in the light or in darkness when weak solutions of certain sugars are added, or when filtrates are introduced from cultures of actively swimming *Chlamydomonas*. In the last instance, swimming forms are induced by the addition of something given off by active cells.

The motility-producing compound has been isolated and is known to be the organic chemical crocin, a carotinoid derivative. It is effective even when only one part is present in 150,000,000,000 parts of water! Conditioning by related chemicals induces mutual attraction of the free-swimming gametes which unite only if the water also contains the proper conditioning agent. The gametes of a heteroecious species are sex labile and may become all female or all male if treated by female-conditioned or by male-conditioned medium.

In this plantlike animal, the sexes are not clearly differentiated, but there is a gradation of sexuality in which sex can be pushed toward maleness or toward femaleness by the presence of products of metabolism from previous or from current inhabitants of the culture water.

Physical Attachment or Close Association.—A variety of animals show consecutive sexuality. One and the same individual is first a male and later a female. With many, maleness is the juvenile, femaleness, the more adult condition. This variety of sexual lability occurs in several invertebrate animals; among others, it is typical of some echinoderms, several molluscs, some annelid worms and certain crustaceans. There may be the increased complexity that the duration of the male phase depends on whether the animal has female associates.

Ophryotrocha is an annelid worm that lives in the coastal waters of Europe and along the Pacific coast of North America. Its general appearance is shown in fig. 4, both in the small male phase and as the large female worm. In early maturity, ophryotrochans function for a while as males and then switch over and become females. The female phase may continue until the individual dies, or the male phase may be resumed. It depends in part on the surrounding conditions.

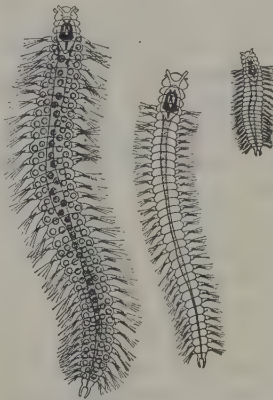
When a few of the anterior segments of a functioning female are cut off, a tail regenerates on one piece, a head on the other, and both regenerated pieces become males. Later, if conditions

are favourable, each becomes a whole female. A male may be continued as such for a long time by repeatedly removing the posterior segments.

Many adverse conditions, including starvation, likewise cause females to revert to maleness or delay the fully developed male from becoming a female. The presence of waste products in the water pushes the reaction in the male direction.

When two females are placed together in a small dish in the laboratory—presumably something similar would occur under comparable conditions in nature—the more vigorous female may obtain a male mate by biting the other in two, by securing the major portion of a scanty food supply, or by being better able to resist the masculinizing effects of excreta-rich water. In time, the newly reverted male may become the more vigorous, develop into a female and cause the longtime female herself to become a male.

The sex of these worms is thus highly labile. The functional expression at any instant depends on a complex of factors that is not clearly understood. The complex includes the degree of conditioning of the medium, the presence or absence of other worms, and their degree of physiological dominance if present.



FROM HARTMANN.
FIG. 4.—MALE AND FEMALE PHASES OF THE ANNELID WORM, OPHRYOTROCHA

A similar story but with pertinent variations is found in the sex history of the boat-shell snails called *Crepidula*. Three species of this genus are common in the coastal waters of southern New England. Active sexual association with a female causes many males to remain members of that sex longer than they would if isolated. All species of *Crepidula* so far studied critically have a few males that do not change sex; these are the so-called true males, as compared with the hermaphroditic males that constitute the majority of the population.

Another variation of the same general sort of relationships is furnished by the worm *Bonellia*, best known from the Bay of Naples. The large female harbours small parasitic males within her uterus. The fertilized eggs are shed into the surrounding sea water. If the free-swimming young settle on the proboscis of a female *Bonellia*, they transform into minute males that become parasitic on the female worm. Those that do not come under female influence normally become functional females themselves. The sexually indifferent larva obtains some substance from the proboscis of the female that retards growth and produces a male. The external relations—usually the social relations, or lack of them—determine which of two alternative paths of development will be followed.

In several other well-studied cases, sex depends on population density. This situation has been worked out with care for certain nematode parasites of grasshoppers. If a few eggs are introduced into each of many grasshoppers, the resulting adult nematodes are females; if many eggs are given to each grasshopper, the nematodes are almost all males. The observed results cannot be ascribed to male-producing eggs having been killed off in one instance and female-producing ones in the other—a real transformation has been affected. The sex of the developing embryos must have been determined by the crowding of the nematode parasites within their hosts.

In the instances discussed, in *Ophryotrocha*, *Crepidula*, *Bonellia*, and in these parasitic nematodes, both sexes are normally present in the population. We turn now to one more much-studied group in which the species is carried for many generations by the female sex alone, i.e. certain cladocerans, a group of primitive crustaceans of which *Daphnia* and *Moina* are examples.

Cladocera are aquatic animals. The ones to be discussed are

common in ponds and pools of fresh water. The sexual history resembles that of aphids. Outbreaks of bisexuality occur usually as the pond becomes dry or as autumn sets in. The fertilized eggs are resistant and carry the species over a period of stress. They hatch into parthenogenetic females with the advent of better conditions and the race is made up for some generations of females only.

Crowding the females of *Moina* is a very effective method of inducing bisexuality. Crowding acts by decreasing the amount of available food, or by the over production of waste products, or perhaps by both of these combined with other unanalyzed factors. In any event, the close association of many parthenogenetic females results in the production of eggs with a different prospective potency from those of the eggs these same females would have produced if uncrowded.

The adaptive value of a mechanism that produces males, sexual females, and the resulting resistant eggs when needed, is rather obvious. This frees all members of the race to be egg-producing members of the community when environmental conditions favour rapid expansion of the population. Each of the other instances cited can also be shown to have certain survival values.

As a result of the specialized method of sex determination that has been evolved in *Bonellia*, the potential loss of males is partially avoided. If the wandering, sexless larva reaches a suitable environment, it transforms into a female and is then able to direct the transformation of the next comer into a functional male. The survival value of the sex situation in *Crepidula* is similar; that in the nematode worms is more complicated and is associated with the necessity of avoiding overcrowding of the host species if the parasites are to persist.

Behaviour.—An animal shows social behaviour when its reactions differ in the presence of others from its normal solitary behaviour. The socially-induced behaviour may or may not have survival value. That is a different test. A higher type of sociality is indicated when the behaviour of one animal is oriented with reference to another or to a group of other animals. A yet higher type of sociality is indicated by behaviour that differentiates between one individual and another, or between groups of animals.

As in many other aspects of sociology, it is interesting to apply the behaviour test to the Protozoa to find to what extent such evidences of social life can be found among animals without differentiated cells. Whatever sociality they show is a part of the life of a whole organism structurally limited to a single cell and represents sociality at the free-living cellular level. Protozoans reach primitive stages of the highest level of social behaviour outlined in the preceding paragraph, particularly in what has come to be known as the mating-type or sex-type reactions.

Sex Types in Protozoa.—The full extent of the distribution of sex types among protozoans is unknown. *Chlamydomonas* has two sex types and a more-or-less labile series of intersexes. In 1946, *Paramecium aurelia* was known to have seven sex varieties divided into two main groups; six of the seven varieties have two sex types each and only one type is known for the seventh variety. *Paramecium bursaria* has four sex varieties, with four, eight, four, and two sex types respectively. These details differ from species to species.

Individual protozoans belonging to the same sex types do not conjugate with each other. They do conjugate readily with a member of the other sex type or types of their own variety; sometimes—though less readily—they conjugate with a sex type of a different variety. Often they will not conjugate across varietal lines.

An individual will bump into others of its own sex type and merely modify its course of swimming. If animals of a different mating type from within the same variety are introduced, individuals from the proper sex types will adhere, perhaps end to end, or in any other possible position, when they make contact with each other. They swim about clumsily and pick up others, each sticking to an individual belonging to the opposite sex type. A clump of some hundreds may collect thus in *P. bursaria*. Later a reshuffling occurs; the clump breaks into conjugating pairs in which each animal is finally lined up parallel to its mate and with

the oral surfaces adhering.

The conjugation continues for 36 hours or more and involves the interchange of nuclear material. Then each breaks free and starts life as an ex-conjugant. All the asexual progeny of a given individual are said to belong to the same clone and, exceptions aside, continue to be a member of the same sex type to which the parent ex-conjugant belonged.

Many pertinent details are known that cannot be presented here. The clones show periods corresponding to youth, maturity and old age. They do not conjugate in early youth; the transition between youth and maturity is often marked by tentative conjugation; maturity is the period of normal conjugation; and in old age, the ex-conjugants usually die.

Other types of social behaviour of protozoans include the reaction pattern of some ciliates in which, after establishing contact, the members of a chance pair turn and swim side by side, with their cilia touching though their bodies remain apart. This may be an example of exploratory behaviour related to the process of finding suitable mates, since in some species it is a regular preliminary to mating.

Lethal effects of one stock on another are known for *P. aurelia*. Such toxicity may be important in natural selection, for the producers of the toxic material would eliminate the members of a susceptible stock with which they were in close association. Such effects may well be an example of competition resulting in unconscious dis-operation for the susceptible stock. In other instances the culture medium conditioned by a given sex type will induce conjugation among members of the sex type with which the first mentioned animals usually conjugate.

The rich literature dealing with the mating behaviour of higher animals cannot be reviewed here although, as with mating in the Protozoa, each item contributes its own bit of social significance. The whole makes an important phase of general sociology. See **COURTSHIP IN ANIMALS**.

Social Facilitation.—In general, social facilitation refers to any increment in frequency, intensity or complexity of the behaviour of one individual resulting from the presence of another. It is a basic element of social physiology. Social facilitation usually implies an increase in frequency, intensity or skill resulting from mutual action; it may also refer to an increased tendency to remain quiet. Social facilitation is involved in observational learning, although this is usually called imitation or contagious behaviour.

The forerunners of social facilitation can be seen in many of the phenomena of mass physiology. Thus grouped *Arbacia* eggs are accelerated in their early cleavages and grouped protozoans often undergo asexual divisions at a faster rate than would be shown if each were isolated. Similar accelerations are known among bacteria and the added activity of a number of bacteria working together, compared with the results if each works alone, is a measure of their communal action. Facilitation across species lines is also well known for bacteria and is called synergism.

Social facilitation in behaviour is shown by a variety of animals under diverse conditions. A few examples will be helpful. Rats fed in a group of five consume as much as 70% more food than if each eats alone. Providing intraflock fighting is avoided, hens may eat only half as much food if isolated as compared with that taken by the same birds when members of a small flock. Hens showing no sign of hunger in the presence of food often begin to eat if they see another start to feed. Similar behaviour is known for children and has been demonstrated for many other animals including a number of species of fish, common guppies among them. With various fishes, the amount of food eaten by the same individuals varies decidedly, on a day-to-day basis, depending on whether they are grouped or isolated.

The degree of social facilitation in the food-taking of fishes has been best studied by the use of known numbers of the common cladoceran, *Daphnia*. The situation is not simple; it usually is not in sociology. When eating *Daphnia*, social facilitation in fishes does not occur if too many are introduced, and a so-called confusion effect develops instead. In one instance, groups of goldfish ate more *Daphnia* than did four similar but isolated

goldfish, until about 600 *Daphnia* were introduced into the relatively small aquarium at the same time. The cloud of active small crustaceans darting in all directions seemed to confuse the fishes and the rate of consumption fell off. When a similar number were introduced, but in small, successive lots, the fishes again showed full group facilitation in food consumption.

The observations of fishes feeding on *Daphnia* give a good demonstration of both aspects of the confusion effect—the decreased consumption on the part of the predator—and the added survival value that mere numbers furnish for the prey. This is another instance of the survival value of optimal numbers, a principle that was discussed at some length in a preceding section.

Caged rhesus monkeys eat oranges more readily than bread. They eat more of both under controlled social conditions than if isolated, but the degree of social facilitation is much greater for bread. Chimpanzees are more likely to eat filter paper if they see a man eating similar stuff. This represents a kind of inter-species facilitation. Under some conditions, competition is a factor in social facilitation; for example, the presence of an imprisoned but clearly visible rat does not stimulate another to eat as does a free and active competitor. In other cases, the stimulus comes from seeing the activity of others without the presence of recognizable competition. Both factors enter into social facilitations in various learning situations with a variety of animals. The goldfish is not notably a schooling fish, and yet they learn a simple aquarium maze more rapidly and with fewer errors if several are present together than if the same number of similar fishes are trained in separate mazes. There is a tendency for the grouped goldfishes to move together in a body and to be less disturbed by outside stimuli and so reduce their learning time. A trained leader will accelerate learning even more.

Extra animals present in the learning situation may retard learning and so produce mutual interference in place of mutual acceleration. This has been found to be the case for a variety of animals, including cockroaches among insects and the shell parakeet among birds. Both retardation and acceleration have been found in studying the effects of numbers on the rate of learning in children. The nature of the effect produced depends in part on the problem and, in part, on the personalities involved.

Social facilitation occurs among representatives of the highly social ants. Some species of *Camponotus* dig their nests in soil. They can dig when alone but the rate of work varies with different individual ants apparently in correlation with deep-seated physiological differences. If marked ants are placed together in pairs, or in groups, they start digging sooner and work with more steadiness than if alone. The accelerating effect is greater for naturally slow individuals than for rapid workers; when ants intermediate in speed are used, they work faster in company with a rapid worker and are slowed down by the presence of one with slow working tendencies.

The presence of other animals of the same species frequently acts to reduce the activity of all present over that shown when each is alone. This social facilitation of relaxation has been carefully studied in the goldfish, in which activity was decreased from one-fourth to one-half in the presence of other similar fishes. In this instance, sight of a single associated fish is sufficient to produce a decided quieting effect and even the presence of its own image reflected in a mirror reduces the activity of an isolated goldfish.

Some aspects of social facilitation approach what is called imitation in human behaviour. Often such behaviour is spoken of more objectively as being contagious. Goldfishes learn to swim a simple maze more readily if they have been placed so that they can see others learning. Song sparrows reared in the half-freedom furnished by an ornithologist's study were stimulated to contagious activity in a number of ways. When one sparrow ate, bathed, or preened, the others were likely to do likewise; when one flew to the desk, another usually followed. Grouped chimpanzees that have some freedom of group movement show waves of activity that seem to be passed along by contagion. Social imitation as seen in man has its forerunners in the behaviour of other forms.

Co-operative Behaviour.—The literature of natural history contains many accounts of group co-operation of animals in nature. Often these anecdotes are more colourful than critical, but some are certainly trustworthy. Attention is again called to the group behaviour of the American pronghorn which, if enough animals are present, forms an effective defensive group when attacked by wolves or coyotes. Variants of group defensive action range from the "mobbing" of an attacker by a flock of birds even though each individual is relatively weak, to the orderly retreat of a horde of baboons with the females and young in the places of least danger.

The group fishing of the double-crested cormorants gives an example of elaborate group co-operation. These birds may be seen fishing entirely alone and in small co-ordinated flocks of from 10 to 12 individuals. They also fish in giant flocks up to as many as 2000 birds. Fishing operations usually begin before the flock is fully formed. The basic pattern in the small flocks consists of a circular arrangement with all birds facing in the same direction. This pattern is changed with the large flocks; then, a long, narrow, well-packed line moves forward, fishing as it goes. Part of the cormorants swim at the surface, part swim at the same rate below the surface and those left behind in the rapid advance take to the air and fly forward to catch up with the others. These large flocks pursue a given school of fish until the hunger of the birds is satiated or until the school escapes. The small flocks swim at about two-thirds of the speed of the largest ones.

Co-operative behaviour under laboratory conditions has been clearly demonstrated in mammals as far down the taxonomic scale as rats. In the best experiments, pairs of rats were placed in an experimental situation that required the co-ordinated efforts of both animals if either was to obtain food and at the same time avoid an electric shock. Each rat was trained individually to feed when the region of the food was not electrified. When a shock was felt, the rat learned to go to a platform arranged so that the added weight of the rat cut off the electric current.

When two rats, so trained as individuals, were placed together in this situation, they learned to take turns at the food dish and on the platform so that one cut off the current while the other ate. They exchanged positions from time to time and both obtained sufficient food and came to spend almost all their time when in the apparatus working at the problem and very little time together on the safe but foodless platform. Pairs of rats even learned to co-operate in a more complicated situation in which the weight of the rat on the platform cut off the electric current, if that was turned on, and at the same time raised a lid over the food dish. Co-operation under these conditions continued if the possibility of being shocked was present only 25% of the time. The co-operation disintegrated in the complete absence of the punishment caused by electric shock.

Roughly similar evidence of co-operative food-getting has been recorded for cats even when the situation was complicated by one cat being socially dominant over the other. As might be expected, chimpanzees learn to execute still more complicated co-operative patterns.

In a fairly complex situation, each of the selected chimpanzees learned by trial and error to operate four devices in a given sequence in order to obtain food from a mechanical vendor. This required learning to make the appropriate responses to a sequence of colour stimuli. When the complex was mastered, pairs were caged close together and within easy sight of each other although they were separated by an open grille. Each chimpanzee could reach two of the four devices that must be operated in a definite sequence and each had a food vendor in its cage.

If both operated the available devices rather steadily, food would be obtained now and then by a chance operation of the appropriate sequence. Co-operative behaviour was considered to have been given when one chimpanzee watched its partner's performance and pushed at the gadgets available to it at the proper time as indicated by the colour sequence. They often obtained food in a somewhat systematic fashion. The apes were

also judged to show co-operation when so-called solicitation was evident; at times the solicitation clearly indicated the location of the next device to be pushed.

Meredith Crawford, who did these experiments, comments (*Jour. Soc. Psychol.*, 13, p. 278, 1941, Journal Press).

The directive elements of the solicitation, that is, the bodily orientation of the partner, were clear and human-like. Perhaps it is significant that a soliciting animal never pointed but always used what seemed to be the more primitive method of pulling or pushing the partner. . . . It may be that an important transitional step in the development of language behaviour lies between the direct orientation of one animal by another through body manipulation and indirect orientation through pointing toward a distant object.

ORGANIZATION OF ANIMAL GROUPS

The most primitive of animal aggregations, sociologically speaking, show no discernible organization. Some of the highly integrated invertebrate groups—those in colonies of bees or ants, for example—have types of organization that we can perceive in part without having a real understanding of the fundamental relationships. The organization of vertebrate groups are more obvious and more like our own. They are based on three general principles: (a) territory, (b) dominance-subordination and (c) leadership, with, of course, the important complementary quality of followership.

These different types of social organizations intergrade with each other to form complicated social patterns that fall into certain recognizable trends in the vertebrate groups beginning with fishes. There is some evidence of the operation of each of the principles among invertebrates. Thus hermit crabs, *Eupagurus longicarpus*, display dominance based on size and force; crayfish show spaced aggregations in which a certain amount of territory about the individual is kept free of intruders, and some ants show leadership-followership relations. In the main, discussion of group organization will be restricted to groups of fishes, reptiles, birds and mammals.

The study of organization requires the consideration of a set of phenomena which are not encountered in the analysis of the primitive, basic relations that make for survival of an organized aggregation or of group effects on behaviour. Defense of territory, and the establishment and the maintenance of social dominance, often calls for hard fighting, between the individuals of a contact pair. This aspect of intra-species struggle appears on the evolutionary scene later than does primitive automatic co-operation. It is apparently made possible in part by the functioning of natural co-operation and of group-oriented behaviour which, together with gradients in the physical environment, permit or condition the formation of aggregations. It is only when animals are somewhat aggregated that organization becomes possible.

Territory.—Group organization based on defended territories has long been known even though much of the knowledge has developed after 1920. A territory, in the sense of comparative sociology, is a more or less restricted area that is actively defended against trespass by other individuals of the same species and sometimes against trespass by other species. Territorial behaviour is a complex phenomenon. In full development, in its least complex form, this type of behaviour is based both on a positive reaction to a particular place and, within that area, on a negative reaction to other individuals of the same species, except for a mate or mates.

Our information about the social aspects and implications of territorial organization is richer for birds than for any other nonhuman group, and birds show the following types of territorial relations (cf. Nice, 1941).

- I. Mating, nesting and feeding ground for young.
- II. Mating and nesting but not feeding ground.
- III. Mating station only.
- IV. Restricted to narrow surroundings of the nest.
 1. Solitary individuals.
 2. Colonial birds.
- V. Winter territories.
- VI. Roosting territories.

This classification does not include all known instances of territorial behaviour among birds, when territory is given the simplest, most inclusive definition of any defended area.

Blue geese (*Chen caerulescens*) were observed in a bird sanctuary to defend the following territorial types: (1) Family territory; (2) mated-female territory; (3) feeding territory; (4) nesting territory; (5) resting, or resting and sleeping, territory; and (6) moving territory. The last type was shown when a family of four kept a certain amount of nearby space clear from geese of their own and other species when they swam about as a family. These territories varied with time of day and with the season of the year. The defended area may be fixed and well-defined; the boundaries may vary or the whole territory may be transitory.

Although the variations are great with different species, each of the types of territories possesses definite social implications. The territory may be taken up before or after mating. Some unmated males do not maintain permanent holdings, others do. Territories are often abandoned in winter, although some birds retain them even then. When one male has more than one mate, his holdings may be subdivided. The role of the female varies greatly in territorial behaviour; often she does not defend her mate's boundaries, though sometimes she does. Some flocks hold and defend definite areas, others do not, and the flock territory may or may not be subdivided.

Territories are often compressible depending on the population pressure in the given area and also on the varying ability of the male in territory defense. The defense of a given territory frequently entails active fights. With widely different species the combats may be formalized. Singing of birds and other sorts of defense short of direct use of force are well authenticated. Hordes of howling monkeys engage—not in fighting—but in howling encounters when they meet near their common boundary line.

When territoriality is well developed there is a reserve of unmated males and females that makes possible the prompt replacement of a lost mate in a functioning territory.

Some of the general biological values associated with the territorial habit in birds are: (a) the unconscious organization of a local population into what may be regarded as a well-spaced aggregation; (b) promotion of monogamy, which is often important in rearing helpless young; (c) limitation of the breeding population and hence partially controlling population density; (d) provision of a relatively safe and more easily defended breeding place that often contains (e) insurance of an easily accessible, adequate food supply for adult and young birds during the rearing of the brood; (f) reduction in the rate of spread of diseases; and (g) reduction of fighting whereby the birds are less likely to be so absorbed in other activities that they fail to perceive the approach of enemies and they also conserve much energy. With suitable modifications, many of these values are to be found in the territorial behaviour of other kinds of animals, especially of fishes, lizards and mammals that defend restricted areas.

The territorial type of organization of populations is closely interrelated with the social hierarchies that often develop in smaller groups and are based on dominance-subordination relations. In fishes, for example, in a restricted amount of undivided space, certain species form a dominance hierarchy, whereas the same individuals in a larger aquarium, or in one that is partially subdivided, will establish defended territories. Usually, the omega fish in the hierarchy is the last to obtain a territory and, if available niches are few, it may not establish one at all.

A territorial animal fights more fiercely within its own territory than when invading that of another animal. Sometimes, at least, the decrease in fighting power is related to relative distance from the territorial centres of the combatants. A bird that is socially subordinate in neutral unclaimed territories tends strongly to become dominant over the same individual when the encounter takes place within its home territory.

Among various birds, especially among pigeons, given individuals establish territories even within a sizable laboratory cage or small house. Records of fights under these conditions show now

one of a pair and now the other winning, depending on the territory in which the combat takes place. Such relations furnish one transition from an organization based primarily on defended territories to social hierarchies of dominance and subordination such as will be considered immediately.

There is no certainty as to whether territoriality preceded dominance hierarchies in evolution, or concerning the general sequence of these two forms of organization in social development. It is not even known that these social patterns are related in evolution; they are not necessarily so, even though they are often functionally interrelated. Young individuals of the green sunfish (*Lepomis cyanellus*) in laboratory aquaria first form social hierarchies; later, with the approach of breeding, the males establish territories; similarly, with many animals, social hierarchies give way to territorial organization during the breeding season. Contrariwise, certain ground squirrels of western North America, belonging to the genera *Eutamias* and *Citellus*, leave their individual territories and collect about food when this is locally abundant. The collected animals then form hierarchies that are revealed by definite chasing orders.

Dominance-subordination Hierarchies.—There is little evidence among invertebrates concerning the existence of dominance-subordination hierarchies resulting from contact relations between pairs of individuals. A simple two-rank hierarchy based on force is known for one of the species of hermit crabs. There is much evidence of the subordination of the individual to the whole social group such as occurs among the highly social insects, termites, bees and ants, for example. The causal relations whereby the entire group comes to dominate all the individuals composing it are only partially known; in fact, the problems involved have not yet been fully sensed and formally stated.

In the higher fishes, social hierarchies based on individual dominance appear with many of their characteristics already in a high state of development. Final social status is typically determined after the first few contacts between two fishes and may harden soon into a fairly lasting despotic relationship in which the dominant member of the contact pair nips or drives or threatens the subordinate one without receiving nips or even threats in return. Such a social system is also known among the slow-moving turtles, as well as for more active lizards. It is well developed in many birds and among mammals, including man. Probably more is known about social dominance and subordination in common chickens than in any other animal except man.

The modern period in the study of social hierarchies was initiated by Thorleif Schjelderup-Ebbe in 1922. An extensive literature has developed much of which has been summarized by W. C. Allee (1938, 1945) and by Nicholas E. Collias (1944). Constant cross reference to human situations should be made while reading the following account.

The most fixed type of social hierarchies among birds is based on what has come to be called the peck-right. The higher ranking individuals are able to peck those of lower rank without being pecked in return. The relations within one flock of white leghorn hens are summarized in Table I.

TABLE I.—The Social Order in a Flock of White Leghorn Hens

Individual	No. pecked	Individuals pecked									
RG	7	BY	RY	BG	RR	GG	...	YY	RW	...	
RW	7	BY	RY	BG	RR	GG	BR	YY	...	...	
YY	6	BY	RY	BG	RR	GG	BR	...	...	...	
BR	6	BY	RY	BG	RR	GG	...	...	...	RG	
GG	4	BY	RY	BG	RR	...	...	...	...	...	
RR	3	BY	RY	BG	...	...	...	...	...	...	
BG	2	BY	RY	...	...	...	...	...	...	...	
RY	1	BY	...	...	...	...	...	...	...	...	
BY	0	...	...	...	...	...	...	...	...	...	

The hen named RG (because she carried a red and green leg band so that she could be distinguished as an individual by the watcher) pecked all her subordinates except BR. Each hen of lower rank, except BR, was pecked by all those above her in the

hierarchy and in turn pecked all those of lower rank. BY, the omega hen, pecked none and was pecked by all.

A flock of hens may or may not be organized into a simple straight-line hierarchy. One of the most frequent irregularities comes when a hen with medium or even with low social status has the peck-right over some individual that otherwise outranks her in general social position. In the flock shown in Table I, BR ranking fourth was pecked by RW and YY and yet had the peck-right over RG, otherwise the alpha bird of the flock.

A more common complication occurs when triangle situations arise in which a pecks b; b pecks c; and c pecks a, and then all three have the peck-right over those below them in the social scale and are pecked by all with higher social rank. Pecking triangles occur at all levels in the hierarchy of hens. Such irregularities are more likely to be found in flocks of cocks than among hens. Sometimes, around a food bowl for example, the hens of a triangle will pass the peck around and around until something happens to break the combination.

The organization in a flock of hens represents a type of social pattern in which dominance, once won, is relatively permanent. The same rank-order has been known to remain fixed for over a year. With pigeons, doves, canaries, shell parakeets and others, although the flock organization is no less real, the outcome of any given pair contact is less predictable. The social structure is based on a differential peck exchange in which dominance is indicated by the ratio of victories to defeats between the members of each contact pair. Such flocks are organized on what may be called peck dominance rather than on the more absolute peck-right relations existing among hens and certain other animals. The peck-dominance type of social order is related in part to territoriality in that animals tend to win contacts in or near their own territories and lose them in those of others. At least under laboratory conditions, peck dominance also occurs among some birds, shell parakeets for example, that have not established special territories.

Pecking organizations among birds are apparently based on the ability of birds to recognize and react to their flockmates as individuals. When territory enters as a factor, as among pigeons, recognition of the individual's territory also becomes a part of the group reaction system. The space available for the flock often determines whether territory will, or will not, affect the system. When groups of canaries are caged in a small space, the social order becomes simple and definite; it is little complicated by territoriality. Given more space, individual territories tend to be established in which each bird becomes supreme in his own holding, regardless of how low his status may be elsewhere.

Early observations upon group organization in birds were limited to penned or caged flocks, in which individuals could be readily marked and observed. Then came the extension of such social order studies to semiferous flocks and finally to several species of birds in nature.

In 1946, it still was not known how large a flock of birds could maintain a definite peck-order. With hens, under experimental conditions, individuals can remember and steadily give the same social reaction to each one of 25 or more individuals. Still larger flocks can be roughly divided by a human observer into upper, middle and lower thirds. Yet three weeks of absence from even a small flock will cause a hen to act and to be received as though she were a total stranger.

Hens, and cocks too, behave differently toward their various associates. Some peck certain inferiors mildly and infrequently and give more and harder pecks to others than is indicated by their position in the social order. A female despot may allow an inferior to pick food from her bill though others are pecked severely if they attempt to take a similar liberty. An alpha cock may even allow an inferior to replace him while mating but will react violently to a similar attempt by another associate. There are many instances among these birds of what would be called favoritism and antagonism in human society.

High-ranking hens differ greatly in their reaction to socially inferior flockmates. Some are mild despots; others are severe, driving ones. Some allow inferiors to feed with them; others feed

alone.

Some inferiors feed quietly between pecks from those of higher social rank; others react strongly to being pecked and cease all attempts to feed for the time being. Often the omega hen feeds only after all others have left the food bowl and may not attempt to eat at all until hunger-driven to accept pecks in order to obtain food; she may even starve to death with only a social peck between her and food. The range of individual reactions within a territorial or other social organization is very great.

Hens can maintain social position in different flocks at the same time. Once their rank in four or five flocks has been established, when shifted back and forth in each flock every day or so, a given hen moves fairly smoothly into her usual social position even though she has a different rank in each flock.

It must not be thought that hens, or animals in general, go about fighting their associates continually. There are hours together when no such social interactions can be seen and watching for them becomes a tedious occupation. Hens, for example, spend much time in sunning, or dusting, or just sitting quietly; during such periods, even the omega hen of the flock, if she goes quietly about her own affairs with head held low, may escape blows from all her superiors. If, however, she darts about actively, some one or another of her social superiors is likely to threaten or peck, and the pecks frequently are so severe that they draw blood.

Dominance orders are common in mammalian groups. Among others, they are found in mice, rats, hamsters, ground squirrels, cats, dogs, horses, cows, monkeys, apes and men. Each species presents its special set of variations from the general principle. Mice stand relatively low in mammalian evolution, hence it is interesting to pause briefly over the social structure of their groups. Little is known about their social organization in nature. Given hideaway niches, food in plenty and abundant space, the social picture would be different from that seen in laboratory cages.

Both males and females fight and, as usual, the males fight more frequently and harder. Small groups of male house mice caged together arrange themselves into various types of social orders. In one set of more than 4,900 observations, exclusive dominance of one male without resistance and without fighting among subordinate animals was found in 43% of the cases. Sometimes there was resistance by one mouse, or a hierarchy of three ranks might be formed in a group composed of five mice. Often there was no fighting at all for a period of several days' duration. Once exclusive dominance in mice is established, it may persist unchanged for months, although the statistical expectancy of continued dominance for one individual in a long series of tests was found to approximate three weeks.

The temptation is great to summarize at length the details of social dominance in monkeys and apes. The interested reader should consult the book by S. Zuckerman (1932) on baboons and that by Robert Yerkes (1943) on chimpanzees. This is also an excellent subject about which to forage in the original research literature. The accounts by Clarence R. Carpenter of his observations of howling monkeys in Panama (1934) and of gibbons in Siam (1940) and of the semiferal rhesus monkeys on Santiago Island off Puerto Rico (1942) make exciting reading. It is a pity to do less than justice to such work by the partial reporting to which the present account must be limited.

Howling monkeys live in bisexual hordes with each group confined to a given territory. The usual adult sex ratio is three males to seven females. Complementary males roam through the tropical jungle between the groups and, if persistent, may gradually gain admission to some horde, or form the centre for a new one. The minimum observed size of these howler hordes was four, one male and three females. The largest numbered 35 animals of which 19 were adults—5 males and 14 females. A co-operative group of adult males dominates and co-ordinates the howler clan.

Rhesus monkeys belong to the old world tropics. Those introduced on Santiago Island numbered about 350 in 1940. After some two years on the island, they had organized themselves into five bisexual groups, and two groups of males only. Typically the young male separates from his home group in early adoles-

cence, joins a gang of other young males and lives with them until he is nearly adult; then he eases himself back into a bisexual horde and may gradually advance in social rank. On the average there are six females for each of the males in an adult group of these monkeys.

Dominance gradients exist in the unisexual groups of young males and separate gradients are found for the males and the females in the bisexual hordes. The lowest-ranking male ordinarily outranks the female of highest rank. Females are characteristically subordinate to males in all the social groups of primates that Carpenter observed in nature with the exception of gibbons, whose adult males and females are co-dominant.

Groups of gibbons are smaller than those of howler or rhesus monkeys and may consist of only two individuals, a mature sex pair. They are essentially family groups in which headship rests equally on the two adults. Senile individuals may or may not be retained within the group. Gibbons of both sexes are very aggressive and now one, now the other dominates in such activities as feeding, play or sex behaviour.

Group life is normal for chimpanzees. Within the group, certainly in artificial segments arranged by man, dominance-subordination relations form the chief means of social organization. Males usually dominate females, although regardless of sex the smaller, weaker, less enduring chimpanzee tends to be the subordinate member of a caged pair, particularly if these traits are combined with such psychobiological factors as sweeter temper, more cowardice and less social assertiveness.

One set of six female chimpanzees, observed in all possible pair combinations, showed a hierarchy of dominance in their success in competition for food. Mira and Nana gave a complete reversal of dominance during the period of observation. Nana, Cuba and Lita formed a social triangle somewhat like those existing among hens. Bentia and Lita were decidedly less dominant than the others, and members of the more dominant quartette associated with them more closely than with each other. Often there is tension between aggressive animals with nearly the same social status.

These apes reacted socially with each other only 17% of the time they were together. Of this time, less than 1% was devoted to definitely aggressive action. Groups of male mice similarly spend about the same amount of time in aggression. Almost 63% of the social behaviour of apes consisted in grooming and about 33% of their interactions were devoted to play of one kind or another, not counting the approximately 3% spent in one form or another of sex behaviour.

Taking vertebrates in general, the most certain sign of dominance is the winning of a definite pair contact. Sometimes an individual gives ground because it has been temporarily out-fought or out-bluffed; it may return to the fray and win eventually. Defeat is often accompanied by easily observed signs of submission. A defeated fish often drops its challenging attitude of tense body and bristling fins; the whole length seems to hang limp in the water; the fish backs slowly from the victor and then turns and flees. Beaten lizards are known to give what is called the subordinate head nod and *Anolis*, with unconscious aspersion, has been described as turning a dirty yellow colour. Many animals, hens and mice among them, sometimes emit characteristic cries when defeated. With hens, the face and head furnishings blanch while those of the victor are literally flushed with victory. Defeated mice show submissive body postures.

Signs of social subordination, in addition to those just listed, include the wary avoidance of superiors; moving quietly with head held low; hiding in obscure places or in protected corners; and accepting or even offering to assume the female position in pseudo-copulation. Yerkes is much impressed by many feminine aspects of the behaviour of socially inferior male apes.

Social status and sexual behaviour are closely interrelated. Although male animals usually dominate their associated females, this is not always true, and it can be demonstrated by a simple experiment that in some fishes, at least, social and sexual drives are distinct. Gradual cooling of the water around sword-tail fishes (*Xiphophorus helleri*) causes them to lose their sexual appetite

before the drive for social status disappears.

There is great variety in the relation between social rank and mating behaviour. The howling monkey hordes in the rain-forests of Panama, with their low dominance gradients, show no correlation between social dominance and the sexual possession of a receptive female. At the other extreme, in the half-wild rhesus monkey hordes on Santiago Island, the dominant male has exclusive possession of a single receptive female and, if more than one female is in sexual heat at the same time, the dominant male asserts his rights during the mid-period when copulation is apparently most satisfactory.

The sexual relation of chimpanzees in nature has not yet been described in accurate detail. When paired in a cage, the male takes possession of limited or of unusually attractive food until the female comes to the sexually receptive stage in her regular cycle; then the dominant male gives way and the female gets first access to the food. The interplay of social forces here is complex and is affected by personality traits of both members of the sex pair. It is significant that, when two females are caged together, precedence to food also shifts from the socially dominant to the subordinate when the latter is sexually receptive. Yerkes (1943) reports many wives by which a subordinate female chimpanzee may manage somewhat her dominant mate.

A socially dominant cock living with other males in a flock of hens may so suppress the subordinate cocks that the latter cease to mate with the hens. An essentially similar reaction has been reported for males of the sage grouse in Wyoming in which so-called master cocks, comprising about 1% of all the males, make some 74% of the matings, and about 97% of the cocks make only 3% of the matings.

Females standing high in the social hierarchies of flocks of hens, at least under some conditions, are courted and mated less than are their lower-ranking subordinates. To the extent that this affects egg fertility, high social rank tends to lessen the long-term survival value for hens. This disadvantage is offset by some decided advantages. Briefly put, high social rank allows greater freedom of movement and certain essential priorities, notably as regards space, food and female mates. Low position in the social gradient carries restrictions that may be very severe and even fatal for the life of the individual. Socially suppressed hens may starve within a few feet of food; and Arthur A. Allen has observed that ruffed grouse, strongly subjugated by associates in a laboratory pen, may die for no known physical cause, though dominant grouse survive.

Dominance-subordination organization among most vertebrate groups results from interindividual fights or threats. There is competition, often strong competition, for social status. The fighting may reach disruptive strength, as it does between males of the fighting fish, *Betta splendens*; but, when the pair conflicts are not too severe, they result in an organized group that has some rather definite survival values as a group in comparison with other aggregations in which organizational fighting is still in progress. Thus mating reactions are more normal in hierarchial groups when the organization is well established, and flocks of hens with an accepted peck-order produce more eggs as a flock, than do similar lots of hens that are in the process of organization.

Competition at the individual level, in such instances, leads to the possibility of closer co-operation or to more effective competition between groups as units. Also, and obviously, co-operation between individuals produces similar results at the group level. Here again it is evident that, up to a certain degree, competition may be a form of co-operation or at least of proto-co-operation. When the interindividual conflicts become over intense, as in *Betta splendens*, competition is disruptive.

Conflicts and co-operation between small group units show similar relations with respect to larger, more inclusive group federations. If the intergroup struggles are not too severe, they yield more comprehensive organizations that have the increased power inherent in a generally accepted, smoothly working organization containing large numbers of individuals. The same effect may be produced by combining smaller co-operative units into a large whole such as happens with many flocking birds.

Leadership-followership.—High-ranking members of a dominance hierarchy possess many social privileges that are not necessarily accompanied by social obligations, and alpha status in the social order is not necessarily correlated with leadership. The alpha hen in a foraging flock may or may not be at the apex in the line of advance; often she is not, and, in any event, the leading bird seems always more or less dependent on her followers.

In contrast, leadership may be closely associated with dominance as in the semiferal hordes of rhesus monkeys on Santiago Island, or it may exist without an obvious dominance order. This last relationship is approached in the Scottish herds of red deer that F. F. Darling (1937) watched where an old, experienced female—usually with a fawn of her own—is the leader of the herd. In pure development, leadership carries with it a variety of social obligations without corresponding social privileges.

Social organization based on leadership shows greater flexibility than does organization growing out of territoriality or from dominance-subordination. Leadership can bring types of social efficiencies, in group protection for example, not provided by the other two organization types. The analysis of leadership is less complete than the others; much detail is known but generalization is difficult and the following treatment is in part tentative.

As with dominance and territoriality, individual leadership is better developed in groups of vertebrates than it is among invertebrates. Individual leaders are known among some species of ants in small artificial colonies, as in a Chinese species of *Camponotus*; and in nature as well, especially in *Eciton*. The raiding columns of these army ants of the American tropics show a shifting type of leadership with the ant or a small "pushing party" of ants at the apex advancing in a hesitant manner and then returning to a larger mass; as in hens, these ant pioneers are apparently much dependent on their followers.

With vertebrates, leadership is known among fishes, lizards, birds and especially among mammals. Among fishes, an experienced animal will lead inexperienced followers through a simple laboratory maze and so help them learn the shortest route much more rapidly than when no experienced leader is present.

Leadership in flocks of birds presents many puzzling problems, of which the most basic deals with whether the front bird is really leading the flock or is merely the fastest flying or one of the least tired birds. In one well-authenticated instance, a mixed flock was composed of a dozen black-bellied plovers, two young dowitchers and a single golden plover. When the flock was flushed, the faster flying golden plover was soon ahead of all the rest. The dowitchers were slow and tended to fall behind, and when this happened the black-bellied plover wheeled. This affected both the apparent leader and the followers. The golden plover, finding itself alone, rose above the others, reoriented, and with a few rapid wing beats dived ahead again apparently the leader of the whole flock. The slow flying dowitchers caught up by taking the shorter course directly toward the circling flock. Soon they fell behind again and the whole series of reactions was repeated. There is almost as much reason for regarding the fast-flying golden plover as following along ahead of the flock as there is for thinking that the slow dowitchers were following behind it.

This whole set of phenomena illustrates pseudo-leadership. The essential orientation is furnished by the body of the flock and the stimulus for turning may originate on one of the flanks rather than being given by the leading individual. Pseudo-leadership is well known to exist in other animals, including man.

In groups of gibbons leadership as well as dominance shifts back and forth between mates. Here, as often among mammals, high social status and leadership are closely correlated. A striking exception is shown in herds of red deer in the Scottish highlands. During the rutting season, stags enter the female herds and each rounds up as many hinds as possible. The stag dominates the hinds. If danger approaches, off goes the stag on his own and the real leadership is seen to remain with the experienced female that usually leads the herd of hinds and their fawns.

Darling (1937) emphasizes a striking difference between male and female-led herds. In the former, as illustrated by the roe deer of England, the group is small, held so by the aggressive intra-

group behaviour of the dominant male and, to a smaller degree, of the female roe deer. In the female-led herds of red deer, in contrast, the group tends to be large and the young remain members of the home herd for a longer time.

From such data, Darling, William Morton Wheeler and others have reached the generalization that throughout the higher reaches of the animal kingdom, man included, males tend to be sufficiently aggressive so that they exert a disruptive social influence in contrast to the less aggressive females. Various devices have evolved that centre about this and other phases of the relations of the sexes. Many insects, like aphids and the more social wasps, bees and ants, produce males in limited quantities and at limited times. The mammalian solution is quite different; in many gregarious mammals the males join the female herd only during the sexual rut and keep off by themselves or gather in small male herds during the remainder of the year. Only among the termites have the males become as highly socialized as are the females, and no one knows the evolutionary or the physiological processes by which this came about.

The Family.—We have already seen that the survival values growing out of aggregations of the simpler protista may have given a set of heightened survival values on which selection could act and so form a basis for the physiological evolution of sex. In the preceding pages there has also been much comment about various aspects of the primary sex relations of animals in relation to their social life. We have been reminded more than once that the association of offspring with parents, especially with the female parent, as in aphids, has significant social bearing, but there has as yet been no adequate emphasis in this article of the social role played by the family, broadly interpreted, in the social life of nonhuman animals.

Premating activities, and all the relations of functional sex pairs, have considerable significance for general sociology. Space does not permit the discussion of sociological phases of premating behaviour, some aspects of which are well treated in the article **COURTSHIP OF ANIMALS** to which reference has already been made in another connection. A number of different kinds of groups are integrated primarily by sexual drives. Some of these will be discussed briefly.

Aggregations of both sexes but of different species form during the mating season, especially when they mate at approximately the same time of year. Male frogs will attempt to clasp females of other species of frogs or toads, or, in fact, almost any moving object that they can grasp, even fishes. Coccinellid beetles of different species attempt copulation. Often there are unisexual aggregations of one sex or the other, or both, at or just before the breeding season.

Sexual congregations of the same species range down to conjugating aggregations of protozoans. Among higher animals the types of mating relationships include: polygyny (often called polygamy), which is the relation in which one male regularly mates with more than one female. The situation is fairly common among lizards, birds and mammals. The domestic cock and hens give a well-known example. Polyandry, in which several males breed interchangeably and successively with one female, is relatively rare in pure form. It occurs when several dwarf males are associated with each female, as in the barnacle *Alcippe*, or the worm *Bonellia*. Polyandry is found in certain species of spiders, in which each female consorts with two males.

Monogamy is fairly widespread among animals. It is found among beetles such as the wood-dwelling Passalidae, in which the adult sex pair remain together with their offspring. Seasonal monogamy seems common among many nonhuman animals. It has been reported for certain spiders, some reptiles, and many birds and mammals. Longer duration of monogamous relations are also known, the common red fox furnishing an outstanding illustration. Among the apes in nature, gibbon families are based on monogamous mateship.

Sexual promiscuity is even more widespread, especially among relatively solitary animals. It occurs among many fishes where the sexes mingle at the spawning grounds. Certain lizards and gregarious bats have this sexual habit. Promiscuity occurs in the

North American cowbird, but is probably secondarily acquired and, although monogamy appears to be the usual condition, polyandry too is not unknown in this species. Among mammals, the female muskrat accepts any male that may appear when she is in her short sexually receptive period.

The sex relations within a horde of howling monkeys presents another variant. These animals, as we have seen, form an almost closed group that contains more females than males. Sex relations are communal within the horde. Any female, on coming into oestrus, accepts the nearest male and moves on to another when he is satiated, with no sign of sexual jealousy on the part of either sex.

The association together of young of the same brood, and still more, the association of offspring with either or both parents, is almost as potent a social force with nonhuman animals as are similar relations in man. Many variations occur. Primary aggregations exist in which the individuals are descended from a common father or a common mother, or from common parents. Such aggregations often remain near the place of hatching or birth and show all gradations between loose and quite firm integrations. The primary reason for the animals being together lies in their common origin, but their continuing aggregation often depends on the favourable character of the place or on the abundance of suitable food rather than on genetic factors. In other instances, social appetite appears to hold the group together.

Primary aggregations may arise as a result of asexual reproduction in Protozoa, of natural parthenogenesis in cladocerans or aphids, or from bisexual reproduction. *Lophyrus* caterpillars, which feed on pine needles, form a larval aggregation that arises in the beginning from the fact that the eggs are laid close together. The female moth departs after depositing her eggs and is not associated with her offspring. The common origin is not sufficient in itself to account for the young remaining together since many other kinds of caterpillars scatter as they become able to crawl about; other forms remain aggregated during early larval life and separate when partly grown; and still others remain together during their whole larval life, spinning a common silken nest and even pupating together only to separate when adult.

Primary aggregations composed solely of young animals may be all of similar age and size, as in schools of young minnows; or they may consist of infertile workers and potentially sexual animals, as in a bee colony when the old queen has departed with her swarm. All may have one or both parents in common, as usually happens with the caterpillars just mentioned, or the offspring from different individual families may join, forming large groups of mixed parentage. This happens at times with young spiders and is more common among juvenile fishes.

It is much more usual for a mother to remain alone with her offspring than for the father to do so. Newly hatched leeches, tiny crayfishes, or minute spiders, clinging to their respective mothers, help show how widely distributed this form of association is in nature. The aphid stem-mother and her brood, mole crickets (*Gryllotalpa*), earwigs (*Forficula*), colonies of ants or bees, red deer, and many other mammals illustrate mother-offspring groupings. Each female may consort only with her own young, or two or more family groups may join as do some ants, seals or wild hogs.

In another smaller series of animals, well illustrated among certain fishes, the male guards the eggs after they are laid by itinerant females in the territory that he defends. Often he aerates them by fanning gently with his fins meantime mounting guard over the developing eggs and newly hatched young. Males of the stickleback and of large- and small-mouthed black bass, among others, have this general habit. Males may establish still more intimate relations with eggs. The midwife toad (*Alytes*) carries strings of eggs twisted about his legs, and a frog of Chilean forests (*Rhinoderma darwini*) crams the fertilized eggs into his singing pouch, which becomes greatly enlarged during the breeding season. The eggs develop and transform in the paternal cavity and the young animals hop forth from their father's mouth as fully developed tiny frogs.

The variations from normal family patterns are numerous and

sometimes important. Thus unmated wolves may be associated with a mated pair—the whole pack then hunts as a unit—and unmated bob-white quail of either sex adopt orphaned young. Such variations as these have great survival value.

The association of both parents with their offspring is by no means uncommon among insects and is the regular habit with many birds and mammals. Passalid beetles live with their young in the tunnels they make in rotting logs. *Necrophorus* beetles live similarly in decaying animal bodies. Both sexes of social wood roaches, the forerunners of termites, like termites themselves, live surrounded by their offspring. Song sparrows, robins, bluebirds and many others of our commonest birds have this habit. Foxes, wolves, roe deer and gibbons are among the mammals that react so.

No attempt has yet been made to estimate what percentage of all the vast variety of known animal aggregations grow immediately from the family or from recognizable variations of family life. Many of them do. The higher forms of social development among insects arise from the association of parents with their offspring as in termites, or from one or more females and their young as in wasps, bees and ants. The family has also been very important in the development of social life of various vertebrates including man. Important as sex and the family are as integrating social factors, they do not form the sole outlet for the expression of the fundamental social appetites nor are they the only foundation on which social structures have arisen. Even so, the most permanent societies appear to have developed when sexual and parental integrations have operated in addition to the more elemental aggregating tendencies.

Whatever the pathway taken, the social life of all animals, man included, rests in final analysis on the basic non-conscious drive toward natural co-operation, that is co-incidental with all life, and is especially developed among animals.

EXTENSIONS AND ANALOGIES

Great care must be exercised in forming judgments about the probable social behaviour in untested situations and especially about the inner social feelings of animals under any conditions. It is unsafe to assume, without direct information, that one order of birds will show social patterns closely resembling those of some species belonging to a different order. It is still more hazardous to try to estimate the degree and kind of sociality across wider taxonomic gaps. For example, pending direct inquiry, it is unsafe to predict that individual-to-individual social hierarchies exist among sharks (subclass Elasmobranchii) from the fact that such social rank-orders exist among many species of bony fishes (subclass Teleostomi).

Still greater caution must be exercised, again pending direct information on the precise point at issue, before making extrapolations between human sociality and the social life of other species. Men may and do disregard or compensate for inconveniences based on position in the social "peck-order," but we cannot judge therefrom that other animals do likewise. Despite the need for great restraint in such matters, there are stimulating cross comparisons that need to be made which help to integrate animal sociology into a unified whole despite the marked differences between the social relations of man and those of other animals.

The Organism and the Supra-organism.—The analogy between the biological processes within the organism and the sociological processes within society long ago attracted attention. Today the *Leviathan* of Thomas Hobbes, and the less cumbersome comparisons of Herbert Spencer, in his discussion of the analogies between the organism and society, are matters of historic interest only. They did more or less vaguely foreshadow the modern realization, particularly by biologists, that similarities exist between individual organisms and organized social groups. Since even ecological communities, as well as more closely knit societies, behave as more or less integrated entities, they are often regarded by biologists as representing a set of emergent levels concisely designated as supra-organisms.

Even biologists do not stress the resemblances between societies

and a closely co-ordinated organism like an insect or a man. They do see pertinent resemblances between the social supra-organism and simpler invertebrates. Sponges, for example, often have one part of the individual colony working in direct opposition to another when the co-operation of both is needed for efficient operation of the whole. Starfishes, in righting themselves, and even in walking across a smooth surface, often tear off some of their tube feet that were working in opposition to the movement of the whole. Society, human society as well as those based primarily on inherited behaviour patterns as are those of insects, shows many pertinent comparisons with these more poorly integrated organisms, and yet primitive organisms and primitive or advanced societies are somewhat integrated wholes.

Numerous social convergences exist between human and insect societies including the following:

Division of labour; social integration through signals, chemical agents, and activity gradients; social dominance; replication and duplication of patterns; specialization of population units through classes or castes; ontogeny of social organization; phylogeny of social systems; divergence; convergence, recapitulation during ontogeny; degenerative evolution and vestigial characters; social variation and selection of social and familial units; and the dynamic maintenance of population equilibrium. (From Emerson's "Levels of Integration in Biological and Social Systems," *Biological Symposia*, vol. VIII, The Jaques Cattell press.)

Insects and mammals stand near the apex of their respective evolutionary branches of the animal kingdom. The similarities between the social life developed in each class are mainly matters of convergence and analogy. To the extent that the sociality of each develops from the co-operative tendencies of their common ancestors, their sociality is vaguely homologous. In many ways this is not a minor point since it is important to note that even the sociality of man developed not alone from a distinctly human drive toward group co-operation but also grows out of the basic drives toward natural altruism that pervades all animal life.

Sub-social and Social.—For general and comparative sociology, the chief interest is not between extrapolations from the organismic to the supra-organismic level in organization—from the biological to the social, so to speak—but rather in the permissible extrapolations from the sub-social to the truly social levels and in the opposite direction too. Here again, we are confronted by the problem as to where truly social life begins.

A part of the difficulty involved in answering this question may be avoided if it is recalled that many different levels of social organization exist and that these usually overlap. Among the groups that the biologist regards as somewhat more social than is implied by more vague ecological relationships we can readily recognize the following: (1) Those that show their social habit merely through the toleration of the close proximity of other similar animals in the same restricted space—these may exist without any positive mutual attraction and represent the toleration level of sociality; (2) those groups that react more or less definitely as units—the group-integration level; (3) those that show physiological division of labour; (4) those that show morphologically distinct castes, each associated with some phase of the division of labour—the highest insect level—and (5) those that are organized to a large part by tradition and by symbolic communication and that frequently react to abstractions—the human level.

In presenting this abbreviated list of recognized social levels among animals, there is no intention of assuming that the more complex types of social life evolved through the less complex ones. Such may, or may not, have been the course of social evolution. The insects do not stand in the direct line of man's ancestry. Their state of social development represents an insect evolution of sociality, not a stage toward that found in man.

Animals on the higher planes of sociality continue to show certain of the group attributes characteristic of the lower levels. Group survival values have been demonstrated throughout the whole series and apparently extend to the threshold of primitive life. Extrapolations forward from the lower to higher social levels can be made with more confidence than those in the opposite direction. We can predict, from studying the social survival values of primitive organisms, that, other conditions being equal, groups

of more complex animals will have certain survival values as groups. It is much more hazardous to try to project highly developed human social traits, like social consciousness, back into the less complex social levels reached by other animals.

For a final summarizing statement, we need to turn back to evaluate two contrasting social forces discussed earlier in this article. The conclusion that emerges from cumulative studies on social biology is that co-operation and its opposite dis-operation both exist. There are egoistic and altruistic tendencies in nature, and both are important. The question arises insistently in general sociology as to which of these is the more fundamental and significant. Any such evaluation should be based on short-run and on long-run effects. Considering all the evidence available in 1946, contrary to Herbert Spencer and the conclusions of social Darwinism, the co-operative forces are biologically and sociologically the more important and vital. The balance between the co-operative, group-centred tendencies and those that are dis-operative and egoistic is relatively close. Under many conditions, the co-operative forces lose. In the long run, however, the group-centred, more altruistic drives are the stronger.

If co-operation had not been the stronger force, the more complicated animals, whether arthropods or vertebrates, could not have evolved from simpler forms and the more complex social levels could not have arisen and persisted. Finally, so far as man is concerned, the weight of the evidence from the sociology of other animals strongly indicates that, despite many appearances to the contrary, human altruistic drives are as firmly based on an animal ancestry as is man himself. As Espinas concluded years ago, social life is not an accident appearing sporadically among a few highly evolved animals. It is a rather a normal and basically a widespread phenomenon. Despite many well known appearances to the contrary, human tendencies toward goodness on the personal, community, national and international levels are as natural as is man's trend toward being intelligent.

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ANIMAL WORSHIP, an ill-defined term, covering facts ranging from the worship of the real divine animal, commonly conceived as a "god-body," at one end of the scale, to respect for the bones of a slain animal or even the use of a respectful name for the living animal at the other end.

Classification.—Animal cults may be classified in two ways: (A) according to their outward form; (B) according to their inward meaning, which may of course undergo transformations.

(A) There are two broad divisions: (1) all animals of a given species are sacred; (2) one or a fixed number of a species are sacred. It is probable that the first of these forms is the primary one and the second in most cases a development from it due to (i) the influence of other individual cults; (ii) anthropomorphic



THE LION GODDESS SEKHMET, AFTER A STATUE FOUND IN RUINS OF THE EGYPTIAN TEMPLES AT KARNAK

tendencies; (iii) the influence of chieftainship, hereditary, and otherwise; (iv) annual sacrifice of the sacred animal and mystical ideas connected therewith; (v) syncretism, due either to unity of function or to a philosophic unification; (vi) the desire to do honour to the species in the person of one of its members, and possibly other causes.

(B) Cults may be classified according to their meaning under ten specific heads: (i) pastoral cults; (ii) hunting cults; (iii) cults of dangerous or noxious animals; (iv) cults of animals regarded as human souls or their embodiment; (v) totemistic cults; (vi) cults of secret societies, and individual cults of tutelary animals; (vii) cults of tree and vegetation spirits; (viii) cults of ominous animals; (ix) cults, probably derivative, of animals associated with certain deities; (x) cults of animals used in magic.

(i) The pastoral type falls into two subtypes, in which the species (a) is spared and (b) sometimes receives special honour at intervals in the person of an individual.

(ii) In hunting cults the species is habitually killed, but (a) occasionally honoured in the person of a single individual, or (b) each slaughtered animal receives divine honours.

(iii) The cult of dangerous animals is due (a) to the fear that the soul of the slain beast may take vengeance on the hunter, (b) to a desire to placate the rest of the species.

(iv) Animals are frequently regarded as the abode, temporary or permanent, of the souls of the dead, sometimes as the actual souls of the dead. Respect for them is due to two main reasons: (a) the kinsmen of the dead desire to preserve the good will of their dead relatives; (b) they wish at the same time to secure that their kinsmen are not molested and caused to undergo unnecessary suffering.

(v) One of the most widely found modes of showing respect to animals is known as totemism (*see* TOTEMISM), but except in decadent forms there is but little positive worship.

(vi) In secret societies we find bodies of men grouped together with a single tutelary animal; the individual, in the same way, acquires the nagual or individual totem, sometimes by ceremonies of the nature of the bloodbond.

(vii) Spirits of vegetation in ancient and modern Europe and in China are conceived in animal form.

(viii) The ominous animal or bird may develop into a deity.

(ix) In certain instances the animals associated with certain deities are sacred because the god was originally conceived in the shape of an animal; but the god may have been appealed to for help and thus become associated with the animals from which he protected the crops, etc.

(x) The use of animals in magic may sometimes give rise to a kind of respect for them, but this is of a negative nature.

Bear.—The bear is respected by all savage races that come in contact with it, shown by the apologies and festivals in its honour. The most important developments of the cult are in east Asia among the Siberian tribes. There is a good deal of evidence to connect the Greek goddess Artemis with a cult of the bear; girls danced as "bears" in her honour, and could not marry before undergoing this ceremony.

Buffalo.—The Todas of southern India abstain from the flesh of their domestic animal, the buffalo; but once a year they sacrifice a bull calf, which is eaten in the forest by the adult males.

Cattle.—Cattle are respected by many pastoral peoples. Conspicuous among the Egyptian animal cults was that of the bull, Apis. Its birthday was celebrated, oracles were obtained from it and after death it was mummified and buried in a rock-tomb. In India respect for the cow is widespread and the products of the cow are important in magic.

Crow.—The crow is the chief deity of the Thlinkit Indians of

northwest America, and together with the eagle hawk, plays an important part in the mythology of southeast Australia.

Dog.—Actual dog-worship is uncommon; the Nosarii of western Asia are said to worship a dog, the Kalangs of Java had a cult of the red dog and dogs are reportedly worshipped at a festival in Nepal.

Elephant.—In Siam the white elephant is believed to contain the soul of a dead person, perhaps a Buddha, and it is baptized and feted and mourned for like a human being at its death. In some parts of Indo-China it is believed that the soul of the elephant may injure people after death; in Cambodia it is held to bring luck to the kingdom and in Sumatra it is regarded as a tutelary spirit.

Fish.—Dagon seems to have been a fish-god, and his worshippers were fish skins. From Xenophon we learn that the fish of the Chalus were regarded as gods.

Goat.—Dionysus was believed to take the form of a goat; Pan, Silenus, the Satyrs and the Fauns were either capriform or had some part of their bodies shaped like that of a goat.

Hare.—In North America the Algonquin tribes had as their chief deity a "mighty great hare" to whom they went after death.

Hawk.—In north Borneo there is what appears to be the evolution of a god in the three stages of the cult of the hawk among the Kenyahs, the Kayans and the sea Dyaks.

Horse.—There is some reason to believe that Poseidon, like other water gods, was originally conceived under the form of a horse. In Gaul we find a horse-goddess, Epona, and the Gonds of India worship a horse-god, Koda Pen.

Leopard.—The cult of the leopard is widespread in West Africa. Among the Ewe a man who kills one is liable to be put to death and in Loango a prince's cap is put upon the head of a dead leopard and dances are held in its honour.

Lion.—The lion is associated with the Egyptian gods Rē and Horus. The Arabs had a lion-god, Yaghuth and in modern Africa we find a lion-idol among the Balonda.

Lizard.—The cult of the lizard is most prominent in the Pacific, where it appears as an incarnation of Tangaloa. It is also a tutelary deity in Madagascar.

Mantis.—Cagn is a prominent figure in Bushman mythology; the mantis and the caterpillar, Ngo, are his incarnations.

Monkey.—In India the monkey-god, Hanuman, is a prominent figure, and at Porto Novo, in French West Africa, twins have tutelary spirits in the shape of small monkeys.

Serpents.—The cult of the serpent is found in many parts of the old world and it is not unknown in America. In Africa the chief centre of serpent worship was Dahomey. The serpent is regarded as the incarnation of deceased relatives in many parts of Africa. The rattlesnake was worshipped in the Natchez temple of the sun and the Aztec deity Quetzalcoatl was a serpent-god. The tribes of Peru are said to have adored snakes in the pre-Inca days and in Chile the Araucanians made a serpent figure in their deluge myth. Over a large part of India there are carved representations of cobras to which food and flowers are offered.

Sheep.—Only in Africa do we find a sheep-god proper; Ammon was the god of Thebes; he was represented as ram-headed and his worshippers held the ram to be sacred.

Tiger.—The tiger is associated with Siva and Durga, but its cult is confined to the wilder tribes; in Nepal the tiger festival is known as Bagh Jatra, and the worshippers dance disguised as tigers.

Wolf.—Both Zeus and Apollo were associated with the wolf by the Greeks and the Thlinkits had a god, Khanukh, whose name means "wolf," and worshipped a wolf-headed image. The wolf is found among the tutelary deities of North American dancing or secret societies.

BIBLIOGRAPHY.—See articles in *E.R.E.* and authorities quoted in Sir James Frazer, *Golden Bough* (3rd ed., 1909-12), and the full bibliography given in vol. xii.

ANIMATISM is the tendency of the primitive mind to regard and treat the inanimate, in so far as it is held to be sacred, as if it were animated—that is, alive and endowed with feelings and a will of its own. In imputing animatism to the savage, due

allowance must be made for the fact that he is largely unconscious of the theory underlying his practice. Thus when a Toda of the Nilgiri hills in India feeds his sacred cattle-bell with milk, the civilized observer might justly draw the inference that the bell was supposed somehow to enjoy the milk; and yet it would probably be the fact that a given Toda who carries out this act of respect is blindly following religious custom, and has never troubled his head to think whether the bell, which obviously cannot drink in the ordinary manner, can nevertheless in some miraculous way get much the same satisfaction out of the milk as could a man or a cat. The word animatism was coined by Marett in 1899 to mark off a distinguishable phase of belief concerning whatever is deemed sacred and as such becomes the object of religious or quasi-religious attention and behaviour. Marett pointed out that Sir E. B. Tylor, when in *Primitive Culture* (1871), chap. xi., he suggested the term animism (*q.v.*), in the sense of "the belief in spiritual beings," as a "minimum definition of religion," had already in a previous chapter on mythology (chap. viii.) used the word animism in a different sense, namely, as the "theory of the universal animation of nature." The latter meaning is thus different and ought to be kept clear of the former. Marett therefore proposes that a separate word "animatism" should be used to express it. He argues that the notion of being alive is logically distinct from and historically and psychologically more rudimentary than the notion of being associated with a spiritual or soul-like being. He is, however, for limiting the application of the notion in question more narrowly than Tylor, who imputes to the savage a tendency to imagine nature as universally animated or alive. For can there ever have existed a savage who was mentally incapable of regarding anything whatever, an ordinary stone for instance, as unalive? Does not even the baby soon learn to distinguish its nurse by her relatively arbitrary proceedings from the chair with its thoroughly wooden way of reacting to the baby's way of thumping it? On the other hand, if the chair creaked in a peculiar manner it might frighten the baby, and might thereupon pass over into the class of objects that act arbitrarily, such as nurse with her uneven temper, or pussy that sometimes purrs and sometimes scratches. So too, then, the savage tends to put the stone into another category if it behaves queerly—if it refuses to be chipped into shape and cuts his finger, or emerges in the midst of the rapids and upsets his canoe. Nay, it need not act queerly; it is enough if it seems about to do so by looking queer. Just so the hunted animal perceives danger lurking in every unusual sight, or sound, or smell. The savage, however, being mentally a long way in advance of the animal, has generalized the unusual in a dim fashion, and has words of the type of *mana* (*q.v.*) to connote in the unfamiliar object a power of affecting man for better or worse—mostly, perhaps, for worse—in ways that defeat reasonable expectation. Animatism is therefore limited to the attribution of life to the unfamiliar, since it is an exaggeration to say that there is no room within the savage mind for any apprehension of the unalive. Further, for the purposes of the comparative study of religion in all its phases, including the most rudimentary, the unfamiliar may be identified with the sacred—that which is positively *mana*, or instinct with power to help or hurt in an unusual degree, and negatively *tabu* (*q.v.*), that is, not lightly to be approached. Correspondingly, a "pre-animistic" type of religious belief and observance is distinguished in which no animism is involved in Tylor's second sense of the recognition of soul or spirit with a being of its own, distinct from bodily substance. In this pre-animistic theory a question of minor importance is whether *mana* and *animatism* go strictly together—that is to say, whether whatever has wonder-working power must necessarily seem likewise alive. It is rather a doubtful point, seeing that *mana* is often treated as if it were transmissible or contagious, like electricity or the influenza; whereas to think of a man's life as extending to his belongings is perhaps not so natural or easy. As a matter of fact, however, magic is practised on a man's clothes or on the clippings of his hair or nails, or on his personal name, or in fact on anything that can be identified with the man so far as to call him up to mind and conjure up a sense of his real

presence, in the belief that thereby the man will be deprived of his very life. Thus life would seem on this vague view of it to be no less contagious than *mana*, one or the other being alike a sort of communicable energy. Now, because such energy is communicable, it does not follow that there are not appropriate centres at which it originates; just as a push started by one man in a row may make itself felt right down the line. Some objects, for instance, would appear to be intrinsically sacred in the eyes of the savage, while in the case of anything else the sacredness is but acquired by association with such things as are sacred in themselves. In particular, certain types of persons, medicine-men, kings, women, strangers and so on, are considered sacred in their own right; and in such cases their *mana* may very naturally be treated as much the same as their will-power—an energy that is bound up with such personal initiative as they display. Indeed, in any case the unfamiliar is bound to strike the mind that is in awe of it as more or less self-active, since it does the threatening and he knocks under to it. In all magical conflict the result depends on which of the two has the initiative; for if I see the wolf before he sees me he cannot cast his spell over me but slinks off powerless. Thus *mana* implies life as manifested in initiative; so that John Murphy in *Primitive Man: his Essential Quest* (1927) is fully justified in representing the content of the confused notion at the back of animatism by the triad, "power-life-will." Further, the body or external appearance in and through which such power-life-will is exerted forms part of the same complex; the driving force and its vehicle, the god and the god's car, not being yet held apart in thought. At the pre-animistic stage the mind takes in the live wire, but has not yet taken in that electricity is the live thing in the wire and the rest but consentient matter. Of course these distinctions are made by the civilized man for his own classificatory purposes. The savage is unaware of stages in his thought, nay, mostly of the very fact that he thinks at all; and he does not change gear with any noticeable jerk when he shifts by slow degrees to a higher plane of analytic consciousness. If, however, the student of comparative religion hopes to make anything of what William James has called the "big buzzing booming confusion" of dawning reflection about the sacred and divine, he must boldly differentiate certain leading types, and may well find "animatism" to be a convenient way of representing the most rudimentary type of all.

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ANIMATO (Ital.), a musical term signifying that the piece or passage so marked is to be played with animation and spirit. "Con anima" and "con spirito" have the same meaning.

ANIMÉ, an oleo-resin (said to be so called because in its natural state it is infested with insects) which is exuded from the locust tree, *Hymenaea courbaril* (family Leguminosae), and other species of *Hymenaea* growing in tropical South America. It is of a pale brown colour, transparent, brittle, and in consequence of its agreeable odour is used for fumigation and in perfumery. It is allied to copal in its nature and appearance, and is much used by varnish-makers. The name animé is also given to Zanzibar copal (*q.v.*).

ANIMISM is derived from *anima*, "breath," which in Latin came to have the secondary sense of "soul," very much as did the equivalent word *spiritus*, whence our "spirit." Hence animism might stand for any doctrine having to do with soul or spirit and, later, with souls or spirits. The word was coined early in the 18th century by Georg Ernst Stahl to describe his philosophy of a world-soul. More recently, William McDougall in *Body and Mind: a history and a defence of Animism* (1911) has used it to designate the "interaction-theory" of mind as an independent factor co-operating with the brain, as opposed to the various versions of what has been nicknamed "a psychology without a soul." Animism, however, will always be chiefly known as the term in which Sir Edward Burnett Tylor in *Primitive Culture* (1st ed. 1871) summed up his account of the origin of religion. Among anthropologists Tylor's animistic theory of religion stood unchallenged for nearly 30 years.

Although to-day the Tylorian explanation of religious origins has to be taken as subject to various important qualifications, it remains of great value; while the help it afforded at the time of its first appearance to anthropological research alike in the study and in the field can hardly be exaggerated. A whole generation of students of primitive culture sat at Tylor's feet, and more especially those whose interest lay chiefly in the history of religion.

The Minimum Definition of Religion.—In what follows, then, Tylor's animistic hypothesis need be considered solely in so far as it claims to supply "a minimum definition of religion." On this view, religion begins with a soul or spirit and ends with a god; a god being historically an evolved spirit, or conversely, a spirit being a god in the making. For the "belief in spiritual beings" comprises, firstly, "souls of individual creatures, capable of continued existence after the death or destruction of the body"; and, secondly, "other spirits, upward to the rank of powerful deities."

Given the idea of soul, the rest follows by a sort of logical extension; seeing that "the ideas of souls, demons, deities and any other classes of spiritual beings, are conceptions of similar nature throughout, the conceptions of souls being the original ones in the series." Thus, in order to make clear the origin and whole subsequent development, all that is still required is to explain the origin of the belief in a soul. Tylor proceeds to do it thus: "It seems as though thinking men, as yet at a low level of culture, were deeply impressed by two groups of biological problems. In the first place, what is it that makes the difference between a living body and a dead one; what causes waking, sleep, trance, disease, death? In the second place, what are those human shapes which appear in dreams and visions?" He goes on to suggest that the answer to the first riddle seemed to these primitive thinkers to be that every one has a life-principle that causes his body to feel, think and act but is capable of leaving it; and the answer to the second riddle that every one has a phantom, which can also leave the body since it appears to others at a distance. Putting the two notions together, the life-principle and the phantom, they created the idea of the *anima* or "ghost-soul"—a separable life-principle with an unsubstantial, wraith-like form of its own. Now this is much more than a crude statement to the effect that the origin of religion is a belief in ghosts.

Herbert Spencer had not much reason on his side when he asserted that he had long before anticipated the Tylorian theory when he put forward the view that "the aboriginal god is the dead chief" (*Mind*, ii. 1877, 415 et seq. citing *Westminster Review*, 1854, 360 et seq.). For Tylor's point is not merely that visionary shapes are seen but likewise that the consciousness of being alive, of moving the body, of leaving it temporarily and so on, is associated with these shapes.

If we describe the Tylorian explanation as "the dream-theory of religion," as is sometimes done, though very inadequately, we must not, at any rate, forget that the argument embraces both these aspects of dream; and that the aspect in which a man is aware of himself as going away to a distance during sleep should at least be as strongly emphasized as the other one in which he seems to be visited by others from a distance. Moreover, Tylor would be the first to allow that in advanced religion when God is said to be a spirit the personality alone is insisted on; whereas the outward appearance, whether man-like, wraith-like or what not, is treated as little more than a matter of symbolic imagery.

So, too, philosophers, from Plato in the *Phaedo* onwards, have deduced the soul's self-existence and immortality from certain data of consciousness, the faculty of reason, the feeling of self-activity, the moral sense and so on; whereas they have ever tended to regard the appeal to so-called objective manifestations of the spiritualistic order as smacking of superstition. To return to the savage, the objection to Tylor's theory is not that it is defective as a piece of reasoning but that, on the contrary, it is much too rational a view for the human mind to have adopted at the very outset of its experience of religion. The modern psychologist utterly disbelieves in Tylor's "thinking men," who begin by conceiving an idea and thereupon proceed to mould their practice in accordance with it, and terms this the fallacy of intel-

lectualism—the error of subordinating action to thought instead of thought to action. Man always thinks while acting, and in some sense after acting, since the function of thought is to be rudder, not propeller—to direct, while impulse drives.

Modern Attitude.—The modern method, therefore, of conceiving the development of man's religious activity would be to presuppose that he was well on his way towards religion before he thought about it at all. Thus, supposing Tylor to be right in taking the ghost-soul to be the earliest notion in the animistic series, the modern way would be to try to find some already current activity—say, funeral custom—in connection with which the idea in question might have grown up, as being in the first instance effect rather than cause. If, for instance, the custom was, as the Australian natives sometimes did, to abandon for the time being their cave-shelter, leaving the corpse there, or possibly the sick or aged man about to die, it might well happen that food and weapons would be left at the side of the body. Whereupon, by a sort of justification after the event the definite idea might grow up of a life after death in which food and weapons were needed; though at first the impulse to leave such things with the body might be almost unreasoning, amounting perhaps to no more than a dread of going near it or removing anything in contact with it. Whatever be the value of such an illustration, there can be little doubt in regard to psychological method that the Tylorian theory of the origin of religion in the idea of soul tends to put the cart before the horse. When, in 1899, the pre-animistic theory was put forward in opposition to Tylor's account of the earliest type of religion (see ANIMATISM and MANA), this was chiefly the point at issue; while it was at the same time suggested that the notion first generated by reaction to the object of religious awe was something much vaguer than that of soul as distinct from body, namely, that of *mana*, or, so to speak, the bare notion of awfulness in action. On the other hand, in the previous year Andrew Lang in *The Making of Religion* (1st ed. 1898) had attacked Tylor's animistic theory of the origin of religion from another side. He brought forward numerous examples of what he called "high gods of low races" who seemed to have nothing of the *anima* about them, but to be more like "magnified non-natural men." There is certainly nothing wraith-like about such beings, who rather resemble glorified human beings such as were the Greek gods. Lang's suggestion as to the origin of such anthropomorphic theism, as it might be termed, was that the notion of a maker or creator of the world might be chiefly responsible for it. This explanation, however, which he put forward quite tentatively in the introduction to the second edition, is also somewhat open to the charge of intellectualism; and it is surely more probable that the respect felt for the great chief or medicine-man—the man with *mana*—might continue to attach to his memory and so generate gods of the anthropomorphic or "man-like" pattern.

Conclusion.—Primitive religion, on fuller investigation than was possible in Tylor's time, turns out to comprise many types of divine being that the savage does not bring under one idea at all unless it is simply that of being divine, that is to say, worshipful; his consciousness of their being worshipful growing out of the very fact that he worships them by impulse precipitated in custom. Thus the Tylorian animism hardly provides a basis for primitive religion, but at most will serve as a key to primitive theology. Undoubtedly, when religion has reached the stage of trying to put its ideas into order, a certain uniformity of doctrine is obtained by assuming a hierarchy of spiritual beings, gods and godlings, demons and fairies, goblins and ghosts, all of which are supposed to have enough in common in respect to their nature to be dealt with by man by methods no less fundamentally alike. Like the soul or mind of which a man is aware in himself, they belong to the unseen; whereas the seen, like a man's body, is but the outward manifestation of a purpose that is essentially spiritual; that is, comes forth from the unseen. Such a theory paves the way for the moralization of religion, because by interpreting that which excites awe and reverence as, whatever the physical manifestation may be, an expression of will at bottom, it makes it easier to reach the position of advanced religion which tends to sum up all the good will in the universe with which man can

commune and co-operate in the notion of a single and personal God.

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Animism is especially prominent in the religions of certain regions, such as Indonesia and South America. For Indonesia see G. A. Wilken, *Het Animisme bij de Völker van der Indischen Archipel*; A. C. Kruyt, *Het Animisme in der Indischen Archipel*; "L'Animisme chez les Peuples de l'Archipel Indien," in *Melusine* (1886). For South America see E. im Thurn, *Among the Indians of Guiana*; R. Karsten, *The Civilization of the South American Indians* (1926). (R. R. M.)

ANIMUCCIA, GIOVANNI, Italian musical composer, was born at Florence in the last years of the 15th century. At the request of St. Filippo Neri he composed a number of *Laudi*, or hymns of praise, to be sung after sermon time, which have given him an accidental prominence in musical history, since their performance in St. Filippo's Oratory eventually gave rise (on the disruption of 16th century schools of composition) to some of the earlier forms of "oratorio." In 1555 Animuccia was appointed *maestro di capella* at St. Peter's, an office which he held until his death in 1571. He was succeeded by Palestrina, who had been his friend and probably his pupil. The manuscript of many of Animuccia's compositions is still preserved in the Vatican Library.

BIBLIOGRAPHY.—His chief published works were *Madrigali e Motetti a quattro e cinque voci* (Venice, 1548) and *Il primo Libro di Messe* (Rome, 1567). From the latter Padre Martini has taken two specimens for his *Saggio di Contrapunto*. A mass from the *Primo Libro di Messe* on the *canto fermo* of the hymn *Conditor alme siderum* is published in modern notation in the *Anthologie des maîtres religieux primitifs* of the *Chanteurs de Saint Gervais*.

ANIO, a river of Italy about 75 miles long; the principal tributary of the Tiber in its lower course. It rises in the limestone mountains east of Subiaco, and thence to Tivoli the road follows its narrow valley. The water of the river supplied Rome in ancient times (see AQUEDUCTS), while the pure and copious springs which served for the ancient Aqua Marcia and Aqua Claudia, and still form the city's main supply, are in its valley. But the *praeceps* (hurrying) Anio of Horace has been transformed by hydro-electric power-plants for the supply of Rome, and the famous waterfalls at Tivoli (*q.v.*) will be largely curtailed.

From Tivoli to its junction with the Tiber it pursues a winding course through the low ground, and formed an effective protection to Latium from the north.

See Colasanti, *L'Aniene* (well illustrated, Bergamo, 1906).

ANION, a negatively charged particle or ion which moves toward the positive electrode or anode during an electrolysis or an electrical discharge. The anion is usually nonmetallic in character and consists of one or more atoms (*q.v.*) carrying a definite number of negative electric charges (see ELECTRON, THE). The chloride ion (Cl^-) and the nitrate ion (NO_3^-) are both univalent anions, while the sulphate ion (SO_4^{2-}) is a bivalent anion. (See also CATION.) (J. B. Ps.)

ANISE (*Pimpinella Anisum*), an umbelliferous plant found in Egypt and the Levant, and cultivated on the continent of Europe for medicinal purposes. The official part of the plant is the fruit, which consists of two united carpels (mericarps).

It is known by the name of aniseed, and has a strong aromatic taste and a powerful odour. By distillation the fruit yields the volatile oil of anise.

Most of the oil of commerce, however, of which anethol is also the chief constituent, comes from *Illicium verum* (family Magnoliaceae) indigenous in northeast China, the star-anise of liqueur makers; also called badian.

It receives its name from its fruit spreading out like a star. The anise of the Bible (Matt. xxiii. 23) is *Anethum graveolens*; i.e., dill (*q.v.*).

ANJAR, a fortified town of India and the capital of a district of the same name in the native state of Cutch in the Western India States agency. The country is arid and is supplied with water by well irrigation. The town is nearly 10 mi. from the Gulf of Cutch. Pop. (1941) 15,468. The town and district

of Anjar were ceded to the British in 1816, but in 1822 were transferred to the Cutch Government in consideration of an annual money payment which was subsequently remitted.

ANJOU, the old name of a French territory representing the ancient Gallic State of the *Andes*, re-organized as the Roman *civitas* of the *Andecavi*, and preserved as an administrative district under the Franks with the name first of *Pagus*, then of *comitatus*, or countship of Anjou. This countship, nearly identical with the ecclesiastical diocese of Angers, occupied the greater part of what is now the department of Maine-et-Loire. It was bounded on the north by the countship of Maine, on the east by that of Touraine, on the south by that of Poitiers and by the *Mauges* and on the west by the countship of Nantes.

From the outset of the reign of Charles the Bald, the integrity of Anjou was seriously menaced by a two-fold danger: from Brittany and from Normandy. Lambert, a former count of Nantes, after devastating Anjou in concert with Nominé, duke of Brittany, had by the end of the year 851 succeeded in occupying all the western part as far as the Mayenne. This principality was occupied, on his death, by Erispoé, duke of Brittany; by him it was handed down to his successors, in whose hands it remained till the beginning of the 10th century. Meanwhile the Normans were ravaging the country, and towards 861, Charles the Bald entrusted it to Robert the Strong (*q.v.*), but he unfortunately met with his death in 866 in a battle against the Normans at Brissarthe. Hugh the Abbot succeeded him in the countship of Anjou as in most of his other duties, and on his death (886) it passed to Odo (*q.v.*), the eldest son of Robert the Strong, who, on his accession to the throne of France (888), probably handed it over to his brother Robert. In any case, during the last years of the 9th century, in Anjou as elsewhere the power was delegated to a viscount, Fulk the Red (mentioned under this title after 898), son of a certain Ingelgerius.

In the second quarter of the 10th century Fulk the Red had already usurped the title of count, which his descendants kept for three centuries. He was succeeded first by his son Fulk II. the Good (941 or 942-c. 960), and then by Fulk's son, Geoffrey I. *Grisegonelle* (c. 960-987), who inaugurated a policy of expansion, aiming at the extension of the boundaries of the ancient countship and the reconquest of those parts of it which had been annexed by the neighbouring states; for, though western Anjou had been recovered from the dukes of Brittany since the beginning of the 10th century, in the east all the district of Saumur had fallen into the hands of the counts of Blois and Tours. Geoffrey succeeded in making the count of Nantes his vassal, and in obtaining from the duke of Aquitaine a grant of the district of Loudun. His son Fulk III. Nerra (*q.v.*) (987-1040) was confronted on his accession by a coalition of Odo I., count of Blois, and Conan I., count of Rennes. The latter having seized upon Nantes, of which the counts of Anjou held themselves to be suzerains, Fulk Nerra came and laid siege to it, routing Conan's army at Conquereuil (June 27, 992) and re-establishing Nantes under his own suzerainty. Then turning against the count of Blois, he established a fortress at Langeais, a few miles from Tours, from which, thanks to the intervention of the king, Hugh Capet, Odo failed to oust him. On the death of Odo I., Fulk seized Tours (996); but King Robert the Pious turned against him and took the town again (997). In 1016 Odo II. of Blois was utterly defeated at Pontevoy, and a few years later, while Odo was besieging Montbouvau, Fulk surprised and took Saumur (1026). Finally, the victory gained by Geoffrey Martel (*q.v.*) (1040-60), the son and successor of Fulk, over Theobald III., count of Blois, at Nouy (Aug. 21, 1044), assured to the Angevins the possession of the countship of Touraine. At the same time, continuing in this quarter the work of his father, Geoffrey succeeded in reducing the countship of Maine to complete dependence on himself. During his father's life-time he had been beaten by Gervais, bishop of Le Mans (1038), but now (1047 or 1048) succeeded in taking the latter prisoner, and in spite of the concerted attacks of William, duke of Normandy, and Henry I., king of France, he was able in 1051 to force Maine to recognize his authority.

On his death (Nov. 14, 1060) there was a dispute as to the

succession. Having no children he had bequeathed the countship to his eldest nephew, Geoffrey III. the Bearded, son of Geoffrey, count of Gâtinais, and of Ermengarde, daughter of Fulk Nerra. But Fulk le Réchin, brother of Geoffrey the Bearded, who had at first been contented with an appanage consisting of Saintonge and the *châtellenie* of Vihiers, having allowed Saintonge to be taken in 1062 by the duke of Aquitaine, took advantage of the general discontent aroused in the countship by the unskilful policy of Geoffrey to make himself master of Saumur (Feb. 25, 1067) and



BY COURTESY OF THE FRENCH BUREAU OF TRAVEL

THE FORTRESS AT CHINON, AN IMPORTANT STRONGHOLD FOR THE MEDIEVAL RULERS OF ANJOU, OVERLOOKING THE MODERN TOWN THAT LIES ON THE BANKS OF THE VIENNE

Angers (April 4) and cast Geoffrey into prison at Sablé. Compelled by the papal authority to release and restore him, he soon renewed the struggle, beat Geoffrey near Brissac and shut him up in the castle of Chinon (1068). In order, however, to obtain his recognition as count, Fulk IV. Réchin (1068-1109) had to carry on a long struggle with his barons, to cede Gâtinais to King Philip I., and to do homage to the count of Blois for Touraine. On the other hand, he was successful on the whole in pursuing the policy of Geoffrey Martel in Maine: after destroying La Flèche, by the Peace of Blanchelande (1081), he received the homage of Robert, son of William the Conqueror, for Maine. Later, he upheld Elias, lord of La Flèche, against William Rufus, king of England, and on the recognition of Elias as count of Maine in 1100, obtained for Fulk the Young, his son by Bertrade de Montfort, the hand of Eremburge, Elias's daughter and sole heiress.

Fulk V. the Young (1109-29) succeeded to the countship of Maine on the death of Elias (July 11, 1110); but this increase of Angevin territory came into such direct collision with the interests of Henry I., king of England, who was also duke of Normandy, that a struggle between the two powers became inevitable. In 1112 it broke out, and Fulk, being unable to prevent Henry I. from taking Alençon and making Robert, lord of Bellême, prisoner, was forced, at the treaty of Pierre Pecoulée, near Alençon (Feb. 23, 1113), to do homage to Henry for Maine. In revenge for this, while Louis VI. was overrunning the Vexin in 1118, he routed Henry's army at Alençon (Nov.), and in May 1119 Henry demanded a peace, which was sealed in June by the marriage of his eldest son, William, with Matilda, Fulk's daughter. William having perished in the wreck of the "White Ship" (Nov. 25, 1120), Fulk, on his return from a pilgrimage to the Holy Land (1120-21), married his second daughter Sibyl, at the instigation of Louis VI., to William Clito, son of Robert Courteuse, and a claimant to the duchy of Normandy, giving her Maine for a dowry (1122 or 1123). Henry I. managed to have the marriage annulled, on the plea of kinship between the parties (1123 or 1124). But in 1127 a new alliance was made, and on May 22, at Rouen, Henry I. betrothed his daughter Matilda to Geoffrey the Handsome, son of Fulk, the marriage being celebrated at Le Mans on June 2, 1129. Shortly after, on the invitation of Baldwin II., king of Jerusalem, Fulk departed to the Holy Land, married Melisinda, Baldwin's daughter and heiress, and succeeded to the throne of Jerusalem (Sept. 14, 1131). His eldest son, Geoffrey IV. the Handsome or "Plantagenet," succeeded him as count of Anjou (1129-51). From the first he tried to profit by his marriage, and after the death of Henry I. (Dec. 1, 1135), laid the foundation of the conquest of Normandy by a series of cam-

paigns: about the end of 1135 or the beginning of 1136 he entered that country and rejoined his wife, the countess Matilda, who had received the submission of Argentan, Domfront and Exmes. Recalled into Anjou by a revolt of his barons, he returned to the charge in Sept. 1136 with a strong army, but after a few successes was wounded in the foot at the siege of Le Sap (Oct. 1) and had to fall back. In May 1137 began a fresh campaign in which he devastated the district of Hiémois (round Exmes) and burnt Bazoches. In June 1138, with the aid of Robert of Gloucester, Geoffrey obtained the submission of Bayeux and Caen; in October he devastated the neighbourhood of Falaise; finally, in March 1141, on hearing of his wife's success in England, he again entered Normandy. Many towns surrendered; in 1144 he entered Rouen, and received the ducal crown in its cathedral. Finally, in 1149, after crushing a last attempt at revolt, he handed over the duchy to his son Henry, who received the investiture at the hands of the king of France.

Meanwhile, the counts were strengthening their authority at home. Of Fulk the Young we know only a few isolated facts and dates. Geoffrey the Handsome was eminently fitted to suppress the coalitions of his vassals, and on his death his son Henry found himself heir to a great empire, strong and consolidated, to which his marriage with Eleanor of Aquitaine (May 1152) further added Aquitaine.

On the death of King Stephen, Henry was recognized as king of England (Dec. 19, 1154). His brother Geoffrey, who had received as appanage the three fortresses of Chinon, Loudun and Mirebeau, tried to seize upon Anjou, on the pretext that, by the will of their father, all the paternal inheritance ought to descend to him, if Henry succeeded in obtaining possession of the maternal inheritance. On hearing of this, Henry marched against his brother, from whom in the beginning of 1156 he succeeded in taking Chinon and Mirebeau; and in July he forced Geoffrey to give up even his three fortresses in return for an annual pension. Henceforward Henry succeeded in keeping the countship of Anjou all his life; for though he granted it in 1168 to his son Henry, he absolutely refused to allow him to enjoy his power. After Henry II.'s death in 1189 the countship passed to his son Richard I. of England, but on the death of the latter in 1199, Arthur of Brittany (born in 1187) laid claim to the inheritance, which ought, according to him, to have fallen to his father Geoffrey, fourth son of Henry II., in accordance with the custom by which "the son of the eldest brother should succeed to his father's patrimony." Supported by Philip Augustus of France, and William des Roches, seneschal of Anjou, he managed to enter Angers (April 18, 1199) and obtain recognition as count of Anjou, Maine and Touraine, for which he did homage to the king of France. Philip Augustus having deserted Arthur by the treaty of Le Goulet (May 22, 1200), John made his way into Anjou; and on June 18, 1200 was recognized as count at Angers. In 1202 he refused to do homage to Philip Augustus, who, in consequence, confiscated all his continental possessions, including Anjou, which was allotted by the king of France to Arthur. The defeat of the latter, who was taken prisoner at Mirebeau on Aug. 1, 1202, seemed to ensure John's success, but he was abandoned by William des Roches, who in 1203 assisted Philip Augustus in subduing the whole of Anjou. A last effort on the part of John in 1214 led to the taking of Angers (June 17) but broke down lamentably at the battle of La Roche-aux-Moines (July 2), and the countship was attached to the crown of France.

In Aug. 1246 King Louis IX. gave it as an appanage to his brother Charles, count of Provence, soon to become king of Naples and Sicily (see NAPLES, KINGDOM OF). On Aug. 16, 1290 his son, Charles II. married his daughter Margaret to Charles of Valois, son of Philip III. of France giving her Anjou and Maine for dowry, in exchange for the kingdoms of Aragon and Valentia and the countship of Barcelona. Charles of Valois at once entered into possession of the countship of Anjou, to which Philip IV., in Sept. 1297, attached a peerage of France. On Dec. 16, 1325, Charles died, leaving Anjou to his eldest son Philip of Valois, on whose recognition as king of France (Philip VI.) on April 1, 1328, the countship of Anjou was again united to the crown. On Feb.

17, 1332, Philip VI. bestowed it on his son John the Good, who, when he became king (Aug. 22, 1350), gave the countship to his second son Louis I., raising it to a duchy in the peerage of France by letters patent of Oct. 25, 1360. Louis I., who became in time count of Provence and king of Naples (see LOUIS I., king of Naples), died in 1384, and was succeeded by his son Louis II., who devoted most of his energies to his kingdom of Naples, and left the administration of Anjou almost entirely in the hands of his wife, Yolande of Aragon. On his death (April 29, 1417) she took over the guardianship of their young son Louis III., and as regent defended the duchy against the English. Louis III., who also succeeded his father as king of Naples, died on Nov. 15, 1434, leaving no children. The duchy of Anjou then passed to his brother René, second son of Louis II and Yolande of Aragon, and king of Naples and Sicily (see NAPLES, KINGDOM OF).

Unlike his predecessors, who had rarely stayed long in Anjou, René from 1443 onwards, paid long visits to it, and his court at Angers became one of the most brilliant in the kingdom of France. But after the sudden death of his son John in Dec. 1470, René, for reasons which are not altogether clear, decided to move his residence to Provence and leave Anjou for good (Oct. 1471). On July 22, 1474, he drew up a will by which he divided the succession between his grandson René II. of Lorraine and his nephew Charles II., count of Maine, but on his death (July 10, 1480) King Louis XI. annexed Anjou to the royal domain. King Francis I. again gave the duchy as an appanage to his mother, Louise of Savoy, by letters patent of Feb. 4, 1515. On her death, in Sept. 1531, it reverted to the king. In 1552 it was given by Henry II. to his son Henry who, on becoming king in 1574, conceded it to his brother Francis, duke of Alençon, at the treaty of Beaulieu near Loches (May 6, 1576). Francis died on June 10, 1584, and the vacant appanage definitively became part of the royal domain.

At first Anjou was included in the *gouvernement* of Orléanais, but in the 17th century it was made into a separate one. Saumur, however, and the Saumurois, for which King Henry IV. had in 1589 created an independent military governor-generalship in favour of Duplessis-Mornay, continued till the Revolution to form a separate *gouvernement*, which included, besides Anjou, portions of Poitou and Mirebalais. Attached to the *généralité* (administrative circumscription) of Tours, Anjou on the eve of the Revolution comprised five *élections* (judicial districts): Angers, Beaugé, Saumur, Château-Gontier, Montreuil-Bellay and part of the *élections* of La Flèche and Richelieu. Financially it formed part of the so-called *pays de grande gabelle* (see GABELLE), and comprised 16 special tribunals, or *greniers à sel* (salt warehouses): Angers, Beaugé, Beaufort, Bourgueil, Candé, Château-Gontier, Cholet, Craon, La Flèche, Saint-Florent-le-Vieil, Ingrandes, Le Lude, Pouancé, Saint-Remy-la-Varenne, Richelieu, Saumur. As regards purely judicial administration, Anjou was subject to the parlement of Paris; Angers was the seat of a presidial court, of which the jurisdiction comprised the *sénéchaussées* of Angers, Saumur, Beaugé, Beaufort and the duchy of Richelieu; there were besides presidial courts at Château-Gontier and La Flèche. When the Constituent Assembly, on Feb. 26, 1790, decreed the division of France into departments, Anjou and the Saumurois, with the exception of certain territories, formed the department of Maine-et-Loire.

BIBLIOGRAPHY.—*Principal Sources:* The history of Anjou may be told partly with the aid of the chroniclers of the neighbouring provinces, in particular those of Normandy and of Maine (especially *Actus pontificum Cenomannis in urbe degentium*). For the 10th, 11th and 12th centuries there are some important texts dealing entirely with Anjou. The most important is the chronicle called *Gesta consulum Andegavorum* or *Chroniques des comtes d'Anjou*, ed. by P. Marchegay and A. Salmon (Paris, 1856-71) and by Louis Halphen and René Poupardin (Paris, 1913). See also with reference to this text Louis Halphen, *Etude sur les chroniques des comtes d'Anjou et des seigneurs d'Amboise* (Paris, 1906). The above may be supplemented by some valuable annals published by Louis Halphen, *Recueil d'annales angevines et vendômoises* (Paris, 1903). For further details see Auguste Molinier, *Les Sources de l'histoire de France*, vol. ii (Paris, 1902).

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naire historique, géographique et biographique de Maine-et-Loire, 3 vol. (Angers, 1874-78), and its volume of *Préliminaires* (including a summary of the history of Anjou), contain comprehensive information on Angevin history. See also J. Chartrou, *L'Anjou de 1109 à 1511* ... (Paris, 1928); J. Boussard, *Le Comté d'Anjou sous Henri Plantagenet et ses fils, 1151-1204* (Paris, 1938) and "La Vie en Anjou aux XI^e et XII^e siècles," *Le Moyen Age* (Paris, 1950, no. 1-2, p. 29-68); Ch. Petit-Dutaillis, *La Monarchie féodale France et en Angleterre, X^e-XIII^e siècle* (Paris, 1933); R. Fawtier, *Les Capétiens et la France* (Paris, 1942).

ANKARA: see ANGORA.

ANKERITE, a member of the mineral group of rhombohedral carbonates. In composition it is closely related to dolomite, but differs from this in having magnesia replaced by varying amounts of ferrous and manganese oxides, the general formula being $\text{Ca}(\text{Mg}, \text{Fe}, \text{Mn})(\text{CO}_3)_2$. The colour is white, gray or reddish. Ankerite occurs with chalybite in deposits of iron ore.

ANKLAM, or ANCLAM, Germany, 5 mi. above the mouth of the river Peene in the Kleines Haff, and 53 mi. N.W. of Stettin. Pop. (1939) 19,858. Anklam, or Tanglīm, originally a Slav fortress, joined the Hanseatic league in 1244. It was Swedish from 1648-76. It suffered in the Thirty Years' and Seven Years' Wars because of its military importance, but still has its old walls and some quaint buildings. Foundries, mills and the making of agricultural machinery, furniture and sugar are carried on.

ANKLE, the joint which connects the foot with the leg (see JOINTS and LIGAMENTS).

ANKOBER, a town in, and at one time capital of, the kingdom of Shoa, Abyssinia, 90 mi. N.E. of Addis Ababa, in 9° 34' N., 39° 54' E., on a mountain about 8,500 ft. above the sea. Ankober was made (c. 1890) by Menelek II. the place of detention of political prisoners. Pop. c. 3,000.

ANKOLE, a term used to designate a plateau of the Uganda Protectorate, British East Africa, and the people (Hima and Iro) occupying it. There has been little except linguistic assimilation here between the Hamitic intruders and the indigenous population. The former, known as Hima, and distinguished by fine features, small, almost Caucasian hands and feet and a light skin, comprise the autocracy. The latter, called Iro, a Hamitic word meaning slaves, with features characterized by rather projecting brow ridges, are the serfs or peasants. Both Hima and Iro wear skins and barkcloth but the latter are more careful about conventional decency, and an Iro married woman in addition to a number of skins worn round the waist must always wear heavy metal anklets. Apart from cicatrization they do not mutilate their bodies in any way. The Hima are cow-people and are subdivided into two classes, the rich and the poor. The former who own the cattle (a long-boned Galla type, sometimes humped owing to crossbreeding) are now sedentary, but the latter, who act as servants and herdsmen to the former (who provide them with wives and a few cattle) are nomads and move from place to place with the cattle. The Iro are purely agricultural and were rarely allowed to possess cattle as they do now; they have to supply the Hima with grain and beer. They are also the hunters of the tribe, as well as the smiths, potters (male and female) and carpenters, members of each craft being attached to the royal court, where they are generously rewarded for their services. War prisoners form a separate class of slaves, distinguished by the amputation of one or both ears.

The Hima live in collections of from ten to twenty houses inside a strong fence of thorn or euphorbia. There is a large courtyard and an inner fence secludes the living quarters, where there is a separate house for bachelors. The royal residence is a larger and more elaborate structure, including a house for pages, another for especially favoured wives, another for women who attend the ruler on his travels, a general house for the wives and a house for the wives who have borne children, all the houses being connected by covered passages. There would also be in the enclosure about a hundred other circular mud and wattle huts for women and attendants. The nomad herdsmen are content with much cruder huts and the bee-hive huts of the Iro are of much smaller dimensions and are scattered singly or in groups in or near plantations.

Polygamy is permitted but monogamy is customary. Marriage is regulated by totemic clans, which are subdivided into sub-clans distinguished by secondary and tertiary totems, and marriage is permitted within the three main clans if at least one totem differs. Princes formerly practised complete clan endogamy. There is an elaborate ceremonial of blood-brotherhood. The ruler's mother and sister have a special importance, and while among the Ganda the *kabaka's* sister has to marry her half-brother, here the *mugabe's* sister may marry whom she likes. Hima women are fattened almost to immobility before marriage, which takes place early in life. Pre-nuptial chastity is essential, followed by considerable post-nuptial license, both among Hima and Iro. Daughters must be married in order of age. Inheritance is by bequest, but the heir must be a son, who inherits the wives as well as the property. Intestate property goes to the ruler.

The Hima live mainly on milk, meat and beer; the Iro on their agricultural products and wild game. Their weapons are throwing spears, small oval shields with a central boss of wood or iron, bows and slings. The Iro shield is slightly larger and is often made of hippopotamus hide instead of basketwork, and they carry clubs instead of slings.

Offerings of beer, milk and cattle are made to the sacred royal drums, which are the only drums in the tribe, and are kept in a special enclosure, which is a sanctuary for malefactors. Music is provided by a primitive harp and by water jars filled to different levels. The Iro use square-shaped canoes on the lake, constructed of wooden boards laced together, but without the Ganda keel or prow.

The *mugabe* or ruler (who used to be called *mukama* like the Nyoro ruler) is the centre of social and political life. He holds all the tribal land in trust and distributes estates to the chiefs and theoretically all property is his. Cattle may not be sold to anyone outside the tribe without his permission and herdsmen may only kill bull-calves up to a given number. All land is free to the cattle-owners and their herdsmen, and the Iro may cultivate where they like, but are attached to cowmen as their agricultural workers, a chief retaining as many as three hundred. The *mugabe* is an absolute ruler with autocratic powers which he may delegate to chiefs. Next in importance to him is his minister called *nganzi* or "favourite." There are 16 districts presided over by chiefs called *bakungu* or *abamangi*, who are appointed by the *mugabe* on his accession, each with a different title and special duties and status. The chiefs are always pastoral. They settle disputes, keep peace and order, guard the royal cattle, and their sons act as pages at the *mugabe's* court. There are also inferior chiefs in each district who are almost independent of the *bakungu*. Pages who are too old for such service are appointed *galagwa*, a title which carries the rank of chieftain, are given estates, cows and serfs and form an autonomous community in each district. All taxation is in the hands of the *mugabe* who collects a percentage of cattle every year on all herds of 50 or more. The *mugabe* commits suicide by taking a special royal poison when too old or suffering from an incurable illness, and his widows are expected to commit suicide at his grave. The milk ceremonies are extremely important to the tribe and in them the *mugabe's* milk vessels play a dominant part.

There is no priestly caste or formulated religion. *Ruhanga*, the Creator, was probably an ancient hero or ruler and is revered with fourteen other sanctified kings, but neither these nor certain natural phenomena which are treated as divine, like *Omusisi* the Earthquake, have shrines or receive sacrifice. The ghosts or spirits of family ancestors are more important, and their religious eminence is recognized by family shrines, prayers and offerings. Spirits of dead rulers are supposed to enter lions. Rainmakers (*abaizi*) belong exclusively to the serf class, but they receive generous gifts not only from the Iro, but also from the Hima including the *mugabe* himself.

See Sir H. H. Johnston, *The Uganda Protectorate* (1902); J. Roscoe, *The Banyankole* (1923). (J. H. D.)

ANKYLOSIS or **ANCHYLOSIS**, a stiffness of a joint, the result of injury or disease. The rigidity may be complete or partial and may be due to inflammation of the tendinous or

muscular structures outside the joint or of the tissues of the joint itself.

When the structures outside the joint are affected, the term false ankylosis has been used in contradistinction to true ankylosis, in which the disease is within the joint. When inflammation has caused the joint ends of the bones to be fused together the ankylosis is termed osseous or complete. Excision of a completely ankylosed shoulder or elbow may restore free mobility and usefulness to the limb.

Ankylosis is also used as an anatomical term, bones being said to ankylose when, from being originally distinct, they coalesce, or become so joined together that no motion can take place between them.

ANKYLOSTOMIASIS or **ANCHYLOSTOMIASIS** is also called helminthiasis, miner's anaemia, and in Germany *Wurmkrankheit*. (See **HOOKWORM**.)

ANNA, BALDASARRE, Italian painter, who flourished during part of the 16th and 17th centuries, was born at Venice, probably about 1560, and seems to have been alive in 1639. He studied under Leonardo Corona, and completed several works left unfinished by him.

The old guidebooks and descriptions of Venice notice a considerable number of paintings by him. Scarcely any of these, however, have survived.

ANNA: see **RUPEE**.

ANNA AMALIA (1739–1807), duchess of Saxe-Weimar, daughter of Charles I, duke of Brunswick-Wolfenbüttel, was born at Wolfenbüttel on Oct. 24, 1739, and married Ernest, duke of Saxe-Weimar, 1756. Her husband died in 1758, leaving her regent for their infant son, Charles Augustus. She was a patroness of art and literature and attracted to Weimar many of the most eminent men in Germany.

Christoph Martin Wieland was appointed tutor to her son, and the names of Johann von Herder, Johann von Goethe and Johann von Schiller shed an undying lustre on her court. In 1775 she retired into private life, her son having attained his majority. In 1788 she set out on a lengthened tour through Italy, accompanied by Goethe. She died on April 10, 1807. A memorial of the duchess is included in Goethe's works under the title *Zum Andenken der Fürstin Anna-Amalia*.

See F. Bornhak, *Anna Amalia, Herzogin von Saxe-Weimar-Eisenach* (1892).

ANNABERG, a town in the *Land* of Saxony, Germany, in the Erzgebirge, 1,894 ft. above the sea, 18 mi. S. by E. of Chemnitz. Pop. (1939) 19,021.

The Annenkirche (1499–1525) possesses fine sculptures and early 16th-century works of art. Annaberg, together with the suburb of Buchholz, is the chief seat of the braid and lacemaking industry in Germany, and makes cardboard boxes, buttons, silk goods, etc.; the industry was introduced there by Barbara Uttmann in 1561, and further developed by Belgian refugees, who settled there in 1590. The mining of tin, silver and cobalt has now ceased.

ANNABERGITE, a mineral consisting of a hydrous nickel arsenate, $\text{Ni}_3(\text{AsO}_4)_2 \cdot 8\text{H}_2\text{O}$, crystallizing in the monoclinic system. Crystals are minute and capillary and rarely met with, the mineral occurring usually as soft earthy masses and incrustations.

A fine apple-green colour is its characteristic feature. It was long known under the name nickel ochre; the name annabergite being from Annaberg in Saxony, one of the localities of the mineral.

ANNA COMNENA (1083–1148), Byzantine historian, daughter of the Emperor Alexius I (Comnenus). She was carefully trained in the study of poetry, science and Greek philosophy. She united with the Empress Irene in a vain attempt to prevail upon her father during his last illness to disinherit his son and give the crown to her husband, Nicephorus Bryennius. She then conspired to depose her brother after his accession; and when her husband refused to join in the enterprise, she exclaimed that "nature had mistaken their sexes, for he ought to have been the woman." The plot being discovered, Anna forfeited her

property and fortune. Shortly afterward she retired into a convent and employed her leisure in writing the *Alexiad*—a history, in Greek, of her father's life and reign (1081–1118), supplementing the historical work of her husband. It is rather a family panegyric than a scientific history.

In addition to her political activities and work as historian, Anna studied medicine. She was physician in chief of a 10,000-bed hospital in Constantinople, kept accurate records of her patients and wrote a treatise on gout.

BIBLIOGRAPHY.—Editions in Bonn *Corpus Scriptorum Hist. Byz.*, by J. Schopen and A. Reifferscheid (1839–78), with C. du Cange's valuable commentary; and Teubner series, by A. Reifferscheid (1884). See also E. Gibbon, *Decline and Fall*, ch. 48; G. Finlay, *Hist. of Greece*, iii, pp. 53, 128 (1877).

ANNA LEOPOLDOVNA, sometimes called **ANNA CARLOVNA** (1718–1746), duchess of Brunswick, regent of Russia for a few months during the minority of her son Ivan, was the daughter of Catherine, sister of the empress Anne, and Charles Leopold, duke of Mecklenburg-Schwerin. In 1739 she married Prince Antony Ulrich of Brunswick-Wolfenbüttel, son of Ferdinand Albert, duke of Brunswick, and their son Ivan was adopted in 1740 by the empress and proclaimed heir to the Russian throne. A few days after the proclamation the empress died, leaving directions regarding the succession and appointing her favourite Ernest Biren, duke of Courland, as regent. Biren was detested by the Russian people, and Anna assumed the regency. In Dec. 1741 Elizabeth, daughter of Peter the Great, excited the guards to revolt, overcame the slight opposition that was offered and was proclaimed empress. Ivan was thrown into prison, where he soon afterward perished. Anna and her husband were banished to a small island in the river Dvina, where on March 18, 1746, she died in childbirth.

ANNALISTS, writers of annals (*Annales*, chronicles, properly yearbooks); a name commonly given to a group of Roman writers to whom is due the formation of the conventional history of Rome from the earliest times. It is alleged that from the beginning it was customary to keep a record of all important events; that these records, restored as far as possible after the Gaulish invasion, were continued down to the pontificate of P. Mucius Scaevola; and that the 80 books of the *Annales Maximi* embodied the substance of them. In modern times, great and well-founded doubt has been expressed as to the age and accuracy of these supposed chronicles.

The oldest annalists, from the time of the Second Punic War, used such public records as they could find, supplementing them with family traditions and, in all probability, filling gaps largely from their own or their Greek preceptors' imaginations, since Rome seems to have been extraordinarily poor in sagas and myths of all kinds. In course of time a sort of orthodox pseudo-tradition grew up concerning the earliest history of Rome (cf. **EVANDER**; **ROMULUS**). The annalists may be divided into two groups, the earlier, from Fabius Pictor (*q.v.*) to Piso, being, on the evidence of Cicero (*de orat.*, ii, 53) very plain and unadorned in style, while the later, mostly of the time of Sulla, were more literary and rhetorical. Coelius Antipater (see below) seems to mark the turning point; he had, says Cicero, little learning and no great stylistic ability, but he polished his work as well as he could. Some of the chief names are as follows: Q. Fabius Pictor and L. Cincius Alimentus, contemporaries of Hannibal, who took the latter prisoner; both wrote histories of Rome from the foundation to their own day, and both wrote in Greek; Marcus Porcius Cato (*q.v.*), who wrote in Latin; L. Cassius Hemina, about 146 B.C.; L. Calpurnius Piso Censorius Fruci, consul 133 B.C. It is noteworthy that Livy thinks him less trustworthy than Fabius, and that he is often cited for details plainly fictitious (cf. **PISO**). Of the later group Quintus Claudius Quadrigarius (about 80 B.C.) wrote a history, in at least 23 books, which began with the conquest of Rome by the Gauls and went down to the death of Sulla or perhaps later. He was freely used by Livy in part of his work (from the sixth book onward). A long fragment is preserved in Aulus Gellius (ix, 13), giving an account of the single combat between Manlius Torquatus and the Gaul. His language was antiquated and his style dry, but his

work was considered important. Valerius Antias, a younger contemporary of Quadrigarius, wrote the history of Rome from the earliest times, in a voluminous work consisting of 75 books. He is notorious for his wilful exaggeration, both in narrative and numerical statements. Nevertheless, Livy at first made use of him as one of his chief authorities, until he became convinced of his untrustworthiness. C. Licinius Macer (died 66), who has been called the last of the annalists, wrote a voluminous work full of rhetoric and of authorities anything but certainly authentic. Having been convicted of extortion, he committed suicide (Cicero, *De Legibus*, i. 2, *Brutus*, 67; Plutarch, *Cicero*, 9).

The writers mentioned dealt with Roman history as a whole; some of the annalists, however, confined themselves to shorter periods. Thus, L. Caelius Antipater (about 120) limited himself to the Second Punic War. He was regarded as the most careful writer on the war with Hannibal, and one who did not allow himself to be blinded by partiality in considering the evidence of other writers (Cicero, *De Oratore*, ii. 12). Livy made great use of him in his third decade. Sempronius Asellio (about 100 B.C.) military tribune of Scipio Africanus at the siege of Numantia, composed *Rerum Gestarum Libri* in at least 14 books. As he himself took part in the events he describes, his work was a kind of memoirs. He was the first of his class who endeavoured to trace the causes of events, instead of contenting himself with a bare statement of facts. L. Cornelius Sisenna (110–67), wrote 23 books on the period between the Social War and the dictatorship of Sulla. His work was commended by Sallust (*Jugurtha*, 95), who, however, blames him for not speaking out sufficiently. Cicero remarks upon his fondness for archaisms (*Brutus*, 74, 259). Sisenna also translated the tales of Aristides of Miletus. The autobiography of Sulla may also be mentioned.

BIBLIOGRAPHY.—*Historicorum Romanorum Fragmenta* (1883). See also *Fragments* in H. Peter, *Historicorum Romanorum Reliquiae* (1870, 1906), and *ROME, History* (ancient) *ad. fin.*, section "Authorities," and *LIVY*, where the use made of the annalists by the historian is discussed; Pauly-Wissowa, *Realencyclopädie*, art. "Annales"; the histories of Roman Literature by Teuffel-Schwabe and Schanz-Hosius (bibl.) (H. J. R.)

ANNALS, a concise historical record in which events are arranged chronologically, year by year (*annales*, from *annus*, a year). The chief sources of information about the annals of ancient Rome are two passages in Cicero (*De Oratore*, ii. 12, 52) and in Servius (*ad Aen.*, i. 373) which have been the subject of much discussion. Cicero states that from the earliest period down to the pontificate of Publius Mucius Scaevola (c. 131 B.C.) it was usual for the pontifex maximus to record on a white tablet (*album*), which was exhibited in an open place at his house, so that the people might read it, first, the name of the consuls and other magistrates, and then the noteworthy events that had occurred during the year (*per singulos dies*, as Servius says). These records were called in Cicero's time *Annales Maximi*. The nature of the distinction between annals and history is a subject that has received more attention from critics than its intrinsic importance deserves. The basis of discussion is furnished chiefly by the above-quoted passage from Cicero, and by the common division of the work of Tacitus into *Annales* and *Historiae*. Aulus Gellius, in the *Noctes Atticae* (v. 18), quotes the grammarian Verrius Flaccus to the effect that history, according to its etymology (*ἱστορεῖν*, *inspicere*, to inquire in person), is a record of events that have come under the author's own observation, while annals are a record of the events of earlier times arranged according to years. This view of the distinction seems to be borne out by the division of the work of Tacitus into the *Historiae*, relating the events of his own time, and the *Annales*, containing the history of earlier periods. It is more than questionable, however, whether Tacitus himself divided his work under these titles. The probability is, either that he called the whole *Annales*, or that he used neither designation.

In the middle ages, when the order of the liturgical feasts was partly determined by the date of Easter, the custom was early established in the Western Church of drawing up tables to indicate that date for a certain number of years or even centuries. These Paschal tables were thin books in which each annual date

was separated from the next by a more or less considerable blank space in which the important events of the year were briefly noted. Among the Anglo-Saxons the compiling of these annals was begun at the end of the 7th century. Introduced by missionaries on the continent, they were augmented and continued, especially in the kingdom of Austrasia. In the 9th century, during the great movement termed the Carolingian Renaissance, these annals became the usual form of contemporary history; it suffices to mention the *Annales Einhardi*, the *Annales Laureshamenses* (or "of Lorsch"), and the *Annales S. Bertini*, officially compiled in order to preserve the memory of the more interesting acts of Charlemagne, his ancestors and his successors. Arrived at this stage of development, the annals now began to lose their primitive character, and henceforward became more and more indistinguishable from the chronicles.

In modern literature the title annals has been given to a large number of standard works which adhere more or less strictly to the order of years. The best known are the *Annales Ecclesiastici*, written by Cardinal Baronius as a rejoinder to and refutation of the *Historia ecclesiastica* or "Centuries" of the Protestant theologians of Magdeburg (Rome, 1788–93; Baronius's work stops at the year 1197). From the 19th century on the annalistic form has been again employed, either to preserve year by year the memory of passing events (*Annual Register*, *Annuaire de la Revue des deux mondes*, *The Year's Work in Classical Studies*, etc.) or in writing the history of obscure mediaeval periods (*Jahrbücher der deutschen Geschichte*, Richter's *Reichsannalen*, etc.).

ANNAM, the central state in French Indo-China (*q.v.*), occupies a long coastal strip between Tonkin and Cochin-China, and is bordered on the east by the South China sea and on the west by Laos, from which it is separated by the Annamite cordillera. It is nearly 800 mi. long and has an area of 56,989 sq. mi. Population in 1936 was 5,566,000, of whom 4,985 were European civilians. The fertile rice-growing plains of northern Annam are a continuation of southern Tonkin, but the mountains are close to the sea in the central and southern parts of the country.

The country is traversed longitudinally by the Annamite cordillera which extends south from the high mass of Laos and bends eastward, just as the cordillera of Burma bends westward, under the influence of the Cambodian block between them. A granitic axis is flanked by ancient rocks; which again have Devonian or Carboniferous limestone on their flanks, and there are narrow strips of newer rock along the east coast, while the granitic rocks form most of the south coast and some vulcanicity is indicated. The dissection of the cordillera by rivers has produced the general form of a high axis with high coastward projecting buttresses that separate successive valleys and actually reach the coast here and there. Broadly, the lower ends of the rivers are often consequent, *i.e.*, at right angles to the high axis, but they have worked back into the cordillera and have subsequent, or longitudinal, sections parallel to the axis. As a result of



AN ANNAMITE COMEDIAN OF TONKIN, INDO-CHINA, ATTIRED IN STAGE COSTUME

dissection there are fragments of chains in the north and larger plateaux in the south, and some high peaks (Pu Hak, 6,560 ft., Pu Atwat, 8,200 ft., Mother and Child, 6,888 ft.) delimited by deep valleys. The general slope to the east is far sharper than that to the west, and the rivers are short, with courses broken by many rapids. The different parts of the coastal zone are linked by cols such as the Assam Gate (390 ft.) in the north, the Col des Nuages (1,540 ft.) in the centre and the Deo Ca (1,310 ft.) in the south. Apart from the fine Tourane bay the coast has little shelter; it is low and flat to Cape Mui-Dong, which stands out; beyond this it remains flat and alluvial southward to Cape Chu May. South again it is more irregular, and very irregular in the far south, but the bays there are too open to offer good anchorage.

Annam has a southwest monsoon from May to October and a northeast monsoon from November to about March. The former brings most of the year's 40–80 in. of rain to the hill regions and northern Annam, but the northeast monsoon is most productive of rain in the central coastal region, particularly around the capital, Hué (q.v.). Typhoons are common and violent, constituting a great menace to shipping and causing loss of life and property in coastal regions. Most of the population resides close to the coast, where the temperature is usually between 75° and 95° F. with temperatures over 100° not infrequent. The hill station of Dalat, about 4,600 feet in elevation, has average temperatures of 65° to 75° and occasional frosts. Temperate zone fruits and vegetables grow near Dalat, while scenery and recreational facilities combine to make it a most attractive spot.

Rice is the chief crop in Annam as elsewhere in monsoon Asia, being cultivated particularly in the northern plain and in the small deltas and plains along the coast. In the north two crops are grown per year. Coffee plantations are common in the north, while French-owned tea and rubber plantations occupy considerable areas in the plateaus of the centre and south. Maize, tobacco, cotton and sugar cane are the other chief crops. Some raw silk is produced but not enough for local weavers. Dyes, sticklac, spices and a variety of gums and resins are among the forest products. Most of the area is heavily forested and there is a large lumber industry, road building in recent years having made additional areas exploitable. Vinh on the northern plain is the chief industrial city, having a large match factory, important railway shops and minor handicrafts. Annam's mineral production is much less than that of Tonkin. About 5,000 tons of iron ore and 3,000 tons of ferromanganese were produced annually prior to Japanese occupation in 1940–41, but there was little or no exploitation of the numerous known deposits of chrome, tin, zinc, lead, antimony, phosphates and bauxite. There was a small production of coal. Fishing is an important industry both along the coast and in numerous streams, and provides a mainstay of the diet. Dense forests contain a wide variety of large and small game, including elephants, tigers, guar, wild boar and deer.

The Trans-Indo-China railway connects Saigon and Hanoi, and thus runs the entire length of Annam, usually skirting the coast to avoid the mountains and passes through the most densely populated areas. A good highway parallels it, while recently-constructed roads cross the mountains to the Mekong river, where ferries make connections with the Siamese highway system. The port of Tourane with a population of about 25,000 is normally visited by two ships per month engaged in international trade, in addition to numerous small coastal vessels. At Nhatrang there is an Oceanographic institute with collections of fish from the atolls of the South China sea.

Annam is ruled in theory by its emperor, assisted by the "comat" or secret council, composed of the ministers of the interior, finance, war, ritual, justice and public works nominated by himself. The French resident superior, at Hué (pop. 17,000), is the virtual ruler and advises the emperor with the help of a council (*conseil de protectorat*). Local administration is in the hands of mandarins chosen by competitive examination. In the province of Tourane a French tribunal alone exercises jurisdiction, but it administers native law where natives are concerned. Outside this province native tribunals are maintained. The Annamite village is self-governing. It has its council of notables, forming a sort of oligarchy which, through the medium of a mayor and two subordinates, directs the interior affairs of the community—policing, recruiting, the assignment and collection of taxes, etc.—and has judicial power in less important suits and crimes. More serious cases come within the purview of the *an-sat*, a judicial auxiliary of the governor. An assembly of notables from villages grouped together in a canton chooses a cantonal representative, who is the mouthpiece of the people and the intermediary between the government and its subjects. The direct taxes, which go to the local budget of Annam, consist primarily of a poll-tax levied on all males over 18 and below 60 years of age, and of a land-tax levied according to the quality and the produce of the holding. Native collaboration in administration is secured to a

considerable extent. A chamber of representatives of the people was established in 1926. Education is both French and Franco-Annamite and is considerably developed.

History.—The ancient tribe of the Giao-Chi, on the confines of south China and in what is now Tonkin and northern Annam, are regarded by the Annamites as their ancestors, and tradition ascribes to their first rulers descent from the Chinese imperial family. These sovereigns were succeeded by another dynasty, during whose rule, at the end of the 3rd century B.C., the Chinese invaded the country, and eventually established there a supremacy destined to last, with little interruption, till the 10th century A.D. In 968 Dinh-Bo-Lanh succeeded in ousting the Chinese and founded an independent dynasty of Dinh. Till this period the greater part of Annam had been occupied by the Chams, a nation of Hindu civilization, which has left many monuments to testify to its greatness, but the encroachment of the Annamites during the next six centuries at last left to it only a small territory in the south of the country. About 1407 Annam again fell under the Chinese yoke. In 1428 an Annamite general Lê-Loi succeeded in freeing the country once more, and founded a dynasty which lasted till the end of the 18th century. During the greater part of this period, however, the titular sovereigns were mere puppets, the real power being in the hands of the family of Trinh in Tonkin and that of Nguyen in southern Annam, which in 1568 became a separate principality under the name of Cochin-China. Towards the end of the 18th century a rebellion overthrew the Nguyen, but one of its members, Gia-long, by the aid of a French force, in 1801 acquired sway over the whole of Annam, Tonkin and Cochin-China. This force was procured for him by Pigneau de Béhaine, bishop of Adran, who saw in the political condition of Annam a means of establishing French influence in Indo-China. Before this, in 1787, Gia-long had concluded a treaty with Louis XVI, whereby in return for a promise of aid he ceded Tourane and Pulo-Condore to the French. That treaty marks the beginning of French influence in Indo-China (q.v.). Present-day Annam is considerably smaller than the Annam of history for both Tonkin and Cochin-China were made separate states by the French.

See also Legrand de la Liraye, *Notes historiques sur la nation annamite* (1866?); E. Sombsthay, *Cours de législation et d'administration annamites* (1898); C. Gosselin, *L'Empire d'Annam* (1904).

ANNAN, royal and small burgh, Dumfriesshire, Scotland, on the Annan, nearly 2 mi. from its mouth and 15 mi. from Dumfries by the L.M.S.R. Pop. (est. 1938) 3,916. There is a branch line from Kirtlebridge and a railway viaduct one mile long crosses the Solway Firth to Port Carlisle (Cumberland). The river Annan is crossed by a stone bridge (1824) and a railway bridge. The Harbour Trust, constituted in 1897, improved the shipping accommodation, giving 15 ft. depth at high water spring tides. Industries include bacon-curing, distilling, sandstone quarrying, corn milling and nursery gardening, but the right of salmon fishing is the town's chief asset. Large marine engineering works are in the vicinity. Roman remains exist in the neighbourhood.

ANNA PERENNA, an old Roman deity of the circle or "ring" of the year, as the name (*per annum*) clearly indicates. Her festival, characterized by revelry and licentiousness, fell on the full moon of the first month (March 15), and was held at the grove of the goddess at the first milestone on the Via Flaminia. Sacrifice was offered to her "that the circle of the year might be happily completed." This is all we know for certain about the goddess and her cult; but the name naturally suggested myth-making, and Anna became a figure in stories in Ovid (*Fasti*, iii, 523 *et seq.*) and in Silius Italicus (viii, 50 *et seq.*). The coarse myth told by Ovid, in which Anna plays a trick on Mars when in love with Minerva, is probably an old Italian folk-tale.

ANNAPOLIS, a city and seaport of Maryland, U.S., the capital of the state, the county seat of Anne Arundel county, a port of entry of the Maryland customs district, and the seat of the United States Naval academy; on the Severn river about 2 mi. from its entrance into Chesapeake bay, 26 mi. S.E. of Baltimore and about the same distance N.E. of Washington, D.C. The population was 15,016 in 1950 (not including area annexed in May 1950, estimated to double the census figure).

Annapolis is one of the most picturesque and historically interesting cities of America. The grounds and buildings of the United States Naval Academy occupy a beautiful site of 200 ac. on the bank of the Severn. On an elevation near the centre of the city stands the State House (1772) with its lofty white dome and pillared portico. Nearby are the State Treasury, erected late in the 17th century for the house of delegates; and St. Anne's Protestant Episcopal church, which was a State church in the later colonial days. A number of residences dating from the 18th century still stand, and colonial associations are further preserved by the names of some of the principal streets, such as King George's, Prince George's, Hanover and Duke of Gloucester.

St. John's college (chartered 1784 as a continuation of King William's school, which had been founded by an act of the legislature in 1696) occupies a campus of 26 ac. adjoining the grounds of the Naval Academy. One of the trees on the campus is believed to be over 600 years old. The main building, McDowell Hall, was built in the 18th century to be the governor's mansion, and was the scene of many historic events. In 1937, a unique unified, all-required curriculum was introduced, built around the reading and discussion of the Great Books of Western Civilization, supplemented by mathematics and language tutorials and by science laboratories. The college is a nonsectarian institution for men. The state offers scholarships to students from each of the counties of Maryland and from the city of Baltimore.

Annapolis was settled in 1649 by Puritan exiles from Virginia. At first it was called Providence; later, Town at Proctor's, Town at the Severn, and Anne Arundel Town; and in 1694 was named Annapolis, in honour of Princess Anne, then heir to the throne of Great Britain. In the same year it was made the seat of the new (royal) government. It was incorporated in 1708. From the middle of the 18th century until the Revolution it was noted for its wealthy and cultivated society, and had a considerable commerce, until Baltimore, in 1780, became a port of entry. Congress was in session in the State House from Nov. 26 1783 to June 3 1784; and it was here that Washington, on Dec. 23 1783, resigned his commission as commander-in-chief of the Continental Army. The "Annapolis Convention" of 1786 was a meeting to which all the States were invited to send delegates, to consider measures for the better regulation of commerce; but as only five States were represented (New York, Pennsylvania, Virginia, New Jersey and Delaware), the delegates merely passed a resolution calling for another convention to meet in Philadelphia the following year, to amend the articles of confederation; and it was this Philadelphia convention that framed the Constitution of the United States.

ANNAPOLIS CONVENTION, a gathering of delegates from several States, of great importance in the movement for a federal convention to revise the articles of confederation. From early colonial days there had been differences of opinion between citizens of Maryland and Virginia relative to the jurisdiction over the waters of Chesapeake Bay and the rivers common to both States. In March, 1785, commissioners representing Maryland and Virginia met at Alexandria for the purpose of arriving at some agreement for the regulation of trade upon these waters. After a session of four days they removed to Mt. Vernon where they finished drawing up a formal compact for joint control. On Dec. 5, 1785, the adhesion of Maryland to the compact was laid before the Virginia legislature, which thereupon promptly announced its approval. In the communication from the legislature of Maryland to the Virginia legislature, a proposal was made to invite commissioners from all the States to meet for the purpose of agreeing upon general commercial regulations. This led to the passage of the well-known resolution of the Virginia legislature (Jan. 21, 1786) which appointed commissioners to meet such commissioners as might be appointed by the other States in the Union to take into consideration the trade of the United States. In answer to this call, five States sent delegates to a convention to be held in Sept. 1786, in the city of Annapolis, Maryland. The States represented at the Annapolis convention were New York, New Jersey, Pennsylvania, Delaware and Virginia. The convention formally opened on Sept. 11, and adjourned on Sept. 14, 1786. New Jersey alone had been liberal in the matter of instruc-

tions. The delegates from the other States were given but little latitude as to their decisions. Because of these restrictions and also because less than half of the States were represented at Annapolis, it was soon apparent that the work of the convention could be merely of a preliminary character. On Sept. 14, the convention adopted an address framed by Alexander Hamilton which prepared the way for the federal convention of 1787. In a concluding paragraph, the delegates, "with the most respectful deference, beg leave to suggest their unanimous conviction, that it may essentially tend to advance the interests of the Union, if the States . . . would use their endeavors to procure the concurrence of the other States, in the appointment of commissioners, to meet at Philadelphia, on the second Monday in May next, to take into consideration the situation of the United States."

See J. Elliot, *Debates in the State Conventions* (1854); K. M. Rowland, *Life of George Mason* (1892); G. Bancroft, *History of the Formation of the Constitution* (1882); G. T. Curtis, *History of the Origin, Formation, and Adoption of the Constitution* (1854); and H. J. Ford, *Alexander Hamilton* (1920). (C. C. TA.)

ANNAPOLIS ROYAL, Nova Scotia, Can., capital of Annapolis county and till 1750 of Nova Scotia; on an arm of the Bay of Fundy, at the mouth of the Annapolis river, 95 mi. W. of Halifax; on the main Canadian Pacific railway, 63 mi. by steamer from Saint John, N.B. Pop. (1951) 765. It is one of the oldest settlements in North America, founded in 1605 by the French, who called it Port Royal. It was captured by the British in 1710, ceded to them by the Treaty of Utrecht in 1713, and renamed in honour of Queen Anne. Fort Anne, the oldest fortification in North America, is a historical museum. Fruit, lumber and fish are exported.

ANN ARBOR, a city of Michigan, U.S., on the Huron river, 38 mi. W. of Detroit; the county seat of Washtenaw county. It is served by the New York Central and the Ann Arbor railways and motor-coach lines. The population was 47,279 in 1950 and 29,815 in 1940. Ann Arbor is the trade centre of a rich farming and fruit-growing region. The river provides good water power, and there are substantial manufacturing industries. In 1949 its establishments produced commodities valued at more than \$30,000,000, including auto gauges and accessories, bearings, broaching machines, balers, cameras and scientific instruments. The University of Michigan (*q.v.*) is situated there, and brings to the city a transient population of 25,000 or more in the course of the year. Catering to their needs gives employment, directly or indirectly, to a considerable part of the permanent population.

The single item of providing lodging for students is a major industry.

Ann Arbor was settled, laid out and chosen as the county seat in 1824; incorporated as a village in 1833; and chartered as a city in 1851.

The city was named in honour of Ann Allen and Ann Rumsey, wives of two of the founders.

ANNATES, in the strictest sense of the word, the whole of the first year's profits of a spiritual benefice which, in all countries of the Roman obedience, were formerly paid into the papal treasury (Lat. *annatae*, from *annus*, year; also *primitiae*, first-fruits). This custom was only of gradual growth. It had its origin in the right of the bishop to claim the first year's profits of the living from a newly inducted incumbent, of which the first mention is found under Pope Honorius (d. 1227). The earliest records show the *annata* to have been, sometimes a privilege conceded to the bishop for a term of years, sometimes a right based on immemorial precedent. In course of time the popes, under stress of financial crises, claimed the privilege for themselves, though at first only temporarily. Thus, in 1305, Clement V. claimed the first-fruits of all vacant benefices in England, and in 1319 John XXII. those of all Christendom vacated within the next two years. In those cases the rights of the bishops were transferred to the Holy See, already regarded as the ultimate source of the episcopal jurisdiction; the more usual custom was for the pope to claim the first-fruits only of those benefices of which he had reserved the patronage to himself. It was from these claims that the papal annates, in the strict sense, in course of time developed.

The system of annates was at no time worked with absolute

uniformity and completeness throughout the various parts of the church owing obedience to the Holy See, and it was never willingly submitted to by the clergy. Disagreements and disputes were not rare, and the easy expedient of rewarding the officials of the Curia and increasing the papal revenue by "reserving" more and more benefices was met by repeated protests, such as that of the bishops and barons of England (the chief sufferers), headed by Robert Grosseteste of Lincoln, at the Council of Lyons in 1245. The subject, indeed, frequently became one of national interest, as when Henry VIII (25 Hen. VIII, c. 20 and confirming act) usurped the rights of bishop and pope by claiming the English annates for the crown. With the gradual transformation of the system of benefices (cf. the classical work of Thomassinus, *Vetus et Nova Eccles. Disciplina*, Part II, 1, xlv) annates as such fell into disuse. When they are levied to-day, it is only when new appointments that are not subject to propaganda are made and then only in strict conformity with the existing concordats or by the Bulls of Circumscription whereby a diocese is established.

ANNATTO (*anatto*, *arnotto*), a colouring matter produced from the seeds of *Bixa orellana* (family *Bixaceae*), a small tree which grows in Central and South America. The seeds are surrounded with a thin coating of a waxy pulp, which is separated from them by washing in water, passing the liquid through a sieve and allowing the suspended pulp to deposit. The water is then drained away and the paste dried, till it is a thick, stiff unctuous mass. In this state it has a dark orange-red colour and is known as "roll" or "flag" annatto, according to the form in which it is put up; when further dried it is called "cake" annatto. Annatto is much used by South American Indians for painting their bodies; among civilized communities its principal use is for colouring butter, cheese and varnishes. It yields a fugitive bright orange colour, and is used alone, or with other dyes, in the dyeing of silks and in calico printing. It contains a yellow colouring matter, bixin, $C_{16}H_{26}O_2$.

ANNE (1693–1740), empress of Russia, second daughter of Ivan V., Peter the Great's imbecile brother, and Praskovia Saltukova. Her girlhood was passed at Ismailovo near Moscow, with her mother, an ignorant, bigoted tsaritsa of the old school, who neglected and even hated her daughters. Peter acted as a second father to the Ivanovs, as Praskovia and her family were called. In 1710 he married Anne to Frederick William, duke of Courland, who died of surfeit on his journey home from St. Petersburg (Leningrad). The reluctant young widow was ordered to proceed on her way to Mittau to take over the government of Courland, with the Russian resident, Count Peter Bestuzhev, as her adviser. He was subsequently her lover, till supplanted by Biren (*q.v.*). Anne's residence at Mittau was embittered by the utter inadequacy of her revenue. On her acceptance of the Russian crown, as the next heir after the death of Peter II. (Jan. 30, 1730), she subscribed to nine articles which would have reduced her from an absolute to a very limited monarch. On Feb. 26 she made her public entry into Moscow under strict surveillance. On March 8 a *coup d'état*, engineered by a party of her personal friends, overthrew the supreme privy council and she was hailed as autocrat. Her government, though in many respects excellent, became at last universally unpopular. This was due in the main to the outrageous insolence of her all-powerful favourite Biren, who hated the Russian nobility and trampled upon them mercilessly. Fortunately foreign affairs and the army were in the able hands of two other foreigners, who thoroughly identified themselves with Russia, Andrei Osterman (*q.v.*) and Burkhard Münnich (*q.v.*). The chief political events of the period were the War of the Polish Succession and the second Crimean War. The former was caused by the reappearance of Stanislaus Leszczyński as a candidate for the Polish throne after the death of Augustus II. (Feb. 1, 1733). The interests of Russia would not permit her to recognize a candidate dependent directly on France and indirectly upon Sweden and Turkey, all three powers being at that time opposed to Russia's "system." She accordingly united with Austria to support

the candidature of the late king's son, Augustus of Saxony. So far as Russia was concerned, the War of the Polish Succession was quickly over. Much more important was the Crimean War of 1736–39, which marks the beginning of that systematic struggle on the part of Russia to recover her natural and legitimate southern boundaries. It lasted four years and a half and cost her a hundred thousand men and millions of roubles, and, though invariably successful, she had to be content with the acquisition of a single city (Azov) with a small district at the mouth of the Don. Yet more had been gained than was immediately apparent. In the first place, it was the only war hitherto waged by Russia against Turkey which had not ended in crushing disaster. Münnich had at least dissipated the illusion of Ottoman invincibility and taught the Russian soldier that 100,000 janissaries and spahis were no match, in a fair field, for half that number of grenadiers and hussars. In the second place the Tatar hordes had been well nigh exterminated. In the third place Russia's signal and unexpected successes in the Steppe had immensely increased her prestige on the Continent. "This court begins to have a great deal to say in the affairs of Europe," remarked the English minister, Sir Claudius Rondeau, a year later.

The last days of Anne were absorbed by the endeavour to strengthen the position of the heir to the throne, the baby tsarevich Ivan, afterwards Ivan VI., the son of the empress's niece, Anna Leopoldovna, against the superior claims of her cousin the tsarevna Elizabeth. The empress herself died three months later (Oct. 28, 1740). Her last act was to appoint Biren regent during the infancy of her great-nephew.

Anne was a grim, sullen woman, frankly sensual, but as well-meaning as ignorance and vindictiveness would allow her to be. But she had much natural good sense, was a true friend and, in her more cheerful moments, an amiable companion. Lady Rondeau's portrait of the empress shows her to the best advantage.

See *Letters from a Lady who resided some years in Russia* (i.e., Lady Rondeau) (1775); Christoph Hermann Manstein, *Mémoires sur la Russie* (Amsterdam, 1771; English edition, London, 1856); Gerhard Anton von Halem, *Lebensbeschreibung des Feldm. B. C. Grafen von Münnich* (Oldenburg, 1803); Claudius Rondeau, *Diplomatic Despatches from Russia, 1728–1739* (St. Petersburg, 1889–92); R. Nisbet Bain, *The Pupils of Peter the Great* (1897); also the chapter in his vol. vi. of the *Cambridge Modern History* (1925).

ANNE (1665–1714), queen of Great Britain and Ireland, second daughter of James, duke of York, afterwards James II., and of Anne Hyde, daughter of the 1st earl of Clarendon, was born on Feb. 6 1665. As a child she resided in France with her grandmother, Henrietta Maria, and, on her death, with her aunt, the duchess of Orleans, and returned to England in 1670. She was brought up, together with her sister Mary, by the direction of Charles II., as a strict Protestant, and as a child she made the friendship of Sarah Jennings (afterwards duchess of Marlborough). On July 28 1683 she married prince George of Denmark, brother of King Christian V., an unpopular union politically, but one of great domestic happiness, the prince and princess being conformable in temper and both preferring retirement and quiet to life in the great world. Sarah Churchill became Anne's lady of the bedchamber and intimate friend. All deference due to the princess's rank was abandoned and the two ladies called each other Mrs. Morley and Mrs. Freeman.

On Feb. 6, 1685, James became king of England. In 1687 a project of settling the crown on the princess, to the exclusion of Mary, on the condition of Anne's embracing Roman Catholicism failed, and beyond sending her books and papers, James appears to have made no attempt to coerce his daughter into a change of faith, and to have treated her with kindness. In any case the birth of his son, June 10 1688, made the religion of his daughters a matter of less importance. Anne was not present on the occasion, having gone to Bath. "I shall never now be satisfied," Anne wrote to Mary, "whether the child be true or false. It may be it is our brother, but God only knows . . . one cannot help having a thousand fears and melancholy thoughts, but whatever changes may happen you shall ever find me firm to my religion and faithfully yours." In later years, however, she had no doubt that the Old Pretender was her brother.

¹Vasily Golitsuin's expedition under the regency of Sophia was the first Crimean War (1687–89).

During the events immediately preceding the revolution Anne remained in seclusion. Though forbidden by James to pay Mary a projected visit in the spring of 1688, she corresponded with her, and was no doubt aware of William's plans. She refused to show any sympathy with the king after William had landed in November and wrote, with the advice of the Churchills, to the prince, declaring her approval of his action. Churchill abandoned the king on the 24th, Prince George on the 25th, and when James returned to London on the 26th he found that Anne and her lady-in-waiting had escaped from Whitehall. They arrived on Dec. 1 at Nottingham, where the princess first made herself known and appointed a council. She returned to London on Dec. 19, when she was at once visited by William. Subsequently the Declaration of Rights settled the succession of the crown upon her after William and Mary and their children.

Meanwhile Anne had suffered a series of maternal disappointments. Between 1684 and 1688 she had miscarried four times and given birth to two children who died infants. On July 24 1689, however, the birth of a son, William, created duke of Gloucester, who survived his infancy, gave hopes that heirs to the throne under the Bill of Rights might be forthcoming. But Anne's happiness was soon troubled by quarrels with the king and queen.

According to the Duchess of Marlborough the two sisters, who had lived hitherto while apart on extremely affectionate terms, found no enjoyment in each other's society. Mary talked too much for Anne's comfort, and Anne too little for Mary's satisfaction. But money appears to have been the first cause of ill-feeling. The granting away by William of the private estate of James, amounting to £22,000 a year, to which Anne had some claim, was a grievance, and a motion brought forward in the House to increase her civil list pension of £30,000, which she enjoyed in addition to £20,000 under her marriage settlement, greatly displeased William and Mary, who regarded it as a plot to make Anne independent and the chief of a separate interest in the state. The Marlboroughs had been active in the affair and had benefited by it, the countess (as she then was) receiving a pension of £1,000. At the close of 1691 Anne had declared her approval of the naval expedition in favour of her father, and expressed grief at its failure. The same year the breach between the royal sisters was made final by the dismissal of Marlborough, justly suspected of Jacobite intrigues, from all his appointments. Anne took the part of her favourites with great zeal against the court, though in all probability unaware of Marlborough's treason; she refused to part with the duchess, and retired with Lady Marlborough to the duke of Somerset's residence at Sion House. Anne was now in disgrace. In May, Marlborough was arrested on a charge of high treason which subsequently broke down, and Anne persisted in regarding his disgrace as a personal injury to herself. In Aug. 1693, however, the two sisters were temporarily reconciled, and on the occasion of Mary's last illness and death Anne showed an affectionate consideration.

The death of Mary weakened William's position and made it necessary to cultivate good relations with the princess. She was now treated with every honour and civility, and finally established with her own court at St. James's Palace. At the same time William kept her in the background and refrained from appointing her regent during his absence. In March 1695 after the reinstatement of Marlborough at court Anne gave her support to William's government. Meanwhile, since the birth of the duke of Gloucester, the princess had experienced six more miscarriages, and had given birth to two children who only survived a few hours, and the last maternal hope flickered out on the death of the young prince on July 29 1700. In default of her own issue, Anne's personal choice would probably have inclined at this time to her own family at St. Germain's, but she acquiesced in the act of Settlement in 1701 and the substitution of the Hanoverian branch.

On March 8 1702, Anne became, by King William's death, queen of Great Britain, being crowned on April 23. Her reign was destined to be one of the most brilliant in the annals of England.

In her first speech to Parliament, like George III. afterwards,

Anne declared her "heart to be entirely English," words which were resented by some as a reflection on the late king. A ministry, mostly Tory, with Godolphin at its head, was established. She obtained a grant of £700,000 a year, and hastened to bestow a pension of £100,000 on her husband, whom she created generalissimo of her forces and lord high admiral, while Marlborough obtained the Garter, with the captain-generalship and other prizes, including a dukedom, and the duchess was made mistress of the robes with the control of the privy purse.

The queen showed from the first a strong interest in church matters, and declared her intention to keep church appointments in her own hands.

She detested equally Roman Catholics and dissenters, showed a strong leaning towards the high-church party, and gave zealous support to the bill forbidding occasional conformity. In 1704 she announced to the Commons her intention of granting to the church the Crown revenues, amounting to about £16,000 or £17,000 a year, from tithes and first-fruits (paid originally by the clergy to the Pope, but appropriated by the Crown in 1534), for the increase of poor livings; her gift, under the name of "Queen Anne's Bounty," still remaining as a testimony of her piety. This devotion to the church, the strongest of all motives in Anne's conduct, dictated her hesitating attitude towards the two great parties in the state. The Tories had for this reason her personal preference, while the Whigs, who included her powerful favourites the Marlboroughs, identified their interests with the war and its glorious successes, the queen slowly and unwillingly, but inevitably, gravitating towards the latter.

In 1704 Anne acquiesced in the resignation of Lord Nottingham, the leader of the high Tory party. In the same year the great victory of Blenheim further consolidated the power of the Whigs and increased the influence of Marlborough, but she long resisted the influence and claims of the *Junta*, as the Whig leaders, Somers, Halifax, Orford, Wharton and Sunderland, were named. Marlborough's successive victories, and the factious conduct of the Tories, who in Nov. 1705 moved in Parliament that the Electress Sophia should be invited to England, drove Anne farther to the side of the Whigs. But she opposed for some time the inclusion in the government of Sunderland, yielded, after a struggle, and only to the appointment of Whigs to bishoprics. In 1708 she was forced to dismiss Harley, who, with the aid of Mrs. Masham, had been intriguing against the government and projecting the creation of a third party. Abigail Hill, Mrs. Masham, a cousin of the duchess of Marlborough, had been introduced by the latter as a poor relation into Anne's service, while still princess of Denmark. The queen found relief in the quiet and respectful demeanour of her attendant, and gradually came to prefer her society to that of the termagant and tempestuous duchess. In the summer of 1707 the duchess discovered to her indignation that her protégée had already undermined her influence with the queen, and had become the instrument of Harley's intrigue.

Even after his retirement, Harley remained Anne's secret adviser and supporter against the faction and the duchess never regained her former influence. The inclusion in the cabinet of Somers, whom she especially disliked as the hostile critic of Prince George's Admiralty administration, was the subject of another prolonged struggle, ending again in the queen's submission after a futile appeal to Marlborough in Oct. 1708, to which she brought herself only to avoid a motion from the Whigs for the removal of the prince, then actually on his deathbed. He died Oct. 28. But no reconciliation with the duchess took place. The queen showed her antagonism to the Whig administration on the occasion of the prosecution of Sacheverell. She was present at his trial, and gave him, immediately on the expiration of his sentence, the living of St. Andrew's, Holborn. Subsequently the duchess, in a final interview which she had forced upon the queen, found her tears and reproaches unavailing. The fall of the Whigs followed.

The queen rejoiced at being freed from what she called a long captivity, and the new Parliament was returned with a Tory majority. On Jan. 17 1711, in spite of Marlborough's efforts to ward off the blow, the duchess was compelled to give up her key

of office. The Queen was now able once more to indulge in her favourite patronage of the church, and by her influence an act was passed in 1712 for building 50 new churches in London. Later, in 1714, she approved of the Schism Bill. She gave strong support to Harley, now earl of Oxford and lord treasurer, in the intrigues and negotiations for peace. To break down the opposition to the terms of the peace of Utrecht Marlborough was dismissed on the 31st from all his employments, while the House of Lords was "swamped" by Anne's creation of 12 peers, including Mrs. Masham's husband. The Queen's conduct was generally approved, for the nation was now violently adverse to the Whigs and war party; and the peace of Utrecht was finally signed on March 31 1713, and proclaimed on May 5 in London.

As the Queen's reign drew to its close, rumours were rife on the subject of the succession to the throne. Both Oxford and Bolingbroke were in communication with the Pretender's party, and on July 27 Oxford, who had gradually lost influence and quarrelled with Bolingbroke, resigned, leaving the supreme power in the hands of Bolingbroke. Anne herself had a natural feeling for her brother. On March 3 1714 James wrote to Anne, Oxford and Bolingbroke, promising, on the condition of his recognition, to make no further attempts against the Queen's Government; and in April a report was circulated in Holland that Anne had secretly determined to associate James with her in the Government. The wish expressed by the Whigs, that a member of the electoral family should be invited to England, had already aroused the Queen's indignation in 1708; and now, in 1714, a writ of summons for the electoral prince as Duke of Cambridge having been obtained, Anne forbade the Hanoverian envoy, Baron Schütz, her presence, and declared all who supported the project her enemies; while to a memorial on the same subject from the Electress Sophia and her grandson in May, Anne replied in an angry letter.

These demonstrations, however, were the outcome merely of her intense dislike of any "successor," "it being a thing I cannot bear to have any successor here though but for a week"; and it is certain that religion and political wisdom kept Anne firm to the Protestant succession. A proclamation was issued (June 23) for the apprehension of James. On April 27, Anne gave a solemn assurance of her fidelity to the Hanoverian succession to Sir William Dawes, Archbishop of York; in June she sent Lord Clarendon to Hanover to satisfy the elector.

The sudden illness and death of the Queen now frustrated any schemes which Bolingbroke or others might have been contemplating. Anne was seized with fatal illness on retiring from a council meeting at two o'clock in the morning. The final act of her life was to secure the Revolution settlement and the Protestant succession. During a last moment of returning consciousness, she placed the lord treasurer's staff in the hands of the Whig duke of Shrewsbury, and measures were immediately taken for assuring the succession of the elector. Her death took place on Aug. 1. She was buried on the south side of Henry VII.'s chapel in Westminster Abbey, in the same tomb as her husband and children. The elector of Hanover, George Louis, son of the Electress Sophia (daughter of Elizabeth, daughter of James I.), peacefully succeeded to the throne as George I. (q.v.).

According to her physician Arbuthnot, Anne's life was shortened by the "scene of contention among her servants. I believe sleep was never more welcome to a weary traveller than death was to her."

By character and temperament unfitted to stand alone, her life had been unhappy and tragical from its isolation. Separated in early years from her parents and sister, her one great friendship had proved only baneful and ensnaring. Marriage had only brought a mournful series of infant funerals. Constant ill-health and suffering had darkened her career. The claims of family attachment, of religion, of duty, of patriotism and of interest, had dragged her in opposite directions, and her whole life had been a prey to jealousies and factions which closed around her at her accession to the throne, and surged to their height when she lay on her deathbed. The modern theory of the relations between the sovereign and the parties, had not then been invented; and Anne, like her Hanoverian successors, maintained the struggle,

though without success, to rule independently, finding support in Harley. Her motive for getting rid of the Whigs was not any real dislike of their administration, but the wish to escape from the domination of the party¹, and on the advent to power of the Tories she carefully left some Whigs in their employments, with the aim of breaking up the party system and acting upon what was called "a moderate scheme."

Anne was a woman of small ability, of dull mind, and of that kind of obstinacy which accompanies weakness of character. According to the duchess she had "a certain knack of sticking to what had been dictated to her to a degree often very disagreeable, and without the least sign of understanding or judgment."² "I desire you would not have so ill an opinion of me," Anne writes to Oxford, "as to think when I have determined anything in my mind I will alter it."³ Burnet considered that "she laid down the splendour of a court too much," which was "as it were abandoned." She dined alone after her husband's death, but it was reported by no means abstemiously, the royal family being characterized in the lines:—

King William thinks all,
Queen Mary talks all,
Prince George drinks all,
And Princess Anne eats all.⁴

She took no interest in the art, the drama or the literature of her day. But she possessed the homely virtues; she was deeply religious, attached to the Church of England and concerned for the efficiency of the ministry. One of the first acts of her reign was a proclamation against vice, and Lord Chesterfield regretted the strict morality of her court. Instances abound of her kindness and consideration for others. Her moderation towards the Jacobites in Scotland, after the Pretender's expedition in 1708, was much praised by Saint Simon.

According to her small ability she served the State well, and was zealous and conscientious in the fulfilment of public duties. Marlborough testifies to her energy in finding money for the war. She surrendered £10,000 a year for public purposes, and in 1706 she presented £30,000 to the officers and soldiers who had lost their horses.

Anne's husband, Prince George (1653–1708), was the second son of Frederick III., king of Denmark. Before marrying Anne he had been a candidate for the throne of Poland. He was created earl of Kendal and duke of Cumberland in 1689.

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¹See Bolingbroke's *Letter to Sir W. Wyndham*.

²*Private Correspondence*, ii. 120.

³*Hist. MSS. Comm., MSS. of Marq. of Bath at Longleat*, i. 237.

⁴*Notes and Queries*, xi. 254.

of *Queen Anne's Bounty* (1867); *Somers Tracts*, xii. xiii. (1814-15); H. Paul, *Queen Anne* (London, 1907). (P. C. Y., X.)

ANNE (OF BRITTANY) (1477-1514), duchess of Brittany and queen consort of France, daughter of Francis II., duke of Brittany, and Marguerite de Foix. She was scarcely 12 years old when she succeeded her father as duchess, Sept. 9 1488. Charles VIII. aimed at establishing his authority over her; Alain d'Albret wished to marry her; Jean de Rohan claimed the duchy; and her guardian, the marshal de Rieux, was soon in open revolt against his sovereign. In 1489 the French Army invaded Brittany.

In order to protect her independence, Anne concluded an alliance with Maximilian of Austria, who married her by proxy (Dec. 1490). But Maximilian was immersed in Austrian affairs and could not defend his bride, and in 1491 the young duchess was besieged at Rennes, and compelled to treat with Charles VIII. The terms of peace included the rupture of her marriage with Maximilian, and marriage with Charles. The two sovereigns made a reciprocal arrangement as to their rights and pretensions to the crown of Brittany, but in the event of Charles predeceasing her, Anne undertook to marry the heir to the throne. Nevertheless, in 1492, after the conspiracy of Jean de Rohan, who had endeavoured to hand over the duchy to the king of England, Charles VIII. confirmed the privileges of Brittany, and in particular guaranteed to the Bretons the right of paying only those taxes to which the Assembly of Estates consented.

After the death of Charles VIII. in 1498, without issue, Anne ruled in Brittany, and in Jan. 1499 she married Louis XII., who had just repudiated Joan of France. The marriage contract was ostensibly directed in favour of the independence of Brittany, for it declared that Brittany should revert to the second son or to the eldest daughter of the two sovereigns, and, failing issue, to the natural heirs of the duchess. Until her death Anne occupied herself personally with the administration of the duchy. In 1504 she made an agreement for the marriage of her daughter, Claude of France, to Charles of Austria (the future Emperor Charles V.). But this unpopular agreement was broken and the queen had to consent to the betrothal of Claude to Francis of Angoulême, who in 1515 became king of France as Francis I. Thus the way was prepared for the definitive reunion of Brittany and France.

See A. de la Borderie, *Choix de documents inédits sur le règne de la duchesse Anne en Bretagne* (Rennes, 1866 and 1902)—extracts from the *Mémoires de la Société Archéologique du département d'Ille-et-Vilaine*, vol. iv. and vi. (1866 and 1868); P. A. N. B. Daru, *Histoire de Bretagne* (1816); Leroux de Lincy, *Vie de la reine Anne de Bretagne* (1860-61); A. Dupuy, *Histoire de La Réunion de la Bretagne à la France* (1880); A. de la Borderie, *La Bretagne aux derniers siècles du moyen âge* (1893), and *La Bretagne aux temps modernes* (1894).

(H. S.)

ANNE (OF CLEVES) (1515-1557), fourth wife of Henry VIII., king of England, daughter of John, duke of Cleves, and Mary, only daughter of William, duke of Juliers, was born on Sept. 22, 1515. Her father was the leader of the German Protestants, and the princess, after the death of Jane Seymour, was regarded by Cromwell as a suitable wife for Henry VIII. She had been brought up in a narrow retirement, could speak no language but her own, had no looks, no accomplishments and no dowry, her only recommendations being her proficiency in needlework and her meek and gentle temper. The marriage treaty was signed on Sept. 24, 1539. The princess landed at Deal on Dec. 27; Henry met her at Rochester on Jan. 1, 1540. The next day he expressed openly his dissatisfaction at her looks; "she was no better than a Flanders mare." The attempt to prove a pre-contract with the son of the duke of Lorraine broke down. On the wedding morning, however, Jan. 6, 1540, he declared that no earthly thing would have induced him to marry her but the fear of driving the duke of Cleves into the arms of the emperor. Shortly afterwards Henry had reason to regret the policy which had identified him so closely with the German Protestantism and denied reconciliation with the emperor. Henry then declared the marriage had not been and could not be consummated, and did not scruple to cast doubts on his wife's honour. On July 9 the marriage was declared null and void by convocation and, subsequently, by an act of parliament. Anne spent the rest of her life happily in England at Richmond

or Bletchingley, occasionally visiting the court, and being described as joyous as ever and wearing new dresses every day. She died on July 28, 1557, at Chelsea, and was buried in Westminster Abbey.

See A. Strickland, *Lives of the Queens of England*, iii. (1851); *Four Original Documents relating to the Marriage of Henry VIII. to Anne of Cleves*, ed. by E. and G. Goldsmid (1884); M. Hume, *The Wives of Henry VIII.* (1905); A. F. Pollard, *Henry VIII.* (1905); for the pseudo Anne of Cleves see *Allgemeine deutsche Biographie*, i. 467. A miniature by Holbein is in South Kensington Museum.

ANNE (OF DENMARK) (1574-1619), queen of James I. of England and VI. of Scotland, daughter of King Frederick III. of Denmark and Norway and of Sophia, daughter of Ulric III., duke of Mecklenburg, was born on Dec. 12 1574. On Aug. 20 1589, in spite of Queen Elizabeth's opposition, she was married by proxy to King James, without dower, the alliance, however, settling definitely the Scottish claims to the Orkney and Shetland islands. The birth of an heir to the throne (Prince Henry) in 1594 strengthened her position and influence; but the young prince was immediately withdrawn from her care and entrusted to the keeping of the Earl and Countess of Mar at Stirling Castle; in 1595 James gave a written command, forbidding them in case of his death to give up the prince to the queen till he reached the age of 18 years.

On the death of Queen Elizabeth, on March 24 1603, Anne took advantage of James's absence to demand possession of the prince, and, at the "flat refusal" of the Countess of Mar, fell into a passion, the violence of which occasioned a miscarriage and endangered her life. In June she followed the King to England with the prince and the coffin containing the body of her dead infant, and reached Windsor on July 2.

On July 24 Anne was crowned with the King, when her refusal to take the sacrament according to the Anglican use created some sensation. Notwithstanding religious differences she lived in great harmony and affection with the King, latterly, however, residing mostly apart. She helped to raise Buckingham to power in the place of Somerset, maintained friendly relations with him, and approved of his guidance and control of the King. In spite of her birth and family she was at first favourably inclined to Spain, disapproved of her daughter Elizabeth's marriage with the elector palatine, and supported the Spanish marriages for her sons, but subsequently veered around towards France.

She used all her influence in favour of the unfortunate Raleigh, answering his petition to her for protection with a personal letter of appeal to Buckingham to save his life. Her interest in State matters was only occasional, and secondary to the preoccupations of court festivities, dresses, jewels, which she much enjoyed; the court being, says Wilson—whose severity cannot entirely suppress his admiration—"a continued maskarado, where she and her ladies, like so many nymphs or Nereides, appeared . . . to the ravishment of the beholders," and "made the night more glorious than the day." Her extravagant expenditure, returned by Chamberlain at her death at more than £84,000, was unfavourably contrasted with the economy of Queen Elizabeth; her debts in 1616 were reckoned at nearly £10,000, while her jewellery and her plate were valued at her death at nearly £500,000. Anne died after a long illness on March 2 1619, and was buried in Westminster Abbey. She was generally regretted. She was intelligent and tactful, a faithful wife, a devoted mother, and a staunch friend. Besides several children who died in infancy she had Henry, Prince of Wales, who died in 1612, Charles, afterwards King Charles I., and Elizabeth, electress palatine and queen of Bohemia.

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ANNE (OF FRANCE) (1460-1522), dame de Beaujeu, was the eldest daughter of Louis XI. and Charlotte of Savoy. Louis XI. betrothed her at first to Nicholas of Anjou, and afterwards offered her hand successively to Charles the Bold, to the duke of

Brittany, and even to his own brother, Charles of France. Finally she married Pierre de Beaujeu, a younger brother of the duke of Bourbon. Before his death Louis XI. entrusted to Pierre de Beaujeu and Anne the entire charge of his son, Charles VIII., a lad of 13; and from 1483 to 1492 the Beaujeus exercised a virtual regency. Anne was a true daughter of Louis XI. Energetic, obstinate, cunning and unscrupulous, she inherited, too, her father's avarice and rapacity.

Although they made some concessions, the Beaujeus succeeded in maintaining the results of the previous reign, and in triumphing over the feudal intrigues and coalitions, as was seen from the meeting of the Estates General in 1484, and the results of the "Mad War" (1485) and the war with Brittany (1488); and in spite of the efforts of Maximilian of Austria and Henry VII. of England they concluded the marriage of Charles VIII. and Anne, duchess of Brittany (1491). But a short time afterwards the king disengaged himself completely from their tutelage, to the great detriment of the kingdom. In 1488 Pierre de Beaujeu had succeeded to the Bourbonnais, the last great fief of France. He died in 1503, but Anne survived him 20 years. From her establishments at Moulins and Chantelle in the Bourbonnais she defended the Bourbon cause against the royal family.

Anne's only daughter, Suzanne, had married in 1505 her cousin, Charles of Bourbon, count of Montpensier, the future constable; and the question of the succession of Suzanne, who died in 1521, was the determining factor of the treason of the Constable de Bourbon (1523). Anne had died on Nov. 14 1522.

See P. Pelicier, *Essai sur le gouvernement de la Dame de Beaujeu* (Chartres, 1882).

ANNEALING, a process of heating and cooling applied to glass and various metals and alloys, with the object of relieving stresses, or of altering the properties of the material. The result is softening, due to rearrangement. In its modern form the process is effected in closed furnaces. Another class of annealing is chemical in nature, being practised in the production of malleable iron castings. The chemical action occurs through the agency of substances, containing oxygen, packed with the castings in boxes and left for many days in the furnace. These substances extract the carbon from the castings.

Annealing Tool Steels.—Annealing becomes necessary for a variety of reasons in numerous manufactures. An early primary reason was and is to soften steel used to make tools, so that it can be cut, filed, turned, and so on, tools having no effect on hardened steel, though it may be ground with an abrasive wheel. Hence any hard bar or tool, if it cannot be worked up or sharpened by grinding, must be softened or annealed first. Bars and tools likewise require annealing after certain processes in manufacture, as casting, rolling, forging, and machining, in order to relieve the internal stresses caused thereby, otherwise the tools made therefrom would crack in hardening or in use. Annealing temperatures vary from 700° to 800° C. for carbon tool-steels, and from about 750° to 900° C. for high-speed tool-steels.

Annealing is also used in processes of manufacturing glass and many other materials. Not only relieving the strain, the annealing causes a rearrangement of the micro-constituents, improving homogeneity. An important essential is to avoid such application of heat as will cause scaling of the metal or alloy. Entire protection in a box or a muffle is sometimes given, or if direct flame impinges on the article, the quality of flame is regulated suitably to avoid fierce action. What is termed bright annealing is the most remarkable attainment in this direction, whereby stampings and other objects of steel, copper, brass, German-silver, etc., may be annealed once or several times with entire freedom from oxidation, scaling or discolouration. Polished surfaces left from rolling, drawing or other machines thus remain clean and bright, and cleansing treatments are rendered unnecessary.

An important application of annealing is its use on chains for pulley-blocks, cranes and other hoisting tackle, as well as some sorts of couplings subject to incessant duty. These become crystalline and fatigued if kept in service too long, and they are liable to fracture; but if the chains are annealed at intervals, this danger disappears.

Annealing Furnaces.—Furnaces for annealing are heated by coal, coke, town or producer gas or oil. The two first-mentioned fuels are not employed much for small furnaces. The smallest furnaces are but a few inches inside capacity, the largest will take steel plates, as much as 60ft. in length. Pieces of work go direct on the floor of the furnace, or in closed boxes, or the furnace is of muffle type, the flame being kept outside the heating chamber. Insertion and removal of the smaller specimens is performed by hand methods, but large units or batches of stampings, coils of wire, etc. require the help of a trolley or a crane. Special charging machines are also used that push the articles in by electric power, or hand gearing. In the case of the 60ft. plates referred to insertion or removal may be effected in 1½ minutes, leaving no risk of overheating of the end of the plate which enters the furnace first and leaves it last.

Large quantities of articles of small or moderate size are dealt with continuously by some form of conveyor system. For cart-ridges a rotary machine is utilised, having gas-burners which impinge on the shells whilst these are carried around automatically, and afterwards discharged down a chute. Closed furnaces have a spiral retort that passes the components through in a certain time, or a conveyor chain takes these through the length of the furnace. Bright annealing is largely done with conveyors.

Variations in Furnace Types.—In some furnaces the flames are kept away from the work, being carried round hollow walls. If the reverberatory construction is adopted, the heat descends directly on to the objects. Gas furnaces operate by natural draught or by blast, the latter giving a quicker heating up, and greater

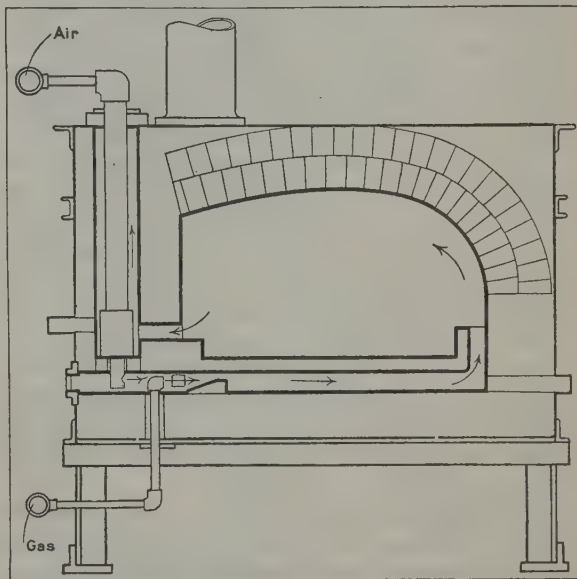


FIG. 1.—SECTION OF A BRAYSHAW, OVEN TYPE, ANNEALING FURNACE SHOWING ONE OF THE BURNERS AND ONE AIR-PIPE

The body is of fire-brick. Waste products, passing in the direction shown by the arrows, heat the air-pipes and thus assist combustion

temperature. Oil may be used in such furnaces, with a difference in the form of burner. Fig. 1 may be studied to understand the arrangement of an oven type annealing furnace. The body is composed of fire-brick bound together with plates and bars, and the design is of the recuperative style; the waste products pass in the direction of the arrows, and so heat the air-pipes, thus assisting combustion. In another design the incoming air is pre-heated by first passing under the furnace floor. In either class there is a marked saving in fuel. The twin-chamber furnace affords another example of economy, this having an upper chamber heated by waste products from the main one below; the work consequently may be pre-heated before being put into the main chamber. A section of a Manchester furnace (fig. 2, p. 988) shows the grate and flue arrangements; heating can be done by coal or coke or

both mixed. Special recuperative flues are built in alongside the firebox for pre-heating the air, these not in the section. Temperatures up to $1,100^{\circ}\text{C}$. are easily maintained. It may be mentioned that uniformity of heating is imperative for good work, while maintenance of the correct temperature (within a few degrees) should be guaranteed. (See also MATERIALS, STRENGTH OF; FORGING.) (F. H.)

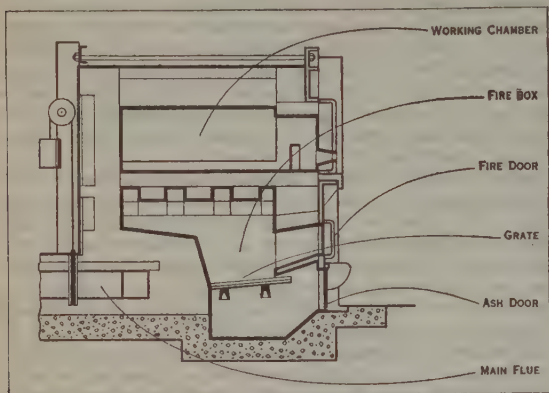


FIG. 2.—A MANCHESTER FURNACE WHICH CAN MAINTAIN, WITH CLOSE UNIFORMITY, A TEMPERATURE OF $1,100^{\circ}\text{C}$.

ANNÉCY, a chief town of the department of Haute Savoie, France. Pop. (1936) 22,901. It is situated at a height of 1,470 ft., amid fine scenery under the Crêt du Maure at the north end of the Lake of Annecy, 25 mi. by rail N.E. of Aix-les-Bains. Annecy was in the 10th century the capital of the counts of the Genevois, from whom it passed in 1401 to the counts of Savoy, becoming French in 1860 on the annexation of Savoy. The town, with its arcaded streets, is intersected by canals, and contains a 16th century cathedral church, an 18th century bishop's palace, and 14th–16th century castle (formerly the residence of the counts of the Genevois), and the reconstructed convent of the Visitation (19th century), which contains the body of St. François de Sales, born at Sales, close by, who held the see from 1602–22. The bishop's see of Geneva was transferred there in 1535, after the reformation, but suppressed in 1801, though revived in 1822. Linen and cotton goods, chocolate, leather, paper and small mechanical fittings are made; and a bell foundry at Annecy-le-Vieux is celebrated. This last-named place existed in Roman times.

The Lake of Annecy, about 9 mi. by 2 mi., is 1,465 ft. above sea level. It discharges, by means of the Thioux canal, into the Fier, which flows through remarkable gorges cut in the soft local sandstone, west of the town, to join the Rhône.

ANNELIDA, the segmented worms, a major phylum of the animal kingdom. The name, proposed by Lamarck, is practically synonymous with the obsolete term *Annulata* of Cuvier. The phylum includes earthworms and leeches, as well as a great number of marine, free-living or tubicolous species belonging to the class Polychaeta. Annelida are metamerically segmented, coelomate Metazoa provided with movable bristles known as setae (chaetae), which are lacking only in a few specialized forms and in leeches.

Basic Plan of Body.—The body of an annelid is described as a tube within a tube. The inner tube, or alimentary canal, is separated from the outer tube, or body wall, by the body cavity or coelom. A pre-segmental head region, corresponding to the episphere of the trochophore larva (fig. 4C and D), is followed by a metameric series of trunk somites. Each typical somite is, theoretically, a complete replica of the one that precedes it (homonymy). However, in virtually all species, there is some measure of differentiation (heteronymy), and in many of the sedentary polychaetes this process of regionalization has advanced to a high degree. The differentiation of segments introduces the correlated phenomenon for which W. Bateson created the term homeosis, the appearance of a structure proper to one

segment in or on another. Homoeotic factors play a very important role in annelidan morphology; an organ normally confined to a certain segment may appear, as a genetic mutation, in another, or a group of associated structures involving the regionalization of several successive segments, such as the male apparatus of megascolecid earthworms, may be displaced.

Body Wall and Musculature.—The epidermis is usually a simple columnar epithelium that secretes a thin cuticle at its surface; sometimes parts of the body are ciliated. A circular muscle coat, derived embryologically from mesectoderm of the somatic plate, underlies the epithelium and is external to the longitudinal musculature which, in contrast, arises from the mesoderm. Muscle fibres are usually smooth, rarely with typical cross-striations; the myofibrillae may completely encircle the sarcoplasm (tubular or hirudinoïd arrangement) or the sarcoplasm, containing the nucleus or nuclei, may be situated laterally (U-shaped or nematoid arrangement).

Setae.—The setae of polychaetes are borne upon projecting lobes (parapodia); in oligochaetes they are embedded in the body wall. Each seta is secreted by a single basal cell situated at the bottom of an epithelial invagination, the setal follicle. The form of the seta is thus determined by the changing activities of the basal cell which atrophies when its function is completed. The setae of *Sabellaria*, and probably also of other annelids, receive a superficial coating secreted by cells lining the follicle. The substance of the seta is a protein. New setae are formed in reserve follicles and move forward to replace the old ones which are discarded. A typical seta has a projecting shaft, and a basal portion or hilt, sunken within and closely invested by the follicle. In many polychaetes the shaft has a movable blade. The essential difference between an annelidan seta and the hairs, spines and bristles of the Arthropoda, lies in the fact that the former are embedded in their follicles, thus providing for the insertion of protractor and retractor muscles (fig. 17C).

Coelom.—Embryologically the body cavity is a schizocoel, developing as a split in the mesoderm. Corresponding to the segmentation of the body, it is typically divided into compartments by transverse partitions, the septa. Septa may be imperfect or lacking, as in the pelagic polychaet *Tomopteris*. They are often strongly muscularized, especially anteriorly, in forms with burrowing habits. The coelom of leeches is almost completely occluded by connective and botryoidal tissue. One of the functions of the coelomic fluid is maintenance of turgor which, in the absence of a skeleton, gives rigidity to the body. Perforations in the septa permit the flow of coelomic fluid from one segment to another; and in many forms, notably those polychaetes in which the vascular system is reduced and the coelomic fluid must perform respiratory functions, circulation is aided by ciliation of the peritoneum. In earthworms of the oriental genus *Pheretima* the flow of coelomic fluid is regulated by sphincter muscles which guard the septal openings; thus it is possible for one part of the body to remain turgid while the rest is relaxed.

The coelomic fluid of marine polychaetes is isosmotic with sea water and contains little or no protein; in earthworms it is more dilute but proteins are present. Coelomic corpuscles are of two main types: leucocytes of various sorts, amoeboid and phagocytic or filled with secretory materials, and chloragogue cells. The latter form a special tissue which invests the surface of the intestine, blood vessels and sometimes other organs. Like the vertebrate liver, chloragogue tissue is the site of many phases of intermediary metabolism, including the temporary storage of food reserves and the elaboration of nitrogenous excretory products. Erythrocytes, found in many polychaetes, contain a respiratory pigment (see below).

Vascular System.—The annelidan vascular system is a closed one. According to A. Lang's trophocoele theory, the most primitive part is the per-intestinal blood plexus. A dorsal longitudinal vessel collects blood from this system, and also from the body wall and other organs, and pumps it forward to the anterior end. From here it passes by lateral connectives (typically, contractile "hearts") to the ventral vessel. The latter is a thin-walled, non-contractile tube which acts as the main distributing organ. The

vascular system may be greatly elaborated, or it may be reduced or rudimentary; in some leeches it is in open communication with coelomic lacunae, forming a kind of haemocoel.

Acetyl choline accelerates the heart beat, which is apparently "neurogenic" like that of Crustacea rather than "myogenic" like that of vertebrates (C. L. Prosser and G. L. Zimmerman). Contractions are independent of the central nervous system but nerve cells occur in the walls of the vessels. Contractility may reside in the lining endothelium or be supplemented by Rouget cells and smooth muscle fibres of the adventitia.

Respiratory Pigments.—The blood and body fluid may be colourless; when present, the respiratory pigments are iron-proteins, usually with an iron-porphyrin (haemin) as prosthetic group. Erythrocruorins, similar to vertebrate haemoglobin, are of common occurrence. Chlorocruorins, which occur in some polychaetes, have a different porphyrin; they are green in dilute and red in concentrated solutions. The little polychaete *Magelona* is unique in having haemerythrin, the respiratory pigment of Sipunculida (*q.v.*), enclosed in blood corpuscles. With this exception, the respiratory pigments are either (1) in solution in the blood plasma, or (2) contained in coelomic corpuscles. A few polychaetes (*Terebella*, *Travisia*) have both red blood plasma and coelomic erythrocruorocytes. Intracorporeal pigments are of relatively low molecular weight, one-half to one-quarter that of vertebrate haemoglobin (69,000), and therefore containing one or two, rather than four, haemin groups. Plasma pigments have enormous molecular weights, of the order of 3,200,000 (T. Svedberg). According to M. Romieu, the presence of a respiratory pigment in solution is primitive, and degeneration of the vascular system led to its enclosure within coelomic corpuscles. A Redfield has argued that the reverse is more probable. The high molecular weight of the plasma pigments serves to prevent their diffusion out of the blood vessels, and to lower their osmotic pressure which would otherwise have a disturbing effect upon osmo-regulation.

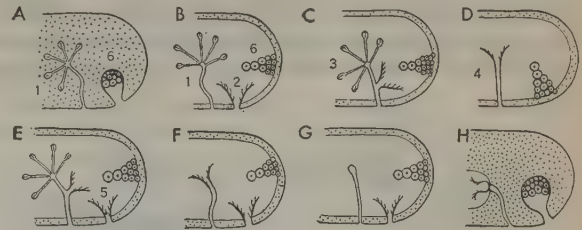
The erythrocruorin of the common earthworm is an oxygen carrier, playing the same role that haemoglobin does in vertebrates (M. L. Johnson); but in the lugworm, *Arenicola*, the pigment can only give up its oxygen to the tissues under conditions of extreme deficiency. Normal needs are supplied by oxygen in solution in the body fluids and the reserve is drawn upon when the worm is confined to its burrow during exposure at low tides.

Alimentary Canal.—The structure is very diversified, according to the mode of life and food habits of the worm. The pharynx and a restricted rectal invagination are ectodermal. Chitinous jaws may be present (most polychaetes and biting leeches), or absent (most oligochaetes and sucking leeches). Sedentary polychaetes with crowns of tentacles are often filter feeders. Archannelids and some true polychaetes possess a blind ventral pharyngeal pouch. The calciferous glands of earthworms are discussed under Oligochaeta (*see below*). Diverticula of the midgut occur both in polychaetes and oligochaetes, but are the exception rather than the rule; leeches have well-developed diverticula. Anal respiration is common in aquatic species. Intracellular digestion does not seem to occur but enzymatic investigations of the digestive juices and studies of the process of assimilation are very inadequate.

Excretory Organs.—The nephridia are straight, looped or coiled tubes lying in the coelom and opening externally, or into the gut. The ental end may be closed by tufts of solenocytes, similar to the flame cells of flatworms, or there may be an open, ciliated funnel (nephridiostome). The former condition is termed protonephridial, the latter metanephridial. A pair of protonephridia constitute the excretory system of the typical annelidan larva, and there is every reason to believe that this is primitive. According to E. S. Goodrich, metanephridia are protonephridia that have acquired an internal opening, and both are of ectodermal origin, while coelomoducts are mesodermal funnels that function as gonoducts; in some polychaetes a nephromixium is formed by the attachment of a coelomic funnel to the nephridium. A. Meyer advanced an alternative theory that open coelomic funnels are always coelomoducts, thus metanephridia are nephro-

mixia, and the gonoducts of oligochaetes, present in the same segments with the nephridia, must be a secondary acquisition. In the remarkable nephridia of leeches the nephridiostome has no communication with the blind end of the nephridial tube.

Ammonia is the chief nitrogenous excretory product of aquatic



BY COURTESY OF GRACE E. PICKFORD

FIG. 1.—DIAGRAM SHOWING ARRANGEMENT OF EXCRETORY AND GENITAL DUCTS IN ANNELIDA: (1) PROTONEPHRIDIUM WITH FLAME CELLS OR SOLENOCYTES. (2) PRIMARY COELOMODUCT. (3) NEPHROMIXIUM. (4) METANEPHRIDIUM. (5) SECONDARY COELOMODUCT (MEYER). (6) GONAD A. Platyhelminthes: no body cavity; closed protonephridia with flame cells; gonads continuous with their ducts. B. Annelida, ancestral plan: closed protonephridia; sex cells liberated into body cavity escape either by rupture of the body wall (not shown) or through primary gonoducts (coelomoducts). C. Annelida, many Polychaeta: genital funnel becomes attached to excretory organ, forming a nephromixium (Goodrich). D. Annelida, some Polychaeta: an open metanephridium subserving both genital and excretory functions. According to Goodrich the nephridiostome is ectodermal, an opening out of the ental end of the nephridium. According to Meyer it is mesodermal and the nephridium is derived from a nephromixium by loss of the solenocytes. This condition is also found in Sipunculida and Echiurida. E. Annelida, some species of *Tomopteris*: according to Meyer there is a nephromixium with secondary gonoducts in addition. F. Annelida, some Polychaeta and most Oligochaeta: excretory organ is an open metanephridium, as in D, but separate genital ducts are present. The latter are primary coelomoducts according to Goodrich, secondary gonoducts according to Meyer. G. Annelida, a few Oligochaeta: the metanephridium is secondarily closed. H. Annelida, Hirudinea: typical leech arrangement; body cavity largely occluded, nephridiostome opens into reduced coelom, but is closed toward the blind ental end of the nephridial duct to which it is attached

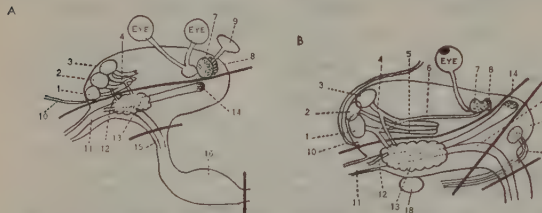
species; the urine of earthworms contains both ammonia and urea. As in the vertebrate kidney, there are three aspects of nephridial function: filtration, resorption and secretion. Coelomic fluid is filtered through closed solenocytes, but the ciliated funnels of open nephridia can only segregate corpuscles and suspended particles of moderate size. In oligochaetes, whose coelomic fluid contains proteins, there is active resorption of colloidal particles in the ciliated section of the tubule (athrophagocytosis, R. Cordier). The tubules must also resorb inorganic ions to produce the hypotonic urine of earthworms (K. N. Bahl). In addition to the activities of the end organ, the whole nephridium is bathed in coelomic fluid and excretory products are brought to it by the blood and by coelomocytes. In *Arenicola* particles collected by the latter are actively secreted by the tubules (C. Strunk).

Nervous System.—The brain, situated dorsally at the anterior end, belongs to the presegmental region (episphaere) of the larva. It communicates by circumpharyngeal connectives with the ventral nerve cord. The latter is embryologically double; the two halves may become completely fused, or they may remain separate, but united by transverse commissures like the rungs of a ladder. Ganglion cells are concentrated in segmental swellings.

The neurology of the brain reaches its highest development among nonsedentary polychaetes. Nerves from the special sense organs enter the brain and are distributed to association centres (corpora pedunculata, globuli) of which there may be one, two or three pairs. In many annelids, as in arthropods, the first ganglion of the ventral cord may become cephalized as the tritocerebrum (fig. 2). B. Hanström believed that the two anterior components of the arthropod brain are represented in annelids by a primitive "Ur-gehirn," or proto-deutocerebrum. The brain contains neurosecretory cells of unknown function (B. Scharer) while chromaffin cells occur in the segmental ganglia of many annelids. These cells elaborate, and probably secrete, an adrenalinlike substance; J. F. Gaskell considered them to be forerunners of the adrenal medullary cells of vertebrates.

The nerve cord of many annelids is provided with giant nerve

fibres (neurocords) which may be either simple or compound. The former are merely very large neurons, their axis cylinders arising from individual giant cells situated in the brain or in segmental ganglia. Compound neurocords, best known among the Oligochaeta, are multicellular structures, each axon receiving contributions from numerous cell bodies along its course. Moreover, each fibre is formed by the end-to-end fusion of segmental components; the intersegmental synapse can be recognized histologically but offers no barrier to transmission of the nerve impulse,



ADAPTED FROM HOLMGREN IN "ROYAL ACAD. SCI. PUB." SWEDEN

FIG. 2.—THE BRAIN OF A POLYCHAETE, NEREIS, COMPARED WITH THE BRAIN OF AN ONYCHOPHORE, PERIPATUS

A. *Nereis*, B. *Peripatus*. The three heavy black lines indicate the limits between the protocerebrum, deutocerebrum and tritocerebrum. (1) First globulus, (2) second globulus, (3) third globulus, (4) globuli tracts, (5) trabecula, (6) peduncle, (7) central body (Corpus striatum) fibres, (8) central body ganglionic cells, (9) nuchal organ, (10) nervus tegumentarius, (11) antennal tract, (12) anterior antennal commissure, (13) antennal glomerulus, (14) antennal commissure, (15) tractus subantennalis, (16) tritocerebrum, (17) stomato-gastric nerve, (18) ventral organ (rudimentary)

perhaps because of its direct, one-to-one relation. The function of giant fibre systems is the mediation of a rapid stereotyped response, such as an escape movement (T. H. Bullock); and, in general, they are high-speed motor pathways. Vertebrate nerve fibres which conduct at similar speeds, 25 m. per sec. and more, are of much smaller diameter but are provided with thick myelin sheaths. The myelotropic sheath of an annelidan giant fibre is extremely thin and it is thought that there may be a correlation between sheath thickness, fibre diameter and speed of conduction (G. W. Taylor).

Sense Organs.—Tactile endings and taste buds are widely distributed, especially at the anterior end. Statocysts occur in many polychaetes, either as epidermal invaginations containing sand grains (fig. 3A) or as closed subepidermal pockets with statoliths. Eyes are often highly developed, varying from simple pigment spots to elaborate structures provided with lens and retina (fig. 3B). Photoreceptor cells of oligochaetes are located in the skin (fig. 3C) and on nerves and the somewhat similar organs of leeches may be arranged in groups forming a direct or an inverted compound receptor (fig. 3D).

Reproductive Organs.—The gonads discharge their products into the coelom, or into genital sacs of coelomic origin. Nourishment for the growth and maturation of the sex cells is provided by the coelomic fluid or mediated by chloragogue cells; the oöcytes of some species have nurse cells. In many polychaetes the majority of segments are fertile, but there is a tendency toward limitation among diverse forms, and this trend reaches its culmination in the oligochaetes. The bisexual condition found in most polychaetes is believed to be primitive, but many hermaphroditic forms are known. The sex products escape through coelomoducts, or, in many polychaetes, by rupture of the body wall. The secondary sexual apparatus reaches its highest development in oligochaetes and leeches whose special hermaphroditic arrangements are adapted to reciprocal copulation.

Development.—Annelidan eggs, like those of flatworms and molluscs, exhibit spiral cleavage (fig. 4A and B). The first four blastomeres, customarily indicated by the letters A—D, give rise by alternating clockwise and anticlockwise divisions to a cap of micromeres at the animal pole. A solid gastrula is formed by overgrowth of the micromeres, some cells of which are arranged in a characteristic pattern, the "Annelidan cross." The typical marine larva is a pelagic trochophore (fig. 4C and D), named from the ciliated band (prototroch) which encircles the equator

and divides the body into episphere, with apical plate, eye-spots and future brain, and hyposphere with alimentary canal, protonephridia and other internal organs. Oligochaetes and leeches, which lay eggs enclosed in cocoons, as well as many polychaetes, omit the free-swimming larva and their development is consequently condensed and modified.

Studies of cell-lineage, originating with the pioneer work of E. B. Wilson, reveal that one of the first four cells, the D blastomere, has an especially significant destination. From it is derived micromere 2d which gives rise to the somatic plate contributing the ectoderm of the adult, and micromere 4d which divides to form the mother cells, left and right mesoteloblasts, of the future mesoderm. In many annelids, as in some molluscs, the D blastomere is visibly as well as potentially distinct; it, and the CD blastomere from which it is derived, may be considerably larger and a part of their contents may be relegated to the so-called "polar lobe" during cell division. The somatic plate grows ventrally and, in typical annelidan development, divides the blastopore into mouth-forming and anus-forming regions. The first three somites are formed practically simultaneously, during larval life; in many species there follows a pause. At metamorphosis the body begins to grow in length by the addition of new segments derived from the teloblasts or, in more specialized cases, by new contributions from an apical growth zone.

Studies on annelidan eggs have contributed much critical information regarding the mosaic type of development. Experiments such as those of A. Penness who used a beam of ultraviolet light to destroy individual blastomeres, have confirmed the earlier observations that development is determinate, with little or no powers of regulation. It was on annelidan eggs that F. R. Lillie first discovered that polarity, laid down in the cytoplasmic structure of the unfertilized egg, can not be changed by centrifugation which only displaces the visible metaplastic inclusions. Of equal significance was the observation that eggs treated with potassium chloride may undergo differentiation, even as far as the trochophore stage, without a partitioning of the cytoplasm such as normally follows each nuclear division: Annelidan eggs have also lent themselves to the study of organ-forming substances, as by the use of vital stains, and, in the critical case of *Nereis dumerilii* studied by J. Spek, the eggs contain a natural indicator, the ectoderm-forming animal pole being tinted violet (alkaline), the endoderm-forming vegetal pole pale yellow (acid). (See INVERTEBRATE EMBRYOLOGY; EXPERIMENTAL EMBRYOLOGY.)

Regeneration.—L. Hyman pointed out that annelids are the most highly organized animals capable of complete regeneration. Regenerative abilities are lacking in leeches, but most polychaetes and oligochaetes can regenerate an amputated tail except from the more anterior, cephalized segments. Conversely, ability to replace an amputated head is usually restricted to the anterior part of the body, although species, like *Lumbriculus*, that multiply by asexual fragmentation, can form a new head at almost any level. In forms that possess a definite number of morphologically cephalized segments, e.g., Naididae and tubicolous polychaetes such as *Chaetopterus*, the exact number is regenerated as a unit and posterior regions are then reorganized under the influence of the new head. Lumbricidae regenerate a hypomeric head of only three to five segments, lacking reproductive organs, but some earthworms are capable of complete or even hypermeric anterior regeneration (*Perionyx*, *Criodrilus*). G. E. Gates obtained a reversal of polarity in *Perionyx*; in this species an anterior piece of the body will regenerate a head at both ends when cut simultaneously, if the anterior head is then removed the heteromorphic head becomes dominant and evokes tail regeneration at the new cut. Anterior regeneration is possible, but often defective, in the absence of a nerve cord at the cut surface. M. Avel finds that morphogenetic capacities are localized in the ventral body wall, that the digestive tube is necessary for the regeneration of the endoderm, and that a brain may be formed *de novo* from regenerated ectoderm. Neoblasts are special cells which migrate to regions of regeneration and may contribute the mesoderm of the blastema; their morphogenetic role is doubted.

The phenomena of annelid regeneration appear to indicate a

physiological dominance of the anterior end, in concordance with the theory of the axial gradient (C. M. Child). (See AXIAL PHYSIOLOGICAL GRADIENTS.)

Fossil Annelids.—Burrows interpreted as those of wormlike creatures are known as early as the pre-Cambrian, and a glimpse of the rich invertebrate life of Middle Cambrian seas is preserved in the Burgess Shales of British Columbia. C. D. Walcott, who discovered these remains, described several genera of segmented worms provided with parapodia on all segments, as in typical non-sedentary polychaetes of the present day. Some resemble living forms, such as scaleworms and the sea mouse. Apart from this, the annelids are among the most poorly known groups preserved in the fossil record. Their chitinous jaws, in the form of minute, shiny black denticles known as scolecodonts, are especially abundant in the Middle Palaeozoic and occur in marine sediments from the end of the Cambrian onward. Calcareous tubes closely similar to those of modern polychaetes, e.g., *Serpula* and *Spirorbis*, are found in various geologic periods, while others, like the trumpet tubes of *Cornulites*, belong to extinct genera. The shells of Palaeozoic brachiopods and lamellibranchs are occasionally marked by U-shaped mud-blisters (*Caulostrepsis*) similar to those of the polychaet *Polydora* which, today, is a pest to oysters and oyster-growers. Jurassic crinoids were infested by parasites belonging to the aberrant polychaet family Myzostomidae. Denticles known as conodonts, which differ from scolecodonts both in chemical composition (calcium phosphate) and mode of formation, have sometimes been thought to represent the jaws of an extinct group of annelids. They are found in pairs, or in assemblages of pairs often representing several "genera." It is evident from their structure that they must have been overlain by their secreting tissues, as the enamel layer of a developing tooth is overlain by the amelocytes of the dental rudiment. Sometimes they appear to be attached to an ill-defined substrate, conceivably cartilage but probably not bone; on the whole it is likely that they are denticles of some pro-vertebrate, now extinct. All records of fossil oligochaetes are doubtful, but J. Stephenson is of the opinion that earthworms could not have evolved before the end of the Mesozoic.

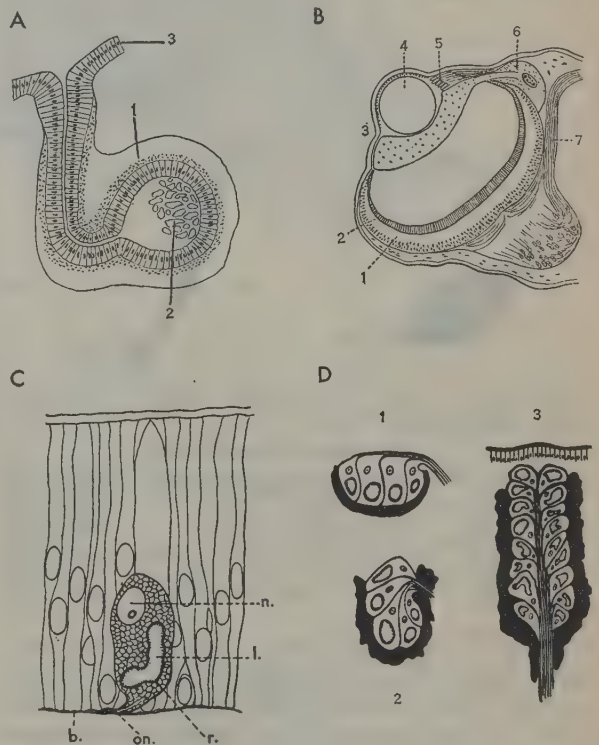
Classification within the Phylum.—The present article recognizes three classes: Polychaeta (including Archiannelida and the Myzostomidae), Oligochaeta and Hirudinea. The Polychaeta are primarily marine; they are the most numerous, the most diverse and phylogenetically the oldest. The Archiannelida, formerly regarded as primitive, appear to comprise a miscellany of divergent types, related to Polychaeta but difficult to classify on account of their partly degenerate and partly persistent larval features. The Echiurida, often regarded as a class of the Annelida, are placed in a separate phylum in accordance with views expressed by many investigators. The Hirudinea are very closely related to the Oligochaeta, so closely that there is scarcely a single peculiarity of the leeches which can not be matched among parasitic oligochaetes. W. Michaelsen united these two classes into one, the Clitellata, named for the girdle or clitellum which, in both, secretes the egg cocoon. On the other hand leeches constitute a well-defined assemblage which it is more convenient to treat as a separate class. The greatest gulf in intra-annelidan phylogeny is that which divides the polychaetes from the oligochaetes. In the past it was customary to unite these two groups in the class Chaetopoda, on account of the presence of setae. The leeches were thus artificially separated from their closest relatives.

Origin of Oligochaeta.—The peculiarities that unite the clitellates (reciprocal copulation, clitellum forming egg cocoon) must be correlated with their predominantly fresh-water and terrestrial habits that preclude a free-swimming larval stage. Evolution from marine ancestors could have taken place: (1) from littoral habitats by direct invasion of the land, or (2) from estuarine, free-swimming forms, via rivers to fresh-water swamps and thence to the land. In the former case the fresh-water families would be descended from terrestrial or limicolous ancestors, in the latter *vice versa*. It happens that the inter-relationships of the oligochaete families are such that they appear to form a

linear sequence from minute, free-living fresh-water forms, via medium-sized limicolous species to the terrestrial families. This sequence may be read either way. If the small aquatic forms are ancestral (W. Michaelsen) oligochaetes can not be derived from polychaetes but must spring from some ancient "archiannelidan" stock.

The alternative view (J. Stephenson), that ancestral oligochaetes may have been medium-sized worms living in mud, opens up the possibility of derivation from some group of littoral polychaetes, probably now extinct.

Fresh-water and Terrestrial Ecology.—A fresh-water worm must be adapted to the hypotonicity of the medium, to the greater extremes of temperature, and to the many other exigencies of its new environment. Interesting experiments, such as those of W. G. Ellis, have been made on the osmo-regulation of marine and brackish-water polychaetes. A stenohaline species, like *Nereis cultrifera*, will die in 20% sea water because it swells up and bursts due to uncontrolled endosmosis. A euryhaline species, like *N. diversicolor*, can make the necessary adjustments through its ability to excrete both salt and water. Earthworms must constantly eliminate water through the nephridia and, if need be, through the gut. There is also a tissue tolerance for lowered salinity of the body fluids. The body temperature of an earthworm is kept below that of the environment by constant



(A, B, D) FROM KÜHNAL'S "HANDBUCH D. ZOOLOGIE" (BERLIN); (C) FROM W. N. HESS IN "JOURNAL OF MORPHOLOGY," VOL. 41, NO. 1 (1925), PUBLISHED BY THE WISTAR INSTITUTE OF ANATOMY AND BIOLOGY

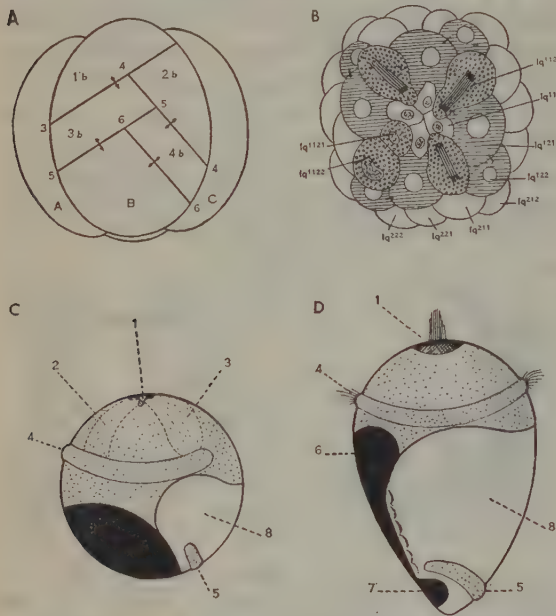
FIG. 3.—SENSE ORGANS OF ANNELEIDA

A. *Arenicola marina*. Statocyst; (1) connective tissue wall of statocyst, (2) statoliths, (3) epidermis. B. *Alciopa cantarinii*. Section through the eye; (1) retinal cells, (2) rods, (3) cornea, (4) lens, (5) accessory retina, (6) cell secreting anterior portion of vitreous body, (7) optic nerve. C. Photoreceptor cell of *Lumbricus terrestris*; (b.) basement membrane, (l.) lens, (n.) nucleus, (on.) optic nerve, (r.) retinella. D. Eyes of Hirudineal; (1) *Glossiphonia*, (2) *Herpobdella*, (3) *Hirudo medicinalis*

evaporation (L. Hogben and R. L. Kirk); this is necessary because the thermal death point of the tissues is low (28.5° C.) like that of marine forms.

Relationships to Other Phyla.—The Echiurida (*q.v.*) are closely related to the Annelida, they possess setae but lack meta-

meric segmentation, probably as the result of a secondary suppression. The Sipunculida (*q.v.*) are more highly modified, lacking both setae and recognizable segmentation so that their annelidan affinities are obscured; their most outstanding characteristic is the forward migration of the anus. Both Echiurida and Sipunculida show features in common with Mollusca (*q.v.*), but the early stages of molluscs and annelids are so similar that few would deny their fundamental affinities. E. Reisinger pointed out that most theories regarding the origin of the Annelida are untenable; the most acceptable is that which relates the trochophore larva to some ancestral turbellarian of the phylum Platyhelminthes (*q.v.*). Before the onset of metamerism it is legitimate to compare the young stages of a segmented with an unseg-



(A) FROM WILSON, "THE CELL," (B) FROM MACBRIDE, "TEXTBOOK OF EMBRYOLOGY" BY PERMISSION OF THE MACMILLAN COMPANY, PUBLISHERS; (C, D) FROM KÜKENHAL'S "HANDBUCH D. ZOOLOGIE" (BERLIN)

FIG. 4.—ANNELIDAN DEVELOPMENT

A. Diagram of spiral cleavage. B. Apical view of developing egg of *Polygordius*, showing the annelidan cross (stippled). Micromeres numbered according to the conventional terminology. C, D. Development of a Polychaete; (1) apical plate, (2) anterior limb of the annelid cross, (3) posterior limb of the annelid cross, (4) prototroch, (5) telotroch (paratroch), (6) future mouth, (7) future anus, (8) somatic plate derived from micromere 2d. The stippled areas represent the larval ectoderm, the black area, the blastopore field. The stippled area above the prototroch is the episphere, the one below, the hyposphere

mented phylum; the nervous system of the annelidan larva is especially instructive, differing radically from that of the adult and resembling that of the platyhelminth orthogon. In passing, it must also be noted that setae of the annelidan type are present in one apparently totally unrelated phylum, the Brachiopoda (*q.v.*).

The gap between Annelida and Arthropoda (*q.v.*) is bridged by intermediate features of the Onychophora (*q.v.*), a group that has become highly specialized at a low level of arthropodan evolution. Arthropoda have jointed appendages which appear to permit, and certainly do not preclude, comparison with parapodia; the coelom is reduced and its place is taken by an open vascular system (haemocoel); blood is received directly into the heart through openings called ostia, a condition not paralleled among Annelida. Arthropods must be regarded as the culmination of annelidan evolution, a point of view which provides some justification for their union in a phylum Articulata, proposed long ago by Cuvier.

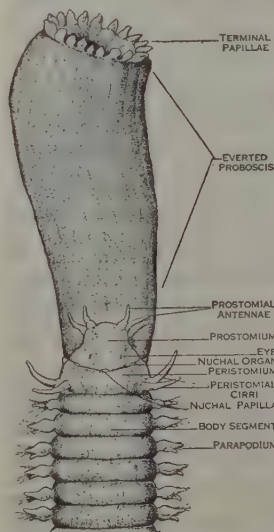
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(G. E. P.)

CLASS I. POLYCHAETA

The name Polychaeta refers to the numerous tufts of setae at the sides of the body. This class is the largest of the phylum Annelida. It comprises 64 families with about 1,600 genera and more than 10,000 species. Its members are widely distributed over all the world in marine habitats but some are found also in brackish and fresh water and in moist earth. They occur largely in littoral zones of all oceans, in depths to about 100 fathoms, but some have been recorded from all explored depths of the sea. Certain groups predominate in tropical waters (Eunicea, Amphinomididae), others in cold waters (Maldanidae, Ampharetidae), still others are geographically limited (many genera). Some are entirely pelagic (Tomopteridae, Alciopidae) but many others are pelagic only through larval stages. Some are largely sand-



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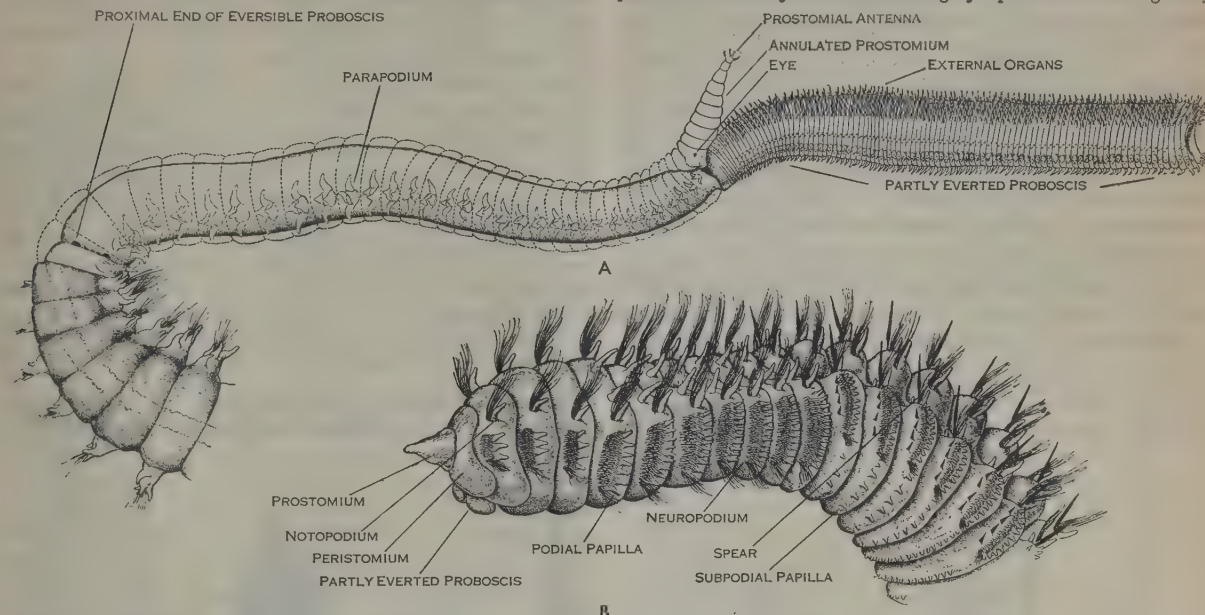
FIG. 5.—ANTERIOR END OF ETEONE, WITH PROBOSCIS EVERTED, IN DORSAL VIEW

dwelling (Nephtyidae), others are rock-borers or nestlers (Serpulidae), some are commensal and a few are parasitic.

External Structure.—The general form varies greatly, depending on whether habits are sedentary, errantiate or pelagic. Diversity in shape is illustrated in some of the common group names, such as bamboo worm, sea mouse, feather duster, shield worm. In size they vary from a fraction of a mm. (some Archannelida) to more than six feet (some Eunicea). Colour varies from brilliant iridescent or metallic to dull or colourless and

or acicula (fig. 7). They consist of an upper, or notopodial, and a lower, or neuropodial, branch, or the notopodium may be lacking. Each of these parts may have characteristic presetal and postsetal lobes, a dorsal cirrus above and a ventral cirrus below. Associated with the parapodia there may be epithelial outgrowths. The various fleshy lobes may be modified as cirri, branchiae or gills, tentacles or elytra (fig. 10).

Setae.—These are hardened secretions formed by certain parapodial cells. They come to be highly specific and are greatly



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FIG. 6.—A. ANTERIOR END OF GLYCINDE, WITH PROBOSCIS PARTLY EVERTE D, IN RIGHT LATERAL VIEW. B. ANTERIOR END OF PHYLO, WITH PROBOSCIS PARTLY EVERTE D, IN LEFT LATERAL VIEW

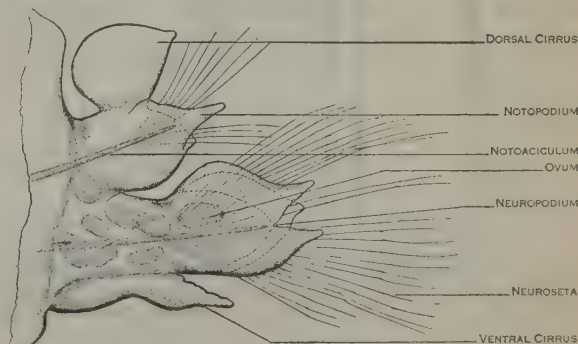
patterns may be highly ornamental. Luminescence may heighten the display of colour and pattern.

The outer surface of the body is fleshy or at least not chitinized; it may be provided with cilia, stiff hairs, sensory papillae, thick scutigerous plates or other modified supporting parts. In some, however, especially in pelagic species, the entire body may be highly translucent. The body consists of head, trunk and tail, or more appropriately prostomium with associated parts, metastomium (which may be divisible into thorax and abdomen) and pygidium. The preoral portion or prostomium may be a simple lobe or highly developed. It is followed by the first segment or peristomium, surrounding the ventral mouth, and this by successive segments which may be similar (fig. 5) or greatly diversified. A pair of palpi (outgrowths of the peristomium) may accompany the mouth. The pygidium may be simple or highly modified and provided with accessory structures. Except in processes of regeneration or abnormal growth, increase in number of segments occurs only in the growth region, immediately in front of the pygidium. The number of segments may be few and limited (some Polynoidae) or many and indefinite (many Polychaeta).

The prostomium may be a simple, entire lobe with or without eyes, or it may be ringed (fig. 6A), incised or ornamented with antennae, ctenidia or other sensory structures. The anterior end of the alimentary tract may be eversible as an epithelial pouch (fig. 6B) or a muscular, cylindrical proboscis (fig. 5); its surface may be nearly smooth or equipped with hard chitinized pieces, called paragnaths, and jaws or with variously formed papillae or special organs (fig. 6A).

Parapodia.—The metasome is provided with characteristic paired appendages or parapodia. They are fleshy, lateral outgrowths of the body wall, ornately developed or reduced to low ridges or tori. They are usually provided with fascicles of extensible, chitinized bristles or setae and supporting, embedded rods

diversified. They are simple (fig. 8B-J) or jointed (fig. 8A); their cutting edges are smooth, serrated or sculptured. In shape they are needlelike to hooked, or paddlelike, or avicular (fig. 8). They may form paleae, spines, hooks without or with a long handle, spears (fig. 9), spinning threads (Polyodontidae), dorsal felt (Aphroditidae) or other modified structures. Acicula also may be simple rods or modified for special purposes as hooks (Pilargiidae), brushes (fig. 8H), etc.



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FIG. 7.—BIRAMOUS PARAPODIUM OF GONIADA, IN ANTERIOR VIEW

The origin and structure of setae has been the subject of controversy and investigation. They are secretions of certain cells and continue to be replaced during the life of an individual, the lowermost dropping out as worn, the newly developing ones pushing in from above. They probably consist of an inner matrix penetrated by longitudinal, strengthening fibrils which push out

to form the surface ornamentation; the whole is overlain by an investing sheath. In some species, where adult stages become pelagic (fig. 12), special paddlelike composite setae replace the normal ones. Setae function for locomotion, to gain traction, to maintain stabilization, to aid in swimming, possibly also for defense and other uses.

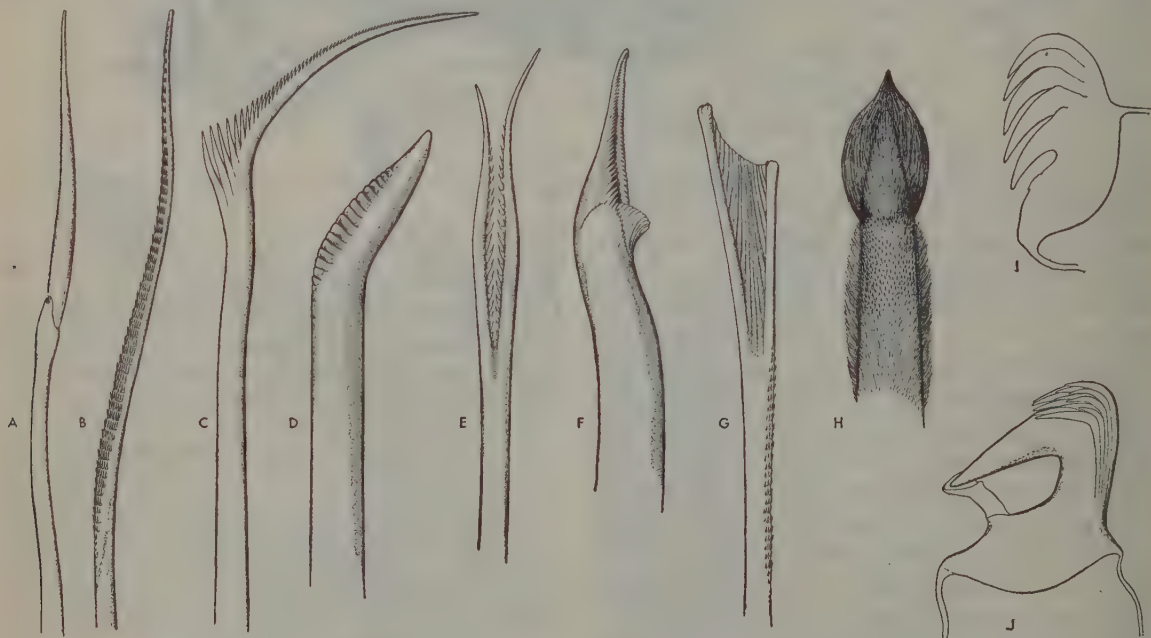
Branchiae.—These structures are sometimes lacking, especially in smaller forms where respiration is accomplished through the surface epithelium. In most polychaetes, however, there are special structures on various parts of the body. Structurally they are epithelial outgrowths penetrated by a vascular loop. They may be simple filaments or tufts, or they may be pectinately divided or ornately spiralled (*Diopatra*). They may be stationary or eversible (some *Glyceridae*). They are often associated with parapodial parts, or limited to branched structures at the anterior end of the body, as in many tube-dwelling forms. The tentacular crown of sabellids and serpulids probably functions both for food gathering and for respiration. In some, the branchiae are outgrowths of the peristomium and retractile into the oral aperture (*Ampharetidae* and others).

Sense Organs.—These function as photo-, chemo- and tangoreceptors. They include the eyes, lateral organs, dorsal ciliated ridges or mounds, statocysts or otocysts, taste buds, various kinds of papillae, stiff hairs and other modifications. The most commonly present are the eyes; these may be simple pigment spots or highly complex, lenticular organs, especially in pelagic species. In location they may be prostomial (fig. 5), peristomial (*Terebellidae*), segmental at the sides of the body (*Opheliidae*), on the

eridae) or serial (fig. 9) arrangement or they may occur as stiff hairs or modified cirri (*Nephtyidae*). Statocysts or otocysts function for maintaining equilibrium and are widely present in many *Sedentaria*. They may be open or closed to the exterior. Numerous small organs of specific design (figs. 11B-E) are characteristic of the proboscis of some (*Glyceridae* and *Goniadidae*). An apical pore leads through a canal to one or several large basal cells, surrounded by connective tissue and epithelium. In addition, neural connection with the nerve complex in the proboscis is made through axial cells. Their structure suggests that they function at least partly to gain attachment and traction and are concerned largely in locomotion.

Special epithelial glands are present in some groups, although their function is not clearly understood. In some orbinids they occur only in posterior thoracic segments and are associated with spears (fig. 9); they have been called repugnatory glands but such function may be argued. Cement glands, posterior to the mouth, secrete fluid to aid in cementing grains of sand in tube construction (*Sabellariidae*). Parapodial spinning glands (fig. 10) are present in some tube-dwelling forms. These glands secrete fine threads which are applied to the walls of the tube by means of special brushlike acicula (fig. 8H). In the sea mouse, comparable secreted threads form the thick dorsal felt. Luminous glands, believed to be oxidative and perhaps excretory, are present in many tube-dwelling species, epitokous forms and others.

Internal Structure.—The alimentary, vascular, excretory, sensory, nervous, respiratory, musculature and reproductive sys-



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FIG. 8.—A. COMPOSITE SETA FROM *ETEONE*. B. SPINOUS SETA FROM *HAPLOSCOLOPLOS*. C. SERRATED SETA FROM *AMPHITRITE*. D. RIDGED UNCINUS FROM *ORBINIA*. E. FURCATE SETA FROM *AGLAOPHAMUS*. F. HOODED UNCINUS FROM *GLYCINDE*. G. SPINOUS FURCATE SETA FROM *PHYLLOCHAETOPTERUS*. H. PENICILLATE ACICULA FROM *DISOMA*. I. PECTINATE UNCINUS FROM *LOIMIA*. J. AVICULAR UNCINUS FROM *SCIONIDES*

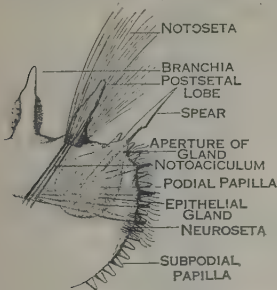
pygidium (some *Sabellidae*) or on the tentacular crown (*Eudistylia*). Lateral organs are ciliated, eversible or stationary pockets, usually located at the sides of the body and segmentally arranged. Those on the prostomium are called nuchal organs (fig. 5). They are most abundant among some *Sedentaria*. They consist of an innervated pouch provided with cilia or hairs. They may function in detection of currents or other external phenomena. Taste buds may be especially abundant in the vicinity of the palpi, proboscis or mouth.

Tangoreceptors may occur as papillae in diffuse (*Flabellig-*

tems display many modifications and are highly diversified. The outer layer of the body wall is epithelial. This is succeeded by circular, longitudinal and oblique muscular layers of which the second is the most important. A coelomic epithelium lines the more or less spacious perivisceral cavity. Successive body segments are typically separated from each other by transverse septa, marking the intersegmental grooves. Muscle tissue is usually smooth, but double striated muscle occurs in *Magelona* and others.

Alimentary Canal.—This is a continuous tube, consisting

of the anterior oral cavity and terminating with the posterior anus. It may be a straight tube, or coiled or segmentally diverticulated. There are often accessory glands or pouches (fig. 10). The anterior part may be an eversible proboscis, especially in errantiate species; this may be sacklike and epithelial or long, cylindrical (fig. 6) and muscular. It may be provided with horny jaws and paragnaths, with papillae or special sense organs. It functions both for food-getting and for locomotion. A barrel-shaped proventriculus and ventriculus with lateral caeca may follow the pharynx (Syllidae). The stomach and intestine lead to the anus.



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FIG. 9.—THORACIC PARAPODIUM OF PHYLO, IN ANTERIOR VIEW

tile vessels. The blood may be colourless (Syllidae), red (Capitellidae) due to the presence of haemoglobin, or green (Flabelligeridae) due to chlorocruorin. A peculiar muscular heart or cardiac body is characteristic of many Sedentaria. It is a glandular organ in intimate contact with the dorsal vessel and the walls of the intestine; it contains granular bodies and is deeply pigmented. Its function is doubtful but perhaps concerned with intravascular excretion (F. Hemplemann). Where a closed vascular system is lacking, the blood is propelled, with other coelomic elements including leucocytes, phagocytes, ova, etc., through a general body cavity.

Excretory System.—Nephridia, sometimes called segmental organs, are of two kinds, protonephridia and metanephridia. The first start blindly within and are provided with vibratile cells or solenocytes. They are characteristic of the families Nephtyidae, Glyceridae, Phyllodocidae and some pelagic groups. Metanephridia are tubes that are more or less coiled and open internally as a funnel or nephridostome. They occur in some Errantia, most Sedentaria and Archiannelida. Nephridia may be segmental, a pair to each segment (many Errantia) or multiple to diffuse (some Capitellidae) or they may be reduced to one to few on anterior segments (Sedentaria). They function to collect and transport waste products from the coelom to the exterior, through nephridiopores that are usually located near a part of the parapodium.

Nervous System.—This system includes a dorsal brain in the prostomium, supplying eyes, palpi, antennae and nuchal organs. This is connected, through a circumoesophageal commissure, to the ventral, ganglionated, paired cords, which may be more or less widely separated (Archiannelida) or fused to form a single cord (*Eunice*). A tetra-neurous condition may be due to a secondary division (Amphinomidae). Lateral branches supply the various segmental elements including parapodia and other fleshy parts. The ventral cord may be embedded in the epithelium or lie freely in the coelomic cavity. Corpora pedunculata, or association centres, serving especially palpi and eyes, are developed in some Errantia (B. Hanström) but perhaps absent in others.

Reproduction.—Although most polychaetes are dioecious, numerous instances of hermaphroditism, protandry and parthenogenesis have been described. Viviparity with hermaphroditism (some syllids and serpulids) or viviparity with parthenogenesis (some cirratulids and syllids) are recorded. Individuals arising from such phenomena may develop into epitokous males and females (R. Herpin). In addition, schizometamerism (fragmentation) may give rise to regenerated individuals of both sexes which enter the plankton as epitokes (A. Dehorne).

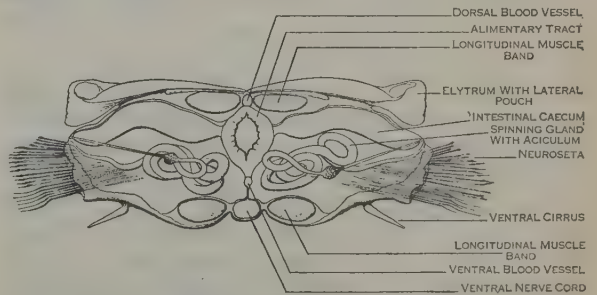
In some species alternation of generations, involving sexually mature, atokous (sedentary) and epitokous (swimming) stages may occur regularly (Nereidae and Syllidae). In some instances there is a marked change in the body, involving a breaking down of the alimentary tract, enlargement of eyes and parapodia and replacement of normal for special, swimming setae. Also there may be marked dimorphism, such as in the polybostrichus (fig. 12) and sacconereis stages of *Autolytus*. In addition, alternation of large and small generations of epitokes is described for *Platynereis* (F. Hemplemann). Swarming at sexual maturity is now known for many families (L. Fage and R. Legendre) but best known for the palolo worm (*q.v.*) of the south Pacific, a West Indian *Eunice*, and a Japanese nereid.

Asexual reproduction is known through budding and transverse fission (syllids and serpulids) and accidental or regular fragmentation. In some instances, asexual stolons give rise to posterior chains of sexual individuals (*Salmacina*); this process is called blastogamy.

Reproductive organs are segmental and usually widely distributed over the length of the body. Gonads first appear on septa of certain segments; the undeveloped ova are shed into the coelom where they are nourished by special nurse cells or other coelomic inclusions. Ripe ova and sperm may leave the body through special gonoducts or they may be shed by rupturing of the body wall.

Development.—The fertilized ovum, unless provided with much yolk, typically gives rise, through spiral cleavage, to a pelagic ciliated larva called a trochophore (fig. 13). The main band of cilia is the prototroch; it is preoral in position. The mouth and anus may be derived from the blastopore, or the anus may arise secondarily. The entire body or metastomium is said to be derived from a single cell resulting from an early cleavage (*Arenicola*, *Polygordius*) but, in many other polychaetes, the entire body except for a few (3 to 14) anterior, so-called larval segments, is said to develop from a preanal, ectodermal, growth zone; these segments are called metatrochophoral (P. P. Iwanoff). The trochophore stage is followed by a polytroch stage, with a few segments, and this by various, larval, free-swimming forms. Metamorphosis results in the replacement of larval structures for those characteristic of the adult and is sometimes abrupt. In some polychaetes, development of the young takes place in capsules or cocoons, with hatching in an advanced stage, resembling the adult. Excess of yolk in the egg or the practice of cannibalism (some spionids) or viviparity (syllids) may provide the materials for development.

Classification.—There is no satisfactory major grouping of the numerous families of Polychaeta in spite of repeated efforts in that direction. They are usually divided into the free-moving ones or Errantia (successive segments similar) and the tube-dwellers or Sedentaria (body divided into thorax and abdomen).

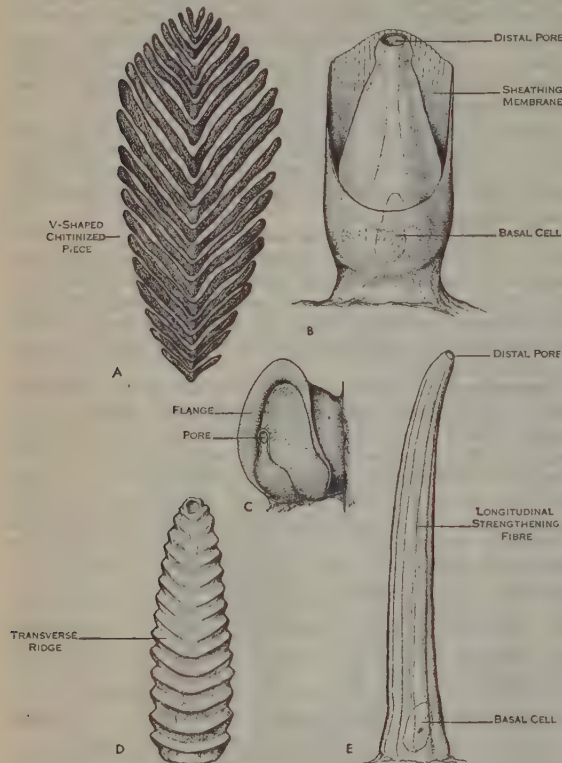


BY COURTESY OF OLGA HARTMAN
FIG. 10.—CROSS SECTION OF BODY SEGMENT OF PANTHALIS

Though this separation is convenient, it allies many tube-dwellers with the Errantia and free-moving ones with the Sedentaria. Likewise, they have been divided into the Phanerocephala or visible headed, and the Cryptocephala or covered headed ones, but this also allies many unlike forms. A more practical plan groups families that have obvious affinities; thus, the scaleworms include those provided with elytra, the eunicids are those with

certain characteristic jaw-pieces, the spioniform ones have a pair of long, prehensile palpi, etc. This plan, however, leaves many families with no obvious affinities. However, this is to be expected in a group as old and large as the marine annelids, since many forms perhaps once extensive have since disappeared from living or also fossil records.

The most helpful guides for identification are those of P.



BY COURTESY OF OLGA HARTMAN

FIG. 11.—A. CHEVRON FROM PROBOSCIS OF GONIAIDA. B. A SINGLE ORGAN FROM PROBOSCIS OF GLYCERA CONVOLUTA. C. A SINGLE ORGAN FROM PROBOSCIS OF GONIAIDA BRUNNEA. D. A SINGLE ORGAN FROM PROBOSCIS OF GLYCERA TENUIS. E. A SINGLE ORGAN FROM PROBOSCIS OF GLYCERA TESSELLATA

Fauvel; they omit only a few small families, but the keys to genera include only 362 of a total of nearly 1,600 genera. It is necessary, therefore, to resort to many widely scattered references to identify most of the species of Polychaeta known today.

The families include the following 64. Among the Errantia are the Aphroditidae, Polynoidae, Polyodontidae, Polylepididae, Sigalionidae and Pareulepidae (or scaleworms) with which the Pisionidae are allied; the Chrysopetalidae and Palmyridae (or paleal worms); the Amphinomidae, Euprosinidae and Spintheridae (or fireworms); the Phyllodocidae, Lopadorhynchidae, Alciopidae, Iosipillidae, Lacydonidae, Typhloscolecidae, Pontodoriidae and Tomopteridae (the leaf and pelagic worms); the Hesionidae and Pilargiidae (including probably Otopsiidae); the Syllidae, Nereidae and Nephtyidae; the Sphaerodoriidae, Goniadidae and Glyceridae; the Eunicea with Onuphidae, Euniciidae, Lumbrineridae, Arbellidae, Lysaretidae and Dorvilleidae; the parasitic Histiobdellidae, Ichthyotomidae and Myzostomidae (see below). The Sedentaria include the Orbinidae, Paraonidae and Apistobranchidae; the Spionidae, Magelonidae, Disomidae, Chaetopteridae; the Cirratulidae, Longosomidae, Ctenodrilidae; the Flabelligeridae; the Scalibregmidae, Opheliidae, Capitellidae, Arenicolidae, Maldanidae and Oweniidae; the Sternaspidae; the Pectinariidae and Ampharetidae; the Terebellidae, Sabellidae,

Serpulidae and Sabellariidae. The Archiannelida (see below) include the Dinophilidae, Nerillidae and Polygordiidae.

Some of these families are monospecific (Ichthyotomidae); others are known through more than 200 species (Polynoidae). Major diagnostic characters pertain especially to the shape and form of the anterior end of the alimentary tract, detailed patterns of parapodia, and those of head structures. Also, in many instances the setae are so specific that they immediately delegate an individual to a particular family.

Phylogeny.—Several theories have been advanced, deriving Polychaeta from more primitive forms but none has received unreserved support. Among these are the trochophore theory (B. Hatschek) relating the annelids with the ctenophores, rotifers and molluscs, the turbellarian (A. Lang) in which pseudometamerism of flatworms is believed to have given rise to true metamerism, the coelenterate (A. Sedgwick) in which bilateral symmetry of Anthozoa supposedly gave rise to a prolonged body with closed alimentary tract, and the linear budding (C. Gegenbaur) in which metamerism may have arisen through the hanging together of discrete units. See F. Hemplemann for discussion and bibliography.

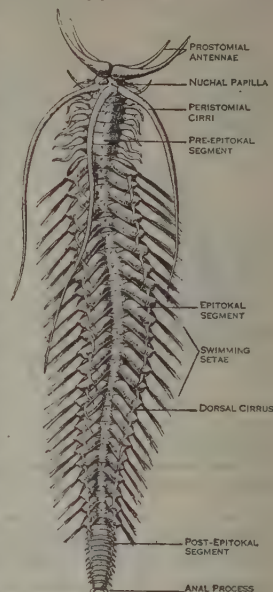
Regeneration.—Replacement of lost parts is common. Restoration of lost anterior and posterior portions is highly developed in some, and may be associated with reproduction (see P. P. Iwanoff for lengthy discussion).

Food.—Many Polychaeta are plankton feeders (Sedentaria), others are slime-feeders, capturing smaller organisms in secreted mucus, and some are ferocious predators. The accessory organs about the mouth and anterior end often indicate the mode of feeding.

Parasitism and Commensalism.—The Histiobdellidae are

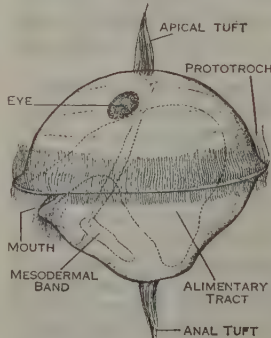
parasitic in the branchial cavity of lobsters and crayfishes, the Ichthyotomidae are blood-sucking on fins of fishes, the Myzostomidae are parasitic in or on echinoderms, and several Eunicea are parasitic in the body cavity of other annelids and a brittle star. Many other polychaetes, notably *Parasitosyllis*, may be externally parasitic. They are themselves parasitized by numerous organisms, notably gregarines and other protozoa, orthonectid Mesozoa, trematodes and other Metazoa. Commensalism occurs commonly, especially among some polynoids, Hesionidae (with echinoderms) and Spintheridae (with sponges). It may be facultative or obligatory, and often occurs in the tubes of other polychaetes.

Incubation.—Instances of incubation and parental care are widespread. Some serpulids (*Spirorbis*) deposit the eggs in the operculum; polynoids are known to carry eggs under the elytra; some Eunicea guard eggs in cases or other devices. In species



BY COURTESY OF OLGA HARTMAN

FIG. 12.—EPITOKOUS MALE OR POLYOSTRICHUS-STAGE OF AUTO-LYTUS, IN DORSAL VIEW



BY COURTESY OF OLGA HARTMAN

FIG. 13.—TROCHOPHORE OF A SERPULID, IN LEFT LATERAL VIEW, MUCH ENLARGED

of *Exogone* the eggs are segmentally attached to the sides of the body, the young remaining there to an advanced stage; this has been called external gestation but is more comparable with the attachment of eggs to the pleopods of some decapods. In some sponiids the eggs are laid in stalked capsules in which the young develop to an advanced stage, the more robust ones feeding on the yolk sacks of the more retarded ones. Viviparity is known for some cirratulids, syllids and nereids.

Tube-building.—Tubes are as variable as the numbers of species that construct them. They may be secretions or aggregations of extraneous materials. If secreted, they may be mucoid (onuphids), calcareous (serpulids), fibrous (polyodontids), or cartilaginous (sabellids). If aggregated, they may be sandy (sabellariids), muddy (terebellids) or reinforced with shell, rock or algal fragments (ampharetids).

Economic.—By virtue of their great abundance in all seas and diversity of activities, polychaetes are important agents in constructing reefs and shoals, and in vertical transport of soils. Many serve as food for larger organisms and some are much used as fish bait. A few are destructive pests (*Polydora* in oysters) and some may cause injury to man (amphinomids). The palolo has been collected for food by inhabitants of the south Pacific islands.

Palaeontology.—Fossil remains of polychaetes are limited largely to hard parts such as calcareous tubes, hard jaws or trails and burrows. The best preserved remains have been described by Walcott from the Middle Cambrian in British Columbia. Much of the literature has been brought together in H. W. Shimer and R. R. Shrock.

Ecology and Distribution.—Nearly all polychaetes are marine; they are especially abundant in littoral zones but inhabit also the greatest known depths of the oceans. Factors controlling their distribution and occurrence are probably linked with kind of substratum, temperature and history of the species. Some families are entirely pelagic. Many creep over surfaces; others burrow, bore, nestle or are associated with other biotic elements. Nearly all families are represented in both Atlantic and Pacific oceans except for a few that are known through only one or few species. Concerning genera, there are many limited to particular oceans, seas or even geographic units. This is especially the case for monospecific genera and those represented by few species. In specific categories, restrictions are even more obvious, with some species known to occupy only very restricted areas or niches. On the other hand, many are circummundane, particularly in tropical waters, others are circumboreal and some are considered cosmopolitan. A few smaller forms, frequently occurring as contamination organisms, are widely distributed; such are *Ctenodrilus serratus*, *Dinophilus gyrocilatus* and *Ophryotrocha puerilis*. Some, as the salt-tolerant nereid, *Neanthes succinea* and the temperature-tolerant serpulid, *Serpula vermicularis*, occupy great geographic areas.

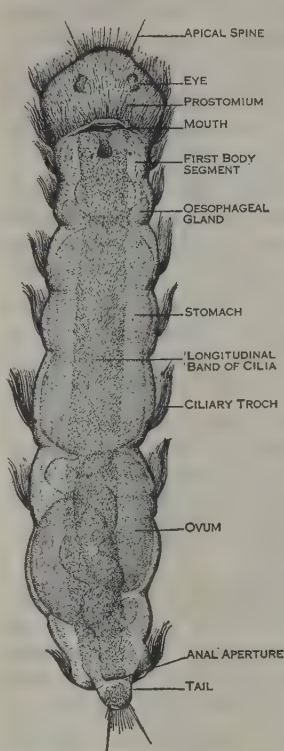
BIBLIOGRAPHY.—General and systematic: P. Fauvel, "Polychètes errantes," *Faune de France*, vol. 5 (1923), and "Polychètes sédentaires," *Faune de France*, vol. 16 (1927); F. Hemplemann, "Vermes Polymera," *Handbuch der Zoologie*, vol. 2 (Lief. 12, 13) (1931). These two sets are comprehensive in general information and give extensive bibliographies. Reproduction, development and regeneration: A. Dehorne, "Le cycle reproducteur annuel de *Dodecaceria concharum* au Portel. La Schizometamerie," *C. R. Acad. Sci. Paris*, vol. 184, pp. 547-549 (1927); L. Fage and R. Legendre, "Pêches planctoniques à la lumière effectuées à Banjuls-sur-Mer et à Concarneau," *Arch. zool. exp. gén. Paris*, vol. 67, pp. 23-222 (1927); R. Herpin, "La reproduction de l'Annelide polychète *Leptonereis glauca* Claparède serait-elle parthenogenetique?" *Bull. Biol. France Belgique*, vol. 67, pp. 291-297 (1933); P. P. Iwanoff, "Die Entwicklung der Larval-segmente bei den Anneliden," *Zeits. Morph. Ökol. Tiere*, vol. 10, pp. 62-161 (1928). Nervous system: B. Hanström, *Vergleichende Anatomie des Nerven-systems der wirbellosen Tiere, unter Berücksichtigung seiner Funktion* (1928). Palaeontology: H. W. Shimer and R. R. Shrock, *Index Fossils of North America* (1944).

MYZOSTOMIDAE

The Myzostomidae are considered an aberrant family of the class Polychaeta. They are associated with echinoderms, chiefly crinoids, less often brittle stars and sea stars. They are usually

external or internal parasites, creeping freely over the surface or causing galls. About 123 species are known (G. Jägersten) of which 117 are referred to the single genus, *Myzostomum*, 3 to the genus *Protomyzostomum*, 2 to *Mesomyzostomum* and 1 to *Stelechopus*. Because of their aberrant modifications, associated with their parasitic mode of life, they have been variously grouped with trematodes, tardigrades, Crustacea, leeches and linguatulids, but are here recognized as polychaetes, especially because of their larval trochophore.

Morphology.—The body is discoid to oblong, depressed and bilaterally symmetrical. Length varies from one-half to nine mm.



BY COURTESY OF OLGA HARTMAN
FIG. 14.—*DINOPHILUS GYROCILIATUS*, IN VENTRAL VIEW, FROM LIFE

wherein the male may be only one-fifth as long as the female phase. There are usually ten pairs of lateral cirri that may be reduced or absent, and five pairs of parapodia that are ventral or lateral in position, alternating with four pairs of ventral suckers, homologous with the lateral organs of other polychaetes. Parapodia are equipped with acicula and hooks. The mouth is anteroventral; it leads to a muscular, eversible, unarmed pharynx, thence into an oesophagus, a stomach with caeca, an intestine and a terminal cloaca. The body cavity or coelom is reduced to a space above the midgut and a pair of ventrolateral cavities or ovisacs for which the oviducts open into the cloaca. Nephridia usually number only one pair. The circulatory system is reduced or absent.

Reproduction is typically through protandric hermaphroditism, the young functioning as a male, thereafter changing to a female. The small egg gives rise to a trochophore larva, provided with prototroch and metatroch, and this to a polytroch with three incompletely separated segments. The settling larva must find a host or perish.

BIBLIOGRAPHY.—G. Jägersten, *Arkiv för Zoologi*, vol. 29A, pp. 1-35, 2 pls. and 34 figs. (1937) gives a good bibliography; vol. 31, pp. 1-21, 13 figs. (1939) gives an account of development. R. von Stummer-Traunfels, *Handbuch der Zoologie*, vol. 3, pp. 132-310 (1926) is a good reference.

ARCHIANNELIDA

This comprises a small number of polychaetes that do not readily ally themselves with the other families. They are considered an appendage of the class Polychaeta. The members are largely marine or brackish water inhabitants, especially in intertidal zones, but some live in fresh water. They are characterized especially for their small size, reduced organ systems and peculiar modifications. They are a heterogeneous group, lumped together for convenience only.

Three families are recognized, the Nerillidae with 5 species in 3 genera, *Nerilla*, *Nerillidium* and *Troglochaetus*; the Polygordiidae (or Protodrilidae) with 32 species in 4 (or 5) genera, *Polygordius*, *Protodrilus*, *Protannelis*, *Saccocirrus* (which may include *Chaetogordius*) (R. G. Aiyar and K. H. Alikunhi) and the Dinophilidae with 8 (or 9) species in 3 genera, *Dinophilus*, *Diurodrilus* and *Triobodrilus*. Names which occur not infrequently in the literature, Archichaetopoda and Protochaeta, both refer to species of *Saccocirrus*, and that of *Trichotoma* refers to *Dinophilus*; they are thus included among the Archannelida.

The organization of the body plan is essentially as in other Polychaeta, but parapodia and setae may be greatly reduced or even lacking. Segmentation may be well marked or hardly visible. The body may be provided with bands or tufts of cilia. The prostomium sometimes has eyes, palpi, nuchal organs or also antennae. The alimentary tract may have an eversible proboscis. The anus is terminal or somewhat dorsal. The nervous system is ectodermal and includes paired ventral ganglia. A circulatory system is simple or lacking. Nephridia are either simple (protonephridia) or complex in origin (metanephridia); they may be few in number to segmental. In some species the sexes are separate and monomorphic or dimorphic (some species of *Dinophilus*); others are hermaphroditic (some Polygordiidae). Development proceeds from a trochophore larva through metamorphosis to a settling young, or is direct, the young resembling the adult. The largest species occur among the Polygordiidae where length may attain 100 mm.; the smallest are among the Dinophilidae where length is measured in fractions of mm.

The Archiannelida are neither degenerate nor primitive, as has been thought. The absence of many parts can be partly attributed to loss because of their small size. Supposedly primitive characters, such as ectodermal contact of the nervous system, presence of bands of cilia, absence of setae, a simple vascular system, have their counterparts among some other polychaetes. Those most nearly resembling other polychaetes are members of the Nerillidae. They are distinctly segmented, retain parapodia with setae; the prostomium is provided with palpi or also antennae and most species are marine. They are usually dioecious but sometimes hermaphroditic.

The Polygordiidae are also usually marine, but parapodia are reduced or absent and the anal end is provided with adhesive glands. In the development of species of *Polygordius*, the metamorphosis of the endolarva to the exolarva, within a few minutes, has been the subject of considerable discussion (see E. W. MacBride); the explanation was criticized by A. Söderström (1924) but sustained by R. Woltereck (1924).

The Dinophilidae are at least like other polychaetes since they totally lack lateral or head appendages and the body is provided with bands or tufts of cilia (fig. 14). There are five to ten segments and a short tail with adhesive glands. Movement is performed by sliding over the substratum with the aid of a longitudinal stripe of cilia. The remarkable processes of encapsulation of the adult female and the development of the young have been compared with similar phenomena among rotifers (Shearer, 1912). Eggs of two kinds are laid, a larger, fertilized egg which gives rise to females, a smaller, unfertilized egg, to males. The sex-determining mechanism is controlled by the rate of division of the oögonial cells. Fertilization of the females is performed before or at the time of hatching from the egg capsule. Maturation division occurs after, not before, fertilization. Both sexes are apparently diploid.

Three groups, earlier regarded as archiannelids, are referred elsewhere. The terrestrial *Parergodrilus* has been referred to the Oligochaeta. *Histiobdella*, a parasite of decapods, and *Ctenodrilus*, with its closely related genera, are considered near the Eunicea and Cirratulidae respectively.

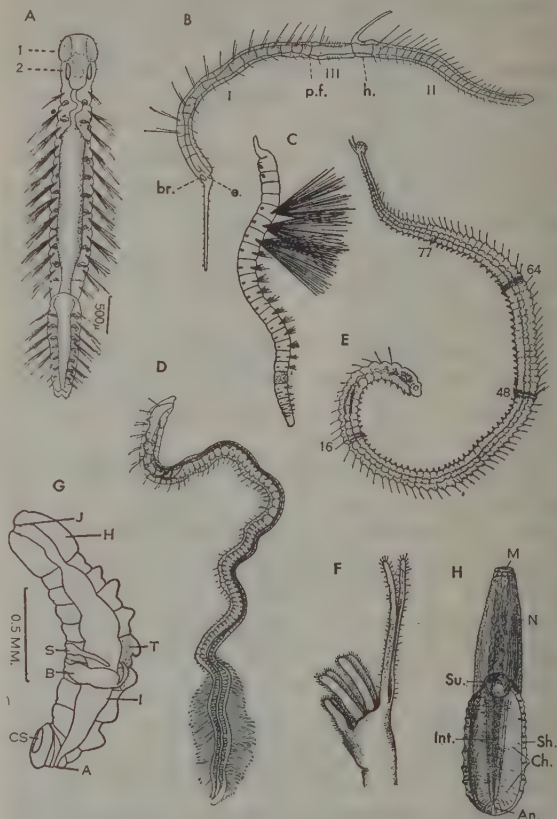
BIBLIOGRAPHY.—F. Hemplemann, *Handbuch der Zoologie*, vol. 2, Lieferung 13, pp. 155–161 (1931) gives a good review of the group. R. G. Aiyar and K. H. Alikunhi, "On Some Archiannelids of the Madras Coast," *Proc. Nat. Inst. Sci. India*, vol. 10, pp. 133–140 (1944) reviews the Polygordiidae. E. W. MacBride, *Text-book of Embryology*, pp. 131–153 (1914) summarizes the results on development of *Polygordius*; this is criticized by A. Söderström, *Das Problem der Polygordius-endolarve*, pp. 1–168 (1924) and upheld by R. Woltereck in the same publication. C. Shearer, "The Problem of Sex-Determination in *Dinophilus gyrocalatus*," *Q. J. Micr. Sci.*, vol. 57, pp. 329–371 (1912) gives an account of development and sex-determination. (O. Hn.)

CLASS 2. OLIGOCHAETA

A group comprising more than 3,100 species of terrestrial, limicolous or fresh-water, sometimes secondarily marine or parasitic worms. Oligochaetes vary in size from minute aquatic species scarcely 0.5 mm. in length to the largest earthworms,

some of which measure several feet and may be an inch in diameter.

Body Form.—The anterior end is without palps or tentacles; the presegmental region or prostomium is a simple lobe overhanging the mouth, sometimes reduced and occasionally produced (figs. 15B and 16F). The anus is terminal, rarely displaced dorsally (Branchiobdellidae, Acanthobdellidae and *Glyphidrilus*). The body is usually cylindrical, sometimes flattened, rarely with



(A, E) FROM MARCUS IN UNIV. SÃO PAULO PUB.; (B) FROM YOSHIZAWA IN TOKUO IMPER. UNIV. PUB.; (C) FROM STOLTE AFTER MICHAELSEN; (D) FROM STOLTE AFTER BEDDARD; (F) FROM STEPHENSON, "THE OLIGOCHAETA," BY PERMISSION OF THE CLARENDON PRESS, OXFORD; (G) FROM GOODNIGHT IN UNIV. OF ILL. PUB.; (H) FROM BAYLISS IN "ANN. & MAG. NAT. HIST." (TAYLOR & FRANCIS, LTD.)

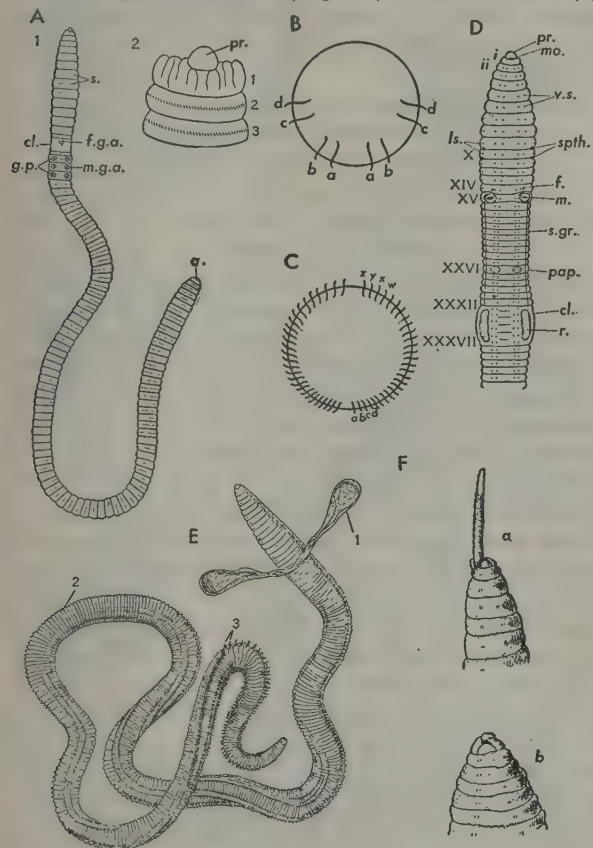
FIG. 15.—BODY FORM IN LOWER OLIGOCHAETA

A. *Aeolosoma headleyi* (Aeolosomatidae), chain of two zooids showing: (1) ciliated prostomium, (2) ciliated pit. B. *Stylaria lacustris* (Naididae), chain of three zooids; the third (III) is forming between the anterior (I) and posterior (II) zooid. Note elongated prostomium; (br.) brain, (e.) eye, (h.) cephalized "head" region of five somites, (p.f.) second plane of fission. C. *Ripistes parasita* (Naididae), whole animal from side with one fission zone, showing very long hair setae in the dorsal bundles of segments six, seven and eight. D. *Branchiura sowerbyi* (Naididae), whole animal with tail turned in side view to show dorsal and ventral gill filaments. E. *Aulophorus superterranus* (Naididae), worm with 95 segments showing anal gills and 4 fission zones; asexual reproduction is by fragmentation. F. *Aulophorus furcatus* (Naididae), posterior end in side view showing the two long, nonvascular palps, and three pairs of gills. G. *Stephenodrilus obscurus* (Branchiobdellidae), whole animal in side view, parasitic on gills of fresh-water crayfish; (A) anus, (B) male atrium, (CS) posterior sucker, (H) head region of four fused somites, (I) intestine, (J) jaws, (S) spermatheca, (T) developing spermatozoa in testis segments. H. *Aspidodrilus kelsalli* (Enchytraeidae), ectoparasitic on W. African earthworms, ventral view. (An.) anus, (Ch.) rows of setae on ventral "holdfast" organ, (Int.) intestine, (M) mouth, (N) ventral nerve cord, (Sh.) frilled margin of "holdfast" organ, (Su.) sucker

projecting gills or processes. The primary segmentation is usually conspicuous but, in some of the larger forms, there is a secondary annulation at the anterior end. External regionalization is rare but branchiobdellids (fig. 15G) have a cephalized "head" of four somites, and *Aspidodrilus* (fig. 15H) has a multisegmental ventral "holdfast" organ.

Number of Segments.—This varies from 7 in some minute aquatic species to 500 or 600 in the largest earthworms. Aquatic oligochaetes that reproduce by asexual fission continue to grow throughout life by the addition of segments. In some earthworms only a few segments are added after hatching. However, all members of a species do not have exactly the same number. In Branchiobdellidae and Acanthobdellidae the formation of a terminal sucker leads to a leechlike standardization.

Setae.—The setae are embedded in the body wall and are rarely absent (enchytraeid *Achaeta* and Branchiobdellidae). They may be simple or ornamented, sigmoid, forked or hairlike (fig.



(A, B, C) FROM BAHL IN "INDIAN ZOOLOGICAL MEMOIRS"; FROM STEPHENSON, "THE OLIGOCHAETA," BY PERMISSION OF THE CLARENDON PRESS, OXFORD; (E, F) FROM MICHAELSEN IN "HÄNDBUCH D. ZOOLOGIE"

FIG. 16.—BODY FORM IN HIGHER OLIGOCHAETES

A. *Pheretima posthuma* (Megascolecidae), a tropical peregrine earthworm; (1) ventral view of entire worm, (a.) anus, (cl.) clitellum, (f.g.a.) female genital aperture, (g.p.) genital papillae, (m.g.a.) male genital aperture, (s.) setae; (2) Dorsal view of anterior end, (pr.) prostomium, (1, 2 and 3) first three segments. B. Diagram showing lumbricine arrangement of setae; (a, b) ventral pair, (c, d) lateral pair. C. Diagram showing perichaetine arrangement of setae. D. *Lumbricus terrestris* (Lumbricidae), ventral view of anterior end; segments indicated by roman numerals, (cl.) clitellum, (f.) female aperture, (ls.) lateral setae, (m.) male aperture, (mo.) mouth, (pap.) genital papilla, (pr.) prostomium, (r.) one of the ridges of puberty or "bands," (s.gr.) seminal groove, (spth.) spermathecal aperture, (v.s.) ventral setae. E. *Alma eubranchiata* (Glossoscolecidae), a limicolous earthworm from tropical Africa, showing (1) copulatory appendages, (2) region of clitellum, (3) gills. F. *Andiodrilus bolleyi* (Glossoscolecidae), a neotropical form living in *Bromelia* foliage; (a) Prostomium exerted as a "feeler," (b) Prostomium retracted

17A). The lumbricine arrangement (fig. 16B), with two pairs of sigmoid setae on every segment except the first, is possibly primitive. In the small aquatic families each pair may be represented by a fan of setae, only functionally comparable with a polychaet parapodium. The perichaetine arrangement (fig. 16C) occurs in some terrestrial oligochaetes, a ring of small sigmoid setae encircles each segment. Fifteen of the 76 genera of Megascolecidae possess this modification and it is evident that setal

multiplication is a trend that has manifested itself independently on several different occasions. Perichaetine multiplication also occurs in the neotropical genus *Periscoclex* (Glossoscolecidae), a clear example of parallel evolution. Transitional conditions are common. The New Zealand genus *Dimodrilus* has six pairs per segment, and in a number of forms setal multiplication affects only the more posterior segments, the last to be laid down during development.

Penial setae, associated with the male intromittent apparatus, and genital or copulatory setae, assume many peculiar forms (figs. 17B and D). The replacement of sigmoid by modified setae takes place in periodic stages, representing increasing degrees of transformation.

Body Wall.—A simple columnar epithelium, with interspersed glandular and sensory cells, secretes a thin cuticle. In *Aeolosoma* the prostomium is ciliated below. The epidermis of earthworms assumes a pseudostratified appearance owing to the presence of numerous small basal cells. Epidermal thickenings are found in species of the tubificid genus *Peloscoclex*. The muscular coats are arranged as in other annelids but the histology of the longitudinal coat is not well understood, by some it is supposed to consist of muscle fibres of the nematoid type but others have claimed that it is a muscular syncytium.

Clitellum.—All oligochaetes possess, at sexual maturity, a glandular development of the epithelium which secretes the egg cocoon. The clitellum may be saddle-shaped or ring-shaped; in small aquatic forms it consists of a single layer of cells and is confined to one or two segments in the vicinity of the genital pores. The clitellum of earthworms occupies several segments and is composed of many layers of cells. In the minute, and probably degenerate Aeolosomatidae, the clitellum is restricted to a ventral patch. Experiments on earthworms indicate that a clitellum may develop in total castrates, provided they are adult and well nourished (M. Avel).

Coelom.—The body cavity is well developed and segmentally partitioned by the septa. The body wall of *Acanthobdella* is very thick and the coelom correspondingly reduced, while that of the remarkable lumbriculid, *Agriodrilus*, from Lake Baikal is obliterated in front of the genital segments, foreshadowing the condition in leeches. The coelom often communicates with the exterior by pores, regulated by sphincter muscles; some aquatic species possess a pore on the prostomium or in the first intersegmental furrow. Dorsal pores are found in the intersegmental grooves of many terrestrial species. Coelomic fluid may be ejected through these pores or, in some earthworms, through special openings in the floor of the pharynx and at the anus. The fluid discharged by earthworms may be milky, mucilaginous, sometimes coloured or malodorous. K. N. Bahl has shown that the coelomic plasma of *Pheretima* is hypotonic to the blood and contains protein. Formed elements consist of coelomocytes, bacteria, granules of pigment and fragments of degenerating musculature (sarcocytes). The bacteria are typical soil species (G. R. Cameron). Some of the leucocytes resemble types found in human blood; lymphocytes and monocytes are amoeboid and phagocytic, taking up foreign particles which are carried to the nephridia, body wall, or coelomic aggregates known as "brown bodies." The granulocytes are mostly acidophil and nonphagocytic. Eleocytes of the branding, *Eisenia foetida*, contain yellow oil droplets which, when liberated, are responsible for the evil smelling odour of the fluid ejected by this species. The phosphorescent discharge of certain earthworms, e.g., *Microscolex phosphoreus*, is due to the liberation of granules from special coelomic corpuscles and is attributed to a luciferin-luciferase reaction. Megascolecid worms have lamprocytes and linocytes of unknown function. The coelomic glands, present in many earthworms, have been variously described as phagocytic and as leucocytopoietic organs.

Chloragogue.—Chloragogue tissue invests the coelomic surface of the intestine, dorsal and adjacent blood vessels and sometimes other organs. The cells are club-shaped with their swollen ends, laden with yellowish-brown globules, projecting into the body cavity. According to E. Liebmann they are liberated into

the coelom as trephocytes, laden with nutritive inclusions (lipid, glycogen and protein) which they carry to the tissues. In Enchytraeidae they are known to nourish the developing ova. They may also perform an excretory function; chloragogue tissue contains and can synthesize urea (C. Heidermanns).

Digestive System.—The mouth opens into a muscular, protrusible pharynx; chitinous jaws are absent, except in Branchiobdellidae (fig. 18B). Chromophilic glands secrete a saliva that

independently evolved in some Eudrilidae and in at least one genus of the Megascolecidae (*Phonogaster*). The intestine is a straight tube, lined by a ciliated, absorptive epithelium. In contrast to the leeches, diverticula are usually absent; *Pheretima* is an exception. The absorptive surface is frequently increased by the typhlosole, a longitudinal fold which hangs downward into the lumen (fig. 18A). The digestive secretions contain enzymes which break down proteins, carbohydrates and fats; cellulose-splitting enzymes have not been found. The intestinal enzymes of various species have optima near neutrality, but the oesophageal stomach of the carnivorous naid *Chaetogaster* digests proteins in a strongly acid medium. The gut of an earthworm also performs an osmo-regulatory function, assisting the nephridia in the elimination of excess water when the animal is in a wet environment.

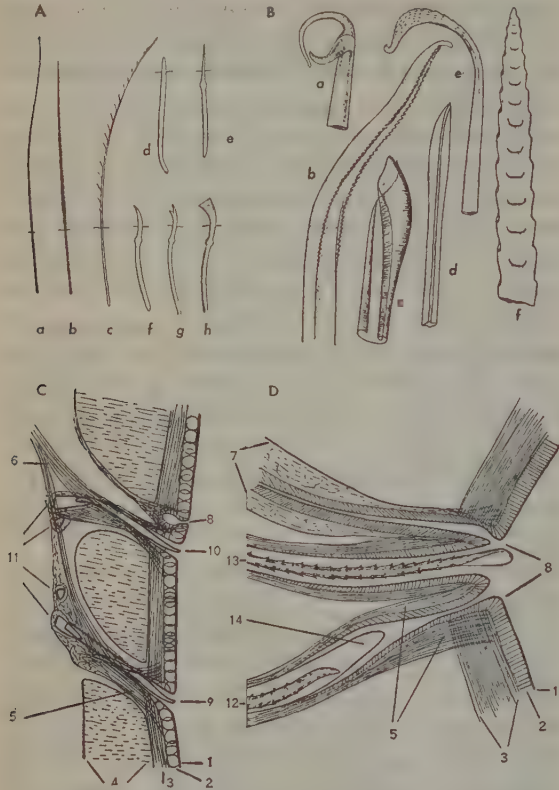
Calciferous Glands.—The calciferous glands of earthworms are associated with terricolous habits; they tend to be absent in more primitive genera and in limicolous forms. In their simplest type they are lamellated outpouchings of the oesophageal wall (fig. 18C); in more evolved forms the gland is separated off and communicates with the lumen of the oesophagus by a duct (fig. 18E). Calciferous glands are well vascularized; they secrete calcium carbonate in the form of calcite crystals. Their primary function is believed to be excretion of calcium; this view was proposed by C. R. Darwin and is supported by J. D. Robertson. Calcareous concretions in the castings are little affected by humic acids, moreover little or no calcite is formed in the glands when worms are fed on acid peat; neutralization of the gut contents is therefore, at most, an incidental function. Under conditions of abnormally high CO₂ pressure the calcium content of the blood increases (K. Aoki), indicating that insoluble carbonate is being converted into soluble bicarbonate. The calciferous glands may thus participate in the pH regulation of the blood.

Vascular System.—In the simplest forms (fig. 19A) this consists of a contractile dorsal vessel arising posteriorly from the peri-intestinal blood sinus, a ventral distributing vessel and segmental connectives, at least at the anterior end. In higher oligochaetes the dorsal vessel is completely separated, receiving tributaries from the sinus, and a subneural vessel is often present. The dorsal vessel arises embryologically by the union of left and right halves and may remain double along part of its course. In the many of the lower oligochaetes and in Lumbricidae one or more pairs of contractile "lateral" hearts connect the dorsal with the ventral vessel. Megascolecidae may have "oesophageal," and some Tubificidae have "intestinal" hearts, connecting the dorsal gut sinus with the ventral vessel; "latero-oesophageal" hearts receive blood both from the sinus and from the dorsal vessel (fig. 19B). The dorsal vessel of Lumbricidae has peculiar, blind contractile appendages.

The blood may appear colourless (some Enchytraeidae and small aquatic species), usually it contains erythrocrurin (= invertebrate haemoglobin) in solution in the plasma. According to K. N. Bahl the blood carries nitrogenous excretory products to the nephridia. Only a small part of its osmotic pressure, which is much less than that of the blood of marine worms, is accounted for by chlorides. The only blood corpuscles are phagocytic amoebocytes. Blood glands occur in *Pheretima*, and a number of lower oligochaetes possess a cardiac body similar to that of polychaetes.

Respiration.—The small aquatic species have anal respiration, water being taken in and out of a rectal chamber. Some Naididae (fig. 15F) have anal gills, and respiratory outgrowths of the body wall are known in a few other genera (figs. 15D and 16E). In earthworms respiratory exchanges take place through the skin, which is well vascularized and must be kept moist. Earthworms can withstand considerable periods of anaerobiosis, when they accumulate lactic acid and build up an oxygen debt.

Excretory Organs.—The primitive (holonephric=meganephric) condition is one pair of nephridia per segment. A typical nephridium (fig. 20A) consists of a preseptal funnel (nephridiostome), an intracellular duct which penetrates the septum, and a coiled tube of varying complexity. Following the thin tube there



(A, B) FROM MICHAELSEN IN "HANDBUCH D. ZOOLOGIE"; (C, D) FROM PICKFORD, "ACANTHODRILINE EARTHWORMS OF SOUTH AFRICA" (HEFFER).

FIG. 17.—SETAE OF OLIGOCHAETA

A. Different types of normal setae: (a) simple hair, (b) feathered hair, (c) saw-toothed hair, (d) peg, (e) single pointed needle, (f) simple sigmoid, (g) forked sigmoid, (h) fan-shaped sigmoid. B. Penial and genital setae, only the distal end is shown: (a) penial seta of *Eudriloides gnu*, (b) penial seta of *Stuhlmannia variabilis*, (c) rolled type penial seta of *Eutereutis dumaensis*, (d) grooved type penial seta of *Hormogaster hispanica*, (e) penial seta of *Chilota platurus*, (f) notched type penial seta of *Andiorrhinus holmgreni*. C. *Chilota purcelli*, very young specimen, cross section segment 17 showing rudiment of prostatic gland and ventral sigmoid setae not yet replaced by penial setae; numbering as for D. D. *Chilota purcelli*, semi-mature specimen, cross section as for C showing relation of penial setae to prostatic pore; (1) cuticle, (2) epidermis, (3) circular muscles, (4) longitudinal mature specimen, cross section as for C showing relation of penial setae to prostatic muscles of seta, (7) prostatic gland, (8) prostatic pore, (9) sigmoid seta a, (10) sigmoid seta b, (11) rudiments of penial setae, (12) penial seta a, (13) penial seta b, (14) cuticle lining follicle of penial seta a, not yet ruptured.

contains mucin and has a proteolytic action. A narrow oesophagus passes backward through the genital segments. A muscular gizzard, with cuticular lining, is present in the majority of earthworms and a few of the smaller oligochaetes. The gizzard is pre-genital or "oesophageal" in typical Glossoscolecidae (fig. 18D) and Megascolecidae, as well as in the supposedly ancestral Haplotaxidae. An oesophageal gizzard is often metamerically repeated in two or three successive segments, but genera showing this modification are not necessarily related. Lumbricidae have a postgenital dilated crop followed by an "intestinal" gizzard preceding the beginning of the intestine. In the Moniligastridae there is a series of preintestinal gizzards, and such have been

is usually a ciliated region and, beyond this, a wide tube. The nephridial duct frequently terminates in a dilated vesicle; nephridial pores are commonly situated on the anterior margins of the segments.

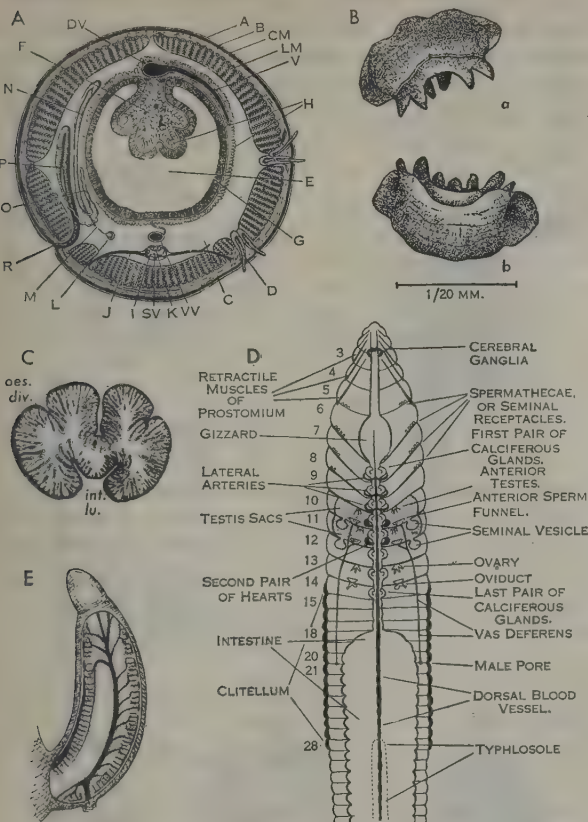
Modifications of nephridia in the small aquatic and limicolous

posterior end, the exact opposite of setal multiplication. *Howa-colex digaster* is holonephric behind the clitellum, meronephric anteriorly; while many genera retain one pair of large, holonephriclike meronephridia in addition to closed meronephridia at the posterior end (fig. 20B). A highly evolved meronephric genus like *Pheretima* has: (1) "tufted" pharyngeal nephridia, (2) closed, integumentary exonephridia, and (3) open, septal enteronephridia. Bahl showed that the function of an enteronephric system is conservation of water, which is resorbed by the gut from the hypotonic urine. Exonephridia may communicate with longitudinal ducts that run in the body wall and open at the anus; among such, *Allolobophora antipae* is holonephric, *Hoplochaetella bifoveata* meronephric. Nephridial physiology is discussed in the introduction.

Reproductive System.—All oligochaetes are hermaphroditic; the gonads are usually restricted to a very limited number of segments and, as distinct from leeches, the testes are in front of the ovaries. The testes of *Chaetogaster orientalis* and, in species of *Aeolosoma*, both testes and ovaries are proliferated in many segments. It is not known whether this condition, so like that occurring in Polychaeta, is primitive or degenerate. Backward proliferation of testes into the seminal vesicles (see below), as seen in the lumbricid *Agriodrilus*, appears to indicate the mode of origin of the post-ovarian testes of leeches. The lower oligochaetes have one pair of testes and one pair of ovaries in successive segments (fig. 21C) and the families may be related to each other by homeoetic displacement of the genital segments (fig. 24). J. Stephenson believed that the small aquatic forms are secondarily simplified but W. Michaelsen, who regarded the Aeolosomatidae as primitive, envisaged a backward migration of the gonad segments, correlated with increasing size and complexity. The terrestrial families appear to be descended from a form in which the position of the gonads was stabilized but metamorphically repeated. Following Michaelsen's theory, which seems acceptable, the Haplotaxidae provide an ancestral type with 2 pairs of testes, in segments 9 and 10 (holandric), and 2 pairs of ovaries in segments 11 and 12 (hologynous), respectively. In higher forms the posterior or anterior pair of testes may be suppressed (pro- or metandric condition); the majority of earthworms retain only the posterior pair of ovaries (metagnynous).

Developing sperm morulae are frequently stored in septal pouches known as seminal vesicles or sperm sacs. The testes, together with the male funnels, may be enclosed in testes sacs partitioned off from the coelom. Male ducts are absent in Aeolosomatidae in which the nephridia are supposed to transport the spermatozoa. In other oligochaetes the sperm duct is provided with a fluted, convoluted funnel, iridescent in mature worms from the innumerable spermatozoa which cling to its surface. Except in Lumbricinae the *vas deferens* penetrates the septum to which the funnel is attached and the male pore is one (lower oligochaetes) or more (earthworms) segments behind the last pair of testes. Sometimes the ectal end of the male duct is enlarged to form a muscular atrium and there may be an eversible penis. Euprostates, glandular enlargements or diverticula of the atrium, occur in Moniligastridae and Eudrilidae. Megascolecoid prostates are of different origin; primitive members of the family have two pairs of tubular glands on the segments in front of and behind the male pores respectively (acanthodriline arrangement) (fig. 21B 1). Either the posterior or the anterior pair may be suppressed (microscolecine and balantine reduction). Union of male and prostatic ducts (megascolecine condition) could represent the culmination either of microscolecine or balantine evolution (fig. 21B 2). Tubular prostates are replaced by branching glands in the more highly evolved members of the Megascolecinae.

The female organs are usually simple. Septal outpouchings known as ovisacs, present in the lower oligochaetes, are very small in earthworms. The oviduct, like the typical sperm duct, perforates the septum to which the funnel is attached and the oviducal pore is on the segment immediately following that of the gonad. In Aeolosomatidae the oviduct is degenerate. Sperma-



(A) FROM MARSHALL AND HURST, "A JR. COURSE OF PRACTICAL ZOOLOGY" (JOHN MURRAY); (B) FROM HALL IN PROC. U.S. NAT. MUS.; (C) ADAPTED FROM ALTMAN IN UNIV. OF WASHINGTON, BIOL. SERIES, VOL. IV; (D, E) FROM PICKFORD IN "TURTLE NEWS"

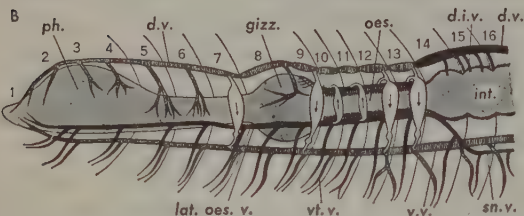
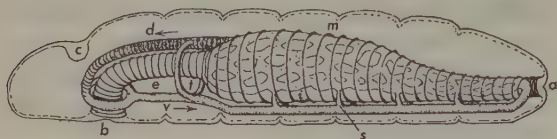
FIG. 18.—GENERAL ANATOMY AND DIGESTIVE SYSTEM OF OLIGOCHAETA

A. *Lumbricus terrestris*, diagrammatic cross section through intestinal region, a nephridium is shown on left and setae on the right. (A) cuticle, (B) epidermis, (C) coelom, (CM) circular muscles, (D) seta, (DV) dorsal vessel, (E) lumen of intestine, (F) typhlosole, (G) intestinal epithelium, (H) chloragogenous tissue, (I) ventral nerve cord, (J) nerve to body wall, (K) giant fibres, (L) nephrostome, (LM) longitudinal muscles, (M) point where nephridial duct perforates septum (not shown), (N) long loop of nephridium, (O) short loop of nephridium, (P) terminal loop of nephridium, (R) nephridial pore, (SV) subneural vessel, (V) intestinal vessel, (VV) ventral vessel. B. *Cirrodilrus thysanosomes*, (a) upper jaw, (b) lower jaw. C. *Plutellus kincaidi*, cross section of oesophagus showing simple pouchlike calciferous glands, (oes. div.) oesophageal diverticula, (int. lu.) intestinal lumen. D. *Thamnodrilus crassus*, general anatomy of a giant earthworm from Ecuador. E. *Thamnodrilus crassus*, internal view of a calciferous gland (stalked type), blood vessels in solid black

species are chiefly in the direction of simplification. The multicellular horseshoe-shaped upper lip (mesanephridiostome) is represented by a few marginal cells (meronephridiostome), or absent (micronephridiostome). Occasionally the ental opening is closed (*Chaetogaster*, *Acanthobdella*). In earthworms not only is the complexity of the individual nephridium increased but, in many forms, there is multiplication and differentiation of nephridial types within a segment (meronephric conditions). Following the terminology of K. N. Bahl nephridia may open to the exterior (exonephric), into the pharynx (pharyngeal) or into the intestine (enteronephric). Nephridial multiplication may affect the whole nephridium, e.g., *Tritogenia* with two and *Lampito dubius* with five pairs of complete nephridia per segment. Alternatively, division of the embryonic rudiment may affect only the funnel (fig. 20C) or only the tubule (fig. 20D). In transitional species nephridial multiplication tends to be suppressed at the

thecae, varying in position, number and form, are pouches into which the spermatozoa are received during copulation. They are rarely absent and frequently possess an elaborate structure (fig. 21A). In Enchytraeidae and a few Lumbriculidae they may communicate with the oesophagus. The greatest elaboration of

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(A) FROM MARCUS IN UNIV. SÃO PAULO PUB. 1 (B) FROM BAHL IN "INDIAN ZOOLOG. MEMOIRS"

FIG. 19.—VASCULAR SYSTEM OF OLIGOCHAETA

A. *Aelosoma headleyi*, simple type of vascular system: (a) anus, (b) mouth, (c) cerebral ganglion, (d) dorsal vessel, (e) oesophagus, (f) intestine, (m) circular splanchnic muscles, (s) vessels connecting ventral vessel with intestinal blood plexus (stippled), (t) circum-oesophageal vessel, (v) ventral vessel. Arrows show direction of flow. B. *Pheretima posthuma*, diagram showing arrangement of blood vessels in the first 16 segments; (d.i.v.) dorso-intestinal vessel, (d.v.) dorsal vessel, (gizz.) gizzard, (int.) intestine, (lat. oes. v.) lateral oesophageal vessel, (oes.) oesophagus, (ph.) pharynx, (sn.v.) subneural vessel, (vt. v.) ventral vessel, (v.v.) ventral tegumentary vessel; "lateral hearts" in segments 7 and 9; "latero-oesophageal hearts" in segments 12 and 13. Collecting vessels shown in full black, distributing vessels shown with cross lines

the female organs is found in Eudrilidae, in which the spermathecae communicate with a closed ovarian system (fig. 21D).

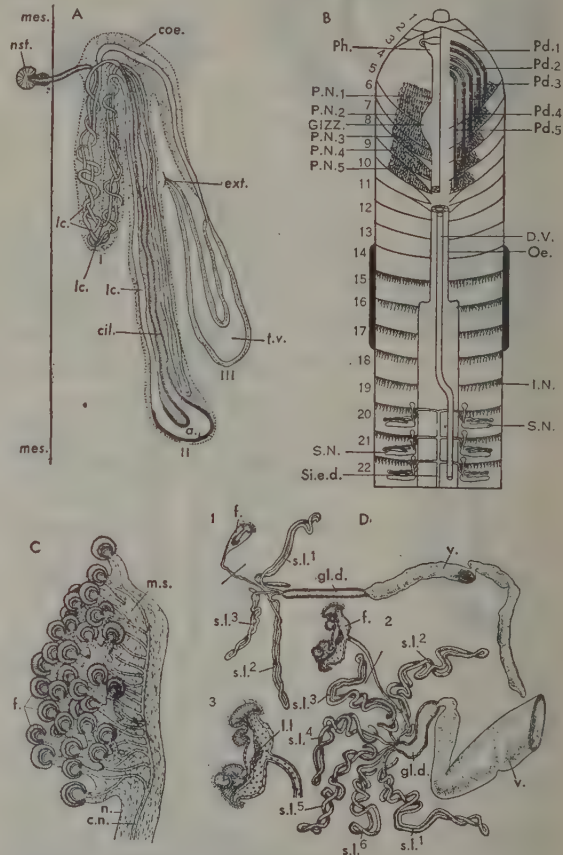
Copulation is reciprocal and takes place in a head-to-tail position, the two ventral surfaces in contact. In lower oligochaetes there is direct apposition of male and spermathecal pores and the spermatozoa, often enclosed in spermatophores, are injected into the receptacles (fig. 21E). This procedure is retained, in principle, in Megascolecidae and Eudrilidae. In Glossoscolecidae and Lumbriculidae transference takes place in the clitellar region, remote from the male pores, and the spermatozoa are carried along external grooves (fig. 16D). A few glossoscolecids possess remarkable copulatory appendages (fig. 16E).

The clitellum secretes the egg capsule and, in earthworms, albuminous material for the nourishment of the embryos. Eggs are passed into the cocoon which is then slipped forward and receives the spermatozoa as it passes the spermathecal openings (fig. 23A). Isolated, unfertilized oligochaetes of many genera can lay fertile eggs, and in some species of *Pheretima* the majority of specimens lack male pores so that copulation is impossible. It is not known whether the progeny result from parthenogenesis or from some process of self-fertilization.

Asexual Reproduction.—The Naidina normally reproduce by paratomy, mis-called budding (figs. 15B and C); sexual reproduction is exceptional. Chains are formed by the development of new zooids while the older ones are still united. In a few forms asexual reproduction is by fragmentation (architomy) (fig. 15E). Asexual fission appears to be a special development of the general capacity, possessed by most worms, to regenerate lost parts.

Nervous System.—The central nervous system consists of a bilobed brain or supra-oesophageal ganglion, circum-pharyngeal connectives and ventral nerve cord. In Aeolosomatidae both brain and ventral cord remain united with the epidermis. Each segmental ganglion gives off nerves (fig. 22B) which supply sub-

epidermal and intermuscular nerve plexuses. The visceral nerve plexus is connected with the central nervous system anteriorly (fig. 22A) and also segmentally by augmentor and depressor reflex pathways (N. Millott). Giant fibres are of the multicellular type (fig. 22C). In *Lumbricus* the median fibre receives sensory messages chiefly from the anterior half of the body and transmits them posteriorly. The two lateral fibres are connected with each other by anastomoses at regular intervals, and behave physiologically as a unit; their sensory field is chiefly posterior and they transmit messages forward to effector organs in the anterior part of the body.



(A) FROM PARKER AND HASWELL, "TEXTBOOK OF ZOOLOGY" (MAZIARSKI); (B, C, D) FROM BAHL IN "QUART. JOURN. MICR. SCI."

FIG. 20.—NEPHRIDIA OF OLIGOCHAETA

A. *Lumbricus*, diagram of a holonephridium; (a.) ampulla between ciliated and nonciliated parts of intracellular canal, (cil.) ciliated part of intracellular canal, (coe.) investment derived from coelomic epithelium, (ext.) nephridial pore, (lc.) nonciliated parts of intracellular canal, (mes.) septum, (nst.) nephridiostome, (t.v.) intercellular canal of the terminal vesicle, (l.-l.) the three principal loops. B. *Lampito trilobata*, general plan of meronephridial system; (D.V.) dorsal blood vessel, (GIZZ.) gizzard, (I.N.) integumentary meronephridia (closed, exonephric), (Oe.) oesophagus, (Pd.) sheaves of ductules of the pharyngeal meronephridia, (P.N.-P.N.s) pharyngeal meronephridia of the fifth to ninth segments, (Ph.) pharynx, (Si. e. d.) supra-intestinal excretory duct, (S.N.) septal meronephridia (open, enteronephric). C. *Thamnodrilus crassus*, multiple preseptal funnels of holonephridium, (c.n.) canal of neck, (f.) funnels, (m.s.) membranous shelf of funnels, (n.) neck of funnels. D. *Pontoscolex corethrurus*, nephridia from anterior segments showing the development of meronephridial loops, simple holonephridia are found posteriorly; (1) nephridium from segment 13, with 3 subsidiary loops, (2) nephridium from segment 3, with 6 subsidiary loops, (3) nephridiostome of above, further enlarged, (f.) funnel enlarged more than rest of nephridium, (gl.d.) glandular duct, (l.l.) lower lip, (s.l.1, s.l.2, etc.) subsidiary loops, (v.) vesicle

Sense Organs and Responses.—Free nerve endings ramify among the epithelial cells. In line with findings in vertebrates, it is probable that they respond to tactile stimuli, perhaps also to heat and pain. Epithelial sense organs resembling taste buds

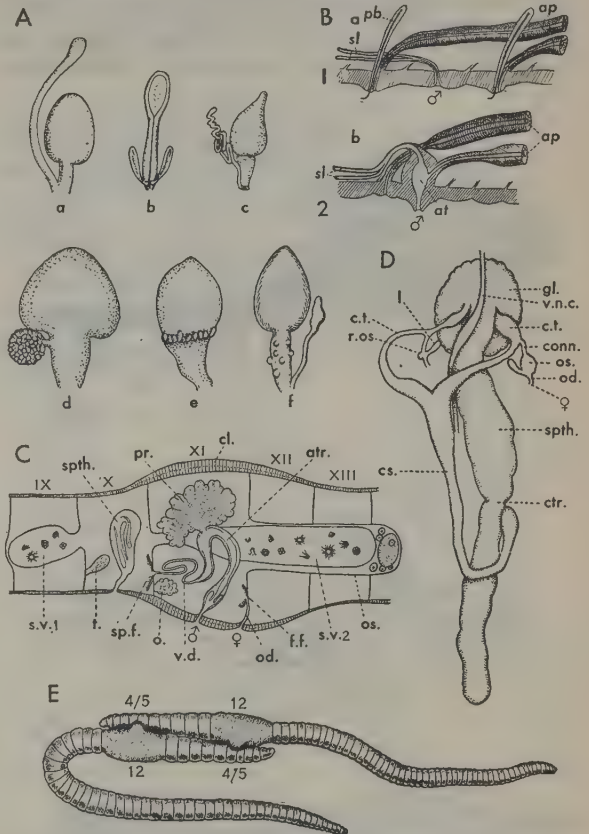
occur in the skin and also inside the buccal cavity; their appearance suggests that they are chemoreceptors. Certain Eudrilidae have encapsulated sense organs resembling Pacinian bodies. Naididae may have projecting sensory hairs and the prostomial ciliated pits of Aeolosomatidae are regarded as sense organs. Photoreceptor organs (fig. 3C) are special cells which contain a lenslike refractile body; in earthworms they are most abundant at the anterior and posterior ends, in some of the lower oligochaetes they are grouped to form eye-spots.

Earthworms are very sensitive to vibrations but indifferent to sound waves; tubificids are said to respond to vibrations in the audible range. The chemical sense is well developed and discrimination of acidity and alkalinity is more acute than in man; salt and quinine are distasteful while oxalic acid is attractive and the branding responds positively to manure water. Earthworms respond negatively to strong light but the majority of species investigated are attracted to very weak light; they are insensitive to the red end of the spectrum. The mating instinct may cause an inhibition of negative phototropism so that pairs of *Lumbricus terrestris* can be observed copulating on the surface of the ground long after the sun has risen. Earthworms orient themselves in an electric field and migrate to the cathode; the effect is believed to be a direct action on the nervous system. All oligochaetes are strongly thigmotactic; a good way to straighten out small species for preservation is to let them crawl into the crack between two parallel glass slides. Earthworms are capable of learning; R. M. Yerkes offered *Eisenia foetida* a T-shaped maze in which one arm, with sandpaper, gave an electric shock; they soon learned to avoid the sandpaper. Light may be used instead of a tactile conditioning stimulus and the normal negatively phototropic response reversed (R. J. Wherry and J. M. Sanders). Negative phototropism is also weakened or suppressed by the removal of the brain, an operation which otherwise has little effect on the activities of the worm.

There are two sorts of locomotion in oligochaetes, peristaltic and looping. The latter, found in comparatively few forms (*Chaetogaster*, Branchiobdellidae), is similar to the looping movements of leeches. The peristaltic movements of an earthworm are tactile reflexes initiated by contact of the ventral surface with the substratum (J. Gray); they occur equally well after decapitation but are abolished by removal of the ventral cord. Progression begins by contraction of the circular muscles at the anterior end. A wave of thinning passes backward, followed (owing to contraction of the longitudinal muscles) by a wave of thickening. The thickened region is at rest with respect to the ground, braced by the setae, and forms a sort of foot. As a result of this the next contraction of the circular muscles forces the parts in front of the foot to move forward.

Embryology.—The cocoons are ovoid and drawn out at the ends; they vary with the size of the worm; thus the cocoon of the giant Gippsland earthworm, *Megascolides australis*, may be two inches in length. The eggs of lower oligochaetes are yolk and contain sufficient nourishment for the growth of the embryo; in earthworms additional nourishment is supplied by an albuminous secretion of the clitellum. The whole of development takes place within the cocoon and there is no free-living larval stage. Segmentation of the ovum is interpreted as a highly modified form of spiral cleavage (fig. 23B). In addition to the mesototoblasts there are three or four pairs of ectototoblasts (fig. 23E) representing the somatic plate of the typical polychaet embryo. All investigators agree that the pair of ectototoblasts nearest the midventral line are neuroblasts. Most also agree that the ectodermal germ bands give rise to the circular musculature and setal sacs, but there is a deep divergence of opinion regarding the origin of the nephridia. Proponents of Goodrich's theory of nephridial homology, discussed in the introduction (*see above*), agree with F. Vejdovsky that the nephridia are derived wholly from the ectototoblasts. Others follow R. S. Bergh in deriving the nephridia from the mesoderm. However this may be, newer investigations appear to indicate that each nephridium or, in meronephric species, each nephridial cord, arises from a single cell, the nephridioblast; the view propounded by E. B. Wilson,

that the funnel is mesodermal and the tubule ectodermal, has not received support. A larva of *Tubifex* lacking ectototoblasts may regenerate the missing tissues from the mesoderm; but in the absence of mesototoblasts there is no regeneration of the mesoderm (A. Penners). Moreover, mesoderm is necessary for harmonic organization of the embryo; in its absence nervous and other ectototoblastic tissues may differentiate but they are not organized and no somites are developed.



(A, C, D) FROM STEPHENSON, "THE OLIGOCHAETA," BY PERMISSION OF THE CLARENDON PRESS, OXFORD; (B, E) FROM MICHAELSEN IN "HANDBUCH D. ZOOLOGIE"

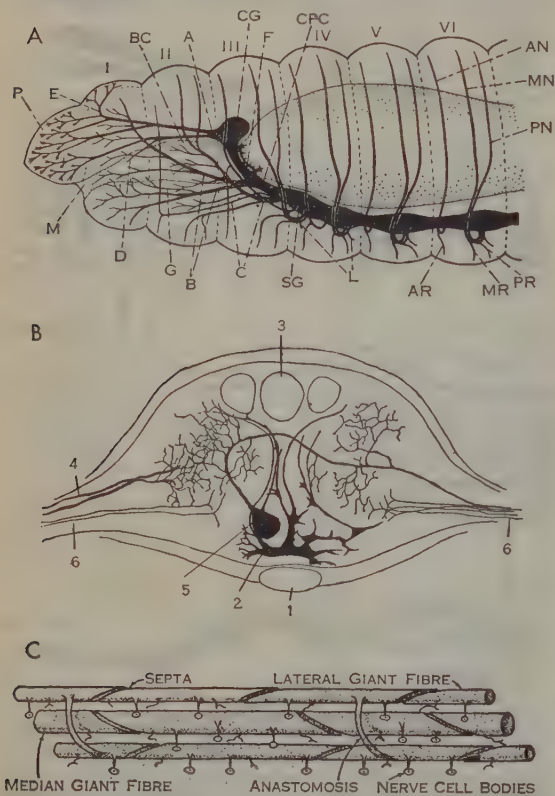
FIG. 21.—REPRODUCTIVE SYSTEM OF OLIGOCHAETA

A. Spermathecae of various species of Megascloecidae, showing various forms of diverticula; (a) *Megasclolex kavalaianus*, (b) *Megasclolex vilpattensis*, (c) *Pheretima suctorica*, (d) *Octochaetoides surensis*, (e) *Hoplochaetella suctorica*, (f) *Pheretima pingi*. B. Longitudinal sections through male terminal apparatus (diagrammatic); (1) *Eodrilus* sp., showing typical acanthodriline arrangement, (2) *Gordodrilus stauderi*, showing a transitional condition similar to that which may have given rise to the Megascloecinae, (ap) anterior and posterior prostatic glands, (a) atrium, (pb) penial setae, (sl) sperm duct. C. Genital organs of a tubificid, diagrammatic; (atr.) atrium with eversible penis, (cl.) clitellum, (f.f.) female funnel, (o.) ovary, (od.) oviduct, (os.) ovisac, (pr.) prostate, (sp.f.) male funnel, (sph.) spermatheca, (s.v.1) anterior seminal vesicle, (s.v.2) posterior seminal vesicle, (t.) testis, (v.d.) vas deferens. Developing sperm morulae are shown in the seminal vesicles, and spermatophores in the spermathecae. D. *Stuhlmannia stappersi*, female organs; (conn.) connecting tube between female duct and coelomic tube, (cs.) coelomic sac, (o.t.) coelomic tube, (ctr.) constriction at middle of spermatheca, (gl.) glandular mass round spermathecal pore, (1) loop of oviduct, (od.) oviduct, (os.) ovisac, (r.os.) right ovisac (vestigial), (sph.) spermatheca, (v.n.c.) ventral nerve cord, (♀) female aperture. E. *Enchytraeus albidus*, two specimens in copulation; the male pore, on segment 12, is directly opposed to the spermathecal pore of the other worm, in intersegment 4/5.

Embryos of earthworms begin to devour albumen at a very early stage. They are frequently provided with osmo-regulators (fig. 23C) derived, in *Bimastos constrictus*, from the A and B blastomeres which play no further part in morphogenesis. P. G. Svetlov found that regulators are necessary because the fluid inside the cocoon is isosmotic with the soil solution and hypotonic to the embryo plasma; they are absent in *Eisenia foetida* which maintains a high intra-capsular osmotic pressure.

Classification.—The system adopted here is a modification of that proposed by W. Michaelsen in 1930; suborders are raised to the rank of orders, since the Oligochaeta themselves are elevated to the rank of a class; the status of certain families and subfamilies is changed in accordance with the progress of knowledge.

Order 1. *Plesiopora plesiotheca*; micronephridiostomal; male pores on the segment following the testes; spermathecae in the region of the genital segments, when present. Family Group 1: Naidina; reproducing mostly by asexual fission; minute freshwater species. Aeolosomatidae have few segments and are characterized by coloured droplets in the skin; "archannelidan"



(A) FROM W. N. HESS IN "JOURN. MORPHOLOGIE," VOL. 40, NO. 2 (1925), PUBLISHED BY THE WISTAR INSTITUTE OF ANATOMY AND BIOLOGY; (B) FROM STOLTE, AFTER RETZIUS; (C) FROM BULLOCK IN "JOURN. NEUROPHYSIOLOGY"

FIG. 22.—NERVOUS SYSTEM OF OLIGOCHAETA

A. *Lumbricus terrestris*, arrangement of nerve trunks in anterior segments; (A) nerve from cerebral ganglion to prostomium, (AN) dorsal ramus of anterior segmental nerve, (AR) ventral ramus of anterior segmental nerve, (B) nerve from circumpharyngeal connective to segment I, (BC) buccal cavity, (C) nerves from circum-pharyngeal connective to segment II, (CG) cerebral ganglion, (CPC) circum-pharyngeal connective, (D) nerve to dorsal region of buccal cavity, (E) nerve to dorsomedian region of segment I, (F) ganglionated thickening of enteric nerve plexus, (G) nerve to ventral region of buccal cavity, (L) septal nerve, (M) mouth, (MN) dorsal ramus of median segmental nerve, (MR) ventral ramus of median segmental nerve, (P) prostomium, (PN) dorsal ramus of posterior segmental nerve, (PR) ventral ramus of posterior segmental nerve, (SG) subpharyngeal ganglion, (V) ventral ramus of posterior segmental nerve, (I-VI) segments one to six. **B. *Lumbricus* sp.**, cross section of a segmental ganglion showing lateral nerves (Golgi impregnation); (1) ventral blood vessel, (2) neuroglia (supporting) cell, (3) plant fibre, (4) motor fibre, (5) ganglion cell, (6) sensory fibre. **C. Schematic representation of giant fibre system in *Lumbricus***

characters are: ciliated prostomium, ciliated pits, central nervous system not free from epidermis, incomplete septa, dorsal vessel only in anterior third of body, multiple production of germ-cells in many segments, nephridia functioning as male ducts. W. Michaelsen regarded this family as ancestral but J. Stephenson argued that supposedly primitive features are the result of rudimentation. Naididae are less larval in character; sexual re-

production is infrequent, when present the testes are usually in segment five and the ovaries in segment six; homeotic displacement of the gonads occurs in *Opistocysta* (testes in seven, ovaries in eight), a genus that is transitional between Naidina and Tubificina. Family Group 2: Tubificina; Tubificidae frequently construct tubes in mud, their tails project, waving in the water (anal respiration); they are larger than Naididae and asexual reproduction is rare; the gonads are usually in segments 10 and 11 but may be displaced forward. Phreodrilidae are closely related to Tubificidae.

Order 2. *Plesiopora prosotoca*; micronephridiostomal; male pores in the segment following the testes; spermathecae considerably in front of the genital segments. Family Group 3: Enchytraeina. Enchytraeidae are small opaque white or reddish worms. Many species are terrestrial and they form an important component of the soil fauna; others are fresh-water or littoral marine. The gonads are typically in segments 11 and 12 but may be shifted anteriorly; the spermathecae are characteristically in segment 5. Many aberrant forms are included in this family, *Aspidodrilus* is ectoparasitic and has a ventral attachment organ (fig. 15H), *Pelmatoedrilus* is somewhat similar; *Parergodrilus* was originally considered to be an archannelid, it has only 13 segments and the ovaries and testes are fused into a single hermaphroditic gonad.

Order 3. *Prosopora*; mesonephridiostomal, male pores in the same segment with the last pair of testes. Family Group 4: Lumbriculina. Lumbriculidae are small to medium-sized limicolous species; the number and arrangement of the gonads and spermathecae is highly variable. W. Michaelsen regarded this family as ancestral to earthworms and J. Stephenson has suggested that all oligochaetes may be derived from them. Against this is their geographical distribution (northern hemisphere) and also the condition of the male genital ducts which appears to be secondary. Branchiobdellidae are ectoparasitic on the gills of fresh-water crayfishes, the body is divided into a head region, probably of 4 somites, and a trunk of 11; there is a posterior sucker. Acanthobdellidae were formerly included in the class Hirudinea; the total number of segments is 30 instead of 34, setae are present on the anterior segments, there is a well-developed coelom, and the reproductive organs are not like those of leeches; the only known species, *Acanthobdella peledina*, is ectoparasitic on Siberian salmon.

Order 4. *Opisthopora*; meganephridiostomal, male pores at least one segment behind the last pair of testes. Family Group 5: Haplotaxina (=Phreoryctina); in many ways transitional between lower oligochaetes and true earthworms; Haplotaxidae may be holandric and hologynous, but the clitellum is a single cell-layer and the eggs are yolky. Moniligastridae are larger forms with peculiar anatomical features. Alluroididae, and the nearly related Syngenodrilidae, provide a connecting link between Haplotaxidae and earthworms, the male pores being more than one segment behind the testes. Family Group 6: Lumbricina; owing to the special method of transference developed in this group, the spermathecal pores are not correlated in position and number with respect to the male pores. Glossoscolecidae, of which there are five subfamilies, retain a pregenital gizzard, as in Haplotaxidae. Many glossoscolecids attain a very large size, *Hormogaster* is the largest European earthworm. Lumbricidae appear to have originated from glossoscolecoid ancestors by development of a post-genital gizzard. Family Group 7: Megascolecina; there is a primary correlation between the number and position of spermathecal and prostatic pores, obscured only in the more highly evolved genera. Nearly half the known species of oligochaetes belong to the Megascolecidae. Ancestral megascolecids (subfamily Acanthodrilinae) are characterized by: acanthodriline genitalia subject to microscelene or balantine reduction, holonephridia and, usually, an absence of calciferous glands. Ocnodrilinae, regarded by G. E. Gates as a separate family, have ventral calciferous glands in segment nine, or nine and ten. Meronephridial acanthodrilines gave rise to a group of genera which W. Michaelsen placed in the subfamily Octochaetinae (not recognized by Gates). Others, as an initial step, developed the megascolecine union of

male and prostatic pores and gave rise to the Megascolecinae. Parallel evolution within these subfamilies has so confused the relationships that it is often difficult to determine the true status of a genus. Eudrilidae possess euprostates and show a remarkable specialization of the female reproductive organs.

The inter-relationships of the families are shown in the diagram (fig. 24) and discussed in connection with the reproductive system (see above).

Zoogeography.—The small aquatic forms are widely distributed and subject to ecological rather than geographical limitations. Terrestrial forms, with the exception of a few peregrine species of world-wide distribution, show a very high degree of geographical endemism, correlated no doubt with their restricted powers of migration. They are therefore important faunal indices but, on account of the prevalence of parallel evolution, it is unwise to regard the presence of apparently similar genera as proof of former land connections between remote continents. Despite this, there is no doubt that the land masses of the southern hemisphere possess a relict oligochaeta fauna (Phreodrilidae, Haplotaxidae, Acanthodrilinae). The northern temperate regions appear to be the home of Enchytraeidae and Lumbricidae, both of which are primarily holarctic in their distribution. The neotropical region is characterized especially by the Glossoscolecinae, the ethiopean region by Ocnodrilinae and Eudrilidae. The Megascolecinae reach their maximum development in the orient, and Moniligastridae are endemic to this region.

Parasites.—Oligochaetes are parasitized by gregarines such as *Monocystis*, which lives in the seminal vesicles; by nematodes such as *Pelodera* (= *Rhabdites*) which lives in the nephridial vesicles; by fly larvae and by various other organisms.

Ecology, Habits, Etc.—Additional information regarding the biology of earthworms is given under the title Earthworm (*q.v.*).

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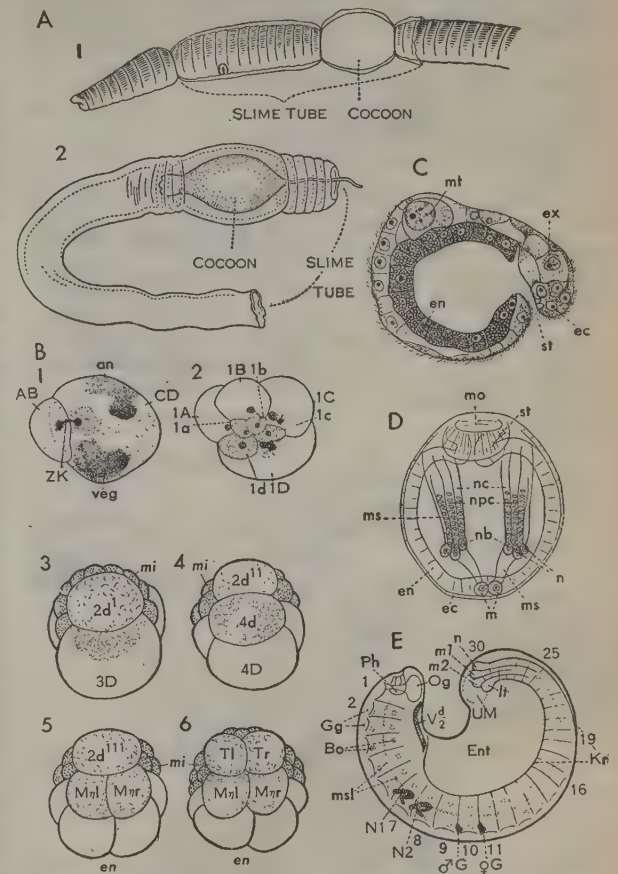
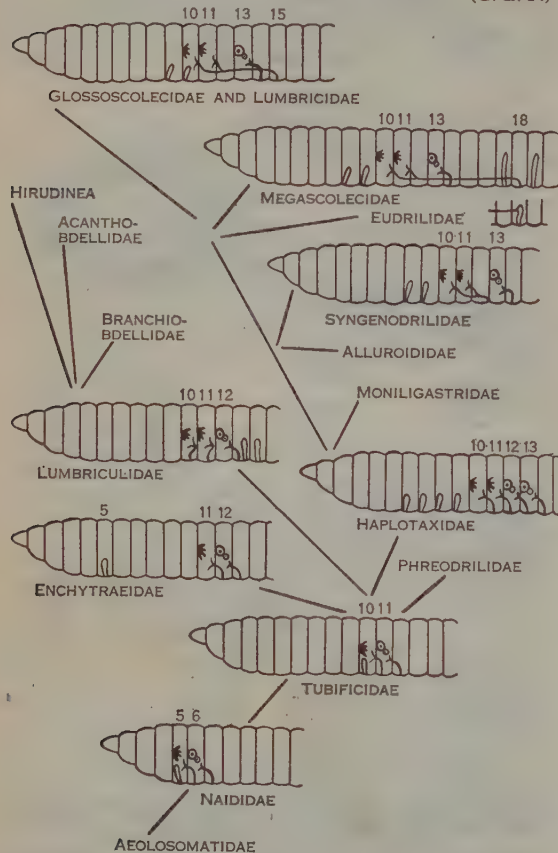


FIG. 23.—EMBRYOLOGY OF OLIGOCHAETA

A. *Eisenia foetida*: (1) anterior end showing cocoon in process of formation, (2) freshly deposited cocoon, the slime tube later dries up and falls off while the capsule of the cocoon hardens. B. *Tubifex tubifex*, six stages in the segmentation of the ovum, (1) two-cell stage, (AB and CD) first two blastomeres, (an) animal pole, (veg) vegetative pole, (ZK) spindle remnant. Pole plasma, finely dotted; yolk, dotted circles. (2) Eight-cell stage, (1a-1d) first quartet of micromeres, (1A-1D) macromeres. (3-6) Later stages: dorsal view, showing formation of ectotoloblasts; (2d) mother cell of ectotoloblasts, (4d) mother cell of mesotoloblasts, (1l and 1r) left and right ectotoloblasts, (M₁l and M₁r) mesotoloblasts, (en) endoderm, (mi) micromeres. C. *Dendrobaena rubida*, sagittal section of advanced gastrula, (ec) ectoderm, (en) endoderm, (ex) excretory cell, (mt) mesotoloblast, (st) stomodaeum. D. *Eisenia foetida*, ventral view of embryo, (ec) ectoderm, (en) endoderm, (m) mesotoloblast, (mo) mouth, (ms) mesoderm bands, (n) ectotoloblasts, (nb) neuroblast (median ectotoloblast), (nc) nerve cord, (npc) ectodermal germ bands, (st) stomodaeum. E. *Tubifex tubifex*, embryo with 30 somites, (Bo) setal sac, (Ent) endoderm, (♂G and ♀G) male and female gonoblasts, (Gg) segmental ganglion, (Kr) germ band, (msl) lateral line of circular musculature, (N1 and N2) nephridia, (Og) cerebral ganglion, (Ph) pharynx, (n, m1, m2 and lt) ectotoloblasts, (UM) mesotoloblast, (v₂) one-half of dorsal blood vessel

Gray and H. W. Lissmann, "Studies in Animal Locomotion. VII. Locomotory Reflexes in the Earthworm," *J. Exp. Biol.*, vol. 15, pp. 506-517 (1938). Embryology: A. Penners, "Abhängigkeit der Formbildung von Mesoderm im Tubifex-Embryo," *Z. wiss. Zool.*, vol. 150, pp. 305-357 (1938). Classification and distribution: the primitive features of the Aeolosomatidae are discussed by E. Marcus, "Sobre Oligochaeta limnicos do Brazil," *Boll. Univ. S. Paulo*, vol. 63, pp. 5-136 (1944); Enchytraeidae have been revised by L. Černovítov, "System der Enchytraiden," *Bull. Ass. Russe Rech. Sci. Prague*, vol.

5, No. 34 (1937); Branchiobdellidae are well treated by C. J. Goodnight, "The Branchiobdellidae of North American Crayfishes," *Illin. Biol. Monogr.*, vol. 17, No. 3 (1940); Syngenodrilidae, G. E. Gates, "On the Oligochaete Genus *Syngenodrilus* and its Taxonomic Importance," *J. Washington Acad. Sci.*, vol. 35, pp. 393-396 (1945); Moniligastridae, Megascolecidae and Eudrilidae have undergone extensive taxonomic revision by G. E. Gates, "Indian Earthworms. I-XIII," *Rec. Indian Mus.*, vols. 39-42 (1937-1940). North American earthworms: G. E. Gates, "Check List and Bibliography of North American Earthworms," *Amer. Midland Nat.*, vol. 27, pp. 86-108 (1942). (G. E. P.)



BY COURTESY OF GRACE E. PICKFORD

FIG. 24.—PHYLOGENY OF THE OLIGOCHAETA

Diagrams illustrate disposition of reproductive organs in typical representatives of selected families. Lumbriculidae, represented by *Lamprodrius*: number and position of testes and spermathecae is variable in this family. Megascolecidae: a typical holandric acanthodriline is shown. Glossoscolecidae + Lumbricidae, represented by *Lumbricus*: number and position of spermathecae variable; position of male pore variable in Glossoscolecidae, often far back. The series Tubificidae—Aelosomatidae is probably one of simplification; the Lumbriculidae are not placed in the direct ancestry of higher oligochaetes

CLASS 3. HIRUDINEA

Hirudinea or leeches have the following characteristics collectively distinguishing them from other annelids: terminal suckers, 34 body segments or somites, no parapodia nor setae, hermaphroditism with the external genital pores unpaired and median and the male in advance, and body cavity largely obliterated. Although many leeches are free-living predators these features are so associated with ectoparasites or epizoots that leeches were formerly classified as flatworms or Platyhelminthes; planarians, trematodes, nemerteans and, with more justification, oligochaetes of similar habits are often mistaken for them. They are true annelids with all of their organ systems constructed of serially repeated segments. The Oligochaeta and Hirudinea have much in common and are closely related. Some zoologists regard the latter merely as parasitic Oligochaeta and Michaelsen has united

them in a class Clitellata but neither *Acanthobdella*, *Agriodrilus*, the *Branchiobdellidae*, nor other known true oligochaetes of similar habit and possessing certain leechlike modifications, can be ancestral to the leeches. A classification reflecting conservative current views is as follows:

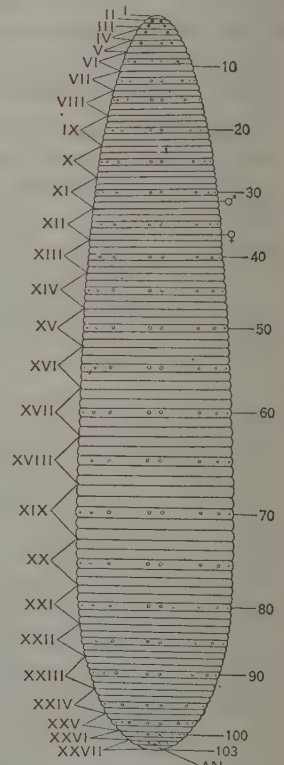
Orders	Families	Common Names
Rhynchobdellae	Glossiphoniidae	snail and turtle leeches
	Piscicolidae	fish and crustacean leeches
Gnathobdellae	Haemadipsidae	jawed land leeches
	Hirudidae	jawed aquatic leeches, blood-suckers
Pharyngobdellae	Semiscolecidae	worm leeches
	Erbobdellidae	worm leeches and jawless land leeches

The Rhynchobdellae have an exertile proboscis which the other two orders have not. It is convenient to use the old group name arynchobdellae purely as a descriptive term to cover the latter two. The Semiscolecidae are in many respects intermediate between the Gnathobdellae and Pharyngobdellae, resembling the former in annulation, eye number and reproductive organs and the latter in external form and alimentary canal. The exact systematic position of such genera as *Cardea*, *Xerobdella* and *Diastecostoma* is still uncertain.

External Anatomy.

Leeches vary in length from about $\frac{1}{4}$ in. to 18 in. and the form is linear, ovate, subcylindrical or foliaceous but both change with the state of contraction. Owing to the absence of parapodia and setae and the consequent uniformity of the annuli, the limits of the somites or segments is often obscured, but good criteria exist in the very constant position of the sensillae and nephridial pores, the slightly differing depths of the furrows and other less constant external characters. As leeches have no caudal growth zone and the number of segments is fixed at 34, increase in length and flexibility is attained by subdivision and growth of the annuli which is greatest in the complete somites of the middle of the body and is reduced gradually toward both ends. In different genera the complete number varies from 2 to 16 and there is exact correspondence between a nerve ganglion and its nerves and the external limits of a somite. Sensillae are arranged in definite lines on the ring in which the ganglion chiefly lies and number four or five pairs on the dorsum and three or four on the venter with an additional marginal pair. They appear as small retractile, whitish dots of sensory cells bearing tactile hairs.

Five body regions are recognized. The cephalic region or head, of six segments each of one to three annuli, includes the oral sucker, mouth, eyes and, when present, the jaws. The sucker may



FROM HARDING AND MOORE, "HIRUDINEA," FAUNA OF BRITISH INDIA, BY COURTESY OF SECRETARY OF STATE FOR INDIA IN COUNCIL FIG. 25.—EXTERNAL ANATOMY OF A TYPICAL TEN-EYED LEECH

The somites are indicated on the left side by Roman numerals and the annuli on the right by Arabic numbers. Eyes, sensillae, position of gonopores and anus are also shown

be discoid, cup-shaped, spoon-shaped or annular. Eyes are modified sensillae and when most complex, consist of an axial optic nerve and ganglion, a sheath of visual cells each with a vitreous body and the whole enclosed in a deep cup of dense pigment. The second region or preclitellum, of somites seven to nine, intermediate in number of annuli, contains the pharynx and anterior nephridia and in a few cases, additional eyes. The middle region, further divided into clitellum (somites 10 to 12) and post-clitellum (13 to 24) includes all of the reproductive system and most of the digestive and excretory organs, together with the complete somites. The short fourth or anal region, of somites 25 to 27, which are again reduced, is followed by the caudal region or sucker (undeveloped in *Lumbricobdella* only) fashioned of the remaining somites.

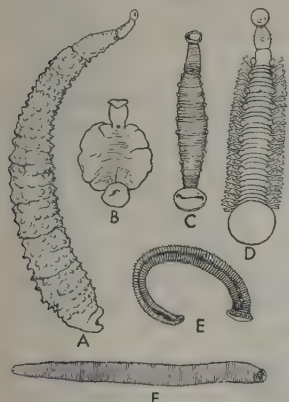


FIG. 26.—CHARACTERISTIC FORMS OF LEECHES

A-D. Fish leeches (A, *Pontobdella*; B, *Phyllobdella*; C, *Cystobranchus*; D, *Branchellion*); ventral views. E. Stinging land leech (*Haemadipsa*), side view. F. Predacious land leech (*Diastecostoma*), ventral view

in the sucker, the remaining 21 (7 to 27) being spaced.

Body Wall.—The musculature of the body wall of active leeches is highly developed, especially in the Pharyngobdellae and land leeches, and consists of a circular, two crossed oblique, and a much thicker longitudinal layer. In addition are vertical and transverse sheets and special muscles for the suckers, jaws, pharynx, genitalia, etc.

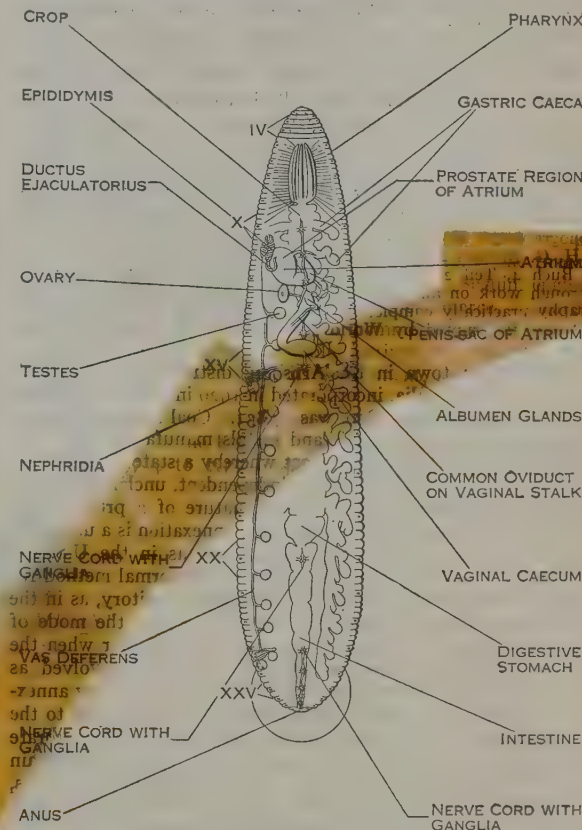
Body Cavity.—The coelom, so spacious in most annelids, is largely replaced by the encroachment of connective tissues and muscles, reducing it to a system of spaces, in many of which organs lie, all connected by capillary branches, and the whole constituting a lymphatic system. In the *Glossiphoniidae* there are five main longitudinal canals or lacunae with connectives and fine subdermal capillaries encircling the body which assist in respiration. Many *Piscicolidae* possess contractile lateral lacunae or special pulsatile vesicles which assist in the circulation of the coelomic fluid. In the Gnathobdellae and Pharyngobdellae the coelom is still further reduced and much of it is taken over by the vascular system and contains red blood. It is also invaded by the so-called botryoidal tissue of pigmented and vacuolated cells largely excretory in function and comparable with the chloragogue cells of other annelids.

Vascular System.—A separate vascular system containing colourless blood is present in the Rhynchobdellae and typically consists of a dorsal and a ventral vessel connected at the extremities by paired loops. An anterior portion of the dorsal vessel is contractile and functions as a heart. Farther back it is continuous with a blood sinus surrounding the gut, the peristaltic contractions of which force the blood forward. In the rhynchobdellid leeches the capillary network is exceedingly rich and is formed in part by the botryoidal tissue. On the transverse connecting vessels of many Erpobdellidae are paired contractile ampullae which serve as hearts.

Digestive System.—The alimentary canal is divided into oral chamber, buccal sinus, pharynx, oesophagus, stomach, intestine, rectum and anus. The first is the cavity of the oral or anterior sucker into which the mouth opens and leads to the buccal sinus, which in the arhynchobdellid leeches is a restricted chamber housing the jaws when present, and in the Rhynchobdellae extends

as a space around the pharynx which is thereby freed as an exsertile proboscis. Salivary glands secreting substances having both antiseptic and anticoagulant (hirudin) properties open either on the jaws or proboscis of blood-sucking leeches. The pharynx is powerfully muscular, short and bulbous in the Gnathobdellae, long and cylindrical in the Pharyngobdellae. The oesophagus connects the pharynx and stomach, which in predacious leeches is tubular and simply chambered, with no caeca or a posterior pair only. In sanguivorous leeches it becomes a capacious crop with a more or less extensive system of often complexly-lobed, paired caeca, for the storage of the solid parts of the blood which may equal several times the weight of the unfed leech and be sufficient to nourish it for several months or even a year. A narrow passage with a sphincter muscle separates the storage stomach from the intestine, which is the principal seat of digestion and absorption. It is either a straight, more or less camered tube or bears four pairs of simple caeca. In blood-suckers the anterior chamber is globoid or bilobed, thick-walled and glandular and acts as a digestive stomach into which small quantities of stored blood are introduced periodically. A simple rectum leads to the dorsal anus.

Reproductive Organs.—All leeches are hermaphrodites with the internal sexual organs paired but the terminal parts and external orifices median. Testes enclosed in coelomic sacs are mul-



FROM HARDING AND MOORE, "HIRUDINEA" FAUNA OF BRITISH INDIA, BY COURTESY OF THE SECRETARY OF STATE FOR INDIA IN COUNCIL
FIG. 27.—THE GENERAL INTERNAL ANATOMY OF A TYPICAL TEN-EYED LEECH, BASED ON *HIRUDINARIA GRANULOSA*. THE ROMAN NUMERALS INDICATE THE SOMITES

iple, usually in segmental pairs but in the Pharyngobdellae divided minutely. A short duct connects them on each side with a *vas deferens*, which becomes enlarged and usually much convoluted anteriorly to form a sperm vesicle or epididymis, followed by a powerfully muscular, often bulbous ejaculatory duct finally opening into the median terminal organ or atrium. This is variously complicated with glands and a more or less eversible copu-

latory organ, which in the *Hirudidae* becomes a long filiform penis. Its function is to form and place the spermatophores. The female organs are a single pair of ovisacs containing the ovaries and continuous with ducts that finally unite into a common vagina, which in its various modifications frequently parallels the male atrium. The sperm is packed in spermatophores for transfer. In all leeches except the *Hirudidae*, where direct copulation occurs, impregnation is by hypodermic injection. A spermatophore is implanted by one leech on the body of another, in some groups on a definite area underlaid by a special conducting tissue. The sperm is forced out and penetrates the partly, histolyzed tissues into the ovisacs, where fertilization occurs. Development is mainly direct. Fertilized eggs are placed in capsules, or cocoons, formed by excretions of the clitellar glands and filled with albuminous mucus. The cocoons are buried in earth, attached to stones, plants or the hosts, or in the *Glossiphoniidae* borne as are the newly hatched young on the ventral surface of the mother.

Excretory Organs.—The nephridia are paired, segmental, convoluted tubes formed of tubular cells, with canals often highly branched, placed end-to-end like drainpipes but not opening into the coelom. Externally they open through a vesicle on the ventral or lateral surface; internally the ciliated and often much-lobed funnel opens into one of the lacunae, or it may be imperforate. Attached to its base or stalk is a capsule containing phagocytic leucocytes, but closed to the nephridial lumen. Excretion takes place with the aid of vascular and botryoidal capillaries. In many *Piscicolidae* the nephridia are united in a continuous network.

Distribution, Ecology and Economics.—These are stated briefly in the article LEECH and fully in the references.

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ANNEN, a town in the Amsberg district of the Prussian province of Westphalia, incorporated in 1929 into the city of Witten on the Ruhr river. Pop. was 17,331. Coal mining is carried on and glass, soap, chemicals and metals manufactured.

ANNEXATION, a formal act whereby a state proclaims its sovereignty over territory hitherto independent, unclaimed, in the possession of another state or in the nature of a protectorate. Unlike cession, which implies agreement, annexation is a unilateral act, although it may rest upon agreement, as in the U.S. annexation of Texas (1845). Annexation is the normal method for manifesting an intention to acquire conquered territory, as in the Italian annexation of Ethiopia in 1936. It is also the mode of manifesting voluntary union of one state with another when the extinction of the former as an independent entity is involved, as when the United States annexed Hawaii in 1898. It is by annexation, too, that areas under protectorates have been added to the territorial domains of a state, usually as a colony; the protectorate of Korea was annexed by Japan in 1910, and in 1914 Great Britain annexed the protectorate of Cyprus. Whatever the circumstances, an annexation proclamation alone is incapable of giving a good title; it must be accompanied by the normal exercise of state authority, so that the intent is effectively carried out in action, and it must gain the recognition or acquiescence of other states to give good title. Because of failure of such recognition, the Italian declaration annexing Ethiopia did not give good title.

The formalities of annexation are not defined by international law. Whether it is done by one official or another within a state is essentially a matter of constitutional law, but if it is done by subordinate officials, the validity of their acts will depend upon prior authorization or subsequent ratification by their superiors in office. On July 4, 1898, Gen. F. V. Greene, commanding a U.S. expeditionary force, sighted the island of Wake and raised

the U.S. flag there. This action was not regarded as official by the United States government, and on Jan. 17, 1899, Comm. J. K. Taussig, acting under orders, announced the annexation of the island. The Italian annexation of Ethiopia was accomplished by means of a decree issued on May 9, 1936, by the king. The U.S. annexations of Texas in 1845 and of Hawaii in 1898 were by joint resolutions of congress.

(See also STATE SUCCESSION.)

BIBLIOGRAPHY.—M. F. Lindley, *The Acquisition and Government of Backward Territory in International Law* (1926); C. C. Hyde, *International Law, Chiefly as Interpreted and Applied by the United States*, vol. 1 (2nd revised edition, 1945). (N. L. Ht.)

ANNICERIS, a Greek philosopher of the Cyrenaic school. A follower of Aristippus, he denied that pleasure is the general end of human life. To each separate action there is a particular end; namely, the pleasure which actually results from it. Secondly, pleasure is not merely the negation of pain. There is, however, an absolute pleasure in certain virtues such as belong to friendship. In these a man will have pleasure, even though it may result in painful consequences. He maintains, in opposition to most of the Cyrenaic school, that prudence alone is an insufficient guarantee against error. The wise man is he who has acquired a habit of wise action; wisdom is liable to lapses at any moment.

ANNISTON, a city of Alabama, U.S., 56 mi. E. by N. of Birmingham, on the slope of Blue mountain, the county seat of Calhoun county. It is on federal highways 78 and 241 and is served by the Southern and the Louisville and Nashville railways. Pop. (1950) 31,150; (1940) 25,523. Anniston is a trade centre for cotton and other products, and has extensive manufactures, especially of cast-iron soil pipe, iron, steel, textiles and chemical products. Fort McClellan, a permanent post of the U.S. army, is situated there.

An iron furnace was built on the site of Anniston during the Civil War, and was destroyed by Federal troops in 1865. The city was founded in 1872 as a private enterprise by the Woodstock Iron company, chartered as a city in 1879 and opened for general settlement in 1884. The Church of St. Michael and All Angels and the Regar Museum of Natural History, including the Werner bird collection, attract many visitors.

ANNO, or **HANNO**, **SAINT** (c. 1010-1075), archbishop of Cologne, belonged to a Suabian family, and was educated at Bamberg. He became confessor to the emperor Henry III, who appointed him archbishop of Cologne in 1056. Anno was the leader of the party that abducted the young king Henry IV from his mother, Agnes. He then seized the regency, but was compelled to share it with Adalbert, the powerful archbishop of Bremen. In 1064 he left the court but recovered some of his former influence on Henry when Adalbert fell in 1066. His most important service was his action at the Council of Mantua (May 1064), when he secured the recognition of Alexander II as pope, against his rival Honorius, who was originally a nominee of the German court. He was killed at Cologne on Dec. 4, 1075, and canonized in 1183.

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ANNOBON, or **ANNO BOM**, an island in the Gulf of Guinea, on the west coast of Africa, in 1° 24' S. and 5° 35' E., belonging to Spain. Length about 4 mi., breadth 2 mi. and area 6½ sq. mi. It presents a succession of beautiful valleys and steep mountains covered with rich vegetation and reaching an elevation of about 3,000 ft. A noted peak is Fogo (or Fuego), an extinct volcano with a crater lake. Pop. 1,313; the chief town is San Antonio de Praia, which has a poor roadstead. Ships can obtain water and fresh provisions there. The island was discovered by the Portuguese on Jan. 1, 1473, from which circumstance it received its name (= New Year). Annobon, together with Fernando P., was ceded to Spain by the Portuguese, by the treaty of El Pardo, 1480, with a stipulation for the continuance of "free and open trade and commerce in negroes." The Portuguese

had valuable plantations, and in their hands Annobon was of some importance. The islanders are Negroes, believed to be the descendants of a cargo of slaves shipwrecked there in the 16th century, with an admixture of Portuguese blood, and professedly Roman Catholics. They revolted against the Spaniards and kept practical independence until the time of the partition of Africa, when, about 1885, Spanish authority was established. The governor general of Spanish Guinea is represented by a native deputy.

See Arnold Schultze, "Die Insel Annobon" in Petermann's *Mitteilungen*, band lix (1913) with map; A. Unzueta y Yuste, *Islas del Golfo do Guinea* (Madrid, 1945).

ANNONA, in Roman mythology, the personification of the produce of the year (Lat. *annus*, year). Her attributes in works of art and on imperial coins were a corn-bushel, a ship's prow pointing to the transport of the grain over the sea, ears of corn and a horn of plenty (*cornu copiae*).

The Latin word itself has various meanings: (1) the produce of the year's harvest; (2) all means of subsistence, especially grain stored in the public granaries for provisioning the city; (3) the market price of commodities, especially corn; (4) a direct tax in kind, levied in republican times in several provinces, chiefly employed in imperial times for distribution among officials and the support of the soldiery.

In order to ensure a supply of corn sufficient to enable it to be sold at a very low price, it was procured in large quantities from Umbria, Etruria and Sicily. Almost down to the time of the empire, the care of the corn-supply formed part of the duties of the aedile (*q.v.*), and possibly of certain special commissaries. As a consequence of the second Punic War, Roman agriculture was at a standstill; accordingly, recourse was had to Sicily and Sardinia (the first two Roman provinces) in order to keep up the supply of corn; a tax of one-tenth was imposed on it, and its export to any country except Italy forbidden. The price at which the corn was sold was always moderate; the corn law of Gracchus (123 B.C.) made it absurdly low, and Clodius (58 B.C.) bestowed it gratuitously. The number of the recipients of this free gift grew so enormously that both Caesar and Augustus were obliged to reduce it. From the time of Augustus to the end of the empire the number of those who were entitled to receive a monthly allowance of corn on presenting a ticket was 200,000.

A *praefectus annonae* was appointed by Augustus to superintend the corn-supply. He was assisted by a large staff in Rome and the provinces. In the 3rd century bread formed the dole. The office lasted till the latest times of the empire.

ANNONACEAE, the custard apple family, an important group of dicotyledonous plants allied to the magnolias (*q.v.*). They are chiefly tropical shrubs and trees and comprise about 80 genera and 820 species. The leaves are simple, entire and alternate; the flowers are regular, usually with three sepals and six petals, the latter brown or tawny yellow, not showy; the stamens numerous; and the fruit an aggregation of berries (syncarp) in which the seeds are embedded or dry or capsular. Many species are grown for their edible fruits, for perfume and for ornament. A few extend into temperate regions, as the North American paw-paw (*Asimina triloba*), found northward to New York and Michigan. Many valuable fruits belong to the genus *Annona*; among these are the cherimoya (*A. cherimola*) of the American tropics, now cultivated in the southern United States; the custard apple or bullock's-heart (*A. reticulata*), of tropical America; the sugar apple, sweet-sop or ate (*A. squamosa*), cultivated throughout the tropics; the soursop or guanábana (*A. muricata*), widely grown in tropical lands; the *ilama* (*A. diversifolia*) of Mexico and Guatemala; the alligator apple, or corkwood (*A. glabra*), of tropical America and the *posh-té* (*A. scleroderma*) of Guatemala and Mexico. The *biribá* (*Rollinsia deliciosa*) and related species are highly esteemed fruits from Brazil to Central America. A tree (*Porcelia saffordiana*) of Bolivia, named and described in 1927, bears immense fruits sometimes attaining 40 lb. weight. The ylang-ylang (*Canarium odoratum*), native to the East Indies, is the source of the famous perfume of Malaysia and the Philippines. The exceedingly fragrant climbing ylang-ylang (*Artabotrys uncinatus*), native to India and China, is sparingly planted in southern Florida. (See CHERIMOYA; CUSTARD APPLE; SWEET-SOP.)

ANNONAY, a town in France, dept. of Ardèche, 50 mi. S. of Lyons by the P.L.M. railway. Pop. (1946) 15,462. Annonay is built on a hill above the confluence of the deep gorges of Déôme and Cance (tributaries of the Rhône), which supply power to local factories. A reservoir constructed in the Ternay valley, an affluent of the Déôme, to the northwest of the town, provides water for industrial and domestic purposes. The brothers Montgolfier, inventors of the balloon, and Marc Seguin, engineer, were natives of Annonay. A tribunal of commerce, a board of trade-arbitrators, and chambers of commerce and of arts and manufactures are among the public institutions. Annonay is the principal industrial centre of its department, making paper, silk, leather, etc.

ANNOY, to vex. In the sense of "nuisance" (*q.v.*) "annoyance" is found in the English "Jury of Annoyance" appointed by an act of 1754 to report upon obstructions in the highways.



END OF VOLUME ONE



